FALL 2001 RAPTOR MIGRATION STUDY
NEAR CORPUS CHRISTI, TEXAS

HawkWatch International, Inc.
Salt Lake City, Utah

February 2002

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Report prepared by:

Jeff P. Smith

Counts conducted by:

Greg Greene, Karen Johnson, Devin Taylor
and Many Other Volunteers

On-site education by:

Roland Zoer

On-site project coordination by:

Joel Simon

Overall project coordination by:

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

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Corpus Christi 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). During fall 2001, HawkWatch International (HWI) conducted the fifth consecutive, full-season migration count at Hazel Bazemore County Park near Corpus Christi. Volunteers conducted peak-season counts at this "Coastal Bend" site each year between 1988 and 1996, following protocols of the Hawk Migration Association of North America (HMANA). These counts ranged from only 6 to 28 days in duration, and therefore are not directly comparable to full-season counts begun in 1997. Previous counts did demonstrate, however, that the raptor flight through the area was substantial. The first full-season count in 1997 confirmed that the migratory flight of raptors through this region is the largest known in North America north of Mexico, with Broad-winged Hawks (see Appendix A for scientific names of all raptor species observed at the site) typically accounting for more than 90% of the total (Smith et al. 2001). To date, 28 species of raptors have been observed migrating through the area, with annual counts ranging from 440,000 to 992,000 migrants. This report summarizes the count results from the 2001 season. A summary of previous, partial-season HMANA counts was included in the December 1997 issue of the HMANA Journal of Hawk Migration Studies.

The Corpus Christi project was 1 of 15 long-term, annual migration counts (12 fall, 3 spring) conducted or sponsored by HWI in North America during 2001. The primary objective of these efforts is to track long-term population trends of diurnal raptors throughout primarily western North America (Smith and Hoffman 2000). Raptors feed atop food pyramids, inhabit most ecosystems, occupy large home ranges, and are sensitive to environmental contamination and other human disturbances. Therefore, they serve as important biological indicators of ecosystem health (Cade et al. 1988; Bednarz et al. 1990a; Bildstein 2001). Moreover, due to the remoteness and widespread distribution of most raptor populations, migration counts likely represent the most cost-effective and efficient method for monitoring the regional status and trends of multiple raptor species (Bednarz and Kerlinger 1989, Titus et al. 1989, Bildstein et al. 1995, Dunn and Hussell 1995, Dixon et al. 1998, Smith and Hoffman 2000, Zalles and Bildstein 2000).

STUDY SITE

The nine-county area around Corpus Christi is commonly called the Coastal Bend. This includes Aransas, Refugio, San Patricio, Nueces, and Kleberg counties along the coast, and Goliad, Bee, Live Oak, and Jim Wells counties to the west. The Texas coast runs from the northeast to the southwest between the Louisiana border and Corpus Christi Bay, then shifts to a north–south direction. Hazel Bazemore Park (HBP) is approximately 27 km (17 mi) west of Corpus Christi Bay near the town of Calallen (27º52'3.0"N, 97º38'30.1"W; elevation 5 m; Figure 1). This geographic location is ideal for monitoring the autumn raptor migration through the region. Past records show that this is a major migration path for Broad-winged Hawks (Rappole and Blacklock 1985).

The HBP monitoring site is situated at an elevation of 28 m (85 ft) above mean sea level, which is the highest elevation along the coast in a four-county area. The park sits on the southern bank of the Nueces River at a horseshoe bend where the river changes from a southeast to north–northwest flow. The watch site offers clear visibility through a 105° arc from the northeast to the west, but the view to the east is restricted by topography at a similar elevation. The Nueces River bottomlands feature a transitional riparian forest. Characteristic plants include hackberry (*Celtis* spp.), Mexican ash (*Fraxinus berlandieriana*), anacua (*Ehretia anacua*), black persimmon (*Diospyros texana*), chittimwood (*Bumelia lanuginosa*), and cedar elm (*Ulmus crassifolia*). Many species of raptors use this forested area for nocturnal roosting during migration (Rappole and Blacklock 1985). Open farmland predominates to the

north and south, open ranchland to the west. Corpus Christi Bay, which is an industrial and urbanized area, lies to the east.

METHODS

Three official or designated observers (generally two on any given day, except during the peak Broad-winged Hawk flight when all three worked together), routinely assisted by numerous local volunteers, conducted daily counts of migrant raptors from a single traditional site at HBP. On-site project coordinator Joel Simon, who served as a full-time observer at the site from 1997–1999, provided supervision and training for the new observers (see Appendix B for a complete history of primary observer participation). None of the three official observers had conducted a full-season raptor migration count before; however, in conjunction with being an owl bander, Greg Greene had assisted opportunistically with counts at Boise Ridge (ID) during two previous fall seasons.

The observers generally tallied raptors only by species, because the demands of counting during peak flight periods usually precluded paying close attention to details other than species identification. High flight altitudes also frequently limited the attainable detail. However, the observers did record age and/or sex data for Northern Harrier, Sharp-shinned and Cooper's Hawk, American Kestrel, and uncommon species (e.g., eagles and uncommon buteos) as often as possible. The primary observer(s) assigned a specific task to each actively participating individual to maximize accuracy of the counts and ensure quality participation by all interested volunteers. Counters were responsible for counting large flights of raptors, usually Broad-winged Hawks. Spotters were responsible for scanning the sky for both large flights and single raptors, and notifying the counters of their sightings. Other individuals were responsible for scanning through large flights of Broad-winged Hawks and recording occurrences of other species. Other assignments included keeping up with the guest log, taking weather observations when the primary observer was too busy with counts, and serving as data recorder on busy days.

Weather permitting, observations typical began by 0800 hrs and ended by 1600 hrs Central Standard Time (CST). At the HBP site, the observers routinely recorded the following data:

1. Species of all migrants (Appendix A lists common and scientific names for all species and two-letter codes used to identify species in some tables and figures).
2. Age and/or sex of Northern Harriers, Sharp-shinned and Cooper's Hawks, American Kestrels and uncommon species, whenever possible.
3. Hour of passage for each migrant; e.g., the 1000–1059 hrs CST.
4. Wind speed and direction, air temperature, barometric pressure, percent cloud cover, predominant cloud type(s), precipitation, visibility, and an assessment of thermal lift conditions, recorded for each hour of observation on the half hour.
5. Predominant direction, altitude, and distance from the lookout of the flight during each hour.
6. 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.
7. A subjective visitor-disturbance rating for each hour, recorded on the hour.
8. Daily start and end times for each active observer.

The observers used high-quality 7–10x binoculars to assist in spotting and identifying birds. They also used spotting scopes (20–60x) to help identify distant birds and for counting distant kettles, but not for spotting birds. Clark and Wheeler (1987), Dunne et al. (1988), and Wheeler and Clark (1995) served as primary identification references. Assessments of wind speed, cloud type, cloud cover, and flight altitude followed guidelines published by HMANA. Assessments of thermal lift conditions as poor, fair, good, or excellent involved subjective evaluations of solar intensity, wind speed, and migrant behavior.

The observers classified as residents and excluded from daily counts any raptor that exhibited hunting, territorial display, or perching behaviors for extended periods. The observers occasionally recorded as migrants birds that were not moving in a southerly direction, if such birds otherwise displayed migrant characteristics; i.e., continuous flight without stopping or substantially changing directions for several kilometers. Such birds may be dispersing juveniles or adults dispersing relatively short-distances from their nesting territories to favored wintering grounds in the same general region. However, we also know from recent satellite telemetry work that species such as Prairie Falcons and Ferruginous Hawks frequently "migrate" in non-standard directions to take advantage of favored post-breeding and wintering grounds (Watson and Pierce 2000, K. Steenhof personal communication).

For purposes of examining long-term variation in annual counts, it is often recommended that count data be standardized for sampling period and adjusted for daily variation in observation effort because seasonal and daily duration of observation effort can greatly affect count statistics (Hussell 1985, Kerlinger 1989, Bednarz et al. 1990b). For purposes of this report, we converted counts to passage rates on a daily basis (raptors/100 hours of observation) to adjust for daily variation in sampling effort, and present both raw counts and passage rates for comparison.

To examine the Corpus Christi data, I compare 2001 annual statistics against means and 95% confidence intervals (mean ± 95% CI) for 1997–2000. Here, I equate significance with a 2001 value falling outside of the 95% CI for the associated 1997–2000 mean. Note that because we have only four years of previous data, the statistical power of these comparisons is limited; nevertheless, such comparisons can highlight areas of significant annual variation.

RESULTS AND DISCUSSION

WEATHER

During 2001, observations occurred every day of the season and inclement weather severely restricted observations (≤4 hrs) on only 4 days (see Appendix C for daily weather summaries). During the previous four seasons, the number of days of no or severely restricted observations ranged from 4 to 18. Rain and/or thunderstorms occurred on 17% of the active observation days in 2001, compared to 10–19% from 1997–2000. A four-day drenching, tropical rainstorm with minimal flight activity occurred from 26–31 August. Other frontal-system/rain events substantially curtailed flight activity for 1–3 day periods in early and mid-September and twice during the first two weeks of October. No flight activity occurred during the last four days of the season in the wake of a final storm front. Otherwise, mostly cloudy to overcast skies predominated on 20% of days, compared to 10–38% previously, and a moderately high proportion of these days also included some fog or especially haze (13% of all days). Transitional weather (i.e., skies changed from primarily fair to mostly cloudy or overcast during the day) occurred on 38% of days, compared to 24–41% previously, and a moderate proportion of these days included fog or especially haze (19% of all days). Fair skies prevailed on 35% of days, compared to 13–39% previously, but a moderately high proportion of these days included some fog or especially haze (18%). Light winds (<12 kph) prevailed on 83% of days and moderate winds (12–28 kph) on 17%, which is almost identical to the pattern in 2000, but a higher proportion of light winds than in 1997 and 1998 (73–74%) and a

lower proportion of light winds than in 1999 (96%). In terms of wind directions, the 2001 season showed an average array, with primarily northeasterly winds prevailing on 24% of days, primarily southeasterly winds on 57%, variable northwest to northeast winds on 5%, variable northeast to southeast winds on 6%, and variable southeast to southwest winds on 6%. Daily-average (mean of hourly readings) temperatures averaged 29.7°C and ranged from 19.6 to 37.0°C, which is the hottest temperature profile for the past five seasons. Daily-average (mean of hourly readings) barometric pressure averaged 30.01, ranging from 29.70 to 30.38, which is a typical profile for the site.

Thus, except for showing an above-average temperature profile, the summary weather data representing active observation periods indicated comparatively moderate conditions in 2001. However, although the warmer temperature profile accurately reflects the sweltering conditions that prevailed during much of the season, the summary data do not do justice to the severity (in terms of precipitation totals) of the rain events that also occurred during that time. In particular, the fact that the rainstorms curtailed relatively few observation periods and the daily weather records do not reflect more rain activity was because most of the primary storm activity occurred at night.

OBSERVATION EFFORT

The official observers worked every day between 15 August and 15 November (Table 1). The number of observation days (93) and hours (723.50) are both 5% higher than the 1997–2000 averages, with the difference in days just significant. The 2001 average of 3.1 observers per hour (includes official and guest observers; value is mean of daily values, which are in turn means of hourly values) is an insignificant 2% lower than average.

MIGRATION SUMMARY

The observers counted 897,519 raptors of 24 species during the 2001 season (Table 1, and see Appendix D for daily count records). Broad-winged Hawks comprised 96% of the total count. Species that comprised ≥1% of the remainder included Swainson's Hawk (43%), Mississippi Kite (31%), Turkey Vulture (15%), Sharp-shinned Hawk (2%), and Cooper's Hawk (1%). Buteos, vultures, and kites were the predominant species groups (Figure 2). With Broad-winged Hawks excluded, the proportions of other buteos and kites were significantly above average, whereas the proportions of all other species groups were significantly below average. The observers recorded no new species in 2001 and four species seen in previous years did not occur this season (Northern Goshawk, Short-tailed Hawk, Rough-legged Hawk, and Aplomado Falcon).

The 2001 Broad-winged Hawk count was 22% higher than average and ranked as the second highest ever recorded at the site; however, the difference was not statistically significant due to high annual variation (Table 1). More noteworthy than the total count was the fact that the season included the first 400,000+ single-day broad-wing count (25 September) and the first two-day sequence of 200,000+ broad-wing counts (25–26 September) ever recorded at the site (Appendix D). The combined-species count excluding Broad-winged Hawks was an insignificant 2% below average (Table 1). Among 20 commonly observed species, 13 showed below average passage rates in 2001 and 7 showed above average passage rates (Table 2). However, although all such species showed 10% or more variation from the 1997–2000 averages, due to high annual variation only four species showed significantly above average passage rates (Swallow-tailed and Mississippi kites, Swainson's Hawks, and Crested Caracaras) and only 6 species showed significantly below average passage rates (Turkey Vulture, White-tailed Kite, Sharp-shinned Hawk, Red-shouldered Hawk, Red-tailed Hawk, and Merlin). In all cases, the significant differences reflected record or near-record high or low counts (Table 1).

Similar to Corpus Christi, counts of Broad-winged Hawks, Swallow-tailed Kites, Mississippi Kites, and Swainson's Hawks were generally higher than average at other monitoring sites around the Gulf Coast

(i.e., Florida Keys, Smith Point, Texas, and Veracruz, Mexico; Smith 2002, HWI and partners, unpublished data). Whether these consistently high counts are indicative of population expansion or weather effects is unclear at this time. Data from Veracruz, Mexico, collected since 1992, currently indicate increasing patterns for each of these species, except for Broad-winged Hawks, which have shown a fluctuating but relatively stable pattern since 1995 (HWI and partners unpublished data). Five-years of data are insufficient to render robust assessments of long-term trends at Corpus Christi. Moreover, at this time the only species that may be showing a distinct increasing or decreasing trend along the Corpus Christi flyway is the Mississippi Kite, whose passage rates have increased each year since 1997 except for a slight downturn in 2000 (Table 2). At Smith Point, Mississippi and Swallow-tailed kites, as well as Swainson's Hawks are showing apparent increasing trends, but again the short, five-year dataset limits the credibility of these indicators (Smith 2002).

It is also noteworthy that, as during past seasons, the 2001 counts at Corpus Christi and Smith Point showed very different patterns for most other species. In fact, compared to averages for 1997–2000, 14 species showed opposite patterns of abundance at the two sites (see Smith 2002). This continues to suggest that for many species the two sites may sample different migratory populations that are showing different trends (Smith et al. 2001). The Corpus Christi project likely samples a continuation of the Smith Point flight (primarily eastern-flyway and eastern central-flyway origins) plus much larger numbers of birds originating from central flyways and potentially as far west as the eastern flanks of the Rocky Mountain Flyway (*sensu* Hoffman et al. in press). However, it is also possible that regional and/or local weather patterns affect counts at the two sites differently and contribute to the differences in count trends (Smith et al. 2001). Additional years of comparative data and appropriate statistical modeling will be necessary to clearly elucidate the relative influence of such factors.

The timing of Broad-winged Hawk flight activity in 2001 showed an average pattern, with the median passage date of 25 September only 1 day later than average (Table 3) and more than 95% of the activity occurring during the last week of September (Figure 3, Appendix D). In contrast, the 2001 median passage date for all other species combined of 5 October was a significant 10 days earlier than average (Table 3), which primarily reflects a record-high count of typically early-season Mississippi Kites (Figure 3). However, Broad-winged and Swainson's hawks were the only species that showed later than average median passage dates (neither significantly later), whereas nine species showed significantly earlier than average median passage dates (Table 3). For species other than kites, the earlier median dates appeared to result primarily from an unusually large push of multi-species activity during the fourth week of September (e.g., Figure 4).

AUXILIARY COUNTS

Unfortunately, this season we were unable to organize sufficient volunteer support to conduct a simultaneous count at the West Lake auxiliary site (Figure 1) during the peak Broad-winged Hawk passage period, as was done last year. We will endeavor, however, to do so again next season and hope to maintain this aspect of the project in the future.

RESIDENT RAPTORS

Resident raptors routinely seen in the count area included a family of White-tailed Hawks (two adults and one juvenile), at least two Red-shouldered Hawks, one Swainson's Hawk, one Red-tailed Hawk, two White-tailed Kites, one Osprey, and numerous Black and Turkey Vultures in August. By September, other winter residents included two American Kestrels, two Northern Harriers, and a second Red-tailed Hawk (adult dark-morph). This is a typical assemblage for this area.

VISITOR PARTICIPATION AND PUBLIC OUTREACH

During the 2001 season, about 200 individuals visited the project site, with many local individuals visiting repeatedly. Visitors originated in Texas, Louisiana, and California. As usual, visitation was highest during the fourth annual "A Celebration of Flight" event, held between 29 September and 1 October. In general, however, visitation during the season, especially during the festival weekend, was much lower than usual due to the effects of the 11-September terrorist event on long-distance travel.

In addition to on-site visitor interactions and education, our project education specialist Roland Zoer conducted 125 off-site educational programs during the 2001 season. These programs at local schools and other community gatherings were attended by 7,552 students and 417 adults. The groups included 34 elementary, middle, special education, and high school classes and a group of adults at a local hummingbird festival.

Education is the key to long-term success in securing public understanding and action on behalf of raptors and the ecosystems upon which they rely. Visitor participation not only helps in the gathering of data, but also provides people with a sense of ownership in the hawkwatch and the important work we are doing. One very desirable feature of the Corpus Christi count site is its accessibility and proximity to a major metropolitan area. This feature, combined with the extraordinarily large overall flight and high species diversity, render this operation of prime value for attracting the public to experience the awesome nature of raptors and learn about their conservation needs. At HWI, ensuring high-quality, effective public outreach on behalf of raptors and the ecosystems that support them is as important a goal as conducting quality scientific research. The Corpus Christi hawkwatch is proving to be a valuable asset in both regards.

Beginning with the fall 2001 season, HWI adopted a new approach to quantifying the influence of visitors on counts at all of its project sites. Encouraging visitation and achieving positive public education and outreach are important goals for all HWI projects; however, during migration counts, visitors can represent a distraction for the official observers that may compromise the integrity of the count. Tolerating a certain level of distraction in the interest of positive outreach is a tradeoff that we gladly accept as part of our operations; however, because the distraction potential fluctuates considerably through time, it is important that the data we record include a means of quantifying the distraction potential through statistical modeling. Previously, at each site we had the observers estimate the number of visitors present during each hour of active counts. Two primary problems confounded use of this system for quantifying the visitor-distraction factor.

First, during busy periods (busy in terms of either birds to count or visitors present) tracking visitors for estimating numbers at the end of the hour often became a difficult task for the observers. This difficulty led to both inconsistent estimation and, in some cases, in and of itself represented an unnecessary distraction. Second, careful reflection over the years suggested that simply recording the number of visitors often failed to capture the true effect of specific situations. For example, a single, highly curious, and talkative individual often represents more of a distraction for the observers than a large group of relatively quiet visitors.

In an effort to overcome these limitations, we have adopted a new system for recording visitor effects, whereby the observers simply record a subjective, visitor-distraction rating for each hour (none, low, moderate, or high). The new system still requires that the observers keep track of the effects of visitors through the hour, but the task is much easier without having to specify numbers. Furthermore, the new rating system allows the observers to incorporate a broader range of input to generate a more representative index of true visitor effects on their performance. Thus, although data-recording protocol changes such as this can be troublesome with regard to analysis of long-term trends, we believe that in the end this new approach to estimating visitor-distraction effects will significantly improve the integrity of our count systems.

In 2001 at Corpus Christi, 784 hourly assessments of visitor disturbance resulted in the following ratings: 96% none and 4% low. This very low level of visitor disturbance experienced by the official observers was due in large part to the efforts of the on-site educator and other dedicated local volunteers to welcome and "chaperone" other guests.

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Table 1. Observation effort and raptor counts by species: 1997–2001.

	1997	1998	1999	2000	Mean ± 95% CI	2001	% Change
Start date	15-Aug	15-Aug	14-Aug	15-Aug	15-Aug ± 0.8	15-Aug	
End date	15-Nov	15-Nov	15-Nov	15-Nov	15-Nov ± 0.0	15-Nov	
Observation days	89	84	90	91	89 ± 3.05	93	+5
Observation hours	725.00	585.75	719.75	728.58	689.77 ± 68.053	723.50	+5
Species					Counts		
Black Vulture	431	138	1398	491	615 ± 533.7	222	-64
Turkey Vulture	11,221	5,011	30,027	36,690	20,737 ± 14,739.8	4,870	-77
Total vultures	11,652	5,149	31,425	37,181	21,352 ± 15,062.0	5,092	-76
Osprey	81	179	181	88	132 ± 54.1	114	-14
Northern Harrier	93	180	331	153	189 ± 99.2	162	-14
Swallow-tailed Kite	7	6	31	0	11 ± 13.4	37	+236
White-tailed Kite	4	6	6	2	5 ± 1.9	2	-56
Mississippi Kite	2,974	3,584	5,513	4,569	4,160 ± 1,093.7	10,155	+144
Total kites	2,985	3,596	5,550	4,571	4,176 ± 1,102.8	10,194	+144
Sharp-shinned Hawk	936	1,208	1,348	929	1,105 ± 203.4	698	-37
Cooper's Hawk	418	260	1,092	555	581 ± 354.0	473	-19
Northern Goshawk	0	0	1	0	0 ± 0.5	0	-100
Unidentified accipiter	308	316	310	379	328 ± 33.3	298	-9
Total accipiters	1,662	1,784	2,751	1,863	2,015 ± 487.6	1,469	-12
Harris' Hawk	5	5	28	10	12 ± 10.7	14	+17
Red-shouldered Hawk	79	38	77	81	69 ± 20.2	45	-35
Broad-winged Hawk	823,602	970,025	640,258	396,774	707,665 ± 242,353.5	864,355	+22
Swainson's Hawk	300	6,790	1,246	2,085	2,605 ± 2,825.9	14,260	+447
White-tailed Hawk	4	5	13	0	6 ± 5.3	7	+27
Zone-tailed Hawk	2	0	6	0	2 ± 2.8	1	-50
Short-tailed Hawk	0	0	2	0	1 ± 1.0	0	-100
Red-tailed Hawk	112	121	282	237	188 ± 83.0	96	-49
Ferruginous Hawk	1	0	14	1	4 ± 6.5	1	-75
Rough-legged Hawk	1	0	4	0	1 ± 1.9	0	-100
Unidentified buteo	18	25	62	215	80 ± 90.2	368	+360
Total buteos	824,106	976,984	641,992	399,403	710,632 ± 243,632.1	879,147	+24
Golden Eagle	1	0	4	1	2 ± 1.7	1	-33
Bald Eagle	0	2	4	0	2 ± 1.9	2	+33
Unidentified eagle	0	0	1	0	0 ± 0.5	0	-100
Total eagles	1	2	9	1	3 ± 3.8	3	-8
Crested Caracara	9	1	18	4	8 ± 7.3	21	+163
American Kestrel	189	438	483	509	405 ± 143.9	292	-28
Merlin	25	29	34	31	30 ± 3.7	26	-13
Prairie Falcon	8	5	33	6	13 ± 13.1	7	-46
Peregrine Falcon	76	163	241	65	136 ± 80.8	114	-16
Aplomado Falcon	0	0	1	0	0 ± 0.5	0	-100
Unidentified falcon	14	39	92	103	62 ± 41.6	41	-34
Total falcons	222	472	884	714	646 ± 235.7	480	-26
Unidentified raptor	220	4,376	3,874	506	2,244 ± 2,141.1	837	-63
Grand Total	841,139	992,950	687,015	444,484	741,397 ± 229,371.7	897,519	+21
Total w/o BW	17,537	22,925	46,757	47,710	33,732 ± 15,434.1	33,164	-2

Table 2. Raptor passage rates (raptors / 100 hrs of observation) by species: 1997-2001.

SPECIES	1997	1998	1999	2000	MEAN ± 95% CI	2001	% CHANGE
Black Vulture	59.4	23.6	194.2	67.4	86.2 ± 73.0	30.7	-64
Turkey Vulture	1548	8556	4172	5036	2,903 ± 1,975.3	673	-77
TOTAL VULTURES	1607	879	4366	5103	2,989 ± 2,018.6	704	-76
Osprey	11.2	30.6	25.1	12.1	19.7 ± 9.4	15.8	-20
Northern Harrier	12.8	30.7	46.0	21.0	27.6 ± 14.0	22.4	-19
Swallow-tailed Kite	1.0	1.0	4.3	0.0	1.6 ± 1.8	5.1	+225
White-tailed Kite	0.6	1.0	0.8	0.3	0.7 ± 0.3	0.3	-59
Mississippi Kite	410	612	766	627	604 ± 143.6	1,404	+132
TOTAL KITES	412	614	771	627	606 ± 144.8	1,409	+132
Sharp-shinned Hawk	129	206	187	128	163 ± 39.5	96.5	-41
Cooper's Hawk	57.7	44.4	151.7	76.2	82.5 ± 47.0	65.4	-21
Northern Goshawk	0.0	0.0	0.1	0.0	0.0 ± 0.1	0.0	-64
Unidentified accipiter	42.5	53.9	43.1	52.0	47.9 ± 5.8	41.2	-14
TOTAL ACCIPITERS	229	305	382	256	293 ± 65.9	203.0	-31
Harris' Hawk	0.7	0.9	3.9	1.4	1.7 ± 1.5	1.9	+14
Red-shouldered Hawk	10.9	6.5	10.7	11.1	9.8 ± 2.2	6.2	-37
Broad-winged Hawk	113,600	165,604	88,956	54,459	105,655 ± 45,815.9	119,4696	+13
Swainson's Hawk	41	1,159	173	286	415 ± 496.0	1,971	+375
White-tailed Hawk	0.6	0.9	1.8	0.0	0.8 ± 0.7	1.0	+21
Zone-tailed Hawk	0.3	0.0	0.8	0.0	0.3 ± 0.4	0.1	-50
Short-tailed Hawk	0.0	0.0	0.3	0.0	0.1 ± 0.1	0.0	-100
Red-tailed Hawk	15.4	20.7	39.2	32.5	27.0 ± 10.6	13.3	-51
Ferruginous Hawk	0.1	0.0	1.9	0.1	0.6 ± 0.9	0.1	-75
Rough-legged Hawk	0.1	0.0	0.6	0.0	0.2 ± 0.3	0.0	-100
Unidentified buteo	2.5	4.3	8.6	29.5	11.2 ± 12.2	50.9	+353
TOTAL BUTEOS	113,672	166,796	89,197	54,819	106,121 ± 46,163.4	121,513	+15
Golden Eagle	0.1	0.0	0.6	0.1	0.2 ± 0.2	0.1	-33
Bald Eagle	0.0	0.3	0.6	0.0	0.2 ± 0.3	0.3	+23
Unidentified eagle	0.0	0.0	0.1	0.0	0.0 ± 0.1	0.0	-100
TOTAL EAGLES	0.1	0.3	1.3	0.1	0.5 ± 0.5	0.4	-11
Crested Caracara	1.2	0.2	2.5	0.5	1.1 ± 1.0	2.9	+160
American Kestrel	26.1	74.8	67.1	69.9	59.5 ± 22.0	40.4	-32
Merlin	3.4	5.0	4.7	4.3	4.3 ± 0.7	3.6	-17
Prairie Falcon	1.1	0.9	4.6	0.8	1.8 ± 1.8	1.0	-47
Peregrine Falcon	10.5	27.8	33.5	8.9	20.2 ± 12.1	15.8	-22
Aplomado Falcon	0.0	0.0	0.1	0.0	0.0 ± 0.1	0.0	-100
Unidentified falcon	1.9	6.7	12.8	14.1	8.9 ± 5.5	5.7	-36
TOTAL FALCONS	43.0	115	1238	98.0	94.7 ± 35.3	66.3	-30
Unidentified raptor	30.3	747	538	69.5	346.3 ± 346.0	116	-67
GRAND TOTAL	116,019	169,518	95,452	61,007	110,499 ± 44,513.9	124,052	+12
TOTAL W/O BW	2,419	3,913	6,496	6,548	4,844 ± 1,990.9	4,584	-5

Table 3. First and last observation, bulk passage, and median passage dates by species for 2001, with a comparison of 2001 and 1997–2000 average median passage dates.

	2001				1997–2000
	First Observed	Last Observed	Bulk (80%) Passage Dates[1]	Median Passage Date[2]	Median Passage Date[2] Mean ± 95% CI
Black Vulture	26-Sep	11-Nov	29-Sep – 30-Oct	20-Oct	24-Oct ± 9.9
Turkey Vulture	25-Sep	11-Nov	6-Oct – 23-Oct	15-Oct	21-Oct ± 6.9
Osprey	21-Aug	15-Oct	8-Sep – 6-Oct	23-Sep	27-Sep ± 1.8
Northern Harrier	17-Aug	11-Nov	11-Sep – 18-Oct	25-Sep	12-Oct ± 9.5
Swallow-tailed Kite	16-Aug	11-Sep	19-Aug 2-Sep	19-Aug	25-Aug ± 4.3
White-tailed Kite	25-Sep	4-Nov	–	–	3-Oct ± 8.8[3]
Mississippi Kite	15-Aug	7-Oct	19-Aug – 2-Sep	23-Aug	28-Aug ± 5.0
Sharp-shinned Hawk	14-Sep	7-Nov	25-Sep – 16-Oct	30-Sep	7-Oct ± 7.4
Cooper's Hawk	11-Sep	11-Nov	25-Sep – 17-Oct	29-Sep	6-Oct ± 4.7
Harris' Hawk	17-Aug	28-Oct	17-Aug – 7-Oct	20-Sep	2-Oct ± 16.9
Red-shouldered Hawk	19-Aug	29-Oct	10-Sep – 28-Oct	23-Sep	3-Oct ± 17.9
Broad-winged Hawk	17-Aug	4-Nov	25-Sep – 27-Sep	25-Sep	24-Sep ± 3.5
Swainson's Hawk	15-Aug	11-Nov	6-Oct – 14-Oct	13-Oct	7-Oct ± 8.5
White-tailed Hawk	16-Aug	26-Sep	16-Aug – 26-Sep	11-Sep	26-Sep ± 7.8[3]
Zone-tailed Hawk	30-Sep	30-Sep	–	–	–
Red-tailed Hawk	21-Aug	10-Nov	11-Sep – 4-Nov	6-Oct	22-Oct ± 17.9
Ferruginous Hawk	13-Oct	13-Oct	–	–	–
Golden Eagle	14-Oct	14-Oct	–	–	–
Bald Eagle	24-Sep	1-Oct	–	–	–
Crested Caracara	17-Aug	11-Nov	14-Sep – 4-Nov	5-Oct	21-Oct ± 0.0[4]
American Kestrel	11-Sep	4-Nov	24-Sep – 12-Oct	29-Sep	4-Oct ± 5.2
Merlin	25-Aug	12-Oct	22-Sep – 10-Oct	24-Sep	30-Sep ± 6.1
Prairie Falcon	28-Sep	13-Oct	28-Sep – 13-Oct	28-Sep	2-Oct ± 8.5
Peregrine Falcon	17-Aug	2-Nov	12-Sep – 12-Oct	29-Sep	1-Oct ± 3.6
All Species	15-Aug	11-Nov	25-Sep – 28-Sep	25-Sep	24-Sep ± 3.8
All w/o BW	15-Aug	11-Sep	20-Aug – 14-Oct	5-Oct	15-Oct ± 7.5

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

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

[3] Data for 1998 and 1999 only.

[4] Data for 1997 and 1999 only.

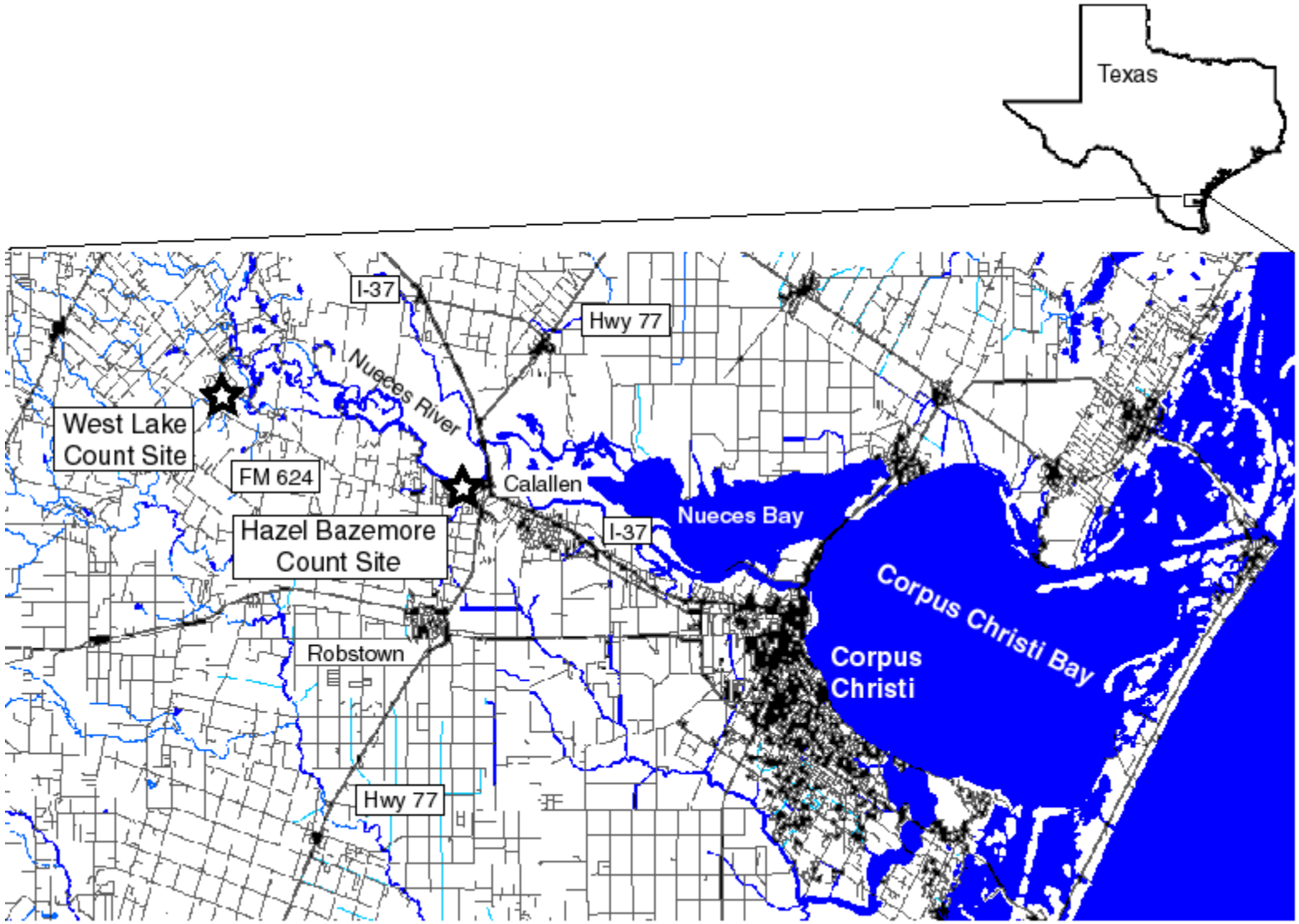

Figure 1. Location of Hazel Bazemore County Park count site near Corpus Christi, Texas.

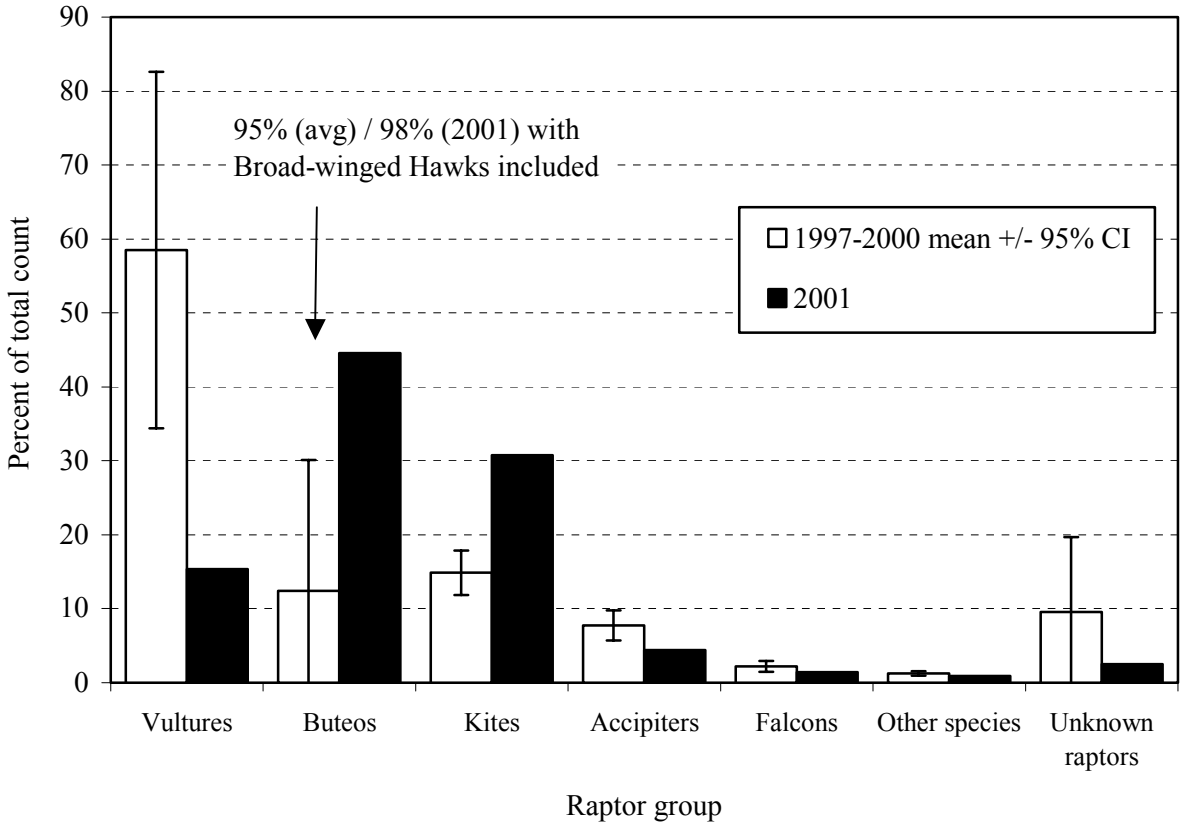

Figure 2. Composition of raptor flights by species groups: 1997–2000 versus 2001.

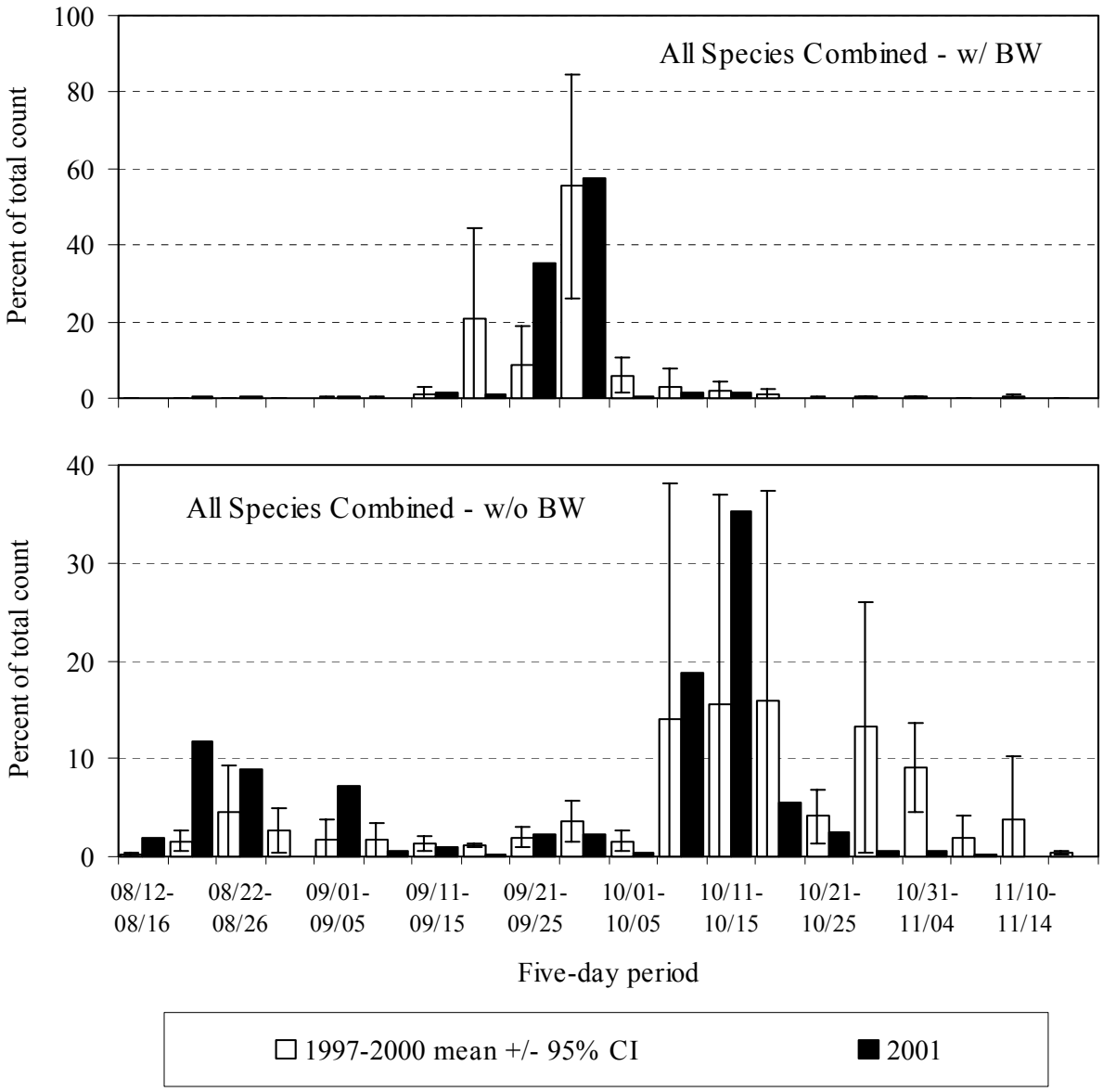

Figure 3. Combined-species flight volume by five-day periods, with and without Broad-wing Hawks: 1997–2000 versus 2001.

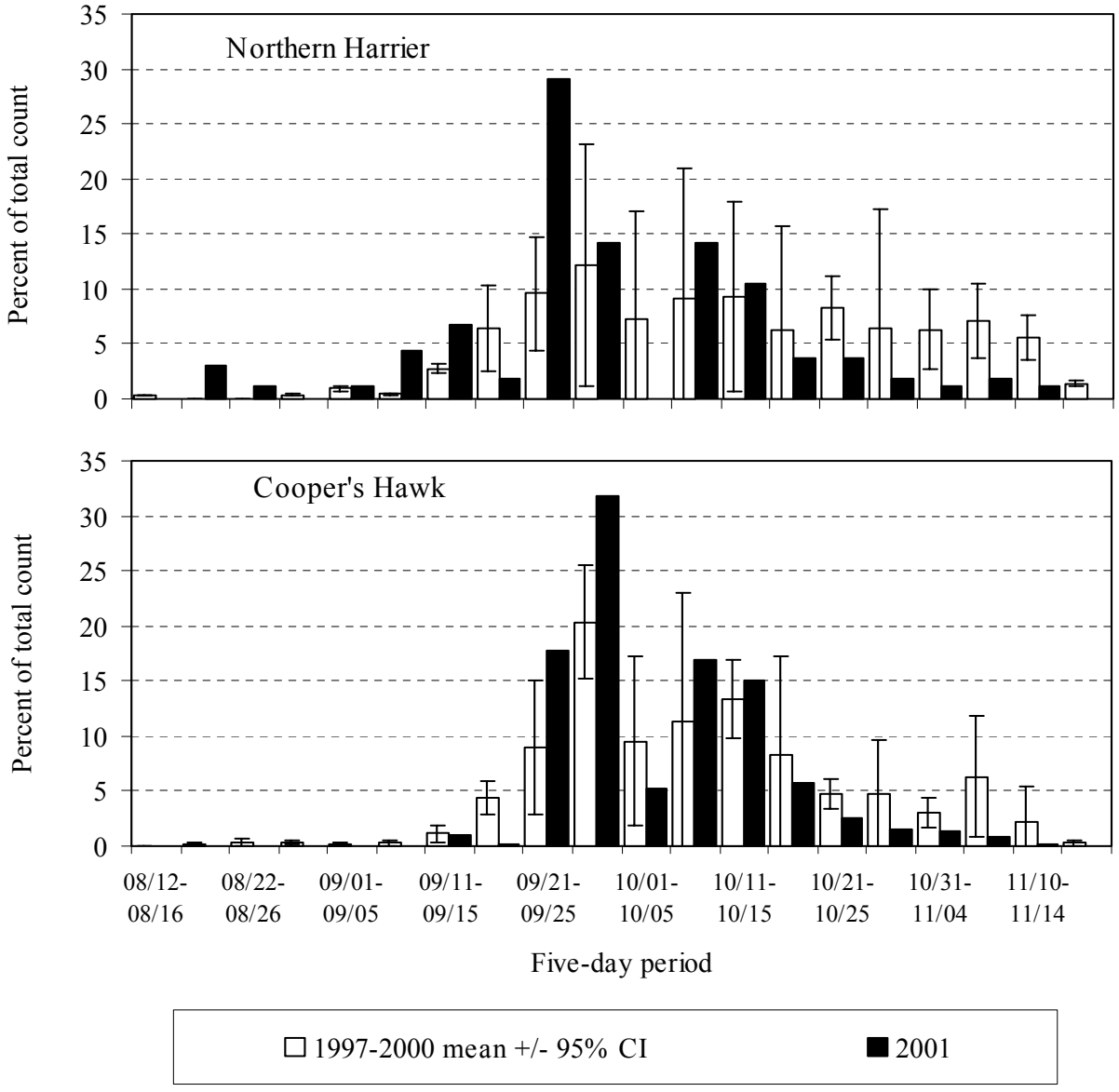

Figure 4. Flight volume by five-day periods for Cooper's Hawks and Northern Harriers: 1997–2000 versus 2001.

Appendix A. Common and scientific names, species codes, and regularly applied age, sex, and color-morph classifications.

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

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

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

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

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

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

Appendix B. History of official observer participation: 1997–2001.

1997: Two observers throughout: Glenn Swartz (6 partial at this site) and Joel Simon (0), regularly assisted by several other dedicated volunteers.

1998: Two observers throughout: Glenn Swartz (1 plus 6 partial at this site) and Joel Simon (1), regularly assisted by several other dedicated volunteers.

1999: Three observers throughout: Joel Simon (2), Fernando Rincon (1), and Ryan Wagner (0), regularly assisted by several other dedicated volunteers.

2000: Rotating team working two at a time except during peak Broad-winged Hawk flight when all three worked together: Scott Rush (2), Beth Hahn (1), and Jo Creglow (several partial at this site), regularly assisted by several other dedicated volunteers.

2001: Rotating team working two at a time except during the peak Broad-winged Hawk flight when all three worked together: Greg Greene (limited experience in Idaho), Devin Taylor (0), and Karen Johnson (0), regularly assisted by several other dedicated volunteers.

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

Appendix C. Daily records of observation effort, visitor participation, and predominant weather conditions at Hazel Bazemore County Park: 2001.

Date	Obs. Hours	Number Obsrvrs[1]	Visitor Disturb[2]	Sky Condition[3]	Wind Speed[4]	Wind Direction	Temp. (°C)[1]	Baro. Press. (in Hg)[1]	Visib. East (km)[1]	Visib. West (km)[1]	Flight Dist.[5]	Raptors / Hour
15-Aug	8.00	2.9	0	clr-pc	2	s, se	37.0	29.83	10	10	2	44.5
16-Aug	8.00	3.3	0	clr-pc	2	s	36.9	29.97	11	11	2	30.9
17-Aug	8.00	3.7	0	pc, AM haze	1	s-se	36.8	30.07	10	10	2	1.4
18-Aug	8.00	2.5	0	clr-pc	1	s-se	35.7	30.03	11	11	2	8.6
19-Aug	8.50	2.4	0	clr-mc	1	s-se	36.4	29.92	11	11	2	183.8
20-Aug	8.00	2.2	0	pc-mc, AM haze	2	e-se	34.3	29.98	11	11	2	283.6
21-Aug	8.00	3.1	0	pc-mc	2	se	35.8	29.99	12	12	2	1.0
22-Aug	8.00	3.4	0	clr-pc	1	ese-sse	35.0	29.97	10	11	2	8.3
23-Aug	8.00	2.7	0	pc-mc	2	ese-sse	34.3	29.92	11	11	2	6.4
24-Aug	8.50	2.8	0	pc-mc	2	ese-sse	34.3	29.92	11	11	2	186.9
25-Aug	8.00	6.2	0	pc-mc	0	ese-sse	34.0	29.92	10	11	2	158.1
26-Aug	6.50	4.8	0	clr-ovc/rain	1	ssw	33.4	29.96	9	9	2	0.9
27-Aug	8.00	2.5	0	pc-mc	1	se-s	34.3	29.93	10	10	3	0.6
28-Aug	2.50	3.0	0	ovc/rain	1	var, ese	29.8	29.93	9	9	-	0.0
29-Aug	6.50	2.5	0	ovc, AM/PM rain	2	ese-s	34.6	29.87	10	10	-	0.0
30-Aug	6.00	2.0	0	ovc, fog/rain	1	se-sse	32.4	29.84	8	8	-	0.0
31-Aug	3.50	1.5	0	ovc, PM ts	0	se	29.4	29.82	6	6	-	0.0
01-Sep	8.50	2.7	0	mc-ovc	0	s-sw	30.7	29.83	10	10	2	35.5
02-Sep	8.00	5.6	0	pc-mc	0	s	35.0	29.82	8	8	1	221.4
03-Sep	8.00	3.9	0	ovc/haze-pc	1	sse	34.4	29.82	9	9	2	4.8
04-Sep	5.00	2.0	0	clr-ovc/rain	1	se-s	33.0	29.88	10	10	2	57.6
05-Sep	8.00	2.4	0	pc	1	sse	31.9	29.93	9	9	2	0.4
06-Sep	8.00	3.4	0	pc	1	se-s	32.7	29.93	10	10	2	3.9
07-Sep	8.00	2.6	0	pc-clr	2	se-s	32.1	29.79	11	12	1	0.5
08-Sep	8.00	3.2	0	pc-mc	1	sse	32.0	29.73	9	9	2	3.3
09-Sep	4.00	3.6	0	pc-mc/fog/ts	0	sse-s	31.6	29.87	9	9	2	1.8
10-Sep	8.00	2.8	0	mc, PM rain	1	ne	28.4	30.08	13	13	2	40.9
11-Sep	8.00	2.7	0	clr-ovc	1	ne	30.7	30.07	11	11	2	201.5
12-Sep	8.00	2.4	0	clr-mc, PM haze	0	ne	31.0	30.00	11	11	2	397.9
13-Sep	8.00	2.6	0	clr-mc, AM haze	1	n-ne	31.9	29.95	9	10	2	135.0
14-Sep	8.50	2.0	0	clr-pc	1	n-se	31.8	29.96	10	10	3	152.2
15-Sep	8.00	3.8	0	clr-pc, AM haze	0	calm, e-ese	31.1	29.96	8	9	2	761.3
16-Sep	8.00	4.7	0	pc-ovc, AM haze	0	ne-e	31.3	29.95	9	10	2	412.6
17-Sep	8.00	3.0	0	clr-mc	1	se	31.6	29.94	9	9	2	94.8
18-Sep	8.00	2.0	0	clr-pc	0	se-s	33.2	29.85	10	10	2	333.5
19-Sep	8.00	2.2	0	pc-mc	0	e-se	32.7	29.90	13	13	2	112.0
20-Sep	8.00	2.4	0	pc-ovc, scat haze	0	sse	32.4	29.95	8	9	2	227.3
21-Sep	8.00	2.7	0	mc-ovc, scat haze	0	var, e-se	31.9	29.97	9	10	2	514.6
22-Sep	8.00	3.0	0	pc-ovc/rain	0	var, e	26.9	29.97	10	10	2	48.0
23-Sep	8.00	3.9	0	pc-ovc, dust, scat rain	1	ne-e	30.7	29.94	10	10	2	109.4
24-Sep	10.00	7.0	0	clr, AM haze	1	nw-nne	27.6	30.01	10	10	3	1883.5
25-Sep	10.00	6.4	0	clr-ovc	1	nw-nne	24.4	30.08	10	11	2	29186.5
26-Sep	10.00	8.7	0	clr-pc	1	n-ne	27.1	30.07	11	11	2	44642.0
27-Sep	10.00	9.8	0	clr-pc, haze	1	ene-e	26.7	30.03	11	11	2	551.4
28-Sep	9.50	8.2	0	clr/haze	1	ne	26.2	29.97	9	9	2	924.8
29-Sep	9.00	9.8	0	clr, AM haze	1	ne-e	28.7	30.04	10	11	2	2456.0
30-Sep	9.50	9.7	0	clr-pc, haze	1	ne	26.5	30.11	11	11	3	3573.2
01-Oct	8.50	2.8	0	pc-mc, haze	1	ne, se	25.8	30.14	8	9	2	266.2
02-Oct	8.00	3.1	0	pc, haze	1	ne-se	27.9	30.09	9	9	2	92.9
03-Oct	8.00	2.0	0	pc-ovc, AM haze, PM rain	2	e-se	29.8	30.02	10	11	2	0.3
04-Oct	8.00	2.7	0	mc-ovc, AM haze	1	se	28.8	29.95	9	9	2	1.1
05-Oct	8.00	2.7	0	ovc, AM haze, AM/PM rain	1	se	31.9	29.84	9	10	2	0.5
06-Oct	10.00	2.8	0	ovc-clr	2	nw	19.8	30.13	8	8	2	1175.5

Appendix C. continued

Date	Obs. Hours	Number Obsrvrs[1]	Visitor Disturb[2]	Sky Condition[3]	Wind Speed[4]	Wind Direction	Temp. (°C)[1]	Baro. Press. (in Hg)[1]	Visib. East (km)[1]	Visib. West (km)[1]	Flight Dist.[5]	Raptors / Hour
07-Oct	8.00	4.4	0	mc-ovc	1	ene	27.2	30.17	10	10	2	185.4
08-Oct	8.00	2.0	0	ovc, AM haze	1	e-ese	28.9	30.07	9	9	1	3.5
09-Oct	8.00	2.0	0	mc-ovc, haze	2	se	30.2	29.97	9	9	2	4.1
10-Oct	8.00	2.1	0	mc-ovc, AM haze	1	se	29.8	29.93	8	8	2	3.3
11-Oct	8.00	2.0	0	mc-ovc, AM haze, PM rain	1	se-s	32.0	29.83	10	10	1	3.9
12-Oct	8.00	2.7	0	pc-ovc, AM fog	1	ene-se	30.1	29.70	8	8	2	13.4
13-Oct	8.00	2.8	0	AM fog/rain-clr	2	w-nw	24.8	29.71	11	11	2	248.8
14-Oct	8.00	2.3	0	clr	1	calm, e	27.7	29.98	13	13	2	1209.1
15-Oct	8.00	2.0	0	clr-pc, AM haze	0	calm, e-se	28.6	30.02	11	11	3	21.9
16-Oct	8.00	2.0	0	clr	2	nw	19.6	30.37	11	11	2	186.5
17-Oct	8.00	2.8	0	clr	1	ne-e	22.8	30.28	13	13	2	18.5
18-Oct	8.00	2.4	0	clr-pc, haze	1	ese-se	26.8	30.08	11	11	2	25.9
19-Oct	8.00	2.0	0	clr-pc	1	ne-ese	28.0	29.95	13	13	1	8.8
20-Oct	8.00	2.6	0	pc-mc	1	e	27.1	30.00	9	9	2	14.9
21-Oct	8.00	2.6	0	clr-pc, AM haze	1	calm, se-s	29.6	29.98	10	10	2	25.6
22-Oct	8.00	2.0	0	ovc/fog-clr	1	se-s	29.9	29.89	8	9	2	46.8
23-Oct	8.00	2.0	0	mc-ovc	1	sse	29.6	29.72	8	9	2	11.6
24-Oct	8.00	2.0	0	clr-pc	1	s	32.4	29.74	11	11	2	6.5
25-Oct	8.00	2.1	0	clr-mc	1	ne-e	28.2	30.10	10	10	2	12.8
26-Oct	8.00	2.0	0	clr-ovc	1	ne-e	26.4	30.29	12	12	1	1.4
27-Oct	8.00	2.0	0	clr, AM haze	1	ne-se	27.3	30.38	11	11	2	1.4
28-Oct	8.00	2.4	0	clr, AM haze	1	ene	26.2	30.36	9	9	2	9.9
29-Oct	8.00	2.0	0	clr, AM haze	0	ese	26.4	30.37	11	11	2	5.8
30-Oct	8.00	2.0	0	pc, AM haze	1	ene-e	26.1	30.28	10	10	1	7.3
31-Oct	8.00	2.0	0	pc-ovc, AM haze	1	se	27.0	30.08	9	9	2	0.9
01-Nov	8.00	2.0	0	pc-mc, AM haze	2	se	29.7	29.97	10	10	2	3.5
02-Nov	7.00	2.0	0	clr-mc	1	se	29.4	30.03	10	11	1	3.7
03-Nov	8.00	2.7	0	mc-ovc, fog/haze/rain	1	ene	26.7	30.16	8	8	2	0.3
04-Nov	8.00	2.7	0	clr-ovc	1	n-nne	27.1	30.19	8	8	2	17.3
05-Nov	8.00	2.0	0	clr	1	nne-ne	25.3	30.16	9	9	2	3.3
06-Nov	8.00	2.0	0	clr-pc	1	ne-e	25.0	30.19	12	12	1	0.4
07-Nov	8.00	2.0	0	clr-pc, AM haze	1	nne-se	25.9	30.14	10	10	2	2.6
08-Nov	8.00	2.0	0	clr-mc, AM fog	1	sse	28.6	30.18	9	9	2	0.5
09-Nov	5.50	1.9	0	mc-ovc	1	nw	22.7	30.35	5	6	2	1.3
10-Nov	8.00	2.3	0	clr, haze	0	ne-ene	27.0	30.24	8	8	3	0.9
11-Nov	7.50	8.3	0	pc-mc, AM haze	1	ene-se	26.8	30.17	9	10	1	2.0
12-Nov	5.50	2.0	0	ovc, fog/haze/rain	1	ese-se	26.1	30.18	7	7	-	0.0
13-Nov	7.50	2.0	0	mc-ovc, AM haze	1	e-ese	28.9	30.12	10	10	-	0.0
14-Nov	6.75	1.6	0	ovc, haze/rain	2	ese-se	27.5	29.95	9	9	-	0.0
15-Nov	1.25	2.0	0	ovc/haze/rain	2	ese	26.0	29.93	8	9	-	0.0

[1] Average of hourly records.

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

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

[4] Average of hourly Beaufort-scale ratings: 0 = less than 1 kph; 1 = 1–5 kph; 2 = 6–11 kph; 3 = 12–19 kph; 4 = 20–28 kph; 5 = 29–38 kph, etc.

[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 count records from Hazel Bazemore County Park: 2001.

Date	Obs.. Hours	Species[1]																															Total	Raptors / hour
		BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	SW	WT	ZT	ST	RT	FH	RL	UB	GE	BE	UE	CC	AK	ML	PR	PG	AF	UF	UU		
15-Aug	8.00	0	0	0	0	0	0	354	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	356	44.5
16-Aug	8.00	0	0	0	0	3	0	242	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	247	30.9
17-Aug	8.00	0	0	0	1	0	0	0	0	0	0	0	2	0	1	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	11	1.4
18-Aug	8.00	0	0	0	0	0	0	64	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	69	8.6
19-Aug	8.50	0	0	0	2	3	0	1540	0	0	0	0	0	1	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1562	183.8
20-Aug	8.00	0	0	0	0	16	0	2250	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2269	283.6
21-Aug	8.00	0	0	1	2	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	1.0
22-Aug	8.00	0	0	0	1	0	0	62	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	8.3
23-Aug	8.00	0	0	1	0	0	0	47	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	51	6.4
24-Aug	8.50	0	0	0	0	3	0	1582	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1589	186.9
25-Aug	8.00	0	0	0	0	0	0	1251	0	0	0	0	0	1	0	9	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1265	158.1
26-Aug	6.50	0	0	0	1	0	0	1	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0.9
27-Aug	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0.6
28-Aug	2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
29-Aug	6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
30-Aug	6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
31-Aug	3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
1-Sep	8.50	0	0	0	0	1	0	297	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	302	35.5
2-Sep	8.00	0	0	1	1	9	0	1751	0	0	0	0	0	0	0	6	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1771	221.4
3-Sep	8.00	0	0	1	0	0	0	34	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	38	4.8
4-Sep	5.00	0	0	0	0	0	0	284	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	288	57.6
5-Sep	8.00	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.4
6-Sep	8.00	0	0	1	0	0	0	28	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	31	3.9
7-Sep	8.00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	0.5
8-Sep	8.00	0	0	6	0	0	0	14	0	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	26	3.3
9-Sep	4.00	0	0	1	1	0	0	4	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	7	1.8
10-Sep	8.00	0	0	0	6	0	0	99	0	0	0	0	0	2	205	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	7	327	40.9
11-Sep	8.00	0	0	2	3	2	0	37	0	1	0	0	0	6	1540	6	0	0	0	5	0	0	2	0	0	0	0	2	0	0	2	0	1	3	1612	201.5
12-Sep	8.00	0	0	2	7	0	0	115	0	2	0	0	0	3	3040	3	1	0	0	1	0	0	2	0	0	0	0	1	0	0	1	0	0	5	3183	397.9
13-Sep	8.00	0	0	1	1	0	0	23	0	2	0	0	1	1	1040	4	0	0	0	2	0	0	1	0	0	0	1	0	0	0	2	0	0	1	1080	135.0
14-Sep	8.50	0	0	1	0	0	0	3	1	0	0	1	0	0	1275	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	9	1294	152.2
15-Sep	8.00	0	0	3	0	0	0	4	1	0	0	1	0	0	6071	4	0	0	0	3	0	0	1	0	0	0	0	1	0	0	0	0	0	1	6090	761.3
16-Sep	8.00	0	0	2	1	0	0	1	1	1	0	1	0	0	3280	8	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	3301	412.6
17-Sep	8.00	0	0	2	0	0	0	0	1	0	0	0	0	0	752	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	758	94.8
18-Sep	8.00	0	0	4	1	0	0	0	0	0	0	0	0	0	2660	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2668	333.5
19-Sep	8.00	0	0	1	0	0	0	1	0	0	0	1	0	0	892	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	896	112.0
20-Sep	8.00	0	0	3	1	0	0	2	0	0	0	1	0	0	1804	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1818	227.3
21-Sep	8.00	0	0	12	4	0	0	4	8	0	0	2	2	0	4045	25	0	0	0	0	0	0	1	0	0	0	0	5	0	0	6	0	0	3	4117	514.6
22-Sep	8.00	0	0	1	5	0	0	5	14	0	0	0	0	0	344	5	0	0	0	0	0	0	1	0	0	0	0	4	4	0	0	0	1	0	384	48.0
23-Sep	8.00	0	0	0	6	0	0	8	7	9	0	0	0	0	813	7	0	0	0	1	0	0	2	0	0	0	0	6	1	0	1	0	1	13	875	109.4
24-Sep	10.00	0	0	23	14	0	0	17	26	32	0	29	1	12	18615	13	0	0	0	4	0	0	3	0	1	0	2	25	0	0	7	0	2	9	18835	1883.5

Appendix D. continued

Date	Obs.. Hours	Species[1]																																Raptors
		BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	SW	WT	ZT	ST	RT	FH	RL	UB	GE	BE	UE	CC	AK	ML	PR	PG	AF	UF	UU	Total	/ hour
25-Sep	10.00	0	12	13	18	0	1	22	90	43	0	20	0	3	291523	22	2	0	0	7	0	0	3	0	0	0	0	46	9	0	15	0	3	13	291865	29186.5
26-Sep	10.00	9	7	4	8	0	0	2	70	40	0	25	0	0	446200	18	1	0	0	4	0	0	2	0	0	0	0	21	2	0	0	0	2	5	446420	44642.0
27-Sep	10.00	0	1	3	7	0	0	0	33	25	0	9	0	1	5416	5	0	0	0	3	0	0	2	0	0	0	0	3	0	0	3	0	0	3	5514	551.4
28-Sep	9.50	7	0	4	3	0	0	0	21	17	0	25	0	0	8676	2	0	0	0	2	0	0	1	0	0	0	2	10	1	2	3	0	2	8	8786	924.8
29-Sep	9.00	7	2	1	3	0	0	1	30	29	0	22	0	1	21977	4	0	0	0	2	0	0	2	0	0	0	1	10	0	2	0	0	3	7	22104	2456.0
30-Sep	9.50	5	18	0	2	0	0	2	34	39	0	42	1	4	33737	23	0	1	0	3	0	0	1	0	0	0	0	11	0	1	5	0	2	14	33945	3573.2
1-Oct	8.50	0	0	2	0	0	0	0	20	12	0	8	0	0	2198	1	0	0	0	1	0	0	0	0	1	0	1	11	0	0	2	0	2	4	2263	266.2
2-Oct	8.00	0	0	1	0	0	0	0	25	13	0	13	0	0	666	3	0	0	0	0	0	0	2	0	0	0	1	11	0	0	1	0	0	7	743	92.9
3-Oct	8.00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.3
4-Oct	8.00	7	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1.1
5-Oct	8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0.5
6-Oct	10.00	0	1043	5	4	0	0	0	33	20	0	13	1	1	5943	4626	0	0	0	1	0	0	3	0	0	0	1	32	0	1	17	0	7	4	11755	1175.5
7-Oct	8.00	7	29	3	13	0	0	2	69	57	0	21	0	6	1148	24	0	0	0	5	0	0	5	0	0	0	0	46	4	0	10	0	7	27	1483	185.4
8-Oct	8.00	0	4	1	5	0	0	0	4	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	3	0	0	1	28	3.5
9-Oct	8.00	0	29	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	33	4.1
10-Oct	8.00	0	21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	0	26	3.3
11-Oct	8.00	0	29	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	2	0	0	0	31	3.9
12-Oct	8.00	2	13	1	0	0	0	0	12	4	0	4	0	0	54	1	0	0	0	1	0	0	0	0	0	0	0	7	2	0	4	0	0	2	107	13.4
13-Oct	8.00	5	503	1	0	0	0	0	8	11	0	2	0	1	166	583	0	0	0	2	1	0	303	0	0	0	0	0	0	1	1	0	0	402	1990	248.8
14-Oct	8.00	22	426	0	13	0	0	0	101	48	0	14	0	0	27	8756	0	0	0	3	0	0	2	1	0	0	0	5	0	0	0	0	0	255	9673	1209.1
15-Oct	8.00	0	119	1	4	0	0	0	13	8	0	3	0	0	12	7	0	0	0	2	0	0	1	0	0	0	0	2	0	0	2	0	0	1	175	21.9
16-Oct	8.00	0	1340	0	1	0	0	0	18	8	0	11	0	0	80	17	0	0	0	0	0	0	2	0	0	0	0	6	0	0	0	0	1	8	1492	186.5
17-Oct	8.00	7	61	0	4	0	0	0	13	11	0	4	0	0	30	4	0	0	0	4	0	0	0	0	0	0	0	4	0	0	2	0	1	3	148	18.5
18-Oct	8.00	0	124	0	1	0	0	0	3	2	0	0	0	0	71	0	0	0	0	2	0	0	0	0	0	0	2	1	0	0	1	0	0	0	207	25.9
19-Oct	8.00	27	34	0	0	0	0	0	0	2	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	8.8
20-Oct	8.00	5	42	0	0	0	0	0	11	4	0	2	0	0	41	3	0	0	0	3	0	0	1	0	0	0	0	4	0	0	0	0	1	2	119	14.9
21-Oct	8.00	15	155	0	0	0	0	0	3	2	0	9	0	0	0	2	0	0	0	1	0	0	7	0	0	0	2	1	0	0	2	0	1	5	205	25.6
22-Oct	8.00	24	326	0	2	0	0	0	5	5	0	3	1	0	2	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	2	374	46.8
23-Oct	8.00	29	60	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	93	11.6
24-Oct	8.00	0	48	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	52	6.5
25-Oct	8.00	1	76	0	2	0	0	0	6	4	0	2	0	0	1	0	0	0	0	4	0	0	2	0	0	0	0	2	0	0	0	0	1	1	102	12.8
26-Oct	8.00	0	2	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.4
27-Oct	8.00	0	9	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.4
28-Oct	8.00	2	60	0	0	0	0	0	2	2	0	3	3	0	1	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	1	0	0	0	79	9.9
29-Oct	8.00	4	29	0	0	0	0	0	5	1	0	3	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	46	5.8
30-Oct	8.00	18	35	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	58	7.3
31-Oct	8.00	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.9
1-Nov	8.00	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	3.5
2-Nov	7.00	6	16	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	26	3.7
3-Nov	8.00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0.3
4-Nov	8.00	1	111	0	1	0	1	0	3	4	0	1	0	0	1	0	0	0	0	7	0	0	0	0	0	0	3	2	0	0	0	0	0	3	138	17.3

Appendix D. continued

Date	Obs.. Hours	Species[1]																																Raptors / hour
		BV	TV	OS	NH	SK	WK	MK	SS	CH	NG	UA	HH	RS	BW	SW	WT	ZT	ST	RT	FH	RL	UB	GE	BE	UE	CC	AK	ML	PR	PG	AF	UF	UU	Total	
5-Nov	8.00	0	24	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	3.3
6-Nov	8.00	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.4
7-Nov	8.00	2	14	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	21	2.6
8-Nov	8.00	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0.5
9-Nov	5.50	0	5	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1.3
10-Nov	8.00	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0.9
11-Nov	7.50	7	3	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	15	2.0
12-Nov	5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
13-Nov	7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
14-Nov	6.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
15-Nov	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total	723.50	222	4870	114	162	37	2	10155	698	473	0	298	14	45	864355	14260	7	1	0	96	1	0	368	1	2	0	21	292	26	7	114	0	41	837	897519	1240.5

[1] See Appendix A for explanation of species codes.