ILLINOIS WOODLAND RAPTOR SURVEY

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By

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INTRODUCTION

Raptor populations in Illinois have declined significantly since pre-settlement times, mainly as a consequence of pesticide poisoning and the loss of foraging and nesting habitat (Bowles and Thom 1981). Twelve species of raptors currently are listed as endangered in Illinois (Illinois Administrative Code, Title 17, Chapter I, subchapter c, part 1010.30, as amended 17 March 1989). Though the decline of raptor populations can be documented, little is known of the actual distribution and abundance of many raptor species in the state today. Successful protection and management of endangered raptors will depend, in part, on population measurements that are as accurate as possible.

Monitoring raptor populations is challenging because birds of prey, occupying a high trophic level in the community, are less common and more widely dispersed than other kinds of birds. Raptors that nest in forests are especially difficult to detect during field surveys because vegetation limits the observer's ability to see birds within even relatively short distances. The inadequacy of traditional census methods for birds of prey has led to the recent development of more efficient raptor surveying methods.

Based on a statistical analysis developed by Geissler and Fuller (1986), Iverson and Fuller (1989) devised a raptor monitoring technique in which data collected along survey routes are used to estimate the area occupied (AO) by a species based upon a correction factor called the probability of detection (PD). The technique was designed for census situations where the following problems are encountered: (1) distance measurements are unreliable, (2) individuals are indistinguishable, and (3) a low rate of detection is probable. These problems are typical of many roadside counts of raptors. Use of the correction factor allows the researcher to account for the low detection rate of nesting woodland raptors. This technique has been used successfully by Iverson and Fuller (1989) and Parker (1990) in southern Indiana and Sargent (1990) in northern Indiana.

The Illinois Department of Conservation (IDOC) contracted with the Illinois Natural History Survey (INHS) to coordinate a statewide survey of Illinois nesting woodland raptor populations using the Fuller, Geissler, and Iverson survey technique. Objectives of the study were as follows: (1) to collect quantitative data that describes the abundance and distribution of nesting woodland raptors detected in 12 wooded areas in Illinois, (2) to assess the effectiveness of the woodland raptor monitoring technique, and (3) to update population information necessary for the further evaluation of the status of woodland raptor species in Illinois.

STUDY AREA DESCRIPTION

Thirteen study areas throughout Illinois were determined to contain suitable nesting habitat for woodland raptors by the INHS and Vernon Kleen, Avian Ecologist, IDOC (Figure 1). Twelve study areas were visited in each of the two years of this study. In each study area three census routes with similar habitat characteristics were established along county roads. The proportion of forested to open area was determined to be the most important gross habitat characteristic on which to base the selection of census routes (Iverson and Fuller 1989).

Habitat heterogeneity was minimized among the three routes within an area, but some variation was unavoidable because the Illinois landscape is greatly disturbed and fragmented. Percent forested to open habitat varied slightly between census routes. For all routes, open areas consisted of a mixture of cropland/pasture and scattered residences, unless otherwise noted. Additional habitat characteristics recorded were type of forest (upland or bottomland) and type of trees (deciduous or coniferous). Table 1 presents a summary of the habitat characteristics of the 36 census routes and Appendix I contains legal locations for all routes.

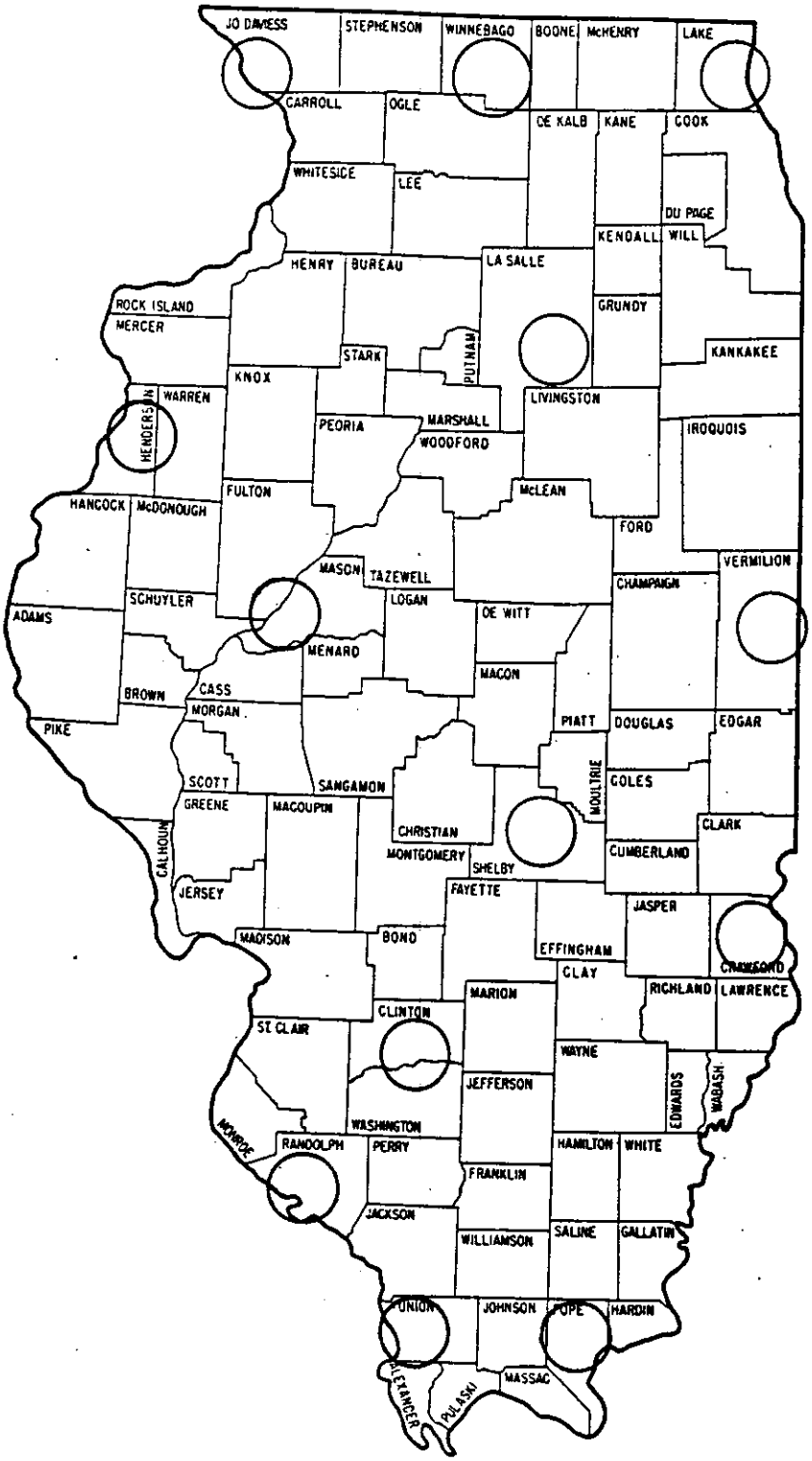

Figure 1. Locations of 13 Illinois Woodland Raptor Survey study areas, 1990/1991. Each study area contains two primary routes and one secondary route.

Table 1. Code numbers, names, counties, and habitat characteristics of the 39 Illinois Woodland Raptor Survey routes, 1990/1991.

Code	Name	County	Habitat characteristics
1	Savanna Depot	JoDaviess	50% forested; upland, >75% deciduous
2	Townhall	JoDaviess	65% forested; upland, >75% deciduous
3	Elizabeth	JoDaviess	50% forested; upland, >75% deciduous
4	Big River State Forest-River	Henderson	45% forested; >75% upland, 40-50% coniferous
5	Big River State Forest-Bluff	Henderson	45% forested; upland, 40-50% coniferous
6	Warren County	Warren	35% forested; upland, 40-50% coniferous
7	Sand Ridge State Forest-Headquarters	Mason	70% forested; upland, >75% coniferous
8	Durang Hill	Mason	75% forested; upland, >75% coniferous
9	Bishop Rd. South	Mason	75% forested; upland, 50% coniferous
10	Sante Fe Bottoms	Clinton	50% forested; bottomland, deciduous
11	Voss	Clinton	65% forested; bottomland, deciduous
12	Covington Bridge	Clinton	55% forested; bottomland, deciduous
13	Rockwood	Jackson	55% forested; upland, >75% deciduous
14	Chester	Randolph	50% forested; upland, >75% deciduous
15	Kaskaskia River	Randolph	40% forested; upland, >75% deciduous
16	Alto Pass	Union	65% forested; upland, >75% deciduous
17	Harrison Creek	Union	65% forested; upland, >75% deciduous
18	Crab Orchard	Union & Williamson	45% forested; >75% upland, >75% deciduous
19	Williams Hill	Pope	55% forested; upland, >75% deciduous
20	South Pope	Pope	60% forested; upland, >75% deciduous
21	Delwood-Burden Falls	Pope	50% forested; upland, >75% deciduous
22	Montgomery	Crawford	30% forested; upland, deciduous
23	Honeycreek 1	Crawford	40% forested; upland, deciduous
24	Honeycreek 2	Crawford	40% forested; upland, deciduous
25	Wolf Creek	Shelby	35% forested; upland, deciduous
26	Railroad	Shelby	25% forested; upland, deciduous
27	Lithia	Shelby	30% forested; upland, deciduous
28	Middlefork Fish and Wildlife Area	Vermilion	25% forested; >75% upland, >75% deciduous
29	Langley Bottoms	Vermilion	35% forested: >75% upland, >75% deciduous
30	Middlefork II	Vermilion	25% forested; >75% upland, >75% deciduous

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Table 1. Code numbers, names, counties, and habitat characteristics of the 39 Illinois Woodland Raptor Survey routes, 1990/1991.

Code	Name	County	Habitat characteristics
31	Starved Rock	LaSalle	40% forested; >75% upland, 1 pine plantation
32	Marseilles	LaSalle	35% forested; >75% upland, >75% deciduous
33	Seneca	LaSalle & Grundy	30% forested; >75% upland, >75% deciduous
34 *	Heller Nature Center	Lake	35% forested; upland, 60% residential
35 *	Ryerson Conservation Area	Lake	45% forested; upland, 50% residential
36 *	Sylvan Lake	Lake	25% forested; upland, 40% residential
37 †	River Road	Winnebago	40% forested; upland, > 75% deciduous
38 †	Kishwaukee Forest Preserve	Winnebago	30% forested;upland, > 75% deciduous
39 †	Kilbuck Bluffs Forest Preserve	Winnebago	30% forested; upland, > 75% deciduous

* = route was included in 1990 only
† = route was included in 1991 only

METHODS

Methodology for the roadside survey technique was from Iverson and Fuller (1989) and Vernon Kleen (IDOC project design). Thirteen qualified participants were hired and trained by the INHS to survey the 12 study areas over a two-year period (see Appendix II for a list of survey participants). One study area was surveyed by INHS biologists in 1990.

Three independent and spatially separate 4.5-mile (7.2 km) survey routes were established along county roads in each of the 12 study areas. Information from 7.5' series United States Geological Survey (USGS) topographic maps, Soil Conservation Service (SCS) county soil survey maps, and field reconnaissance was used to select routes with similar habitat characteristics. Percent forest cover on each census route was estimated from the area 0.5 mile (0.8 km) to either side of the route (11.5 km^2). Forests and open areas were further characterized by site visits. Two routes were designated as "primary" routes and the third as a "secondary" route. Ten observation stops were located along each transect (numbered 1-10) at 0.5-mile (0.8 km) intervals to obtain continuous coverage along the route.

Censusing was conducted from mid-April through mid-July at 4- to 8-day intervals. Primary routes were run ten times each. Secondary routes were run twice and were added between the fourth and sixth survey replications to coincide with peak raptor breeding activity (an average for all species). Routes were surveyed consecutively on the same morning and begun within one half hour of sunrise. Routes first were surveyed beginning at stop 1 and ending at stop 10, and next were surveyed in the reverse order--the order thus alternated for each replication. Survey routes required approximately 2.5 hours each to complete. Surveys were conducted on days when visibility exceeded 1 mile (1.6 km), wind speeds were less than 10 mph, and there was no persistent precipitation.

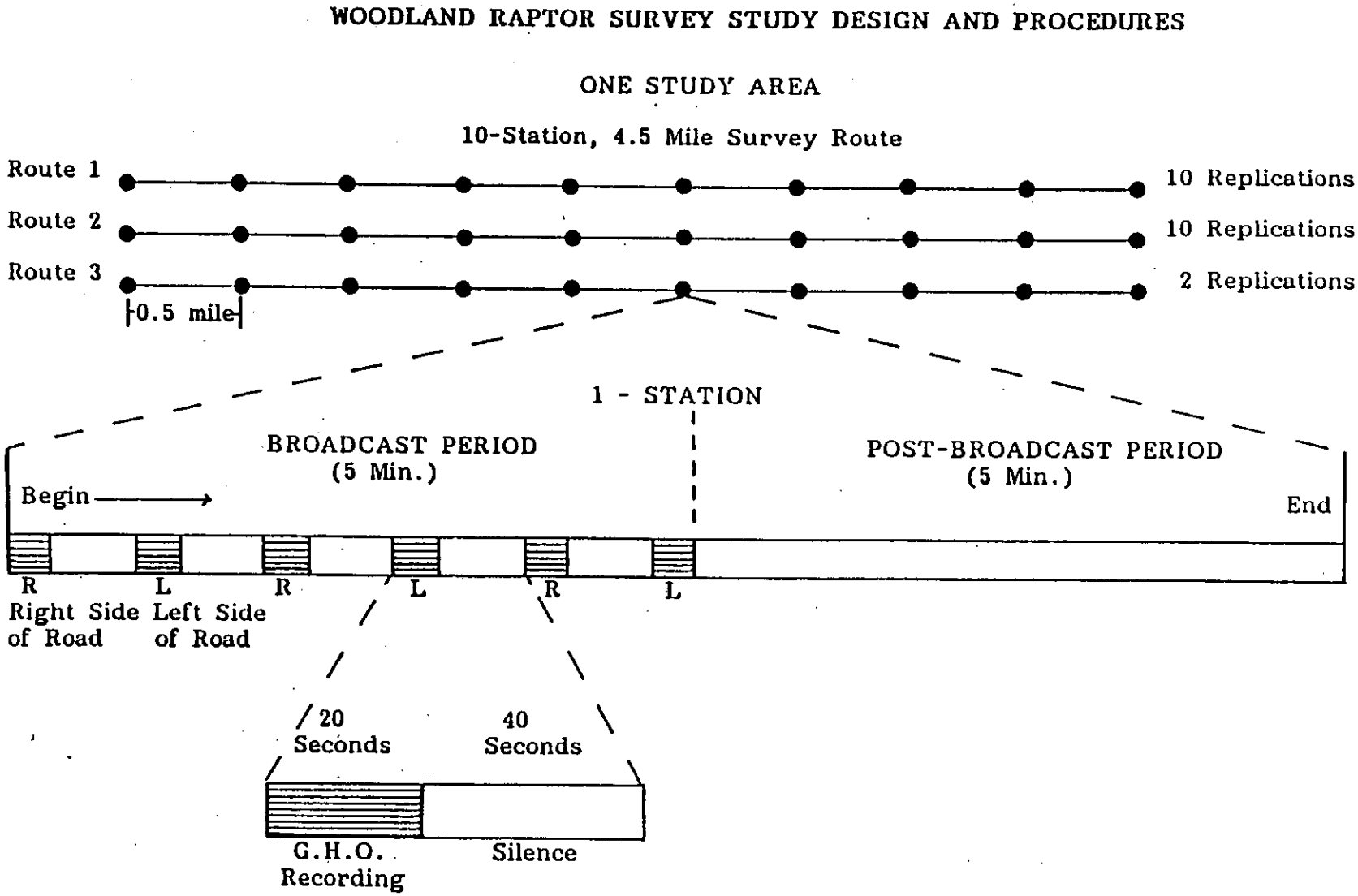
A tape recording of a great horned owl call (National Geographic Society) was broadcast at each stop along a survey route. The tape recording was divided into 5-minute broadcast and 5-minute post-broadcast periods. The broadcast period consisted of six repetitions of 20 seconds of great horned owl calls followed by 40 seconds of silence (see Figure 2). Identical tapes were made for each participant.

Broadcast equipment consisted of a Realistic brand MPA 25, 20-watt amplifier, 40-watt, 8-ohm power horn, and portable cassette recorder purchased from Radio Shack. Sound levels on the 10 units were standardized through field experiments to a 0.5 mile (0.8 km) broadcast radius. Dials and connections were secured with electrical tape to insure consistency among routes.

All species of raptors observed during surveys were recorded. Also noted were station number, type of detection (observed, heard, or both), period of detection (broadcast or post-broadcast), and comments about sightings. Individual raptor observations were plotted on 7.5' series USGS topographic maps.

Data on 19 raptor species were collected during this study, but we emphasized only six species (turkey vulture, red-tailed hawk, red-shouldered hawk, broad-winged hawk, Cooper's hawk, and sharp-shinned hawk) because the methods were logistically and temporally designed to favor their detection. Woodland nesting hawks listed as endangered in Illinois (red-shouldered hawk, Cooper's hawk, and sharp-shinned hawk) were species of "special interest" in this study. Observed species that did not nest in woodlands, were nocturnal, or were migrants were not included in the discussion of this report. Species for which we had very small sample sizes (eg., peregrine falcon, bald eagle) also are not included in the discussion.

Figure 2. Field sampling method used on primary and secondary routes in each of 13 study areas for the Illinois Woodland Raptor Survey, April through June, 1990/1991.



Data were analyzed using a statistical technique developed by Geissler and Fuller (1986). Probability of detection and AO values were calculated with a software package obtained from the U. S. Fish and Wildlife Service, Patuxent Wildlife Research Center. Assumptions inherent in this analysis are: 1) if more than one detection of a species occurs at one station, then it is assumed that the station is occupied by that species, and 2) if a station or area is occupied, then it is assumed that there is a breeding pair present. It is also assumed in this study that: 1) the 13 study areas are a representative sample of raptor habitat in Illinois and reflect statewide patterns, and 2) study areas known to be occupied represent habitat mosaics associated with a 11.5 km^2 area that includes the nest-site.

Relative frequency and relative abundance values for all observed species also were calculated for comparison to results of the Geissler and Fuller analysis. A statewide index was developed to assess trends in raptor abundance and frequency. This index is the rank of the sum of the ranks of species abundance or frequency values in each of the 13 study areas over two years.

Population densities were estimated for each species in each forest cover category on both local and statewide scales. Densities were expressed as a minimum derived from stops with > 1 observation of a species (Parker 1990, Sargent 1990). A maximum density estimate (see Parker 1990) was not applicable to this study design because stops were located at 0.5 mi (0.8 km) intervals to insure continuous coverage of the survey routes. A distance of 1 mi (1.62 km) between stops would be required to decrease overlap of broadcast radii and assume a separation between breeding pairs (Fuller pers. comm., Sargent 1990).

RESULTS

Results are presented as the combination of the data recorded in 1990 and 1991. It is beyond the scope of this study to identify and compare differences between years. Confidence intervals overlapped for all but one PD value and no significant differences were found for AO values between the 1990 and 1991 data, so the combining of years was statistically sound (data from Lake and Winnebago counties were excluded from comparisons of 1990/1991). Results from 1990 and 1991 are presented separately in Appendix III and IV, respectively.

Nineteen raptor species, including two federally endangered and six state endangered species, were detected during this investigation for a total of 2,383 observations (1,187 in 1990 and 1,196 in 1991). Appendix V is a taxonomic order of observed species; Appendix VI is a summary of all observations in each study area. Overall, the turkey vulture was the most frequently detected species with 995 observations, followed by the red-tailed hawk with 714 observations (Table 2). Species least detected were the golden eagle, merlin, peregrine falcon, and eastern screech-owl with one observation each. Distribution patterns ranged from detections at 190 out of 360 stops and 32 out of 36 survey routes in all 12 study areas for the red-tailed hawk to one observation at one stop on one route in one study area for the golden eagle, merlin, peregrine falcon, and eastern screech-owl. The red-shouldered hawk was observed 206 times at 54 stops on 16 routes in nine of the study areas. Other species of special interest, Cooper's hawk and sharp-shinned hawk, were observed substantially less often than the forenamed species (Table 2).

Statistical Analysis of PD and AO

This analysis technique uses two parameters, the probability of detection (PD) and the proportion of area occupied by a species (AO), as abundance estimators for species populations. The PD value estimates the chance of detecting individuals of a species at a stop that is known to be occupied by that species (established by the first detection of that species at a stop). Therefore, the

Table 2. Total number of stops, routes, and areas at which each raptor species was observed during the Illinois Woodland Raptor Survey, 1990/1991 †.

Species	Total	Species Observations		
		Number of stops N=360	Number of routes N=36	Number of areas N=12
Black vulture	4	2	2	2
Turkey vulture	995	170	26	12
Osprey*	14	11	4	3
Mississippi kite*	4	4	2	2
Bald eagle**	2	2	2	2
Northern harrier*	6	6	5	3
Sharp-shinned hawk*	34	23	13	7
Cooper's hawk*	54	36	14	8
Red-shouldered hawk*	206	54	16	9
Broad-winged hawk	151	56	16	8
Swainson's hawk #	2	1	1	1
Red-tailed hawk	714	190	32	12
Golden eagle	1	1	1	1
American kestrel	48	32	16	9
Merlin	1	1	1	1
Peregrine falcon**	1	1	1	1
Great horned owl	86	41	15	8
Barred owl	59	29	10	7
Eastern screech-owl	1	1	1	1

** federally endangered species
* Illinois endangered species
# federal candidate species under category 2
† totals include data taken from Lake (1990) and Winnebago (1991) counties

PD for a given species on a route is the mean of the proportion of detections that occur after a first detection is made at each of the 10 stops.

The PD, a "correction factor" used in the calculation of the AO, compensates for individuals that are present, but not detected. The AO value is the proportion of points (stops) occupied by a species. A point is considered "occupied" if a species engaging in "normal activity" is observed within the observer's detection radius of the points (Geissler and Fuller 1986). Because more than one bird can occupy a point, the AO is not a direct estimate of density.

Primary Routes -- The PD estimates for species observed on primary routes ranged from 40.5% for the broad-winged hawk on Route (Rt.) 32 in LaSalle County to 1.7% for the red-tailed hawk on Rt. 11 in Clinton County (Table 3). Red-shouldered hawk PD estimates ranged from 21.8% on Rt. 11 in Clinton County to 3.1 on Rt. 14 in Randolph County. Artifacts of this method caused a large proportion of data collected for Cooper's and sharp-shinned hawk to be unusable. On only two routes could PD values be calculated for Cooper's hawk (7.0 on Rt. 01 in JoDaviess County and 12.6 on Rt. 31 in LaSalle County) and on only two routes for sharp-shinned hawk (7.4 on Rt. 23 in Crawford County and 19.0 on Rt. 02 in JoDaviess County).

Variations occur between primary route PD values as seen in Iverson and Fuller (1986). Factors contributing to this variability include differences in habitat characteristics between primary routes and individual bird behavior, particularly in response to the unseasonably cool, wet weather during the 1991 field season. Confidence intervals are large mainly because of small sample sizes.

Area occupied values calculated using the PD values for primary routes contained within the same study area may not be reliable in cases with small sample sizes and large confidence intervals (DeVaul 1989). Area occupied values ranged from 100% on 20 of the routes (10 for red-tailed hawk, seven for turkey vulture, one for broad-winged hawk, one for American kestrel, and one for great horned owl) to 10.2% for broad-winged hawk on Rt. 19 Pope County (Table 3). For the red-shouldered hawk AO values ranged from 87.3 on Rt. 14 in Randolph County to 21.6% on Rt. 31 in LaSalle County. Cooper's hawks occupied 71.0% of the area on Rt. 31 in LaSalle County and 60.5% of the area on Rt. 01 in JoDaviess County. Sharp-shinned hawks occupied 29.4 % of the area on Rt. 23 in Crawford County and 20.9% of the area on Rt. 02 in JoDaviess County.

Data obtained from study areas that were surveyed in only one year of this study were not included in the analyses of combined 1990/1991 data. No useable data was obtained from the Lake County study area in 1990; however, Winnebago County was chosen to replace Lake County during the 1991 field season and produced some interesting results. These routes had the greatest species composition of the 12 study areas. The Cooper's hawk, great horned owl, and osprey each occupied 100% of Rt. 32 and the turkey vulture and broad-winged hawk each occupied 100% of Rt. 33. Cooper's hawk occupied 86.5% and sharp-shinned hawk occupied 14.4% of Rt. 33.

Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for raptor species detected on primary routes within 11 study areas located throughout Illinois, 1990/1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01	TV	26.2	16.3 - 36.1	90.0	90.3	68.9 - 100.0
	RTH	18.5	10.5 - 26.6	100.0	100.0	95.7 - 100.0
	CH	7.0	0.0 - 20.2	40.0	60.5	0.0 - 100.0
02	TV	14.4	6.1 - 22.8	100.0	100.0	90.4 - 100.0
	RTH	16.3	7.7 - 24.9	100.0	100.0	93.0 - 100.0
	BWH	13.0	0.0 - 35.6	50.0	58.7	0.0 - 100.0
	SSH	19.0	0.0 - 100.0	20.0	20.9	0.0 - 100.0
Henderson County						
04	TV	21.7	9.4 - 33.9	70.0	70.7	35.8 - 100.0
	RTH	13.9	0.0 - 30.1	70.0	80.2	0.0 - 100.0
	BO	9.5	6.4 - 12.7	40.0	46.3	0.0 - 100.0
05	TV	14.4	0.0 - 29.0	70.0	86.6	21.6 - 100.0
	RTH	13.8	0.0 - 30.1	70.0	80.2	0.0 - 100.0
	AK	6.2	0.0 - 18.9	30.0	52.3	0.0 - 100.0
Mason County						
07	TV	9.0	0.0 - 32.5	30.0	42.3	0.0 - 100.0
08	TV	10.5	0.0 - 27.7	40.0	49.6	0.0 - 100.0
	RTH	8.5	0.0 - 19.5	40.0	51.9	0.0 - 100.0
Clinton County						
10	RSH	21.5	4.1 - 38.9	80.0	81.6	48.8 - 100.0
	GHO	5.2	0.2 - 14.6	100.0	100.0	0.0 - 100.0
	BO	6.3	0.0 - 14.6	50.0	72.3	0.0 - 100.0
11	TV	6.1	2.8 - 9.4	90.0	100.0	71.5 - 100.0
	RTH	1.7	0.0 - 4.9	40.0	100.0	0.0 - 100.0
	RSH	21.8	1.6 - 42.0	50.0	50.4	5.4 - 95.4
	GHO	7.1	-------**	10.0	12.9	-------**

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Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for raptor species detected on primary routes within 11 study areas located throughout Illinois, 1990/1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Randolph County						
13	RTH	16.0	8.7 - 23.2	100.0	100.0	95.6 - 100.0
	BWH	16.7	0.0 - 49.0	30.0	30.8	0.0 - 94.9
14	RTH	27.7	14.4 - 41.0	100.0	100.0	98.3 - 100.0
	RSH	3.1	0.0 - 9.4	30.0	87.3	0.0 - 100.0
	BWH	3.1	0.0 - 8.2	60.0	100.0	0.0 - 100.0
	AK	14.8	0.0 - 33.5	30.0	31.3	0.0 - 96.3
Union County						
16	RTH	28.8	17.4 - 40.3	100.0	100.0	99.0 - 100.0
	AK	3.3	0.0 - 8.2	50.0	100.0	0.0 - 100.0
17	RTH	9.0	1.8 - 16.2	100.0	100.0	42.2 - 100.0
	RSH	20.0	0.0 - 44.4	50.0	51.5	0.0 - 100.0
	BWH	14.4	0.0 - 32.9	70.0	77.6	0.0 - 100.0
Pope County						
19	TV	10.1	3.2 - 17.0	100.0	100.0	73.1 - 100.0
	RTH	10.7	0.0 - 22.0	70.0	83.0	21.7 - 100.0
	RSH	16.2	0.0 - 34.8	40.0	41.3	0.0 - 95.9
	BWH	18.7	-------**	10.0	10.2	-------**
20	TV	9.3	0.0 - 19.9	60.0	74.2	0.0 - 100.0
	RTH	10.2	5.0 - 100.0	80.0	94.6	50.0 - 100.0
	RSH	21.0	3.6 - 38.4	80.0	80.7	48.8 - 100.0
	BWH	15.2	0.0 - 38.1	50.0	54.1	4.4 - 100.0
Crawford County						
22	TV	3.7	0.0 - 8.1	60.0	100.0	0.0 - 100.0
23	TV	6.2	0.0 - 14.2	60.0	84.4	0.0 - 100.0
	RTH	11.6	5.5 - 17.7	90.0	100.0	69.7 - 100.0
	SSH	7.4	0.0 - 44.5	10.0	29.4	0.0 - 100.0
	GHO	6.7	-------**	10.0	13.4	-------**
	BO	2.6	0.0 - 8.0	30.0	96.8	0.0 - 100.0

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Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for raptor species detected on primary routes within 12 study areas located throughout Illinois, 1990/1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Shelby County						
25	TV	16.5	8.9 - 24.0	90.0	93.1	69.2 - 100.0
	RTH	13.2	0.0 - 26.9	70.0	77.2	5.5 - 100.0
26	TV	13.7	1.7 - 25.7	90.0	100.0	60.2 - 100.0
	RTH	7.3	2.4 - 12.2	70.0	90.8	26.3 - 100.0
Vermilion County						
28	TV	23.4	16.5 - 30.3	100.0	100.0	99.3 - 100.0
	RTH	11.4	2.3 - 20.6	100.0	100.0	52.1 - 100.0
29	TV	14.3	7.8 - 20.9	100.0	100.0	94.5 - 100.0
	RTH	12.1	4.5 - 19.6	90.0	100.0	68.4 - 100.0
LaSalle County						
31	TV	5.5	0.0 - 12.2	60.0	96.4	0.0 - 100.0
	RTH	10.4	0.0 - 37.0	30.0	40.4	0.0 - 100.0
	RSH	12.3	0.0 - 74.0	20.0	21.6	0.0 - 100.0
	BWH	2.8	0.0 - 6.8	40.0	96.2	0.0 - 100.0
	CH	12.6	0.0 - 36.9	60.0	71.0	0.0 - 100.0
32	TV	5.4	0.0 - 11.4	40.0	59.7	0.0 - 100.0
	RTH	18.9	0.0 - 38.6	80.0	82.5	45.6 - 100.0
	BWH	40.5	0.0 - 95.9	30.0	30.0	0.0 - 89.2

* = values calculated from 1990/1991 combined data do not include Lake and Winnebago counties

** = too rare to calculate confidence intervals

Primary Routes Combined -- Combining data collected on the two primary routes over two years within each study area increased sample sizes and, therefore, reduced confidence intervals for both PD and AO values. Data collected on primary routes were combined on the grounds that few forested areas in Illinois can be classified as being truly "homogeneous" and routes were established with as similar habitat characteristics as possible. Confidence interval overlap (in most cases) showed no significant difference between the PD values of primary routes (non-overlap in confidence intervals is used as an inferred Student's t-test, $p > 0.05$).

Probability of detection values for combined primary routes in a study area ranged from 22.0 for the red-tailed hawk in Randolph County to 1.7 for the red-tailed hawk in Clinton County (Table 4). The probability of detecting a red-shouldered hawk ranged from 3.1 in Randolph County to 21.9 Clinton County. Probability of detection values for Cooper's hawk were 7.0 in JoDaviess County and 10.8 in LaSalle County. The combined PD for the sharp-shinned hawk remained equal to PD value from individual primary routes because the species was observed on only one of the two primary routes.

Area occupied values range from 100% in six study areas (one turkey vulture, five red-tailed hawk) to 6.7 for the great horned owl in Crawford County. Red-shouldered hawks occupied a high of 65.6% of the area surveyed in Clinton County and a low of 21.6% of the area surveyed in LaSalle County. Area occupied values for Cooper's hawk were 30.3% in JoDaviess County to 46.2% in LaSalle County. Sharp-shinned hawks occupied 38.8% of the area surveyed in JoDaviess County and 14.7% in Crawford County.

In 1991 Cooper's hawk occupied 97.3% of the Winnebago County study area, the broad-winged hawk 91.9%, the turkey vulture 81.5%, and the red-tailed hawk 80.9%. Sharp-shinned hawks occupied only 7.2% of the study area.

When primary route data were combined, area occupied values for species that were observed on only one primary route changed, unlike the PD values, because more replications were added. Area occupied values always decreased in this situation. Confidence intervals for areas with small sample sizes remained large.

Secondary Routes -- Probability of detection values were established for study areas by combining data collected on two primary routes of a study area. This value can then be used to calculate AO values for secondary routes known to be occupied by a species because habitat characteristics are assumed to be similar. Probability of detection values calculated for secondary routes are influenced by PD values calculated for a study area in this statistical analysis. Therefore, PD values that were calculated for the primary routes are similar to those values calculated for the secondary routes (Table 5). For example, in Pope County the probability of detecting a red-shouldered hawk in the study area was 19.3% (8.0 - 33.3) for the two primary routes and 17.2% (6.1 - 28.3) for the secondary route. Area occupied values for the secondary route are adjusted either up or down in response to influence from the primary routes.

In theory, the use of a pre-established PD value allows the researcher to reduce the amount of field time necessary to conduct this survey and analysis method. In this study, no significant differences were found between PD and AO values that were calculated for primary routes and secondary routes in each study area. The three routes in each study area were selected to have the same habitat characteristics, so one would not expect to find significant differences among these routes if this procedure were valid. However, the degree to which habitat variances influence PD values needs further investigation. If a pre-established PD is used to calculate AO values in a slightly different habitat type, are these numbers valid? If confidence intervals are large, differences will go undetected. This practice must be further tested in order to assess whether the numbers reflect what is occurring in the study area.

Table 4. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for two primary routes combined within 12 study areas throughout Illinois, 1990/1991.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01,02	TV	20.2	13.5 - 26.8	95.0	96.6	85.4 - 100.0
	RTH	17.4	11.7 - 23.1	100.0	100.0	98.2 - 100.0
	BWH	11.1	0.0 - 28.3	30.0	35.0	0.0 - 78.1
	CH	7.0	0.0 - 19.9	20.0	30.3	0.0 - 90.2
	SSH	5.4	0.0 - 14.8	26.0	38.8	0.0 - 100.0
Henderson County						
04,05	TV	18.3	10.2 - 26.3	70.0	76.7	55.6 - 97.8
	RTH	13.8	4.1 - 23.6	60.0	65.2	34.8 - 95.6
	AK	6.2	0.0 - 19.0	15.0	26.2	0.0 - 100.0
	BO	9.6	6.3 - 12.9	20.0	23.1	0.0 - 54.3
Mason County						
07,08	TV	9.9	0.0 - 20.1	35.0	42.5	0.0 - 95.0
	RTH	8.5	0.0 - 19.3	20.0	24.8	0.0 - 71.1
Clinton County						
10,11	TV	6.1	2.8 - 9.3	45.0	63.7	19.2 - 100.0
	RTH	1.7	0.0 - 5.2	20.0	72.1	0.0 - 100.0
	RSH	21.9	10.8 - 33.0	65.0	65.6	41.4 - 89.7
	GHO	5.4	1.1 - 9.8	40.0	60.9	4.0 - 100.0
	BO	6.3	0.0 - 14.6	25.0	36.2	0.0 - 91.1
Randolph County						
13,14	RTH	22.0	14.3 - 29.7	100.0	100.0	98.4 - 100.0
	RSH	3.1	0.0 - 9.6	15.0	40.5	0.0 - 100.0
	BWH	7.3	0.0 - 16.3	45.0	64.9	0.0 - 100.0
	AK	14.7	0.0 - 32.5	15.0	15.6	0.0 - 49.4
Union County						
16,17	RTH	18.9	10.6 - 27.2	100.0	100.0	96.5 - 100.0
	RSH	10.5	0.0 - 23.7	45.0	53.3	0.0 - 100.0
	BWH	11.1	0.0 - 26.2	45.0	52.6	0.0 - 100.0
	AK	2.7	0.0 - 6.8	60.0	72.1	0.0 - 100.0

Table 4 concluded on next page

Table 4 concluded

Table 4. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for two primary routes combined within study areas throughout Illinois, 1990/1991.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Pope County						
19,20	TV	9.6	4.1 - 15.2	80.0	93.2	61.6 - 100.0
	RTH	18.9	10.6 - 27.2	100.0	100.0	96.5 - 100.0
	RSH	19.3	8.0 - 30.7	60.0	61.1	35.8 - 86.5
	BWH	15.8	0.0 - 33.3	30.0	31.0	3.5 - 58.6
Crawford County						
22,23	TV	4.8	0.3 - 9.4	60.0	99.2	0.0 - 100.0
	RTH	11.6	6.0 - 17.2	85.0	94.9	71.7 - 100.0
	SSH	7.4	0.0 - 45.3	10.0	14.7	0.0 - 100.0
	GHO	6.7	-------**	0.5	6.7	-------**
	BO	3.5	0.0 - 100.0	20.0	45.4	0.0 - 100.0
Shelby County						
25,26	TV	15.3	8.6 - 22.0	90.0	94.8	78.2 - 100.0
	RTH	10.1	3.2 - 17.0	70.0	81.0	48.6 - 100.0
Vermilion County						
28,29	TV	18.7	14.1 - 23.3	100.0	100.0	99.4 - 100.0
	RTH	11.7	6.1 - 17.3	95.0	100.0	84.4 - 100.0
LaSalle County						
31,32	TV	5.5	1.3 - 9.6	50.0	76.5	10.9 - 100.0
	RTH	16.7	1.8 - 31.5	55.0	57.3	27.8 - 86.8
	RSH	8.2	0.0 0 28.9	30.0	21.6	0.0 - 87.6
	BWH	18.3	0.0 - 40.7	35.0	36.1	0.0 - 73.8
	CH	10.8	0.0 - 33.0	35.0	46.2	0.0 - 100.0

* = values calculated from 1990/1991 combined data do not include Lake and Winnebago counties

** = too rare to calculate confidence intervals

Table 5. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for secondary routes within 11 study areas throughout Illinois, 1990/1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
03	TV	18.0	11.6 - 24.5	70.0	83.5	60.1 - 100.0
	RTH	19.1	12.7 - 25.5	83.3	100.0	83.1 - 100.0
	SSH	14.3	0.0 - 43.9	10.0	25.0	0.0 - 100.0
Henderson County						
06	TV	18.2	10.2 - 26.2	80.0	63.7	39.5 - 87.9
	RTH	16.5	2.6 - 30.4	53.3	68.0	12.3 - 100.0
	AK	6.2	0.0 - 19.0	10.0	28.4	0.0 - 100.0
	BO	9.5	6.1 - 12.8	13.3	24.9	0.0 - 63.1
Mason County						
09	RTH	8.8	0.0 - 19.2	13.3	27.2	0.0 - 96.2
Clinton County						
12	TV	5.5	2.3 - 8.6	33.3	76.6	0.0 - 100.0
	RSH	25.2	13.5 - 37.0	75.0	52.9	31.6 - 74.1
Randolph County						
15	RTH	20.4	12.9 - 27.9	76.6	85.3	63.5 - 100.0
	AK	11.3	0.0 - 25.7	13.3	20.7	0.0 - 82.8
Union County						
18	RTH	20.7	10.9 - 30.5	83.3	96.0	71.7 - 100.0
	RSH	20.0	0.0 - 42.3	33.3	48.6	0.0 - 99.0
	BWH	10.2	0.0 - 23.0	33.3	46.1	0.0 - 100.0
	AK	2.1	0.0 - 4.9	26.7	100.0	0.0 - 100.0
Pope County						
21	TV	9.1	3.7 - 14.4	85.0	100.0	22.6 - 100.0
	RTH	13.7	35.1 - 23.9	80.0	67.5	30.3 - 100.0
	RSH	17.2	6.1 - 28.3	43.0	47.5	20.7 - 74.2

Table 5 concluded on next page

Table 5 concluded

Table 5. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated* for secondary routes within 11 study areas throughout Illinois, 1990/1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Crawford County						
24	TV	4.5	0.1 - 8.8	63.3	100.0	0.0 - 100.0
	RTH	8.3	3.7 - 12.9	73.3	100.0	45.2 - 100.0
Shelby County						
27	TV	18.8	12.3 - 25.3	90.0	100.0	91.1 - 100.0
	RTH	14.7	1.7 - 97.6	53.0	64.5	31.5 - 97.6
Vermilion County						
30	TV	17.2	12.1 - 22.0	80.0	93.7	68.8 - 100.0
	RTH	11.8	6.3 - 17.2	73.0	100.0	60.1 - 100.0
LaSalle County						
33	TV	4.5	0.9 - 8.1	40.0	94.2	0.0 - 100.0
	RTH	10.4	0.0 - 20.7	56.7	98.1	0.0 - 100.0
	BWH	15.6	0.0 - 35.0	26.7	34.5	0.0 - 100.0
	CH	9.5	0.0 - 27.7	26.7	39.6	0.0 - 100.0

* = values calculated from 1990/1991 combined data do not include Lake and Winnebago counties

Study Areas Combined-- Results from the 12 study areas were combined to increase sample size, decrease confidence intervals, and extract large-scale trends in the data. The most logical and biologically sound way of grouping study areas was by percent forest cover (< 50% forested and ≥ 50% forested), an important raptor habitat characteristic. Two types of comparisons were made between forest cover categories: 1) to provide a local (nest-site) perspective PD and AO values were calculated using the subset of study areas that birds were known to occupy (observed multiple times at one station and assumed to be nesting), and 2) to provide a statewide perspective PD and AO values were calculated for the two groups of study areas as a whole (each group includes all study areas regardless of raptor occupation).

Six study areas qualified for the ≥ 50% forested category and five qualified for the < 50% forested category using combined 1990/1991 data. The results from Winnebago County could not be included in this comparison because it was surveyed in only one of the two years of this study.

Sufficient data for six species were available for comparison. In the group of study areas known to be occupied (local perspective), the red-tailed hawk, turkey vulture, and Cooper's hawk had higher AO values for study areas that were less than 50% forested (Table 6). The red-shouldered, broad-winged, and sharp-shinned hawks showed a predominance (no significant differences) in study areas that were at least 50% forested.

The statewide perspective produced a significant difference between AO values for the red-shouldered and broad-winged hawks (Student's t-test, $p < 0.05$), which indicated a strong preference for study areas that were at least 50% forested (Table 7). Also, sharp-shinned hawks showed a slight affiliation with study areas that were at least 50% forested. Area occupied values for red-tailed and Cooper's hawks indicate a slight predominance in, and turkey vultures showed a significant preference for, study areas that were < 50% forested.

Data analyzed in this way for 1991 alone (which includes important data from Winnebago County) show higher AO values for the broad-winged and Cooper's hawk in study areas with less than 50% forest cover on both local and statewide scales when compared to the values for 1990/1991 combined (Appendix IV). These larger values, however, do not change the pattern that was observed for combined data (excluding Winnebago County). For example, AO values for the broad-winged hawk in Winnebago County indicated a prevalence in habitats that were < 50% forested, but statewide broad-wings occupied more area that was ≥ 50% forested.

Table 6. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species known to occupy study areas* with ≥ 50% forest cover and study areas with < 50% forest cover throughout Illinois, 1990/1991.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	13.0	9.5 - 16.4	64.0	68.5	56.4 - 80.6
	RTH	16.5	13.0 - 20.0	69.0	71.6	62.9 - 80.3
	RSH	16.7	10.5 - 22.8	46.2	47.2	36.0 - 58.4
	BWH	11.2	5.3 - 17.2	37.5	42.4	28.9 - 57.0
	CH	5.3	0.0 - 15.6	25.0	39.1	0.0 - 100.0
	SSH	7.1	0.0 - 19.7	20.0	30.0	0.0 - 85.4
< 50	TV	13.9	10.9 - 16.8	74.0	79.1	69.3 - 88.9
	RTH	12.5	9.1 - 15.9	73.0	78.6	67.6 - 89.7
	RSH	6.2	0.0 - 18.5	20.0	29.9	0.0 - 100.0
	BWH	18.1	0.0 - 39.8	35.0	36.4	2.9 - 69.8
	CH	11.1	0.0 - 33.1	35.0	44.7	0.0 - 100.0
	SSH	7.4	0.0 - 45.7	10.0	14.7	0.0 - 100.0

* = using data collected on primary routes only, excluding Lake and Winnebago counties
Study areas with ≥ 50 = JoDaviess, Mason, Clinton, Randolph, Union, Pope counties
Study areas with < 50 = Henderson, Crawford, Shelby, Vermilion, LaSalle counties

Table 7. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species over all study areas* with ≥ 50% forest cover and study areas with < 50% forest cover throughout Illinois, 1990/1991.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	13.0	9.6 - 16.5	42.5	45.6	35.6 - 55.5 **
	RTH	16.3	13.0 - 19.7	69.2	71.2	62.3 - 80.2
	RSH	16.7	10.5 - 22.9	30.8	31.6	23.1 - 40.2 **
	BWH	11.1	5.2 - 17.0	25.0	28.1	18.0 - 38.2 **
	CH	5.3	0.0 - 15.3	5.0	8.2	0.0 - 22.4
	SSH	7.1	0.0 - 20.7	3.3	5.0	0.0 - 14.9
< 50	TV	13.9	10.9 - 16.8	74.0	79.1	69.3 - 88.9
	RTH	12.5	9.1 - 15.9	73.0	78.6	67.6 - 89.7
	RSH	6.2	0.0 - 18.2	3.0	6.3	0.0 - 21.7
	BWH	18.2	0.0 - 41.4	7.0	7.1	0.0 - 14.2
	CH	11.1	0.0 - 33.5	7.0	9.1	0.0 - 35.2
	SSH	7.4	0.0 - 44.8	2.0	3.8	0.0 - 43.0

* = using data collected on primary routes only, excluding Lake and Winnebago counties
** = significant at the $p < .05$ level
Study areas with ≥ 50 = JoDaviess, Mason, Clinton, Randolph, Union, and Pope counties
Study areas with < 50 = Henderson, Crawford, Shelby, Vermilion, and LaSalle counties

Relative Frequency and Relative Abundance

As a comparison to the new technique, which cannot include certain observations because of small sample size or data configuration, relative frequency and relative abundance values were calculated for species observed in each study area (Tables 8 and 9), in areas combined according to percent forest cover ($\geq$ 50% forested, < 50% forested), and in all areas combined (Table 10).

An index of statewide frequency and abundance (defined in methods section) developed for this analysis showed that the red-tailed hawk was the most widely distributed raptor over the 12 study areas and the most frequently detected species in five of the 12 study areas (Table 8). The second most widely distributed species was the turkey vulture (also most detected in five of the 12 study areas). The broad-winged hawk ranked third out of nineteen species. The red-shouldered, Cooper's and sharp-shinned hawks were ranked 7, 8, and 9, respectively, in their distribution frequencies. The red-shouldered hawk was the most widely distributed species in two of the 12 study areas, while the Cooper's and sharp-shinned hawks showed moderate to low distribution rankings overall .

The red-tailed hawk also was the most abundant species over the 12 study area and the most abundant in five of the 12 study areas (Table 9). The second most abundant species was the turkey vulture (most abundant species in six of the 12 study areas), followed by the broad-winged hawk. The red-shouldered hawk was ranked six out of 19 and varied greatly in abundance rankings for the 12 study areas. The Cooper's hawk and sharp-shinned hawk ranked moderate in relative abundance values.

In study areas with $\geq$ 50% forest cover, the most widely distributed species was the red-tailed hawk followed by the turkey vulture (Table 10). Relative abundance values switched the order of these two species. The red-shouldered hawk ranked third in both values followed by the broad-winged, Cooper's, and sharp-shinned hawks. In study areas with < 50% forest cover, the turkey vulture was most abundant and widely distributed followed by the red-tailed hawk. The broad-winged hawk replaced the red-shouldered hawk as the third most abundant and widely distributed species. The Cooper's and sharp-shinned tied for forth rank and the red-shouldered hawk became the least abundant species with the most restricted distribution. Frequency and abundance values combined for all 12 study areas exhibited the same pattern as that for areas $\geq$ 50% forested: the red-tailed hawk and turkey vulture alternated as the most widely distributed and most abundant species, whereas the Cooper's and sharp-shinned hawks were at the opposite extreme. The red-shouldered hawk ranked third followed by the broad-winged hawk.

Population densities

Table 11 presents gross estimates of minimum population densities for each species in each forest cover category on local and statewide scales. The turkey vulture and red-tailed hawk had the greatest number of pairs/km^2 overall. The red-shouldered and broad-winged hawks had larger densities in the forest cover category of $\geq$ 50% forested on both local and statewide scales. Red-shoulders had higher densities than broad-wings in the $\geq$ 50% forest cover category, but broad-wings had higher densities in areas that were < 50 % forested. Cooper's and sharp-shinned hawks showed very low population densities overall.

Table 8. Percent relative frequencies for raptor species observed in each of the 13 Illinois Woodland Raptor Survey study areas, 1990/1991.

Species	Study Area[1]												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Black vulture	-	-	-	-	-	0.6	1.1	-	-	-	-	-	-
Turkey vulture	39.7	46.4	45.2	32.6	-	1.2	26.6	21.7	59.7	51.4	16.2	-	6.7
Osprey	-	-	-	-	-	-	-	5.5	0.8	-	-	-	6.7
Mississippi kite*	-	-	-	-	-	1.8	-	-	-	0.6	-	-	-
Bald eagle	0.5	-	-	-	0.8	-	-	-	-	-	-	-	-
Northern harrier*	0.9	-	-	-	-	-	-	-	0.8	-	2.2	-	-
Sharpsh. hawk*	4.8	1.8	7.1	-	-	-	-	4.4	1.6	3.3	-	-	1.9
Cooper's hawk*	4.30	0.9	4.7	-	2.3	-	2.8	2.1	-	-	8.1	-	11.5
Red-sh. hawk*	0.9	0.9	-	44.4	3.1	16.8	29.4	2.1	-	1.1	5.9	-	1.0
Broad-w. hawk	9.6	2.7	-	-	13.1	16.8	7.9	-	1.6	2.2	19.1	25.3	9.6
Swainson's hawk	-	-	-	-	-	-	-	-	-	-	-	-	1.9
Red-tailed hawk	38.8	28.5	28.6	4.9	70.8	56.3	26.6	53.3	29.8	35.2	28.7	25.3	34.6
Golden eagle	-	-	2.4	-	-	-	-	-	-	-	-	-	-
American kestrel	-	4.5	-	<0.1	7.7	6.6	1.1	2.1	3.2	0.3	-	49.4	3.8
Merlin	-	-	-	-	-	-	-	-	-	-	-	-	1.0
Peregrine falcon	-	-	-	-	0.8	-	-	-	-	-	-	-	-
Great horned owl	-	4.5	2.4	10.4	1.5	-	3.4	2.1	0.8	3.3	1.3	-	18.3
Barred owl	0.5	9.8	9.5	6.9	-	-	1.1	6.5	0.8	-	9.5	-	2.9
E. screech-owl	-	-	-	-	-	-	-	-	0.8	-	-	-	-

[1]Key to study area counties: A = JoDaviess, B = Henderson/Warren, C = Mason, D = Clinton, E = Jackson/Randolph, F = Union/Williamson, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle/Grundy, L = Lake, M = Winnebago.

* = Illinois endangered species
** = federally endangered species

Table 9. Percent relative abundances for raptor species observed in each of the 13 Illinois Woodland Raptor Survey study areas, 1990/1991.

Species	Study Area[1]												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Black vulture	-	-	-	-	-	0.9	7.6	-	-	-	-	-	-
Turkey vulture	52.7	59.3	59.3	26.2	2.5	13.8	43.3	32.6	76.9	64.4	19.0	-	7.9
Osprey*	-	-	-	-	-	0.5	-	3.9	-	-	-	-	5.6
Mississippi kite*	-	-	-	-	-	1.4	-	-	0.3	-	-	-	-
Bald eagle	0.3	-	-		0.6	-	-	-		-	-	-	-
Northern harrier*	-	-	-	-	-	-	-	-	-	-	-1.8	-	-
Sharp-sh. hawk*	3.1	1.1	5.4	-	-	-	-	4.6	-	2.3	0.6	-	1.6
Cooper's hawk*	3.1	0.6	3.6	-	2.5	-	2.3	2.3	-	0.6	7.1	-	10.3
Red-sh. hawk*	0.6	0.6	-	50.0	3.2	15.2	24.3	1.5	-	1.0	5.4	-	0.8
Broad-w. hawk	8.1	3.9	-	-	12.7	13.4	5.3	-	1.3	1.6	19.6	6.7	8.7
Swainson's hawk	-	-	-	-	-	-	-	-	-	-	-	-	1.6
Red-tailed hawk	31.4	21.5	25.0	5.2	70.1	50.7	20.1	46.5	16.7	25.8	26.2	6.7	36.5
Golden eagle	-	-	1.8	-	-	-	-	-	-	-	-	-	-
American kestrel	-	3.4	-	0.6	6.4	4.1	0.8	1.5	2.6	1.6	0.6	66.7	3.2
Merlin	-	-	-	-	-	-	-	-	-	-	-	-	0.8
Peregrine falcon	-	-	-		0.6	-	-	-		-	-	-	
Great horned owl	-	2.8	1.8	10.5	1.3	-	2.3	1.5	-	2.3	10.1	-	20.6
Barred owl	0.3	6.8	8.9	7.6	-	-	0.8	5.4	-	-	9.5	-	2.4
E. screech-owl	-	-	-	-	-	-	-	-	1.3	-	-	-	-

[1]Key to study area counties: A = JoDaviess, B = Henderson/Warren, C = Mason, D = Clinton, E = Jackson/Randolph, F = Union/Williamson, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle/Grundy, L = Lake, M = Winnebago.

* = Illinois endangered species
** = federally endangered species

Table 10. Percent relative frequency (RF) and percent relative abundance (RA) values for raptor species in study areas combined by percent forest cover (≥ 50% or < 50%) of study area and all study areas combined, Illinois Woodland Raptor Survey, 1990/1991.

Species	Areas ≥50% forested[1]		Areas <50% forested[2]		All study areas	
	% RF	% RA	% RF	% RA	% RF	% RA
Black vulture	<0.1	0.3	-	-	1.3	0.2
Turkey vulture	6.7	33.6	40.4	55.9	27.7	41.7
Osprey	-	<0.1	0.9	0.6	0.8	0.6
Mississippi kite*	0.1	0.2	0.2	0.1	0.3	0.2
Bald eagle**	<0.1	0.2	-	-	0.1	<0.1
Northern harrier*	<0.1	0.3	0.6	0.2	0.4	0.2
Sharp-shinned hawk*	0.5	1.1	2.2	1.7	1.8	1.4
Cooper's hawk*	0.7	1.9	2.2	1.7	2.8	2.3
Red-shouldered hawk*	5.7	15.5	2.0	1.5	10.3	8.6
Broad-winged hawk	3.0	7.5	5.4	4.6	7.8	6.3
Swainson's hawk†	-	-	-	-	1.3	<0.1
Red-tailed hawk	12.6	33.3	34.2	25.2	36.9	30.0
Golden eagle	<0.1	0.2	-	-	<0.1	<0.1
American kestrel	0.9	1.8	2.5	1.7	2.9	2.0
Merlin	-	-	-	-	<0.1	<0.1
Peregrine falcon**	<0.1	0.2	-	-	<0.1	<0.1
Great horned owl	0.9	2.2	1.6	3.2	4.4	3.6
Barred owl	0.6	1.7	1.8	3.4	3.2	2.5
Eastern screech-owl	-	-	<0.1	0.1	<0.1	<0.1

[1]Study areas with ≥ 50% forest cover = JoDaviess, Mason, Clinton, Randolph, Union, Pope
[2]Study areas with < 50 forest cover = Henderson, Crawford, Shelby, Vermilion, LaSalle Lake and Winnebago

* = Illinois endangered species
** = federally endangered species
† = federal candidate under category 2

Table 11. Estimates of minimum population density for raptor species in two forest cover categories (≥ 50% or < 50% forested) on both local (known to occupy study areas) and statewide (over all study areas) scales, Illinois Woodland Raptor Survey, 1990/1991.

Species	< 50% forest cover (pairs/km^2)	≥ 50% forest cover (pairs/km^2)
LOCAL		
Turkey vulture	0.97	0.62
Red-tailed hawk	0.89	0.68
Red-shouldered hawk	0.09	0.42
Broad-winged hawk	0.22	0.30
Cooper's hawk	0.09	0.04
Sharp-shinned hawk	0.04	0.04
STATEWIDE		
Turkey vulture	0.97	0.41
Red-tailed hawk	0.89	0.68
Red-shouldered hawk	0.03	0.28
Broad-winged hawk	0.09	0.20
Cooper's hawk	0.03	0.01
Sharp-shinned hawk	0.02	0.01

DISCUSSION

Distribution and Abundance

The turkey vulture and the red-tailed hawk were the most common species observed during this investigation. (The turkey vulture was included in the discussion because of its "omnipresence" and its response rate to the great horned owl tape.) The turkey vulture may have a slightly more restricted distribution than the red-tailed hawk in Illinois, but is found in larger numbers (typically a pair or small group), as shown by its high relative abundance and AO values. The turkey vulture was observed in all 12 study areas regardless of their forest cover or north/south location (Figures 3 and 4. Study areas in Union and Randolph counties in southeastern Illinois failed to produce PD and AO values for the turkey vulture, however, because of the lack of multiple detections at stops located in these areas.

It has been documented that flocking or colonial species are more detectable than solitary species (Fuller and Mosher 1987). The significant difference found between AO values for percent forest cover categories in study areas that were less than or at least 50% forested may be the result of the turkey vulture's greater detectability in open areas.

Data suggest that in certain areas the red-tailed hawk is more detectable and more evenly distributed than the turkey vulture (for example in southern Illinois and in areas where forest cover is $\geq$ 50%). As the continental population of red-tailed hawks appears to be increasing, trend analysis of Breeding Bird Survey (BBS) data showed that there was a significant increase in red-tailed hawk populations in Illinois between 1966 and 1987 (Castrale 1989).

The red-tailed hawk is typically thought of as an "open country" species, requiring large open areas for foraging (Howell et al. 1978, Bednarz and Dinsmore 1981, 1982). However, Luttich et al. (1970) observed red-tailed hawks equally in forested and open habitats and noted foraging in both cover types. In accordance with this observation, red-tailed hawks also have been described as woodland-edge species (Bork and Lepthien 1976).

In northern Indiana, red-tailed hawks were more prevalent in areas where many small forest patches were interspersed with fields, and in southern Indiana, red-tailed hawks associated with open areas, cropland, and water edges (Sargent 1990, Parker 1990). Sargent (1990) found that an increasing degree of habitat dissection directly correlated to the probability of occupation by red-tailed hawks. Iowa nests were associated with nearly equal amounts of woodland, pasture, and cropland and are characterized by high accessibility (Bednarz and Dinsmore 1982). These findings support the statement that red-tailed hawks are capable of occupying diverse habitats and are absent only from the most extensive forests (Castrale 1989).

The habitat associations of red-tailed hawks in Indiana and Iowa also describe red-tailed hawk habitat in Illinois. In this study red-tailed hawks occupied all 12 study areas, regardless of their percent forest cover or north/south locations (Figures 3 and 4). Large AO values for red-tailed hawks in study areas with at least 50% forest cover may indicate that forested areas in Illinois considered to be large contiguous tracts are fragmented to the extent that open-country species can thrive. Area occupied values from forest cover comparisons suggest that the red-tailed hawk frequents habitat mosaics of slightly less than 50% forest cover on both local (near nest-site) and statewide scales.

Trend analysis of BBS data revealed that there was a negative trend for red-shouldered hawk populations in Illinois between 1966 and 1987 (Castrale 1989). This study suggests that the red-shouldered hawk can be locally common in suitable habitat. The limiting factor in Illinois, however, is the availability of suitable habitat. In general, serious declines in red-shouldered hawk populations have resulted from the destruction or alteration of riparian woodlands (Fredrickson and

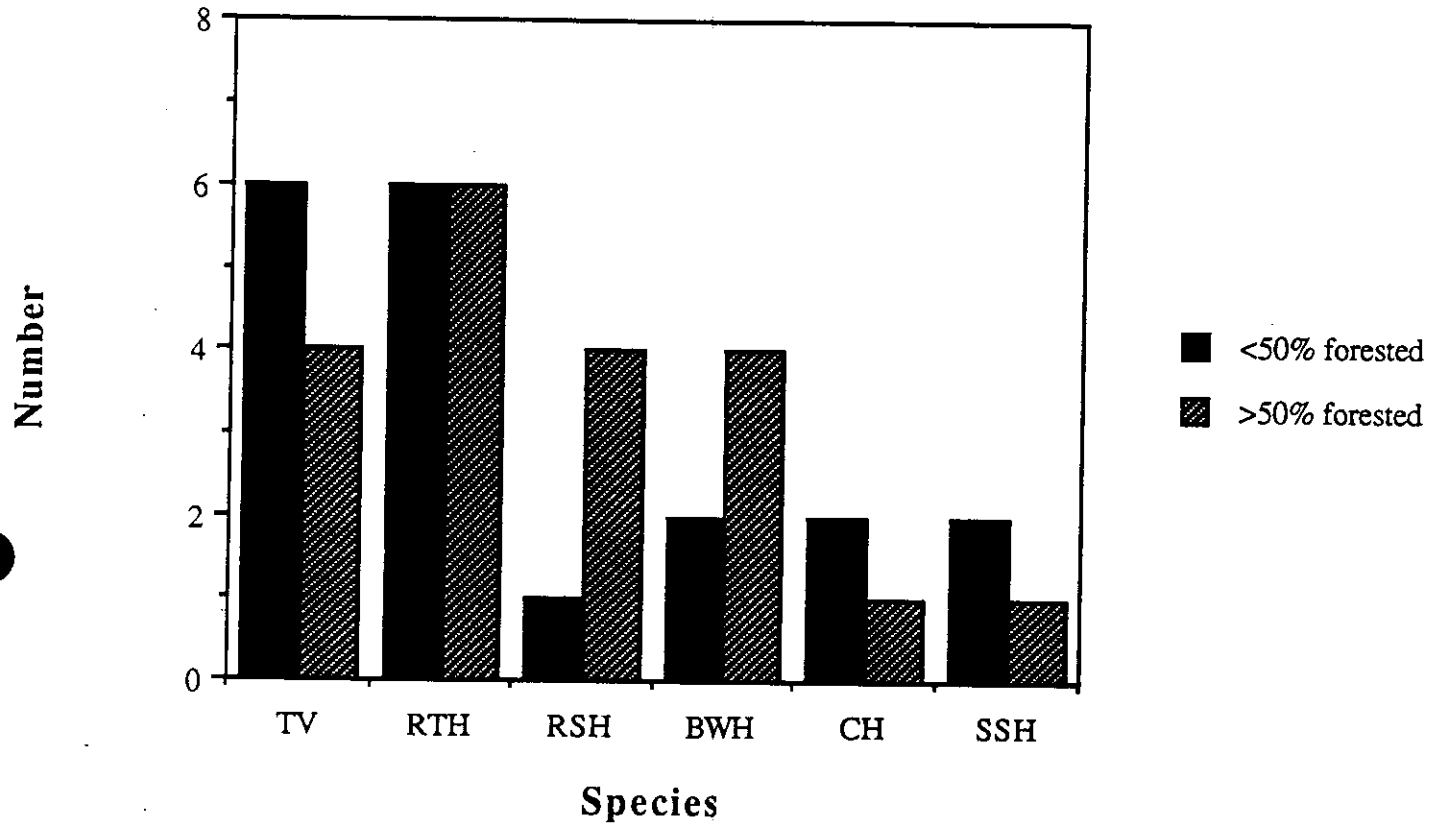

Figure 3. Numbers of study areas occupied by raptor species; study areas grouped by % forest cover (< 50% forested and > 50% forested), Illinois Woodland Raptor Survey, 1990/1991.

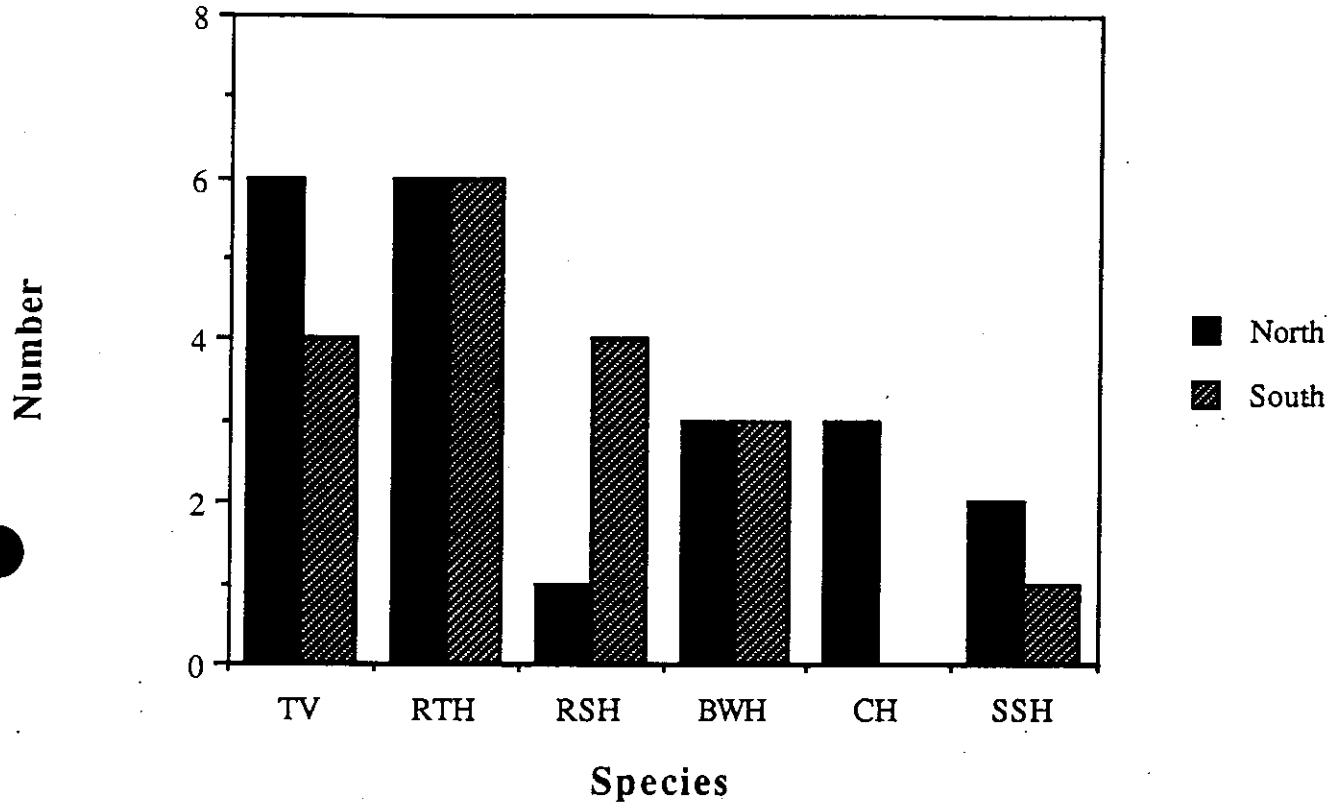

Figure 4. Numbers of study areas occupied by raptor species in northern and southern Illinois, Illinois Woodland Raptor Survey, 1990/1991.

Reid 1986). Minimum area requirements for red-shouldered hawks in Iowa and Illinois are suggested to approach 250 ha of suitable habitat (Bednarz and Dinsmore 1981, Robinson 1989).

Red-shouldered hawks were observed in eight out of 12 study areas and occupied four study areas in southern Illinois, but only one study area in the north (Figure 4). This predominantly southern distribution pattern is consistent with that observed for the red-shouldered hawk in Indiana by Sargent (1990). Both states have a similar land-use pattern of open habitats and urban development in the north and a greater proportion of forested lands in the south. Red-shouldered hawks were not observed using cropland, upland pasture, or human-associated habitats (farmsteads, residential) in Iowa (Bednarz and Dinsmore 1981).

Area occupied values for the red-shouldered hawk were significantly higher in study areas that were at least 50% forested on both local and statewide scales, which indicates a preference for larger forest tracts, and is consistent with a southern distribution pattern in Illinois. Red-shouldered hawks are known to associate with extensive tracts of mature forest (Portnoy and Dodge 1979, Titus and Mosher 1981), especially bottomland forest (Kimmel and Frederickson 1981, Bednarz and Dinsmore 1982, Preston et al. 1989). In Iowa, red-shouldered hawk habitat consisted of extensive tracts of floodplain forest with numerous small openings for hunting. Woodlot size, total % forest cover and areas of greatest density of potential habitat were important nesting requirements of red-shouldered hawks in Iowa (Bednarz and Dinsmore 1981, 1982). In this study, the Clinton County study area contained the greatest amount of bottomland forest of all study areas and generated the highest AO values for red-shouldered hawks.

Upland sites were commonly used by red-shouldered hawks in New York and Indiana, and nesting ranges were strongly associated with riparian forest and water (Crocall and Parker 1989, Parker 1990, Sargent 1990). Upland sites were used in Iowa only if they were adjacent to bottomland sites (Bednarz and Dinsmore 1981, 1982). In this study, the predominantly upland Pope and Union county study areas, both dissected by streams, had the second and third highest AO values for red-shouldered hawks. This study shows that red-shouldered hawks use both upland and bottomland forest tracts in Illinois, but suggests that proximity to water is extremely important. This study also suggests that red-shouldered hawks are attracted to large tracts that are at least 50% forested on a statewide scale. Once a large area is selected, the nest site is typically associated with a habitat or mosaic that is also at least 50% forested.

One can assume that fragmentation of Illinois forests would bring the red-shouldered and red-tailed hawks into contact. It has been documented that forest fragmentation favors the more aggressive red-tailed hawk and that the red-tail has indeed replaced the red-shouldered hawk throughout much of the latter's breeding range (Bednarz and Dinsmore 1982, Portnoy and Dodge 1979). In this study, red-shouldered hawks occupied more area than red-tailed hawks on only one route. Route 10 in Clinton County was located in the Kaskaskia River bottoms, which IDOC recently determined to be one of the largest block of contiguous forest remaining in Illinois today (Large Forest Ecosystem Database, IDOC)). Red-shouldered hawks occupied 80% of the area on Rt. 10 and red-tailed hawks were not observed on the route.

Broad-winged hawks and red-shouldered hawks have been observed nesting in the same kinds of upland woods less than 1 km from streams, ponds, or swamps (Crocall and Parker 1989). Like red-shouldered hawks, broad-winged hawks have been associated with large tracts of forest, but in their case these forested tracts can vary in age-class of trees, cover type, and stand size (Matray 1974, Keran 1978, Fuller 1979, Armstrong and Euler 1983, Parker 1990). Studies also indicate that broad-wings have an affinity for woodland openings and water (Keran 1978, Rosenfield 1984).

In this study, significant AO values suggest that the broad-winged hawk strongly preferred areas that were at least 50% forested on a statewide scale. Broad-winged hawks occupied both northern

and southern study areas, but were conspicuously absent from central Illinois where there are few extensive forest tracts. Rusch and Doerr (1972) never observed broad-wings using intensively farmed (≥ 64%) areas and where farmland comprised approximately 25% of the habitat, broad-wings were observed in or adjacent to large blocks of forest.

Sargent (1990) suggested that broad-winged hawks in Indiana selected for large forest tracts interspersed with openings-- a mosaic typical of those study areas located in northern and southern Illinois. Crocall and Parker (1989) believe the broad-winged hawk displays a degree of adaptability in choice of nesting habitat, but no detailed patterns are apparent. Similar to the red-shouldered hawk, the broad-wing showed a significant preference for areas that were at least 50% forested on a statewide scale and a slight preference for the same kind of habitat or mosaic on a local scale.

The Cooper's hawk and sharp-shinned hawk were uncommon nesting species in the 12 study areas. Cooper's hawks were observed in five of the 12 study areas and AO values in this study suggest a predominantly northern distribution. However, more data are needed to confirm this observation because several active nests were also known to occur in southern and central Illinois.

Cooper's hawk has been associated with large overstory trees, a mature understory, and 95% canopy closure (Titus and Mosher 1981, Moore and Henny 1983). However, in Indiana, Sargent (1990) found no association between Cooper's hawk and mature forests, but detected this species where woodlands were patchy and relatively young. Parker (1990) found an association between Cooper's hawk and both residences and clearcut areas.

In this study AO values for Cooper's hawk show a slight predominance in study areas that are less than 50% forested. The classic description of Cooper's hawk habitat is probably no longer appropriate for Illinois or other intensively farmed regions of the Midwest. The most important factor in nest-site selection appears to be the proximity of a food source (habitats that produce or attract songbirds). Reported nests in Illinois have been located in woodlots 300 m from the nearest edge, to solitary trees in the middle of a vacant lot, and a small group of pines above a backyard patio (Richard Hamilton, Jerry Davidson, Roger Tucker pers. comm.)

In 1991, Cooper's hawk occupied 97.3% of the Winnebago County study area which was by far the largest AO value produced for this species in the state. Winnebago County appears to be a stronghold for Cooper's hawk and broad-winged hawk in Illinois. Factors that may attract these raptors to this particular area of the state are the presence of the confluence of three rivers (Kiskwaukee, Pecatonica, and Rock) and their associated riparian forests, and a well-developed and extensive forest preserve system that has been able to protect many forested tracts in the county. The survey routes for this study were located in habitat mosaics that were less than 50% forested, but there were many large woodlots interspersed throughout the open areas that provided nesting habitat on a local scale.

Pine plantations appear to be an important habitat for Cooper's hawks in the Midwest (Rosenfield et al. 1989). Six out of seven nests in southwestern Ohio were found in pine plantations even though this habitat type comprised only 1% of the study area (Mutter et al. 1984). The Mason County study area was dominated by pine forests, but only two Cooper's and three sharp-shinned observations were recorded during the two years of this study. Henderson County also had extensive pine forests, but only one Cooper's and two sharp-shinned hawk observations were recorded. The lack of detections in these areas can not be explained by this study.

Sharp-shinned hawks were detected in five of 12 areas, but AO values could be calculated only for the Crawford County and JoDaviess County study areas. The majority of birds observed in Illinois were detected only once per stop with no subsequent observations and assumed to be migrants (and therefore could not be included in the data analysis). Sharp-shinned hawks in this study showed a slight affiliation for study areas that were at least 50% forested on both local and

statewide scales, but more data are needed to qualify this observation. Sharp-shinned hawk habitat is thought to be similar to that of the Cooper's hawk (classical description), but with a greater tree density, especially in overstory trees < 20 cm dbh (Rosenfield et al. 1989). Pine plantations also may be important to this species.

In summary, the red-tailed hawk and turkey vulture are both abundant and widely distributed in Illinois. The red-shouldered hawk can be common locally, predominantly in southern Illinois, but appears to be dependant on large tracts of mature bottomland or riparian forest on a statewide scale and locally on parcels that are at least 50% forested. Broad-winged hawks can be locally common in areas that are at least 50% forested on statewide and local scales. Forest age class is not as critical for the broad-wing as for the red-shouldered hawk, but the presence of water appears essential for both species. Cooper's hawk appears to have a stronghold in Winnebago County, but was uncommon in the remainder of the state. This species appears to be "adapting" to more open or fragmented habitats and a reliable food source may be the most important factor in nest-site selection. The sharp-shinned hawk is uncommon to rare as a nesting species in Illinois. More data are needed to speculate about general habitat affiliations or areas of concentration.

The Raptor Monitoring Technique

Detection rates, overall, were improved by using the field sampling method suggested in Iverson and Fuller (1989). It is believed that more raptors were observed with the playing of the great horned owl call, as has been documented in other studies (Fuller and Mosher 1987, Iverson and Fuller 1989). The great horned owl call was used instead of conspecific calls because the owl is recognized as the "universal predator" and stimulates more responses from a wider variety of species in less time (Fuller and Mosher 1987). Therefore, the great horned owl call was more efficient for this study. A woodland raptor survey using tape-recordings alone would increase detections, but still would not account for those individuals present but not responding.

The use of conspecific tape-recordings is known to increase detections of nesting Cooper's hawks (Rosenfield et al. 1985, 1988; Mosher et al 1990). Two researchers attempted to test the great horned owl recording's effect on nesting Cooper's hawks in southeastern Illinois. Judy DeNeal (Pope County study area) and Todd Fink (IDOC, District Heritage Biologist) located two active Cooper's hawk nests in Pope and Johnson counties. They were interested to see if the great horned owl call would evoke a response from a known breeding pair. The birds at the Pope County site did not respond to the call, but upon inspection of the nest they found that it had been predated and at least one of the adults had been killed. The birds at the Johnson County site responded by the third series of hoots with aggressive defensive behavior and a very unfamiliar call (see Rosenfield and Bielefeldt 1991).

Bird species react to the tape differently (Parker 1991, Sargent 1990, this study). It was difficult to determine percent response values for each species. If a bird actively responded with a vocalization or aggressive behavior, there was no question that the bird was responding to the owl call. However, if a bird was observed sitting in a tree at one station, we could not be sure that the bird had not moved in response to the tape when played at the preceding station. Many red-tailed hawks and turkey vultures appeared to ignore the recording and reports of red-tails and kestrels moving away after the call was played were not uncommon. Results of time period analysis are shown in Figure 5).

Species that responded with alarm calls were the red-shouldered hawk, broad-winged hawk, and Cooper's hawk. The majority of vocally responsive birds flew to the forest edge to "confront" the owl recording. Approximately 61% of red-shouldered hawks were detected by sound during the study and an additional 24% were both heard and observed (Figure 6). Nineteen percent of broad-winged hawks were heard and 31% were both heard and observed (a total of 50% vocalized).

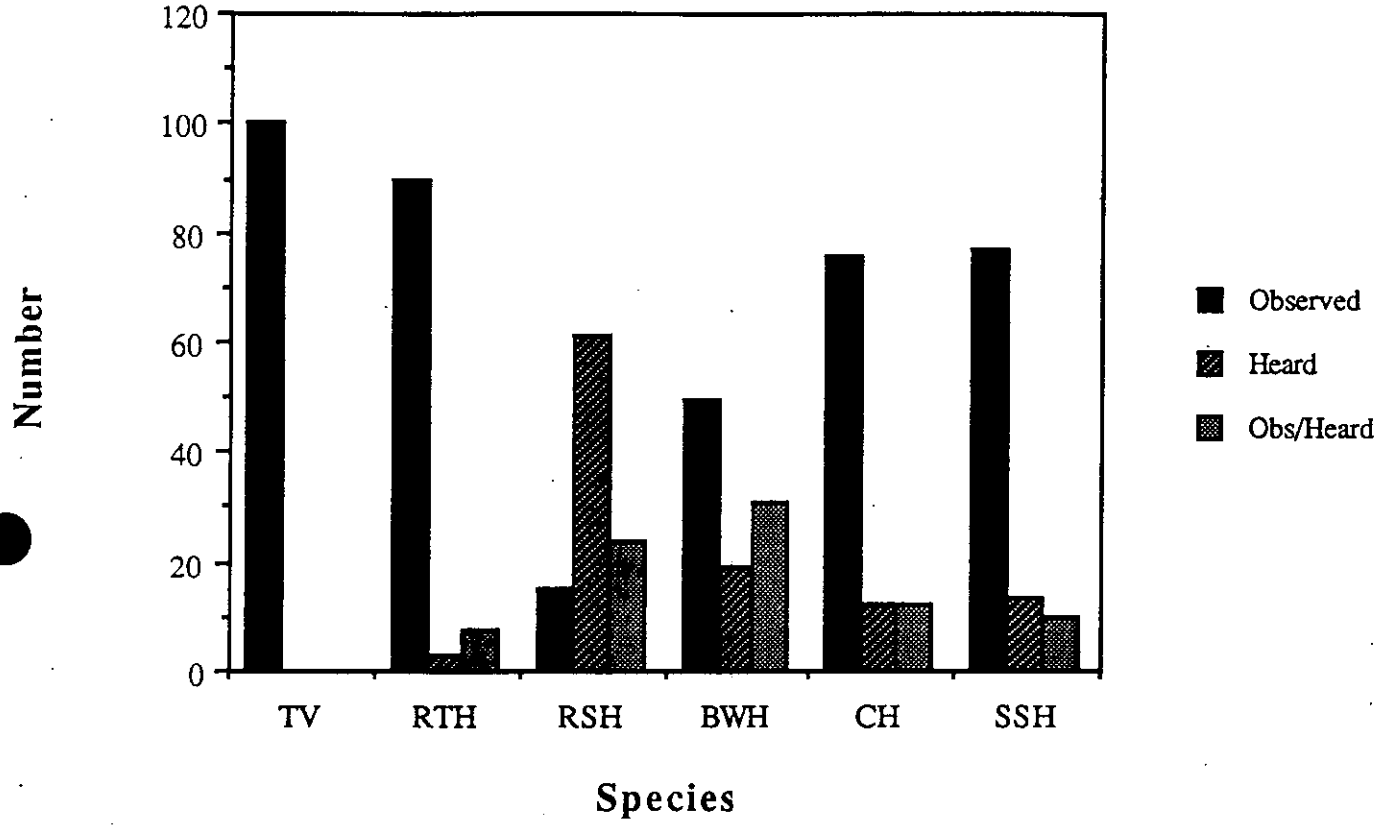

Figure 5. Percent detections of raptor species recorded during the broadcast, post-broadcast, and broadcast/post-broadcast (both) time periods, Illinois Woodland Raptor Survey. 1990/1991.

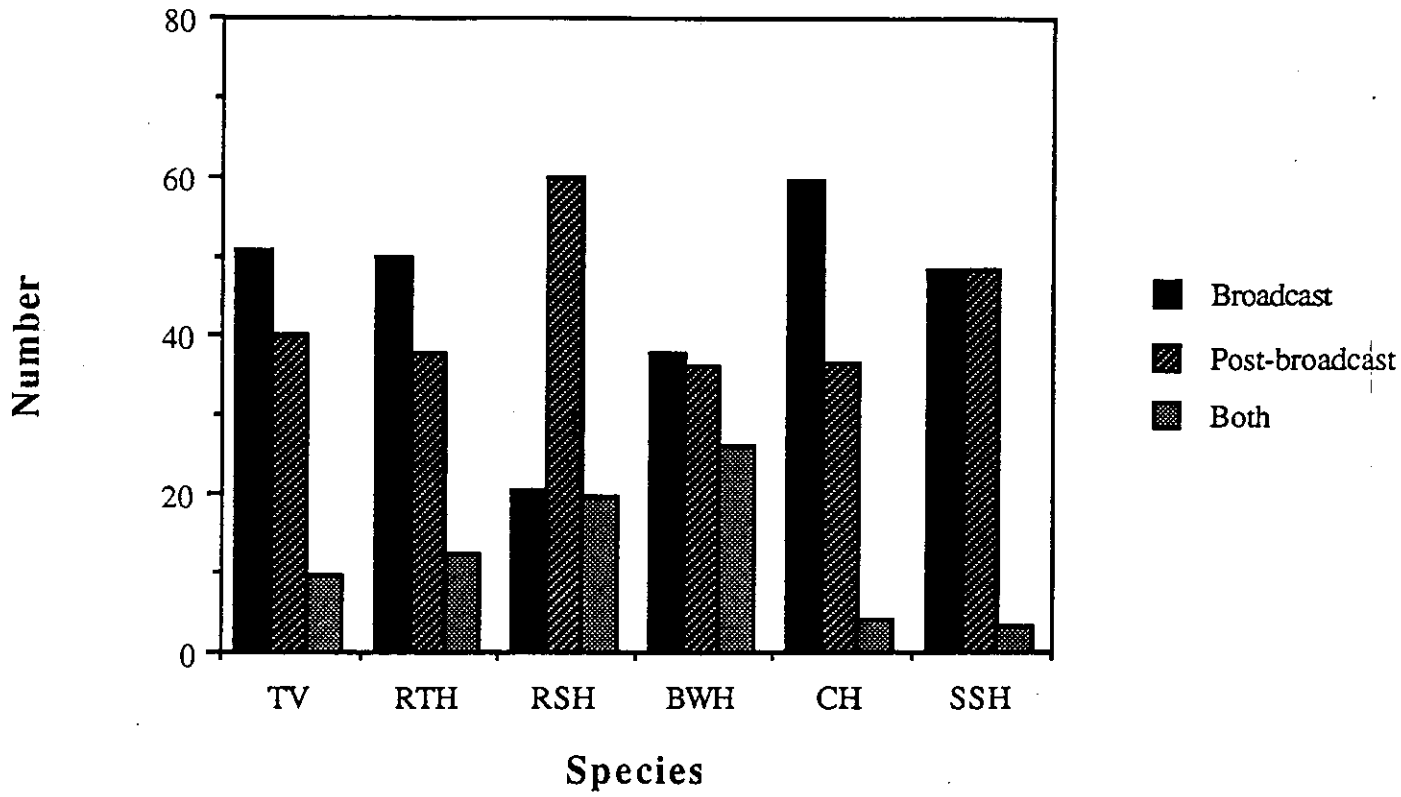

Figure 6. Percent response types of raptor species to broadcasts of great horned owl vocalizations, Illinois Woodland Raptor Survey, 1990/1991.

Approximately 75% of Cooper's hawks were observed in this study, but this value includes many one-time sightings that were assumed to be migrant birds. The birds that comprised the 12% that vocalized and the additional 12% that were both heard and observed occupied areas and were assumed to be breeders.

Caution must be taken when using a playback technique repeatedly in an area. Johnson et al. (1981) suggested that if censuses were conducted too often some individuals or species may become less responsive over time. This situation would have a direct effect on PD and AO values. Detectability would decrease, artificially inflating the area occupied by a species. This phenomenon was not observed during this study.

Crows and blue jays were very responsive to the great horned call and may have deterred raptors from moving into the open. On many occasions during the study crows and blue jays could be heard mobbing "something" behind a tree line. We and other surveyors assumed that a raptor moved in response to the owl call, but did not fly into the open--perhaps because it was being harassed by many birds. Mobbing crows created such commotion in the Lake County study area that few data were collected. Other researchers have found that hawk species were more responsive to taped calls if crows were absent (Balding and Dibble 1984). The question of whether raptors will leave the protective forest environment to defend against a great horned owl calling from 0.5 mile (0.8 km) away is unresolved. The distance a bird will travel to give an alarm response is unknown (but see Parker 1990).

A problem encountered during this study was finding three homogeneous and linear 4.5 mile (7.2 km) roadside survey routes of suitable raptor habitat in one general area. County roads, along which survey routes necessarily must be located for this study, did not provide access to many forested habitats. Larger forest patches without roads either were excluded from the survey or were surveyed from the nearest road. To include the greatest proportion of forested habitats within a study area, several census routes could not remain linear. Precautions were taken to avoid recording the same individuals at subsequent stops.

An attempt was made to minimize variation in habitat features and land-use patterns, but Illinois has such a variable landscape that some habitat variation among routes was unavoidable. The problem occurs when data are combined from separate routes to generate PD values for a particular habitat type, or data are combined to establish PD values that will be used in future calculations of AO values for a particular habitat type. The AO then would be incorrect because of improper compensation for undetected birds. In this study the question of potential validity arose only when established PD values were used to calculate AO values for secondary routes. No significant differences were found, but some confidence intervals were so large that differences probably could not be detected even if they existed.

It is important to determine and define objectives when using this raptor survey technique. Once the objectives are defined, survey routes can be designed and chosen. The number and placement of stops and location of survey routes can then be customized to accommodate the objectives. For example, a combination of roadside and off-road stops can be used. One can assess area occupied by raptors in any unit area regardless of forest cover or habitat type. The survey routes chosen for this study contained raptor habitat and provide contiguous coverage in study areas located throughout the state.

One attribute of this method is that it discriminates against migrant sightings. If at least one subsequent observation does not occur, the initial observation cannot be used in the statistical analysis, (eg. Cooper's and sharp-shinned hawks in this study). This statistical method, therefore, may also discriminate against unpaired summering birds. A researcher considering using this technique must decide if these kinds of data are important to a particular study. To determine if

data are useful one must examine the objectives of the study. In this study, information on the status and distribution of breeding woodland raptors was the objective.

The statistical method of calculating PD and AO values has received mixed reviews from Midwest researchers (Iverson and Fuller 1989, U.S. Fish and Wildlife Service Raptor Survey Meetings, Minneapolis, August 1991). The overwhelming problem with the technique is that sample sizes may not produce reliable PD and AO values. Area occupied values are based on a series of probability equations and variance estimates that can generate large confidence intervals. If confidence intervals are large, can PD and AO values be trusted to reflect what is really occurring in the study area? Confidence intervals can be changed depending on the study's objectives (instead of 95% confidence limits perhaps using 80 or 75%). Therefore, this technique requires an intensive field effort and large sample sizes to make meaningful comparisons among areas and years and decrease confidence intervals.

These data are still useful, especially when comparing population trends. If confidence intervals are large, only gross changes can be detected reliably. In situations where there are very few birds and areas occupied, no survey method will provide much information.

Therefore, the requirement for gathering better information is to increase sample sizes through an intensive field effort. A rule of thumb for this method is that 6 to 10 repetitions are required for each stop from a statistical perspective (Fuller pers. comm) and Iverson and Fuller (1989) suggest that 10 stops be the minimum to which this method is applied.

This method does give presence/absence data which are valuable in themselves. These surveys can help to establish "gross estimates" of status and distribution and subsequent studies can focus on particular species. This technique can be used in monitoring programs that would assess relative population changes over time and also to assess effects of management activities for certain species in certain areas. This method is important for those species that are uncommon and secretive (eg., accipiters and owls) and that are not usually detected on BBS routes (Iverson and Fuller 1989).

Following is a summary of the amount of effort that it took to complete this pilot study. It took 18 work days to plan and set up the project. This included locating qualified participants, assembling and field-testing equipment, preparing data sheets, maps, and other materials, and visiting the study areas to set up survey routes.

Data collection demanded a substantial time commitment from participants. Each survey route took approximately 2.5 hours to complete. On days when only two routes were run, the survey (including travel time) took an average of 6 hours. When three routes were run, it took approximately 8 hours. Therefore, one work day was needed for each survey, and a total of ten work days to collect data for each study area. For this study, a total of 120 work days was required to complete data collection within the 60- to 80-day field season (per year).

Obviously one full-time person could not conduct a study of this magnitude. The IDOC originally assumed that 2 to 3 people could cover the 12 study areas. Even three people would have been able to do little else but travel and collect data from 15 April to 30 June (which includes listening to the great horned owl call nearly 1,000 times). In fact since most qualified individuals who were interested in participating in the study had other commitments, each participant surveyed only one or two study areas. Ten people participated in 1990 and ten in 1991. Finally, the data analysis and report preparation took approximately 4.5 weeks. Thus, a total effort of 160.5 work days were required for each year of this study.

A regional raptor monitoring program was discussed at the USFWS-sponsored Minnesota Raptor Survey meetings in Minneapolis, MN. Representatives from all the midwestern states included in USFWS Region 3 were present. The general consensus was that states would benefit from

increased information on woodland nesting raptor populations,but do not have time or resources were available for a study of this magnitude. Also, states would be trying to address multiple objectives with one survey method. Mark Fuller (pers. comm) discouraged states from using this method because if data were not properly used, invalid conclusions could be drawn.

A monitoring program in Illinois would be possible, however, on a 5-or 10-year schedule. Baseline data have been collected for 12 study areas throughout the state and changes in relative abundance and distribution could be assessed and possibly related to changes in land-use patterns with the aid of GIS technology and satellite data.

If Illinois were to initiate a raptor monitoring program, a minimum of 10 visits would be required which would translate into 10 field days per study area surveyed. It would be preferable to reduce the number of visits to the study areas. If pre-established PD values could be applied to study areas, the field time could be cut substantially, perhaps by more than 50%. This study does not endorse this procedure, however, and suggests that additional research be conducted to determine whether or not it can be used with confidence.

The most efficient means for a raptor monitoring program would be to use the survey routes (two primary routes) that were established for this study because baseline data already have been gathered. The survey could be completed over a two-year period by surveying six of the study areas in a given year. District Heritage Biologists could conduct field work or outside participants could be hired through non-game funds to conduct the surveys (most of the people who participated in this study said that they would gladly do it again).

This study suggests that changes in woodland raptor populations may be monitored effectively using AO values if surveys are repeated in specific areas over a number of years. Results of this study describe the abundance and distribution of nesting woodland raptors in 13 study areas in Illinois. Ultimately, the raptor monitoring technique could be applied to larger scale evaluations of the status of woodland raptor populations throughout the state and possibly the Midwest. However, the technique must be accompanied by clearly defined objectives, sufficient data, and qualified trained personnel to guard against invalid conclusions. Costs and benefits of this technique must be weighed for individual studies, in particular areas, and for particular objectives. This study suggests that Illinois could profit from this technique.

AKNOWLEDGMENTS

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Appendix I. Legal locations of the 39 Illinois Woodland Raptor Survey Routes.

1 IL, JoDaviess Co., 4th P.M.: T. 26N, R. 2E, Sec. 17, 18, 19, 20, 28, and 29, Green Island, Ia. - Ill. (7.5' series, 1953 ed., 1975 P.R.) and T. 26N, R. 2E, Sec. 17 and 18, Hanover, Ill. (7.5' series, 1968 ed., 1975 P.I.) USGS topographic quadrangle maps.

2 IL, JoDaviess Co., 4th P.M.: T. 27N, R. 1E, Sec 14, 23, and 26, Hanover, Ill. (7.5' series, 1968 ed., 1975 P.I.) and T. 27N, R. 1E, Sec. 27, 28, 33, and 34, Bellevue, Ill. (7.5' series, 1968 ed.) USGS topographic quadrangle maps.

3 IL, JoDaviess Co., 4th P.M.: T27N, R. 2E, Sec. 1, 11, 12, and 13, Elizabeth, Ill. (7.5' series, 1968 ed.) and T. 26N, R. 2E, Sec. 13, 23, and 24, Blackhawk, Ill. - Ia., (7.5' series, 1953 ed., 1975 P.R.) USGS topographic quadrangle maps.

4 IL, Henderson Co., 4th P.M.: T. 12N, R. 5W, along county road between sections 2/3, 10/11, and 14, 15, 23, and 26, Keithsburg, Ill. - Ia., (7.5' series, 1982 ed.) USGS topographic quadrangle map.

5 IL, Henderson Co., 4th P.M.: T. 12N, N-S along county road between R. 4W and R. 5W, and between sections 19/24 and 25/30, Keithsburg, Ill. - Ia., (7.5' series, 1982 ed.) and T. 12N, N-S along county road between R. 5W and R. 4W and between sections 25/30, 31/36, and T. 11N and R. 5W, Sec. 1 and 2, Oquawka, Ill. (7.5' series, 1982 ed.) USGS topographic quadrangle maps.

6 IL, Warren Co., 3rd P.M.: T. 11N, N-S along county road between R. 1W and R. 2W, and between sections 13/18, 17/18, 19/20, 19/24, and 19/30, Cameron Ill. (7.5' series, 1982 ed.) USGS topographic quadrangle map.

7 IL, Mason Co., 3rd P.M.: E-W along county road between T. 22N and T. 23N, R. 7W, and between sections 3/34, 4/33, and 5/32, Duck Island, Ill. (7.5' series, 1982 prov. ed.) and T. 22N and T. 23N, R. 7W, along county road between sections Sec. 1/36, 2/35, and 3/34, Manito, Ill. (7.5' series, 1971 ed.) USGS topographic quadrangle maps.

8 IL, Mason Co., 3rd P.M.: T. 23N, R. 7W, Sec. 20, 21, 27, and 28, Duck Island, Ill. (7.5' series, 1982 prov. ed.) and T. 23N, R. 7W, Sec. 27, 34, and 35, Manito, Ill. (7.5' series, 1971 ed.) USGS topographic quadrangle maps.

9 IL, Mason Co., 3rd P.M.: T. 22N, R. 7W, Sec. 2 and 11, Manito, Ill. (7.5' series, 1971 ed.) and T. 22N, R. 7W, Sec. 10, 11,.and 15, Forest City, Ill. (7.5' series, 1982 prov. ed.) and T. 22N, R. 7W, Sec. 9, 15 and 16, Topeka, Ill. (7.5' series, 1982 prov. ed.) USGS topographic quadrangle maps.

10 IL, Clinton Co., 3rd P.M.:. T. 1N, R. 3W, Sec. 19, 21, 22, 27, 28, 29, and 30, Beckemeyer, Ill. (7.5' series, 1962 ed., 1981 P.R.) USGS topographic quadrangle map.

11 IL, Clinton Co., 3rd P.M.: T. 1N, R. 4W, Sec. 25, 30, 31, 32, and 33, Okawville, Ill. (7.5' series, 1962 ed., 1981 P.R.) and T. 1N, R. 4W, Sec 30, Breese, Ill. (7.5' series, 1962 ed., 1981 P.R.) USGS topographic quadrangle maps.

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12 IL, Clinton and Washington cos., 3rd P.M.: T. 1N and E-W along county road between T. 1N and T. 2S, R. 3W, Sec. 4, 5, 27, 28, 32, and 33, Addieville, Ill. (7.5' series, 1974 ed.) USGS topographic quadrangle map.

13 Il, Jackson Co., 3rd P.M.:T. 8S, R. 5W. Sec. 10, 11, 15, 16, and 21, Rockwood, Ill. - Mo. (7.5' series, 1968 ed.) and T. 8S, R. 5W, Sec. 11 and 12, Raddle, Ill. (7.5' series, 1968 ed.) USGS topographic quadrangle maps.

14 IL, Randolph Co., 3rd P.M.: T. 7S, R. 6W, Sec. 22, Chester Ill. - Mo. (7.5' series, 1970 ed.) and T. 7S, R. 6W and R. 5W, Sec. 22, 25, 26, 27, and 31, Welge Ill. (7.5' series, 1968 ed.) and T. 7S, R. 5W, Sec. 31, Rockwood, Ill. (7.5' series, 1968 ed.) USGS topographic quadrangle maps.

15 IL, Randolph Co., 3rd P.M.: T. 6S, R. 8W, Sec. 3, 4, and 10, Evansville, Ill., 7.5' series (1970 ed., PR. 1982) and T. 6S, R. 8W, Sec. 32, Prairie du Rocher, Ill. - Mo. (7.5' series, 1970 ed., 1980 P.I.) USGS topographic quadrangle maps.

16 IL, Union Co., 3rd P.M.: T. 11S, R. 2W, Sec. 15, 21, 22, 28, 29, 31, and 32, Cobden, Ill. (7.5' series, 1947 ed.) USGS topographic quadrangle map.

17 IL, Union Co., 3rd P.M.: T. 13S, R. 2W, Sec. 11, 14, 15, 16, 17, and 20, Jonesboro, Ill. (7.5' series, 1948 ed.) and T. 13S, R. 2W, Sec. 20, Mill Creek, Ill. (7.5' series, 1948 ed.) USGS topographic quadrangle maps.

18 IL, Williamson and Union cos., 3rd P.M.: T. 10S, R. 1E, Sec. 32 and 33 and T. 11S, R. 1E, along county road between sections 4/5, 8/9, 16/17, 20/21, and 32/33, Lick Creek, Ill. (7.5' series, 1966 ed.) USGS topographic quadrangle map.

19 IL, Pope Co., 3rd P.M.: T. 11S, R. 6E, Sec. 9, 13, and 14, Eddyville, Ill. (7.5' series, 1961 ed.) and T. 11S, R. 6E and R. 7E, Sec. 7, 8, 9, 12, and 13, Herod, Ill. (7.5' series, 1961ed.) USGS topographic quadrangle maps.

20 IL, Pope Co., 3rd P.M.: T. 11S, R. 5E and R. 6E, Sec. 7, 11, 12, and 14, Eddyville, Ill. (7.5' series, 1961 ed.) and T. 11S and R. 6E, Sec. 14 and 15, Stonefort, Ill. (7.5' series, 1961 ed.) USGS topographic quadrangle maps.

21 IL, Pope Co., 3rd P.M.: T. 15S, R. 6E, Sec. 1, 2, 10, 11, and 14, Paducah NE, Ill. (7.5' series, 1967 ed.) USGS topographic quadrangle map.

22 IL, Crawford Co., 2nd P.M.: T. 5N, R. 11W, Sec. 21 and 22, Birds, Ill. (7.5' series, 1964 ed.) and T. 5N, R. 11W, Sec. 4, 9, and 16, Flat Rock, Ill. (7.5' series, 1964 ed.) USGS topographic quadrangle maps.

23 IL, Crawford Co., 2nd P.M.: T. 5N, R. 12W, county road between Sec. 14/15, and 23/24, Birds, Ill. (7.5' series, 1964 ed.) and T. 5N, R. 12W, Sec. 2, 11, and 14, Flat Rock, Ill. (7.5' series, 1964 ed.) USGS topographic quadrangle maps.

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24 IL, Crawford Co., 2nd P.M.: T. 5N, R. 12W, Sec. 15 and 22, Birds, Ill. (7.5' series, 1964 ed.) and T. 5N, R. 12W, Sec. 3, 10, 15, and T. 6N, R. 12W, Sec. 34, Flat Rock, Ill. (7.5' series, 1964 ed.) USGS topographic quadrangle maps.

25 IL, Shelby Co., 3rd P.M.: T. 12N, R. 5E, along county road between sections 5/6, and 7/8, Kirksville, Ill. (7.5' series, 1983 prov. ed.) and T. 12N, R. 4E and R. 5E, along county highway between sections 7/8 and Sec. 18, 19, 24, and 25, Middlesworth, Ill. (7.5' series, 1981 ed.) USGS topographic quadrangle maps.

26 IL, Shelby Co.,3rd P.M.: T. 13N, R. 4E and R. 5E, Sec 19, 24, and along county road between sections 15/22, 16/21, and 17/20, Kirksville, Ill. (7.5' series, 1983 prov. ed.) USGS topographic quadrangle map.

27 IL, Shelby Co., 3rd P.M.: E-W along county road between T. 12N and T. 11N, R. 4E, and between sections 1/36, 2/35, 3/34, and between sections 25/30 and 31/36, Middlesworth, Ill. (7.5' series, 1981 ed.) USGS topographic quadrangle map.

28 IL, Vermilion Co., 3rd P.M.: T. 20N, R12W and R. 13W, Sec. 7, 8, 13, 17, and 18, Collison, Ill. (7.5' series, 1968 ed.) and T. 20N, R. 12W, Sec. 8, 16, and 17, Danville NW, Ill. (7.5' series, 1966 ed.) USGS topographic quadrangle maps.

29 IL, Vermilion Co., 3rd P.M.: T. 19N and T. 20N, R. 11W and R. 10W, Sec. 1, 12, 13, 18, and 36, Danville SE, Ill. (7.5' series, 1966 ed.) USGS topographic quadrangle map.

30 IL, Vermilion Co., 3rd P.M.: T. 21N, R. 13W, Sec. 11, 12, 13, 14, and 23, Potomac, Ill. (7.5' series, 1984 prov. ed.) USGS topographic quadrangle map.

31 IL, LaSalle Co., 3rd P.M.: T. 33N, R. 2E, Sec. 20 and 21, LaSalle, Ill. (7.5' series, 1966 ed., 1979 P.R.) and T. 33N, R. 2E, Sec. 21, 22, 23, 26, 27, and 28, Starved Rock, Ill. (7.5' series, 1970 ed.) USGS topographic quadrangle maps.

32 IL, LaSalle Co., 3rd P.M.: T. 33N, R. 4E and R. 5W, Sec. 22, 23, 24, 25, 30, 31, and 32, Marseilles, Ill. (7.5' series, 1970 ed., 1980 P.R.) USGS topographic quadrangle map.

33 IL, LaSalle and Grundy cos., 3rd P.M.: T. 33N, R. 5E, Sec. 26, 27, 28, 34, and 35, Marseilles, Ill. (7.5' series, 1970 ed., 1980 P.R.) and T. 33N, R. 5E and R. 6E, Sec. 25, 29, and 30, Seneca, Ill. (7.5' series, 1970 ed. 1980 P.R.) USGS topographic quadrangle maps.

34 IL, Lake Co., 3rd P.M.: T. 43N, R. 12E, Sec. 5, 6, 8, 16, and 17, Highland Park, Ill. (7.5' series, 1963 ed., 1972 P.R.) and T. 43N, R. 11E and R. 12E, along IL 60 between sections 1/36, 2/35, and 6/31, Wheeling, Ill. (7.5' series, 1963 ed., 1972 P.R.) USGS topographic quadrangle maps.

35 IL, Lake Co., 3rd P.M.: T. 43N, R. 11E, along Riverwoods Road between sections 1/2, 11/12, 13/14, 23/24, and Sec. 25 and 36, Wheeling, Ill. (7.5' series, 1963 ed., 1972 P.R.) USGS topographic quadrangle map.

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36 IL, Lake Co., 3rd P.M.: T. 44N, R. 10E, Sec. 1, 2, 3, and 34, Lake Zurich, Ill. (7.5' series, 1960 ed., 1972 and 1980 P.R.) USGS topographic quadrangle map.

37 IL, Winnebago Co.,3rd P.M.: T.42N, R. 2E, Sec. 1 and T. 42N, R. 2E, Sec. 36, 25, 24, and 13, Cherry Valley, Ill. (7.5' series, 1968 ed. 1975 P.R.) USGS topographic map.

38 IL, Winnebago Co., 3rd P.M.: T. 43N, R. 2E, Sec. 10, 15, 21, 28, Cherry Valley, Ill. (7.5' series, 1968 ed. 1975 P.R.) and T. 43N, R. 2E, Sec. 28, Rockford South, Ill. (7.5' series, 1971 ed., 1976 P.R.) USGS topographic maps.

39 IL, Winnebago Co., 3rd P.M., T. 43N, R. 1E, Sec. 25,26,27,34,28, Rockford South, Ill. (7.5' series, 1971 ed., 1976 P.R.) and T. 43N, R. 1E, Sec. 21, Kishwaukee, Ill. (7.5' series, 1971 ed.) USGS topographic map.

Appendix II. Illinois woodland raptor survey participants and their study areas.

Colleen Stiefel -- JoDaviess County
Mike Baum -- Henderson & Mason counties
Keith McMullen -- Clinton County
Dave Fletcher -- Randolph and Union counties
Judy DeNeal -- Pope County
Dave Schuur -- Crawford County
Dave Enstrom -- Shelby County 1990
L. Barrie Hunt -- Shelby County 1991
Patti Malmborg and Glendy Vanderah -- Vermilion County 1990
Steve Bailey -- Vermilion County 1991
Joe Milosevich -- LaSalle County 1990
Terese Dudek -- LaSalle County 1991
Roger Tucker -- Lake County 1990
Rod Myers -- Winnebago County 1991

Addresses available on request.

Appendix III. Illinois Woodland Raptor Survey data collected in 1990.

Table 1. Number of stops, routes, and areas at which each raptor species was observed during the Illinois Woodland Raptor Survey, 1990. Appendix III.

Species	Total	Species observations		
		Number of stops N=360	Number of routes N=36	Number of areas N=12
Black vulture	2	1	1	1
Turkey vulture	506	131	25	10
Osprey*	4	4	2	1
Mississippi kite*	1	1	1	1
Bald eagle**	2	2	2	2
Northern harrier*	5	5	5	3
Sharp-shinned hawk*	15	10	9	5
Cooper's hawk*	16	11	7	5
Red-shouldered hawk*	102	36	14	8
Broad-winged hawk	80	29	14	9
Red-tailed hawk	366	157	31	12
American kestrel	27	25	15	9
Peregrine falcon**	1	1	1	1
Great horned owl	32	25	14	7
Barred owl	28	16	9	7

** federally endangered species
* Illinois endangered species

Table 2. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois,1990. Appendix III.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01 Savanna Depot	TV	25.0	10.1 - 39.9	90.0	97.9	66.2 - 100.0
	CH	12.5	0.0 - 37.7	30.0	51.6	0.0 - 100.0
	BWH	12.5	-------*	10.0	13.5	-------*
	RTH	17.3	3.8 - 30.8	100.0	100.0	33.6 - 100.0
02 Townhall	TV	10.6	0.0 - 21.1	90.0	100.0	0.0 - 100.0
	BWH	27.4	0.0 - 84.3	30.0	31.3	0.0 - 100.0
	RTH	21.2	10.6 - 31.9	80.0	90.3	51.3 - 100.0
Henderson County						
04 BRSF - River	TV	27.1	13.9 - 40.3	60.0	62.6	21.5 - 100.0
	RTH	14.5	0.0 - 30 5	50.0	68.8	0.0 - 100.0
05 BRSF - Bluff	TV	11.6	0.0 - 25.9	80.0	100.0	0.0 - 100.0
	RTH	19.2	0.0 - 44.1	50.0	70.0	1.0 - 100.0
Mason County						
07 SRSF - Hdqtrs	TV	6.2	0.0 - 18.9	30.0	86.5	0.0 - 100.0
08 Durang Hill	TV	11.1	0.0 - 27.4	40.0	57.8	0.0 - 100.0
	RTH	25.0	------*	10.0	10.6	-------*
Clinton County						
10 Santa Fe Bottoms	RSH	14.1	0.0 - 31.2	70.0	92.4	0.0 - 100.0
	BO	13.9	0.0 - 40.1	20.0	25.8	0.0 - 100.0
11 Voss	TV	1.8	0.0 - 4.5	80.0	100.0	0.0 - 100.0
	RSH	25.1	4.3 - 45.8	40.0	42.1	0.0 - 94.0
	RTH	37.0	0.0 - 10.3	40.0	100.0	0.0 - 100.0
	GHO	25.0	-------*	10.0	10.6	-------*
Randolph County						
13 Rockwood	BWH	16.7	0.0 - 49.5	30.0	35.8	0.0 - 100.0
	RTH	22.2	10.7 - 33.7	90.0	100.0	72.0- 100.0
14 Chester	BWH	13.3	0.0 - 37.5	40.0	68.2	0.0 - 100.0
	RTH	31.6	10.5 - 52.8	90.0	93.6	66.7 - 100.0
	AK	7.1	0.0 - 21.6	30.0	76.4	0.0 - 100.0
Union County						
16 Alto Pass	RTH	42.7	24.4 - 61.0	90.0	90.5	68.0 - 100.0
	AK	6.0	0.0 - 14.7	40.0	91.9	0.0 - 100.0
17 Harrison Creek	RSH	25.6	0.0 - 56.1	40.0	43.3	0.0 - 100.0
	BWH	21.4	0.0 - 55.4	60.0	72.1	0.0 - 100.0
	RTH	5.7	0.0 - 11.8	100.0	100.0	0.0 - 100.0

Table 2 (Appendix III) concluded on next page

Table 2 (Appendix III) concluded

Table 2. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois, 1990.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Pope County						
19 Williams Hill	TV	8.2	0.0 - 21.1	70.0	100.0	0.0 - 100.0
	RSH	11.8	5.1 - 18.5	20.0	28.0	0.0 - 100.0
	BWH	50.0	-------*	10.0	100.0	-------*
	RTH	6.9	0.0 - 17.7	50.0	100.0	0.0 - 100.0
20 South Pope	TV	15.3	0.0 - 32.7	50.0	64.9	0.0 - 100.0
	RSH	21.6	0.0 - 48.3	60.0	70.4	15.6 - 100.0
	BWH	33.3	0.0 - 100.0	20.0	21.2	0.0 - 100.0
	RTH	50.0	0.0 - 100.0	20.0	20.0	0.0 - 100.0
Crawford County						
22 Montgomery	TV	4.2	0.0 - 12	40.0	100.0	0.0 - 100.0
	RTH	8.0	0.0 - 18.4	70.0	100.0	0.0 - 100.0
23 Honeycreek 1	TV	2.8	0.0 - 7.6	50.0	100.0	0.0 - 100.0
	SSH	16.7	0.0 - 100.0	20.0	27.1	0.0 - 100.0
	RSH	33.3	-------*	10.0	10.2	-------*
	RTH	10.8	3.4 - 18.1	70.0	100.0	32 - 100.0
Shelby County						
25 Wolf Creek	TV	17.4	8.4 - 26.4	80.0	96.7	52.5 - 100.0
	RTH	20.3	0.0 - 44.4	50.0	58.6	0.0 - 100.0
26 Railroad	TV	18.3	1.4 - 35.1	90.0	100.0	12.1 - 100.0
	RTH	7.5	0.0 - 15.6	60.0	100.0	0.0 - 100.0
Vermilion County						
28 Middlefork CA	TV	16.8	3.7 - 29.9	90.0	100.0	33.4 - 100.0
	RTH	12.8	2.5 - 23.1	70.0	97.0	5.8 - 100.0
29 Langley Bottoms	TV	6.7	0.0 - 13.8	60.0	100.0	0.0 - 100.0
	RTH	9.2	0.0 - 21.0	70.0	100.0	0.0 - 100.0
LaSalle County						
31 Starved Rock	TV	9.3	0.0 - 25.3	30.0	48.3	0.0 - 100.0
	CH	33.3	0.0 - 100.0	30.0	32.6	0.0 - 100.0
	RSH	32.1	0.0 - 100.0	20.0	20.4	0.0 - 100.0
	RTH	9.5	0.0 - 57.4	20.0	38.2	0.0 - 100.0
	BO	39.5	0.0 - 100.0	20.0	20.1	0.0 - 100.0
32 Marseilles	BWH	60.0	0.0 - 100.0	20.0	20.1	0.0 - 100.0
	RTH	18.5	0.0 - 42.6	70.0	85.1	0.0 - 100.0
	GHO	11.1	0.0 - 32.2	40.0	65.7	0.0 - 100.0
Lake County						
34 Heller NC	N/D					
35 Ryerson CA	N/D					

* = too rare to calculate confidence intervals

Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for two primary routes combined within 12 study areas throughout Illinois, 1990. Appendix III.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01,02	TV	17.8	8.7 - 26.9	90.0	100.0	75.1 - 100.0
	CH	12.5	0.0 - 37.4	15.0	25.8	0.0 - 100.0
	BWH	23.7	0.0 - 60.8	20.0	21.4	0.0 - 59.9
	RTH	18.9	10.2 - 27.5	90.0	100.0	78.0 - 100.0
Henderson County						
04,05	TV	18.9	9.1 - 28.8	70.0	82.4	49.3 - 100.0
	RTH	16.8	4.5 - 29.0	50.0	61.4	17.1 - 100.0
Mason County						
07,08	TV	8.3	0.0 - 16.9	35.0	64.5	0.0 - 100.0
	RTH	25.0	------*	5.0	5.0	------*
Clinton County						
10,11	TV	2.1	0.0 - 5.1	40.0	100.0	0.0 - 100.0
	RSH	18.2	6.6 - 29.7	55.0	65.8	31.9 - 99.7
	RTH	3.7	0.0 - 10.9	20.0	68.9	0.0 - 100.0
	GHO	25.0	------*	5.0	5.3	------*
	BO	13.9	0.0 - 40.5	10.0	12.9	0.0 - 100.0
Randolph County						
13,14	BWH	13.3	0.0 - 28.6	35.0	51.8	0.0 - 100.0
	RTH	26.4	15.2 - 37.6	90.0	96.0	78.2 - 100.0
	AK	7.1	0.0 - 21.6	15.0	38.8	0.0 - 100.0
Union County						
16,17	RSH	26.9	0.0 - 57.2	20.0	21.1	0.0 - 54.6
	BWH	21.4	0.0 - 54.4	30.0	36.0	1 - 100.0
	RTH	23.3	11.2 - 35.3	95.0	100.0	82.1 - 100.0
	AK	6.2	0.0 - 14.8	20.0	43.9	0.0 - 100.0
Pope County						
19,20	TV	10.8	1.4 - 20.3	60.0	91.1	1.2 - 100.0
	RSH	18.6	0.5 - 36.7	40.0	47.0	10.7 - 83.4
	BWH	33.3	0.0- 85.9	15.0	15.3	0.0- 49.5
	RTH	18.5	0.0- 43.6	35.0	43.2	0.0- 97.7
Crawford County						
22,23	TV	2.8	0.0- 6.1	45.0	100.0	0.0- 100.0
	SSH	16.7	0.0- 100.0	10.0	13.6	0.0- 100.0
	RSH	33.3	------*	5.0	5.1	------*
	RTH	7.9	0.6 - 15.1	70.0	100.0	7.3 - 100.0

Table 3 (Appendix III) concluded on next page

Table 3 (Appendix III) concluded

Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for two primary routes combined within study areas throughout Illinois, 1990.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Shelby County						
25,26	TV	17.5	8.3 - 26.6	85.0	100.0	67.2 - 100.0
	RTH	12.9	2.0 - 23.8	55.0	75.8	6.0 - 100.0
Vermilion County						
28,29	TV	12.1	4.6 - 19.7	75.0	100.0	52.9 - 100.0
	RTH	10.9	3.9 - 17.9	70.0	100.0	41.5 - 100.0
LaSalle County						
31,32	TV	100.0	0.0 - 25.6	15.0	24.1	0.0 - 96.6
	CH	12.5	0.0 - 37.4	15.0	25.8	0.0 - 100.0
	BWH	60.0	0.0 - 100.0	10.0	10.1	0.0 - 86.6
	RTH	15.9	0.0 - 34.8	45.0	57.8	2.0 - 100.0
	GHO	11.1	0.0 - 33.2	20.0	32.8	0.0 - 100.0
	BO	39.6	0.0 - 100.0	10.0	10.1	0.0 - 85.4
Lake County						
34,35	N/D					

* = too rare to calculate confidence intervals

Table 4. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for secondary routes within 12 study areas throughout Illinois, 1990. Appendix III.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess Count						
03 Elizabeth	TV	15.7	7.5 - 24.1	67.0	95.9	40.1 - 100.0
	RTH	15.8	8.0 - 23.5	73.0	100.0	41.2 - 100.0
Henderson County						
06 Warren Co.	TV	17.4	7.8 - 27.0	53.0	76.8	28.3 - 100.0
	RTH	15.3	3.7 - 26.9	47.0	89.3	0.0- 100.0
Mason County						
09 Bishop Road	N/D					
Clinton County						
12 Covington Bridge	RSH	22.5	5.2 - 39.8	43.0	57.1	22.5 - 91.8
Randolph County						
15 Kaskaskia River	RTH	30.3	17.4 - 43.3	67.0	75.0	51.9 - 98.1
	AK	4.8	0.0 - 14.2	17.0	68.5	0.0 - 100.0
Union County						
18 Crab Orchard	N/D					
Pope County						
21 Delwood-	TV	9.8	0.6 - 19.1	43.0	81.5	0.0 - 100.0
Burden Falls	RSH	17.2	0.6 - 33.9	30.0	43.3	0.0 - 92.4
	RTH	16.3	0.0 - 36.8	27.0	40.8	0.0 - 100.0
Crawford County						
24 Honeycreek 2	TV	2.2	0.0 - 5.0	47.0	100.0	0.0 - 100.0
	RTH	7.7	1.2 - 14.3	63.0	100.0	0.0 - 100.0
Shelby County						
27 Lithia	TV	25.2	11.1 - 39.3	80.0	100.0	70.9 - 100.0
	RTH	19.8	0.6 - 39.1	40.0	52.0	19.0 - 85.1
Vermilion County						
30 Middlefork II	TV	15.3	2.6 - 30.0	60.0	96.0	21.0 - 100.0
	RTH	10.6	3.5 - 17.6	50.0	86.4	0.7 - 100.0

Table 4 (Appendix III) concluded on next page

Table 4 (Appendix III) concluded

Table 4. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for secondary routes within 12 study areas throughout Illinois, 1990.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
LaSalle County						
33 Seneca	TV	5.6	0.0 - 13.9	10.0	76.8	0.0- 100.0
	CH	33.3	0.0 - 100.0	10.0	17.9	0.0 - 64.1
	BWH	46.6	0.0 - 100.0	13.0	16.7	0.0 - 51.7
	RTH	10.1	0.0 - 22.2	50.0	100.0	0.0 - 100.0
	BO	39.5	0.0 - 100.0	6.0	18.7	0.0 - 100.0
Lake County						
36 Sylvan Lake	N/D					

N/D = no data

Table 5 Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species in study areas* known to occupy study areas with ≥ 50% forest cover and study areas with < 50% forest cover throughout Illinois, 1990. Appendix III.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	11.5	6.9 - 16.2	56.0	79.5	54.5 - 100.0
	CH	12.5	0.0 - 37.4	15.0	25.8	0.0 - 100.0
	RSH	18.4	10.5 - 26.4	42.0	48.4	31.5 - 65.2
	BWH	20.6	8.5 - 32.6	25.0	28.4	15.6 - 41.3
	RTH	21.5	16.1 - 27.0	67.0	73.5	62.3 - 84.7
< 50	TV	13.8	9.7 - 17.9	57.0	75.2	58.5 - 91.9
	CH	33.3	0.0 - 100.0	15.0	16.3	0.0 - 56.1
	RSH	21.4	0.0 - 75.4	15.0	19.1	0.0 - 68.9
	BWH	60.0	0.0 - 100.0	10.0	10.1	0.0 - 86.6
	RTH	12.6	8.3 - 16.9	58.0	78.4	58.4 - 97.5

* using data collected on primary routes only
Study areas with ≥ 50% forest cover are JoDaviess, Mason, Clinton, Jackson, Union, Pope
Study areas with < 50% forest cover are Henderson, Crawford, Shelby, Vermilion, LaSalle

Table 6. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated over all study areas* with ≥ 50% forest cover and study areas with < 50% forest cover throughout Illinois, 1990. Appendix III.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	11.6	7.1 - 16.2	56.0	49.4	32.8 - 66.0
	CH	8.3	0.0 - 25.2	3.3	6.8	0.0 - 24.1
	RSH	18.5	10.3 - 26.6	42.0	24.2	31.5 - 65.2
	BWH	20.2	8.7 - 31.7	25.0	18.8	9.8 - 27.8
	RTH	21.4	16.1 - 27.0	67.0	61.2	62.3 - 84.7
< 50	TV	13.8	9.7 - 17.9	57.0	75.2	58.5 - 91.9
	CH	33.3	0.0 - 100.0	15.0	3.3	0.0 - 11.8
	RSH	21.4	0.0 - 75.4	3.0	4.0	0.0 - 15.3
	BWH	45.0	0.0 - 100.0	2.5	3.2	0.0 - 10.3
	RTH	12.6	8.3 - 16.9	58.0	78.4	58.4 - 97.5
	SSH	16.7	0.0 - 1.00	2.0	3.4	0.0 - 36.7

* using data collected on primary routes only
Study areas with ≥ 50% forest cover are JoDaviess, Mason, Clinton, Jackson, Union, Pope
Study areas with < 50% forest cover are Henderson, Crawford, Shelby, Vermilion, LaSalle

Table 7. Percent relative frequencies for raptor species observed in each of the 12 Illinois Woodland Raptor Survey study areas, 1990. Appendix III.

Species	Study Area[1]											
	A	B	C	D	E	F	G	H	I	J	K	L
Black vulture	-	-	-	-	-	1.1	-	-	-	-	-	-
Turkey vulture	36.5	48.5	57.3	20.9	-	1.1	28.5	28.1	60.6	44.9	9.7	-
Osprey	-	-	-	-	-	-	-	6.9	-	-	-	-
Mississippi kite*	-	-	-	-	-	1.1	-	-	-	-	-	-
Bald eagle**	1.0	-	-	-	1.4	-	-	-	-	-	-	-
Northern harrier*	1.8	-	-	-	-	-	-	-	1.4	-	2.4	-
Sharp-shinned hawk*	2.7	2.7	-	-	-	-	-	6.9	2.5	1.5	-	-
Cooper's hawk*	4.5	-	9.4	-	-	-	1.5	1.9	-	-	7.3	-
Red-shouldered hawk*	1.8	1.5	-	51.4	-	13.8	30.0	3.5	-	1.5	8.6	-
Broad-winged hawk	9.8	1.5	-	-	15.7	16.8	9.6	-	1.4	2.8	17.1	26.3
Red-tailed hawk	41.0	32.0	18.7	11.3	71.2	57.6	21.9	47.3	30.3	39.3	33.0	26.3
American kestrel	-	2.7	-	1.7	7.7	8.3	1.5	1.9	2.5	4.3	-	47.4
Peregrine falcon**	-	-	-	-	1.4	-	-	-	-	-	-	-
Great horned owl	-	5.5	5.2	8.1	2.6	-	5.4	-	1.4	5.6	8.6	-
Barred owl	1.0	5.5	9.4	6.4	-	-	1.5	3.5	-	-	13.4	-

[1]Key to study area counties: A = JoDaviess, B = Henderson, C = Mason, D = Clinton, E = Randolph, F = Union, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle, L = Lake.

* Illinois endangered species
** federally endangered species

Table 8. Percent relative abundances for raptor species observed in each of the 12 Illinois Woodland Raptor Survey study areas, 1990 . Appendix III.

Species	Study Area[1]											
	A	B	C	D	E	F	G	H	I	J	K	L
Black vulture	-	-	-	-	-	1.5	-	-	-	-	-	-
Turkey vulture	55.8	58.9	65.4	21.2	-	22.5	35.2	31.4	80.7	55.5	8.6	-
Osprey*	-	-	-	-	-	-	-	5.7	-	-	-	-
Mississippi kite*	-	-	-	-	-	0.8	-	-	-	-	-	-
Bald eagle**	0.5	-	-	-	1.1	-	-	-	-	-	-	-
Northern harrier*	1.0	-	-	-	-	-	-	-	0.6	-	2.1	-
Sharp-shinned hawk*	1.5	1.8	-	-	-	-	-	8.6	1.2	-	-	-
Cooper's hawk*	2.4	-	7.7	-	-	-	1.2	2.9	-	-	6.5	-
Red-shouldered hawk*	1.0	0.9	-	55.3	-	10.9	28.6	2.9	-	1.8	8.6	-
Broad-winged hawk	8.7	3.6	-	-	13.6	12.4	9.9	-	0.6	1.8	18.3	16.7
Red-tailed hawk	28.6	25.9	15.4	10.6	75.0	46.5	18.7	44.3	14.6	32.7	31.2	16.7
American kestrel	-	1.8	-	1.2	6.8	5.4	1.2	1.4	1.2	2.7	-	66.7
Peregrine falcon**	-	-	-	-	1.1	-	-	-	-	-	-	-
Great horned owl	-	3.6	3.8	7.1	2.3	-	3.3	-	1.2	3.6	9.7	-
Barred owl	0.5	3.6	7.7	4.7	-	-	1.2	2.9	-	-	15.1	-

[1]Key to study area counties: A = JoDaviess, B = Henderson, C = Mason, D = Clinton, E = Randolph, F = Union, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle, L = Lake.

* = Illinois endangered species
** = federally endangered species

Table 9. Percent relative frequency (RF) and percent relative abundance (RA) values for raptor species; study areas combined by percent forest cover (≥ 50% or < 50%) of study area and all study areas combined, 1990. Appendix III.

Species	Areas ≥ 50% forested[1]		Areas < 50% forested[2]		All study areas	
	% RF	% RA	% RF	% RA	% RF	% RA
Black vulture	0.2	0.3	-	-	0.1	< 0.1
Turkey vulture	19.4	33.8	38.1	52.5	27.8	42.6
Osprey*	-	-	1.1	0.7	0.5	0.3
Mississippi kite*	0.2	0.2	-	-	0.1	< 0.1
Bald eagle**	0.4	0.3	-	-	0.3	0.2
Northern harrier*	0.4	0.3	0.8	0.5	0.6	0.4
Sharp-shinned hawk*	0.7	0.5	2.5	2.1	1.5	1.3
Cooper's hawk*	1.8	1.3	1.9	1.4	1.8	1.3
Red-shouldered hawk*	18.1	14.2	3.0	2.3	11.4	8.6
Broad-winged hawk	10.1	8.8	5.2	4.4	7.9	6.7
Red-tailed hawk	40.4	34.4	35.6	26.9	38.3	30.8
American kestrel	3.5	2.4	2.7	2.1	3.2	2.3
Peregrine falcon**	0.2	0.2	-	-	0.1	< 0.1
Great horned owl	2.6	2.1	4.4	3.4	3.4	2.7
Barred owl	1.8	1.3	4.7	3.5	3.0	2.4

[1]Study areas with ≥ 50% forest cover are JoDaviess, Mason, Clinton, Jackson, Union, Pope
[2]Study areas with < 50% forest cover are Henderson, Crawford, Shelby, Vermilion, LaSalle, and Lake

** = federally endangered species
* = Illinois endangered species

Table 10. Summary of all raptor observations recorded in each Illinois Woodland Raptor Survey study area, 1990. Appendix III.

Vermilion County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	36	14	11	61
Sharp-shinned hawk	--	2	--	2
Red-shouldered hawk	--	2	--	2
Broad-winged hawk	--	2	--	2
Red-tailed hawk	18	17	1	36
American kestrel	3	--	--	3
Great horned owl	--	2	2	4
Total	57	39	14	110

LaSalle County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	6	--	2	8
Northern harrier	1	1	--	2
Cooper's hawk	5	--	1	6
Red-shouldered hawk	6	2	--	8
Broad-winged hawk	1	15	1	17
Red-tailed hawk	3	20	6	29
Great horned owl	3	6	--	9
Barred owl	11	--	3	14
Total	36	44	13	93

JoDaviess County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	89	24	2	115
Bald eagle	1	--	--	1
Northern harrier	1	1	--	2
Sharp-shinned hawk	1	1	1	3
Cooper's hawk	5	--	--	5
Red-shouldered hawk	2	--	--	2
Broad-winged hawk	2	16	--	18
Red-tailed hawk	27	26	6	59
Barred owl	--	1	--	1
Total	128	69	9	206

Table 10 (Appendix III) continued on next page

Table 10 (Appendix III) continued

Union County

Species	Number of observations Route 1	Route 2	Route 3	Total
Black vulture	2	--	--	2
Turkey vulture	29	--	--	29
Mississippi kite	--	1	--	1
Red-shouldered hawk	2	12	--	14
Broad-winged hawk	--	16	--	16
Red-tailed hawk	40	14	6	60
American kestrel	5	1	1	7
Total	78	44	7	129

Randolph County

Species	Number of observations Route 1	Route 2	Route 3	Total
Bald eagle	--	1	--	1
Broad-winged hawk	6	6	--	12
Red-tailed hawk	29	34	3	66
American kestrel	1	4	1	6
Peregrine falcon	1	--	--	1
Great horned owl	1	--	1	2
Total	38	45	5	88

Crawford County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	6	10	6	22
Osprey	1	3	--	4
Sharp-shinned hawk	--	6	--	6
Cooper's hawk	2	--	--	2
Red-shouldered hawk	--	2	--	2
Red-tailed hawk	9	16	6	31
American kestrel	1	--	--	1
Barred owl	--	2	--	2
Total	19	39	12	70

Table 10 (Appendix III) continued on next page

Table 10 (Appendix III) continued

Pope County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	11	11	10	32
Cooper's hawk	1	--	--	1
Red-shouldered hawk	7	18	1	26
Broad-winged hawk	5	4	--	9
Red-tailed hawk	9	7	1	17
American kestrel	1	--	--	1
Great horned owl	--	1	3	4
Barred owl	--	1	--	1
Total	34	42	15	91

Clinton County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	5	13	--	18
Red-shouldered hawk	23	21	3	47
Red-tailed hawk	2	7	--	9
American kestrel	--	1	--	1
Great horned owl	4	2	--	6
Barred owl	4	--	--	4
Total	38	44	3	85

Henderson County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	43	21	2	66
Sharp-shinned hawk	1	1	--	2
Red-shouldered hawk	1	--	--	1
Broad-winged hawk	4	--	--	4
Red-tailed hawk	9	15	5	29
American kestrel	--	2	--	2
Great horned owl	2	2	--	4
Barred owl	4	--	--	4
Total	64	41	7	112

Table 10 (Appendix III) concluded on next page

Table 10 (Appendix III) concluded

Mason County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	4	13	--	17
Cooper's hawk	--	1	1	2
Red-tailed hawk	1	3	--	4
Great horned owl	--	--	1	1
Barred owl	1	1	--	2
Total	6	18	2	26

Lake County

Species	Number of observations Route 1	Route 2	Route 3	Total
Broad-winged hawk	1	--	--	1
Red-tailed hawk	--	1	--	1
American kestrel	1	3	--	4
Total	2	4	0	6

Shelby County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	39	77	22	138
Norther harrier	1	--	--	1
Sharp-shinned hawk	1	1	--	2
Broad-winged hawk	1	--	--	1
Red-tailed hawk	13	10	2	25
American kestrel	1	1	--	2
Great horned owl	2	--	--	2
Total	58	89	24	171

Appendix IV. Illinois Woodland Raptor Survey data collected in 1991.

Table 1. Number of stops, routes, and areas at which each raptor species was observed during the Illinois Woodland Raptor Survey, 1991. Appendix IV.

Species	Total	Species observations		
		Number of stops N=360	Number of routes N=36	Number of areas N=12
Black vulture	2	1	1	1
Turkey vulture	489	213	28	12
Osprey*	10	8	5	4
Mississippi kite*	3	3	2	2
Bald eagle**	--	--	--	--
Northern harrier*	1	1	1	2
Sharp-shinned hawk*	19	15	8	5
Cooper's hawk*	38	19	10	8
Red-shouldered hawk*	104	83	11	7
Broad-winged hawk	71	50	14	9
Swainson's hawk	2	1	1	1
Red-tailed hawk	348	214	28	11
Golden eagle	1	1	1	1
American kestrel	21	17	11	9
Merlin	1	1	1	1
Peregrine falcon**	--	--		--
Great horned owl	54	33	14	6
Barred owl	31	21	9	6
Eastern screech-owl	1	1	1	1

** federally endangered species
* Illinois endangered species

Table 2. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois, 1991. Appendix IV.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01	TV	18.5	2.3 - 35.3	80.0	95.7	30.3 - 100.0
	RTH	17.6	4.8 - 30.4	90.0	100.0	61.2 - 100.0
	CH	7.4	0.0 - 44.6	20.0	45.9	0.0 - 100.0
02	TV	17.9	0.0 - 36.0	80.0	96.3	14.6 - 100.0
	RTH	2.5	0.0 - 6.5	60.0	100.0	0.0 - 100.0
	BWH	12.5	0.0 - 37.9	40.0	58.5	0.0 - 100.0
Henderson County						
04	TV	16.7	0.0 - 37.7	50.0	64.2	0.0 - 100.0
	RTH	0.5	-------*	10.0	10.0	-------*
	BO	7.7	0.0 19.1	40.0	76.8	0.0 - 100.0
05	TV	16.7	0.0 - 46.8	40.0	54.3	0.0 - 100.0
	RTH	7.1	0.0 - 22.2	30.0	76.4	0.0 - 100.0
	AK	12.5	-------*	10.0	13.6	-------*
Mason County						
07	TV	16.7	0.0 - 100.0	20.0	27.1	0.0 - 100.0
08	TV	14.8	0.0 - 90.0	20.0	28.9	0.0 - 100.0
	RTH	8.3	0.0 - 22.2	40.0	68.8	0.0 - 100.0
Clinton County						
10	RSH	31.5	0.0 - 7.5	60.0	63.1	0.0 - 100.0
	BO	2.8	0.0 - 7.5	50.0	100.0	0.0 - 100.0
	GHO	11.1	0.0 - 24.6	60.0	91.9	0.0 - 100.0
11	TV	8.5	1.0 - 15.9	60.0	100.0	0.0 - 100.0
	RSH	21.0	0.0 - 54.8	40.0	47.4	0.0 - 100.0
Union County						
16	RTH	22.7	10.8 - 34.7	90.0	98.5	70.5 - 100.0
17	RTH	33.3	0.0 - 91.6	40.0	42.3	0.0 - 100.0
	RSH	31.1	0.0 - 98.7	30.0	32.6	0.0 - 100.0
	BWH	16.1	0.0 - 38.7	40.0	51.6	0.0 - 100.0
Pope County						
19	TV	14.2	4.1 - 24.3	90.0	100.0	29.0 - 100.0
	RTH	18.4	0.0 - 4.2	50.0	60.2	0.0 - 100.0
	RSH	24.7	0.0 - 48.7	40.0	42.5	0.0 - 97.7
20	TV	11.1	0.0 - 31.7	40.0	68.8	0.0 - 100.0
	RTH	11.1	0.0 - 24.8	80.0	100.0	0.0 - 100.0
	RSH	23.6	9.8 - 38.3	70.0	76.6	36.1 - 100.0
	BWH	18.7	1.6 - 35.9	40.0	45.7	0.0 - 100.0

Table 2 (Appendix IV) concluded on next page

Table 2 (Appendix IV) concluded

Table 2. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois, 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Crawford County						
22	TV	6.2	0.0 - 18.9	30.0	100.0	0.0 - 100.0
	RTH	12.5	0.0 - 32.4	60.0	83.5	0.0 - 100.0
23	TV	30.0	0.0 - 89.7	40.0	50.0	0.0 - 100.0
	RTH	11.8	0.0 - 24.1	60.0	88.4	0.0 - 100.0
	GHO	20.0	-------*	10.0	11.2	-------*
	BO	5.6	0.0 - 17.0	30.0	95.4	0.0 - 100.0
Shelby County						
25	TV	8.5	1.0 - 15.9	80.0	100.0	0.0 - 100.0
	RTH	4.2	0.0 - 11.8	40.0	100.0	0.0 - 100.0
26	TV	14.3	0.0 - 40.2	40.0	59.0	0.0 - 100.0
	RTH	9.5	0.0 - 23.5	30.0	49.4	0.0 - 100.0
Vermilion County						
28	TV	33.1	26.0 - 40.3	90.0	91.9	69.6 - 100.0
	RTH	9.3	0.0 - 20.5	90.0	100.0	0.0 - 100.0
29	TV	20.3	8.8 - 31.7	100.0	100.0	81.6 - 100.0
	RTH	13.7	0.8 - 26.5	80.0	100.0	2.6 - 100.0
LaSalle County						
31	RTH	33.3	0.0 - 100.0	20.0	20.3	0.0 - 100.0
	BWH	8.9	0.0 - 22.1	30.0	51.6	0.0 - 100.0
	CH	40.0	0.0 - 100.0	30.0	40.0	0.0 - 100.0
32	TV	12.2	0.0 - 25.3	40.0	55.9	0.0 - 100.0
	RTH	31.5	0.0 - 91.0	40.0	47.4	0.0 - 100.0
	BWH	33.0	0.0 - 76.0	20.0	20.4	0.0 - 100.0
Winnebago County						
37	RTH	27.1	9.8 - 45.3	80.0	86.4	4.4 - 100.0
	BWH	11.1	0.0 - 34.3	30.0	55.9	0.0 - 100.0
	CH	6.2	0.0 - 15.0	50.0	100.0	0.0 - 100.0
	GHO	75.0	-------*	10.0	100.0	-------*
	SH	10.7	-------*	10.0	11.9	-------*
	OSP	5.6	0.0 - 17.1	40.0	100.0	0.0 - 100.0
38	TV	3.7	0.0 - 10.5	40.0	100.0	0.0 - 100.0
	RTH	22.4	3.0 - 41.8	70.0	80.9	22.3 - 100.0
	BWH	3.7	0.0 - 10.4	40.0	100.0	0.0 - 100.0
	CH	6.2	0.0 - 19.9	30.0	86.5	0.0 - 100.0
	SSH	11.1	-------*	10.0	14.4	-------*
	GHO	50.0	0.0 - 100.0	40.0	40.7	0.0 - 100.0
	BO	8.3	0.0 - 50.6	20.0	42.1	0.0 - 100.0
	OSP	11.1	-------*	10.0	14.4	-------*

* = too rare to calculate confidence intervals

Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for two primary routes combined within 12 study areas throughout Illinois, 1991. Appendix IV.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01,02	TV	18.6	7.9 - 29.3	93.8	61.7 - 100.0	
	RTH	11.5	31.8 - 19.8	100.0	38.3 - 100.0	
	BWH	10.0	0.0 - 28.4	43.3	0.0 - 100.0	
	CH	5.6	0.0 - 17.1	47.7	0.0 - 100.0	
	SSH	------*	-------	--------	----------	
Henderson County						
04,05	TV	14.0	0.0 - 29.4	60.0	0.0 - 100.0	
	RTH	16.7	0.0 - 50.9	25.5	0.0 - 88.8	
	AK	12.5	-------*	6.5	-------*	
	BO	8.3	0.0 - 19.2	40.5	0.0 - 100.0	
Mason County						
07,08	TV	12.5	0.0 - 29.9	28.0	0.0 - 84.5	
	RTH	8.3	0.0 - 22.8	37.6	0.0 - 100.0	
Clinton County						
10,11	TV	3.6	0 0 - 8.8	100.0	0.0 - 100.0	
	RSH	26.7	6.3 - 47.0	53.7	15.3 - 92.0	
	GHO	11.1	0.0 - 24.0	47.1	0.0 - 100.0	
	BO	2.8	0.0 - 7.6	95.4	0.0 - 100.0	
Randolph County						
13,14	RTH	18.2	6.8 - 29.5	93.9	59.7 - 100.0	
	RSH	8.3	0.0 - 25.5	34.4	0.0 - 100.0	
	BWH	41.7	0.0 - 11.8	60.1	0.0 - 100.0	
	AK	44.4	0.0 - 100.0	10.2	0.0 - 94.5	
Union County						
16,17	RTH	27.5	11.3 - 43.6	69.9	43.6 - 96.2	
	RSH	18.5	0.0 - 50.7	32.6	0.0 - 93.7	
	BWH	10.7	0.0 - 25.0	49.0	0.0 - 100.0	
Pope County						
19,20	TV	12.1	3.3 - 21.0	90.9	20.2 - 100.0	
	RTH	14.1	2.8 - 25.3	86.6	10.4 - 100.0	
	RSH	24.0	13.0 - 35.0	59.3	31.1 - 87.5	
	BWH	20.0	3.3 - 36.7	22.9	0.0 - 58.1	
Crawford County						
22,23	TV	17.9	0.0 - 49.5	52.5	0.0 - 100.0	
	RTH	10.6	0.0 - 21.6	92.4	0.0 - 100.0	
	GHO	20.0	-------*	5.6	-------*	
	BO	5.6	0.0 - 17.0	47.7	0.0 - 100.0	

Table 3 (Appendix IV) concluded on next page

Table 3 (Appendix IV) concluded

Table 3. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for two primary routes combined within study areas throughout Illinois, 1991.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Shelby County						
25,26	TV	9.0	0.3 - 17.5	99.9	0.0 - 100.0	
	RTH	5.6	0.0 - 11.5	82.0	0.0 - 100.0	
Vermilion County						
28,29	TV	26.5	19.4 - 33.6	100.0	88.7 - 100.0	
	RTH	11.0	3.5 - 18.6	100.0	40.0 - 100.0	
LaSalle County						
31,32	TV	4.8	0.0 - 10.3	100.0	0.0 - 100.0	
	RTH	32.1	0.0 - 67.3	30.8	2.3 - 59.3	
	BWH	18.7	1.0 - 36.5	30.5	0.0 - 66.9	
	CH	40.0	0.0 - 100.0	20.0	0.0 - 52.3	
Winnebago County						
37, 38	TV	3.7	0.0 - 10.7	81.5	0.0 - 100.0	
	RTH	24.9	12.6 - 37.1	80.9	54.3 - 100.0	
	BWH	5.6	0.0 - 12.5	91.9	0.0 - 100.0	
	CH	5.4	0.0 - 11.0	97.3	0.0 - 100.0	
	SSH	11.1	-------*	7.2	-------*	
	GHO	55.4	1.8 - 100.0	25.0	0.0 - 55.3	
	BO	8.3	0.0 - 50.9	21.0	0.0 - 100.0	
	SH	16.7	-------*	6.0	-------*	
	OSP	5.6	0.0 - 13.6	60.2	0.0 - 100.0	

* = too rare to calculate confidence intervals

Table 4. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for secondary routes within 12 study areas throughout Illinois in 1991. Appendix IV.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
03	TV	18.5	7.4 - 30.0		72.2	30.0 - 100.0
	RTH	16.7	2.1 - 31.2		100.0	13.9 - 100.0
Henderson County						
06	TV	17.8	8.2 - 27.4		66.2	22.5 - 100.0
	RTH	23.8	2.9 - 44.7		43.8	16.4 - 71.3
Mason County						
09	TV	3.2	0.0 - 7.6		100.0	0.0 - 100.0
	RTH	8.9	0.0 - 22.8		43.8	0.0 - 100.0
Clinton County						
12	RSH	25.4	6.4 - 44.4		51.0	0.0 - 100.0
Randolph County						
15	RTH	17.7	6.8 - 28.6		74.3	21.4 - 100.0
Union County						
18	RTH	30.5	13.5 - 47.5		57.7	31.2 - 84.3
	RSH	30.6	0.0 - 70.6		37.3	0.0 - 100.0
	BWH	8.6	0.0 - 20.7		51.9	0.0 - 100.0
Pope County						
21	TV	12.2	3.9 - 20.5		100.0	0.0 - 100.0
	RTH	18.3	19.7 - 34.6		79.8	9.4 - 100.0
Crawford County						
24	TV	11.3	0.0 - 31.6		100.0	0.0 - 100.0
	RTH	9.8	0.0 - 20.0		81.3	0.0 - 100.0
Shelby County						
27	TV	6.0	0.3 - 11.7		100.0	0.0 - 100.0
	RTH	14.3	0.0 - 40.3		56.4	0.0 - 100.0
Vermilion County						
30 TV	25.0	17.9 - 32.1		75.4	0.0 - 100.0	
	RTH	10.5	3.2 - 17.8		100.0	50.7 - 100.0
Winnebago County						
39	TV	2.8	0.0 - 7.9		100.0	0.0 - 100.0
	RTH	22.9	10.7 - 35.0		62.9	30.0 - 95.9
	CH	5.1	0.0 - 10.7		98.5	0.0 - 100.0

Table 5. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species in study areas* known to occupy study areas with ≥ 50% forest cover and study areas with < 50% forest cover in 1991. Appendix IV.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	12.4	5.5 - 19.3	50.0	68.8	35.1 - 100.0
	RTH	17.9	11.9 - 23.9	55.0	70.4	54.5 - 86.3
	RSH	20.7	7.4 - 34.1	30.0	34.2	13.8 - 54.6
	BWH	7.3	0.0 - 15.5	20.0	48.8	0.0 - 100.0
	CH	5.6	0 0 - 16.9	15.0	47.7	0.0 - 100.0
	SSH	22.2	0.0 - 65.1	20.0	23.8	0.0 - 64.5
< 50	TV	16.1	10.7 - 21.5	57.0	70.2	54.3 - 86.0
	RTH	13.7	7.7 - 19.8	45.0	60.6	41.0 - 80.2
	RSH	N/D				
	BWH	18.2	0.9 - 35.5	25.0	29.3	0.0 - 64.5
	CH	33.3	0.0 - 83.5	2.0	21.2	0.0 - 51.8
	SSH	N/D				
< 50 including Winnebago County	TV	15.2	10.2 - 20.0	50.8	65.2	50.2 - 80.2
	RTH	16.4	11.0 - 22.0	50.0	61.3	47.6 - 75.0
	RSH	ND				
	BWH	10.1	0.2 - 18.4	30.0	46.4	0.0 - 100.0
	CH	11.3	0.0 - 29.7	30.0	45.5	0.0 - 100.0
	SSH	11.1	-------*		7.2	-------*

* using data collected on primary routes only
Study areas with ≥ 50% forest cover = JoDaviess, Mason, Clinton, Randolph, Union, and Pope
Study areas with < 50% forest cover = Henderson, Crawford, Shelby, Vermilion, LaSalle, and Winnebago

Table 6. Probability of detection (PD) and area occupied (AO), confidence intervals (CI), and % stop detection values calculated for raptor species over all study areas* with ≥ 50% forest cover and study areas with < 50% forest cover in 1991. Appendix IV.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	12.4	5.8 - 18.9	25.0	34.3	19.1 - 49.5
	RTH	17.8	11.8 - 23.9	40.0	46.7	34.9 - 58.4
	RSH	20.6	8.0 - 33.3	15.0	15.5	7.6 - 23.4
	BWH	6.8	0.7 - 12.8	15.0	30.3	0.0 - 71.6
	CH	5.6	0.0 - 17.3	2.5	7.7	0.0 - 39.3
	SSH	22.2	0.0 - 67.6	1.7	3.4	0.0 - 9.6
< 50	TV	15.9	10.5 - 21.3	57.0	70.9	55.0 - 86.7
	RTH	13.6	7.8 - 19.4	45.0	60.6	41.9 - 79.4
	RSH	N/D				
	BWH	18.2	3.0 - 36.3	5.0	5.9	0.0 - 13.7
	CH	33.3	0.0 - 81.9	4.0	4.2	0.0 - 11.3
	SSH	N/D				
< 50 including Winnebago County	TV	15.2	10.3 - 20.1	50.8	66.5	51.2 - 81.8
	RTH	16.6	11.3 - 21.9	50.0	60.9	47.6 - 74.2
	RSH	ND				
	BWH	10.3	2.3 - 18.3	10.0	15.4	0.1 - 29.8
	CH	11.8	0.0 - 33.0	0.9	13.9	0.0 - 45.4
	SSH	11.1	-------*	0.1	1.2	-------*

* using data collected on primary routes only
ND species was not observed
Study areas with > 50% forest cover = JoDaviess, Mason, Clinton, Randolph, Union, and Pope
Study areas with , 50% forest cover = Henderson, Crawford, Shelby, Vermilion, and LaSalle

Table 7. Percent relative frequencies for raptor species observed in each of the 12 Illinois Woodland Raptor Survey study areas, 1991. Appendix IV.

Species	Study Area[1]												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Black vulture	-	-	-	-	-	-	1.9	-	-	-	-	-	-
Turkey vulture	43.3	4.0	33.3	21.3	1.8	1.4	25.0	32.6	59.2	54.5	25.0	-	6.7
Osprey	-	-	-	-	-	1.4	-	2.1	2.2	-	-	-	6.7
Mississippi kite*	-	-	-	-	-	2.7	-	-	-	0.9	-	-	-
Northern harrier*	-	-	-	-	-	-	-	-	-	-	1.8	-	-
Sharp-shinned hawk*	7.2	-	14.3	-	-	-	-	-	-	4.5	1.8	-	1.9
Cooper's hawk*	4.1	2.5	-	-	5.5	-	3.8	2.1	-	1.8	8.9	-	11.5
Red-shouldered hawk*	-	-	-	52.5	7.4	20.6	28.9	-	-	0.9	1.8	-	0.9
Broad-winged hawk	9.3	5.0	-	-	9.2	16.4	6.7	-	2.2	1.8	21.4	-	9.6
Swainson's hawk†	-	-	-	-	-	-	-	-	-	-	-	-	1.9
Red-tailed hawk	36.1	22.5	38.1	-	68.5	53.4	29.8	47.8	29.5	31.8	21.4	-	34.6
Golden eagle	-	-	4.7	-	-	-	-	-	-	-	-	-	-
American kestrel	-	7.5	-	-	7.4	4.1	0.9	2.1	4.5	1.8	1.7	-	3.8
Merlin	-	-	-	-	-	-	-	-	-	-	-	-	0.9
Great horned owl	-	2.5	-	16.4	-	-	1.9	4.3	-	1.8	12.5	-	18.3
Barred owl	-	17.5	9.5	9.8	-	-	0.9	8.7	-	-	3.6	-	2.9
Eastern screech-owl	--	-	-	-	-	-	-	-	2.2	-	-	-	-

[1]Key to study area counties: A = JoDaviess, B = Henderson, C = Mason, D = Clinton, E = Randolph, F = Union, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle, L = Lake, M = Winnebago.

* = Illinois endangered species
** = federally endangered species
† = federal candidate species under category 2

Table 8. Percent relative abundances for raptor species observed in each of the 12 Illinois Woodland Raptor Survey study areas, 1991. Appendix IV.

Species	Study Area[1] A	B	C	D	E	F	G	H	I	J	K	L	M
Black vulture	-	-	-	-	-	-	1.2	-	-	-	-	-	-
Turkey vulture	48.3	60.0	43.3	31.0	5.8	1.1	47.7	33.9	76.9	69.4	32.0	-	7.9
Osprey*	-	-	-	-	-	1.1	-	1.7	1.3	-	-	-	5.6
Mississippi kite*	-	-	-	-	-	2.3	-	-	-	0.5	-	-	-
Northern harrier*	-	-	-	-	-	-	-	-	-	-	1.3	-	-
Sharp-shinned hawk*	5.3		10.0	-	-	-	-	-	-	2.5	1.3	-	1.6
Cooper's hawk*	4.0	1.5	-	-	5.8	-	2.9	1.7	-	1.0	8.0	-	10.3
Red-shouldered hawk*	-	-	-	44.8	7.2	21.6	22.1	-	-	0.5	1.3	-	0.8
Broad-winged hawk	7.3	4.6	-	-	11.6	14.8	2.9	-	1.3	1.5	21.3	-	8.7
Swainson's hawk†	-	-		-	-	-		-	-	-	-	-	1.6
Red-tailed hawk	35.1	13.8	33.3	-	63.8	56.8	20.9	49.1	16.7	21.9	20.0	-	36.5
Golden eagle	-	-	3.3	-	-	-	-	-	-	-	-	-	-
American kestrel	-	6.1	-	-	5.8	2.3	0.6	1.7	2.6	1.0	1.3	-	3.2
Merlin	-	-	-	-	-	-	-	-	-	-	-	-	0.8
Great horned owl	-	1.5	-	13.8	-	-	1.5	3.4	-	1.5	10.7	-	20.6
Barred owl	-	12.3	10.0	10.3	-	-	12.3	-	-	-	2.7	-	2.4
Eastern screech-owl	-	-	-	-	-	-	-	-	1.3	-	-	-	-

[1]Key to study area counties: A = JoDaviess, B = Henderson, C = Mason, D = Clinton, E = Randolph, F = Union, G = Pope, H = Crawford, I = Shelby, J =Vermilion, K = LaSalle, L = Lake, M = Winnebago.

* Illinois endangered species
** federally endangered species
† = federal candidate under category 2

Table 9 Percent relative frequency (RF) and percent relative abundance (RA) values for raptor species; study areas combined by percent forest cover (≥ 50% or < 50%) of study area and all study areas combined, 1991. Appendix IV.

Species	Areas ≥50% forested[1]		Areas <50% forested[2]		All study areas	
	% RF	% RA	% RF	% RA	% RF	% RA
Black vulture	0.5	0.3	-	-	0.3	0.2
Turkey vulture	21.9	33.5	34.7	4.8	18.3	40.9
Osprey	0.3	0.2	2.2	1.5	1.2	0.8
Mississippi kite*	0.5	0.3	0.3	0.2	0.4	0.2
Northern harrier*	-	-	0.3	0.2	0.1	<0.1
Sharp-shinned hawk*	2.4	1.8	2.0	1.3	2.2	1.6
Cooper's hawk*	2.7	2.5	5.2	3.8	3.9	3.2
Red-shouldered hawk*	19.8	16.9	0.8	0.5	10.4	8.7
Broad-winged hawk	8.0	6.2	6.7	5.7	7.4	5.9
Swainson's hawk	-	-	0.5	0.3	0.3	0.2
Red-tailed hawk	36.6	32.3	31.7	25.9	34.2	29.1
Golden eagle	0.3	0.2	-	-	0.1	<0.1
American kestrel	2.0	1.2	3.2	2.3	2.5	1.8
Merlin	-	-	0.3	0.2	0.1	<0.1
Great horned owl	2.9	2.3	7.7	6.7	5.3	4.5
Barred owl	2.2	2.2	4.0	3.0	3.1	2.6
Eastern screech-owl	-	-	0.3	0.2	0.1	<0.1

[1]Study areas with ≥ 50% forest cover = JoDaviess, Mason, Clinton, Randolph, Union, and Pope
[2]Study areas with < 50% forest cover = Henderson, Crawford, Shelby, Vermilion, LaSalle, Lake, and Winnebago

* Illinois endangered species
** federally endangered species

Table 10. Summary of raptor observations in each Illinois Woodland Raptor Survey study area, 1991. Appendix IV.

Vermilion County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	80	54	2	136
Mississippi kite	1	--	--	1
Cooper's hawk	2	--	--	2
Sharp-shinned hawk	2	3	--	5
Red-shouldered hawk	--	1	--	1
Broad-winged hawk	2	--	1	3
Red-tailed hawk	20	20	3	43
American kestrel	--	2	--	2
Great horned owl	--	--	3	3
Total	107	80	14	201

LaSalle County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	10	14	--	24
Northern harrier	--	1	--	1
Sharp-shinned hawk	--	1	--	1
Cooper's hawk	4	2	--	6
Red-shouldered hawk	--	1	--	1
Broad-winged hawk	9	7	--	16
Red-tailed hawk	4	11	--	15
American kestrel	1	--	--	1
Great horned owl	2	4	2	8
Barred owl	1	--	1	2
Total	31	41	3	75

JoDaviess County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	37	33	3	73
Sharp-shinned hawk	1	6	1	8
Cooper's hawk	5	1	--	6
Broad-winged hawk	1	10	--	11
Red-tailed hawk	36	11	6	53
Total	80	61	10	151

Table 10 (Appendix IV) continued on next page

Table 10 (Appendix IV) continued

Union County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	1	--	--	1
Osprey	1	--	--	1
Mississippi kite	--	2	--	2
Red-shouldered hawk	2	12	5	19
Broad-winged hawk	2	10	1	13
Red-tailed hawk	35	11	4	50
American kestrel	1	--	1	2
Total	42	35	11	88

Randolph County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	1	3	--	4
Cooper's hawk	2	2	--	4
Red-shouldered hawk	--	5	--	5
Broad-winged hawk	5	3	--	8
Red-tailed hawk	17	25	2	44
American kestrel	--	4	--	4
Total	25	42	2	69

Crawford County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	7	6	7	20
Osprey	1	--	--	1
Cooper's hawk	--	1	--	1
Red-tailed hawk	13	14	2	29
American kestrel	1	--	--	1
Barred owl	--	5	--	5
Total	22	26	9	57

Table 10 (Appendix IV) continued on next page

Table 10 (Appendix IV) continued

Pope County

Species	Number of observations Route 1	Route 2	Route 3	Total
Black vulture	2	--	--	2
Turkey vulture	42	36	4	82
Cooper's hawk	--	5	--	5
Red-shouldered hawk	25	13	--	38
Broad-winged hawk	5	--	--	5
Red-tailed hawk	20	12	4	36
American kestrel	--	1	--	1
Great horned owl	--	--	2	2
Barred owl	1	--	--	1
Total	95	67	10	172

Clinton County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	10	14	3	27
Red-shouldered hawk	24	13	2	39
Great horned owl	12	--	--	12
Barred owl	9	--	--	9
Total	55	27	5	87

Henderson County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	18	20	1	39
Cooper's hawk	--	1	--	1
Broad-winged hawk	3	--	--	3
Red-tailed hawk	3	4	2	9
American kestrel	--	3	1	4
Great horned owl	1	--	--	1
Barred owl	7	--	1	8
Total	32	28	5	65

Table 10 (Appendix IV) concluded on next page

Table 10 (Appendix IV) concluded

Mason County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	3	10	--	13
Sharp-shinned hawk	2	1	--	3
Red-tailed hawk	--	9	1	10
Golden eagle	--	1	--	1
Barred owl	2	1	--	3
Total	7	22	1	30

Shelby County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	--	28	6	34
Broad-winged hawk	1	--	--	1
Red-tailed hawk	5	5	3	13
American kestrel	1	1	--	2
Eastern screech-owl	1	--	--	1
Total	8	34	9	51

Winnebago County

Species	Number of observations Route 1	Route 2	Route 3	Total
Turkey vulture	2	7	1	10
Osprey	5	2	--	7
Sharp-shinned hawk	--	2	--	2
Cooper's hawk	8	4	1	13
Red-shouldered hawk	1	--	--	1
Broad-winged hawk	6	5	--	11
Swainson's hawk	2	--	--	2
Red-tailed hawk	23	22	1	46
American kestrel	1	2	1	4
Merlin	1	--	--	1
Great horned owl	7	19	--	26
Barred owl	--	3	--	3
Total	56	66	4	126

Appendix V. Taxonomic order of raptor species observed on the Illinois Woodland Raptor Survey.

ORDER Falconiformes

FAMILY Cathartidae

Black Vulture	*Coragyps atratus*
Turkey Vulture	*Cathartes aura*

FAMILY Accipitridae

SUBFAMILY Pandioninae

Osprey	*Pandion haliaetus*

SUBFAMILY Accipitrinae

Mississippi Kite	*Ictinia mississippiensis*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Golden Eagle	*Aquila chrysaetos*

FAMILY Falconidae

American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*

ORDER Strigiformes

FAMILY Strigidae

Eastern Screech-Owl	*Otus asio*
Great Horned Owl	*Bubo virginianus*
Barred Owl	*Strix varia*

Appendix VI. Summary of the total number of raptor observations recorded in each Illinois Woodland Raptor Survey study area during the study period, 1990/1991.

Vermilion County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	36	80	14	54	11	2	197
Mississippi kite	--	1	--	--	--	--	1
Cooper's hawk	--	2	--	--	--	--	2
Sharp-shinned hawk	--	2	2	3	--	--	7
Red-shouldered hawk	--	--	2	1	--	--	3
Broad-winged hawk	--	2	2	--	--	1	5
Red-tailed hawk	18	20	17	20	1	3	79
American kestrel	3	--	--	2	--	--	5
Great horned owl	--	--	2	--	2	3	7
Total	57	107	39	80	14	6	306

LaSalle County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	6	10	--	14	2	--	32
Northern harrier	1	--	1	1	--	--	3
Sharp-shinned hawk	--	--	--	1	--	--	1
Cooper's hawk	5	4	--	2	1	--	12
Red-shouldered hawk	6	--	2	1	--	--	9
Broad-winged hawk	1	9	15	7	1	--	33
Red-tailed hawk	3	4	20	11	6	--	44
American kestrel	--	1	--	--	--	--	1
Great horned owl	3	2	6	4	--	2	17
Barred owl	11	1	--	--	3	1	16
Total	36	31	44	41	13	3	168

JoDaviess County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	89	37	24	33	2	3	188
Bald eagle	1	--	--	--	--	--	1
Northern harrier	1	--	1	--	--	--	2
Sharp-shinned hawk	1	1	1	6	1	1	11
Cooper's hawk	5	5	--	1	--	--	11
Red-shouldered hawk	2	--	--	--	--	--	2
Broad-winged hawk	2	1	16	10	--	--	29
Red-tailed hawk	27	36	26	11	6	6	112
Barred owl	--	--	1	--	--	--	1
Total	128	80	69	61	9	10	357

Appendix VI continued on next page

Appendix VI continued

Union County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	29	1	--	--	--	--	30
Osprey	--	1	--	--	--	--	1
Mississippi kite	--	--	1	2	--	--	3
Red-shouldered hawk	2	2	12	12	--	5	33
Broad-winged hawk	--	2	16	10	--	1	29
Red-tailed hawk	40	35	14	11	6	4	110
American kestrel	5	1	1	--	1	1	9
Total	76	42	44	35	7	11	215

Randolph County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	--	1	--	3	--	--	4
Bald eagle	--	--	1	--	--	--	1
Cooper's hawk	--	2	--	2	--	--	4
Red-shouldered hawk	--	--	--	5	--	--	5
Broad-winged hawk	6	5	6	3	--	--	20
Red-tailed hawk	29	17	34	25	3	2	110
American kestrel	1	--	4	4	1	--	10
Peregrine falcon	1	--	--	--	--	--	1
Great horned owl	1	--	--	--	1	--	2
Total	38	25	45	42	5	2	157

Crawford County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	6	7	10	6	6	7	42
Osprey	1	1	3	--	--	--	5
Sharp-shinned hawk	--	--	6	--	--	--	6
Cooper's hawk	2	--	--	1	--	--	3
Red-shouldered hawk	--	--	2	--	--	--	2
Red-tailed hawk	9	13	16	14	6	2	60
American kestrel	1	1	--	--	--	--	2
Great horned owl	--	--	--	2	--	--	2
Barred owl	--	--	2	5	--	--	7
Total	19	22	39	28	12	9	129

Appendix VI continued on next page

Appendix VI continued

Pope County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Black vulture	--	2	--	--	--	--	2
Turkey vulture	11	42	11	36	10	4	114
Cooper's hawk	1	--	--	5	--	--	6
Red-shouldered hawk	7	25	18	13	1	--	64
Broad-winged hawk	5	5	4	--	--	--	14
Red-tailed hawk	9	20	7	12	1	4	53
American kestrel	1	--	--	1	--	--	2
Great horned owl	--	--	1	--	3	2	6
Barred owl	--	1	1	--	--	--	2
Total	34	95	42	67	15	10	263

Clinton County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	5	10	13	14	--	3	45
Red-shouldered hawk	23	24	21	13	3	2	86
Red-tailed hawk	2	--	7	--	--	--	9
American kestrel	--	--	1	--	--	--	1
Great horned owl	4	12	2	--	--	--	18
Barred owl	4	9	--	--	--	--	13
Total	38	55	44	27	3	5	172

Henderson County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	43	18	21	20	2	1	105
Sharp-shinned hawk	1	--	1	--	--	--	2
Cooper's hawk	--	--	--	1	--	--	1
Red-shouldered hawk	1	--	--	--	--	--	1
Broad-winged hawk	4	3	--	--	--	--	7
Red-tailed hawk	9	3	15	4	5	2	38
American kestrel	--	--	2	3	--	1	6
Great horned owl	2	1	2	--	--	--	5
Barred owl	4	7	--	--	--	1	12
Total	64	32	41	28	7	5	177

Appendix VI concluded on next page

Appendix VI concluded

Mason County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	4	3	13	10	--	--	30
Sharp-shinned hawk	--	2	--	1	--	--	3
Cooper's hawk	--	--	1	--	1	---	2
Red-tailed hawk	1	--	3	9	--	1	14
Golden eagle	--	--	--	1	--	--	1
Great horned owl	--	--	--	--	1	--	1
Barred owl	1	2	1	1	--	--	5
Total	6	7	18	22	2	1	56

Lake County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Broad-winged hawk	1	ND	--	ND	--	ND	1
Red-tailed hawk	--	ND	1	ND	--	ND	1
American kestrel	1	ND	3	ND	--	ND	4
Total	2	ND	4	ND	0	ND	6

Shelby County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	39	26	77	28	22	6	198
Osprey	--	1	--	--	--	--	1
Norther harrier	1	--	--	--	--	--	1
Sharp-shinned hawk	1	--	1	--	--	--	2
Broad-winged hawk	1	1	--	--	--	--	2
Red-tailed hawk	13	5	10	5	2	3	38
American kestrel	1	1	1	1	--	--	4
Great horned owl	2	--	--	--	--	--	2
Eastern screech-owl	--	1	--	--	--	--	1
Total	58	35	89	34	24	9	249

Winnebago County

Species	Number of observations Route 1 1990	Route 1 1991	Route 2 1990	Route 2 1991	Route 3 1990	Route 3 1991	Total
Turkey vulture	ND	2	ND	7	ND	1	10
Osprey	ND	5	ND	2	ND	--	7
Sharp-shinned hawk	ND	--	ND	2	ND	--	2
Cooper's hawk	ND	8	ND	4	ND	1	13
Red-shouldered hawk	ND	1	ND	--	ND	--	1
Broad-winged hawk	ND	6	ND	5	ND	--	11
Swainson's hawk	ND	2	ND	--	ND	--	2
Red-tailed hawk	ND	23	ND	22	ND	1	46
American kestrel	ND	1	ND	2	ND	1	4
Merlin	ND	1	ND	--	ND	--	1
Great horned owl	ND	7	ND	19	ND	--	26
Barred owl	ND	--	ND	3	ND	--	3
Total	ND	56	ND	66	ND	4	126

ILLINOIS WOODLAND RAPTOR SURVEY

DRAFT RESULTS
SEPTEMBER 1991

By

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METHODS

Methodology for the roadside survey technique used was obtained from Iverson and Fuller (1989) and Vernon Kleen (IDOC project design). Ten qualified participants were hired and trained by the INHS to survey the 12 study areas (see Appendix II for a list of survey participants). The twelfth study area was surveyed by INHS biologists in 1990.

Three independent and spatially separate 4.5-mile (7.2 km) survey routes were established along county roads in each of the 12 study areas. Information from 7.5' series United States Geological Survey (USGS) topographic maps, Soil Conservation Service (SCS) county soil survey maps, and field reconnaissance was used to select routes with similar habitat characteristics. Percent forest cover on each census route was estimated by looking at the area 0.5 mile (0.8 km) to either side of the route. Forests and open areas were further characterized by site visits. Two routes were designated as "primary" routes and the third as a "secondary" route. Ten observation stops were located along each transect (numbered 1-10) at 0.5-mile (0.8 km) intervals in order to obtain continuous coverage along the route.

Censusing was conducted from mid-April through mid-July at 4- to 8-day intervals. Primary routes were run ten times each. Secondary routes were run twice and were added between the fourth and sixth survey replications to coincide with peak raptor breeding activity. Routes were surveyed consecutively on the same morning and began within one half hour of sunrise. Routes first were surveyed beginning at stop 1 and ending at stop 10, and next were surveyed in the reverse order--the order thus alternated for each replication. Survey routes required approximately 2.5 hours each to complete. Surveys were conducted on days when visibility exceeded 1 mile (1.6 km), when wind speeds were less than 10 mph, and when there was no persistent precipitation.

A tape recording of a great horned owl call (National Geographic recording) was broadcast at each stop along a survey route. The tape recording was divided into 5-minute broadcast and 5-minute post-broadcast periods. The broadcast period consisted of six repetitions of 20 seconds of great horned owl calls followed by 40 seconds of silence (see Figure 2). Identical tapes were made for each participant.

Broadcast equipment consisted of a Realistic brand MPA 25, 20-watt amplifier, 40-watt, 8-ohm power horn, and portable cassette recorder purchased from Radio Shack. Sound levels on the 10 units were standardized through field experiments to a 0.5 mile (0.8 km) broadcast radius. Dials and connections were secured with electrical tape to insure consistency among routes.

All species of raptors observed during surveys were recorded. Also noted were station number, type of detection (observed, heard, or both), period of detection (broadcast or post broadcast), and comments about sightings. Individual raptor observations were plotted on 7.5' series USGS topographic maps. (Marked maps are on file in our office and available upon request.)

Table 3. Probability of detection (PD) and area occupied (AO) values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois in 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01 Savanna Depot	TV	18.5	2.3 - 35.3		95.7	30.3 - 100.0
	CH	7.4	0.0 - 44.6		45.9	0.0 - 100.0
	RTH	17.6	4.8 - 30.4		100.0	61.2 - 100.0
02 Townhall	TV	17.9	0.0 - 36.0		96.3	14.6 - 100.0
	BWH	12.5	0.0 - 37.9		58.5	0.0 - 100.0
	RTH	2.5	0.0 - 6.5		100.0	0.0 - 100.0
Henderson County						
04 BRSF - River	TV	16.7	0.0 - 37.7		64.2	0.0 - 100.0
	RTH	0.5	-------*		10.0	-------*
	BO	7.7	0.0 19.1		76.8	0.0 - 100.0
05 BRSF - Bluff	TV	16.7	0.0 - 46.8		54.3	0.0 - 100.0
	RTH	7.1	0.0 - 22.2		76.4	0.0 - 100.0
	AK	12.5	-------*		13.6	-------*
Mason County						
07 SRSF - Hdqtrs	TV	16.7	0.0 - 100.0		27.1	0.0 - 100.0
08 Durang Hill	TV	14.8	0.0 - 90.0		28.9	0.0 - 100.0
	RTH	8.3	0.0 - 22.2		68.8	0.0 - 100.0
Clinton County						
10 Santa Fe Bottoms	RSH	31.5	0.0 - 7.5		63.1	0.0 - 100.0
	BO	2.8	0.0 - 7.5		100.0	0.0 - 100.0
	GHO	11.1	0.0 - 24.6		91.9	0.0 - 100.0
11 Voss	TV	8.5	1.0 - 15.9		100.0	0.0 - 100.0
	RSH	21.0	0.0 - 54.8		47.4	0.0 - 100.0
Randolph/Jackson counties						
13 Rockwood	BWH	12.5	-------*		13.6	-------*
	RT	6.8	0.0 - 16.1		100.0	0.0 - 100.0
14 Chester	RSH	8.3	0.0 - 24.8		68.9	0.0 - 100.0
	RTH	30.6	13.5 - 47.6		82.7	48.9 - 100.0
	AK	44.4	0.0 - 100.0		20.3	0.0 - 100.0

Table 3 continued on next page

Table 3 continued

Table 3. Probability of detection (PD) and area occupied (AO) values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois in 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Union County						
16 Alto Pass	RTH	22.7	10.8 - 34.7		98.5	70.5 - 100.0
17 Harrison Creek	RSH	31.1	0.0 - 98.7		32.6	0.0 - 100.0
	BWH	16.1	0.0 - 38.7		51.6	0.0 - 100.0
	RTH	33.3	0.0 - 91.6		42.3	0.0 - 100.0
Pope County						
19 Williams Hill	TV	14.2	4.1 - 24.3		100.0	29.0 - 100.0
	RSH	24.7	0.0 - 48.7		42.5	0.0 - 97.7
	RTH	18.4	0.0 - 4.2		60.2	0.0 - 100.0
20 South Pope	TV	11.1	0.0 - 31.7		68.8	0.0 - 100.0
	RSH	23.6	9.8 - 38.3		76.6	36.1 - 100.0
	BWH	18.7	1.6 - 35.9		45.7	0.0 - 100.0
	RTH	11.1	0.0 - 24.8		100.0	0.0 - 100.0
Crawford County						
22 Montgomery	TV	6.2	0.0 - 18.9		100.0	0.0 - 100.0
	RTH	12.5	0.0 - 32.4		83.5	0.0 - 100.0
23 Honeycreek 1	TV	30.0	0.0 - 89.7		50.0	0.0 - 100.0
	RTH	11.8	0.0 - 24.1		88.4	0.0 - 100.0
	BO	5.6	0.0 - 17.0		95.4	0.0 - 100.0
	GHO	20.0	-------*		11.2	-------*
Shelby County						
25 Wolf Creek	TV	8.5	1.0 - 15.9		100.0	0.0 - 100.0
	RTH	4.2	0.0 - 11.8		100.0	0.0 - 100.0
26 Railroad	TV	14.3	0.0 - 40.2		59.0	0.0 - 100.0
	RTH	9.5	0.0 - 23.5		49.4	0.0 - 100.0
Vermilion County						
28 Middlefork CA	TV	33.1	26.0 - 40.3		91.9	69.6 - 100.0
	RTH	9.3	0.0 - 20.5		100.0	0.0 - 100.0
29 Langley Bottoms	TV	20.3	8.8 - 31.7		100.0	81.6 - 100.0
	RTH	13.7	0.8 - 26.5		100.0	2.6 - 100.0

Table 3 concluded on next page

Table 3 concluded

Table 3. Probability of detection (PD) and area occupied (AO) values calculated for raptor species detected on primary routes within 12 study areas located throughout Illinois in 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
LaSalle County						
31 Starved Rock	BWH	8.9	0.0 - 22.1		51.6	0.0 - 100.0
	CH	40.0	0.0 - 100.0		40.0	0.0 - 100.0
	RTH	33.3	0.0 - 100.0		20.3	0.0 - 100.0
32 Marseilles	BWH	33.0	0.0 - 76.0		20.4	0.0 - 100.0
	RTH	31.5	0.0 - 91.0		47.4	0.0 - 100.0
	TV	12.2	0.0 - 25.3		55.9	0.0 - 100.0
Lake County						
34 Heller NC	N/D					
35 Ryerson CA	N/D					
Winnebago County						
37 Kishwaukee	RTH	27.1	9.8 - 45.3		86.4	4.4 - 100.0
	BWH	11.1	0.0 - 34.3		55.9	0.0 - 100.0
	CH	6.2	0.0 - 15.0		100.0	0.0 - 100.0
	SWH	10.7	-------*		11.9	-------*
	OSP	5.6	0.0 - 17.1		100.0	0.0 - 100.0
	GHO	75.0	-------*		100.0	-------*
38 Pec	TV	3.7	0.0 - 10.5		100.0	0.0 - 100.0
	RTH	22.4	3.0 - 41.8		80.9	22.3 - 100.0
	BWH	3.7	0.0 - 10.4		100.0	0.0 - 100.0
	CH	6.2	0.0 - 19.9		86.5	0.0 - 100.0
	SSH	11.1	-------*		14.4	-------*
	OSP	11.1	-------*		14.4	-------*
	GHO	50.0	0.0 - 100.0		40.7	0.0 - 100.0
	BO	8.3	0.0 - 50.6		42.1	0.0 - 100.0

* = too rare to calculate confidence intervals

Table 4. Probability of detection (PD) and area occupied (AO) values calculated for primary routes combined within 12 study areas throughout Illinois.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
01,02	TV	18.6	7.9 - 29.3	93.8	61.7 - 100.0	
	CH	5.6	0.0 - 17.1	47.7	0.0 - 100.0	
	BWH	10.0	0.0 - 28.4	43.3	0.0 - 100.0	
	RTH	11.5	31.8 - 19.8	100.0	38.3 - 100.0	
	SSH	------*	-------	-------	----------	
Henderson/Warren counties						
04,05	TV	14.0	0.0 - 29.4	60.0	0.0 - 100.0	
	RTH	16.7	0.0 - 50.9	25.5	0.0 - 88.8	
	BO	8.3	0.0 - 19.2	40.5	0.0 - 100.0	
	AK	12.5	-------*	6.5	-------*	
Mason County						
07,08	TV	12.5	0.0 - 29.9	28.0	0.0 - 84.5	
	RTH	8.3	0.0 - 22.8	37.6	0.0 - 100.0	
Clinton County						
10,11	TV	3.6	0 0 - 8.8	100.0	0.0 - 100.0	
	RSH	26.7	6.3 - 47.0	53.7	15.3 - 92.0	
	GHO	11.1	0.0 - 24.0	47.1	0.0 - 100.0	
	BO	2.8	0.0 - 7.6	95.4	0.0 - 100.0	
Randolph/Jackson counties						
13,14	BWH	41.7	0.0 - 11.8	60.1	0.0 - 100.0	
	RTH	18.2	6.8 - 29.5	93.9	59.7 - 100.0	
	RSH	8.3	0.0 - 25.5	34.4	0.0 - 100.0	
	AK	44.4	0.0 - 100.0	10.2	0.0 - 94.5	
Union County						
16,17	RSH	18.5	0.0 - 50.7	32.6	0.0 - 93.7	
	BWH	10.7	0.0 - 25.0	49.0	0.0 - 100.0	
	RTH	27.5	11.3 - 43.6	69.9	43.6 - 96.2	

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Table 4 concluded

Table 4. Probability of detection (PD) and area occupied (AO) values calculated for primary routes combined within study areas throughout Illinois.

Study Area Routes	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Pope County						
19,20	TV	12.1	3.3 - 21.0	90.9	20.2 - 100.0	
	RSH	24.0	13.0 - 35.0	59.3	31.1 - 87.5	
	BWH	20.0	3.3 - 36.7	22.9	0.0 - 58.1	
	RTH	14.1	2.8 - 25.3	86.6	10.4 - 100.0	
Crawford County						
22,23	TV	17.9	0.0 - 49.5	52.5	0.0 - 100.0	
	RTH	10.6	0.0 - 21.6	92.4	0.0 - 100.0	
	GHO	20.0	-------*	5.6	-------*	
	BO	5.6	0.0 - 17.0	47.7	0.0 - 100.0	
Shelby County						
25,26	TV	9.0	0.3 - 17.5	99.9	0.0 - 100.0	
	RTH	5.6	0.0 - 11.5	82.0	0.0 - 100.0	
Vermilion County						
28,29	TV	26.5	19.4 - 33.6	100.0	88.7 - 100.0	
	RTH	11.0	3.5 - 18.6	100.0	40.0 - 100.0	
LaSalle County						
31,32	TV	4.8	0.0 - 10.3	100.0	0.0 - 100.0	
	CH	40.0	0.0 - 100.0	20.0	0.0 - 52.3	
	BWH	18.7	1.0 - 36.5	30.5	0.0 - 66.9	
	RTH	32.1	0.0 - 67.3	30.8	2.3 - 59.3	
Winnebago County						
37, 38	TV	3.7	0.0 - 10.7	81.5	0.0 - 100.0	
	RTH	24.9	12.6 - 37.1	80.9	54.3 - 100.0	
	BWH	5.6	0.0 - 12.5	91.9	0.0 - 100.0	
	CH	5.4	0.0 - 11.0	97.3	0.0 - 100.0	
	SSH	11.1	-------*	7.2	-------*	
	GHO	55.4	1.8 - 100.0	25.0	0.0 - 55.3	
	BO	8.3	0.0 - 50.9	21.0	0.0 - 100.0	
	SWH	16.7	-------*	6.0	-------*	
	OSP	5.6	0.0 - 13.6	60.2	0.0 - 100.0	

* = too rare to calculate confidence intervals

Table 5. Probability of detection (PD) and area occupied (AO) values calculated for secondary routes within 12 study areas throughout Illinois in 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
JoDaviess County						
03 Elizabeth	TV	18.5	7.4 - 30.0		72.2	30.0 - 100.0
	RTH	16.7	2.1 - 31.2		100.0	13.9 - 100.0
Henderson/Warren counties						
06 Warren Co.	TV	17.8	8.2 - 27.4		66.2	22.5 - 100.0
	RTH	23.8	2.9 - 44.7		43.8	16.4 - 71.3
Mason County						
09 Bishop Road	TV	3.2	0.0 - 7.6		100.0	0.0 - 100.0
	RTH	8.9	0.0 - 22.8		43.8	0.0 - 100.0
Clinton County						
12 Covington Bridge	RSH	25.4	6.4 - 44.4		51.0	0.0 - 100.0
Randolph/Jackson counties						
15 Kaskaskia River	RTH	17.7	6.8 - 28.6		74.3	21.4 - 100.0
Union County						
18 Crab Orchard	RTH	30.5	13.5 - 47.5		57.7	31.2 - 84.3
	RSH	30.6	0.0 - 70.6		37.3	0.0 - 100.0
	BWH	8.6	0.0 - 20.7		51.9	0.0 - 100.0
Pope County						
21 Delwood-Burden Falls	TV	12.2	3.9 - 20.5		100.0	0.0 - 100.0
	RTH	18.3	19.7 - 34.6		79.8	9.4 - 100.0
Crawford County						
24 Honeycreek 2	TV	11.3	0.0 - 31.6		100.0	0.0 - 100.0
	RTH	9.8	0.0 - 20.0		81.3	0.0 - 100.0

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Table 5 concluded

Table 5. Probability of detection (PD) and area occupied (AO) values calculated for secondary routes within 12 study areas throughout Illinois in 1991.

Study Area Route	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
Shelby County						
27 Lithia	TV	6.0	0.3 - 11.7	100.0	0.0 - 100.0	
	RTH	14.3	0.0 - 40.3	56.4	0.0 - 100.0	
Vermilion County						
30 Middlefork II	TV	25.0	17.9 - 32.1	75.4	0.0 - 100.0	
	RTH	10.5	3.2 - 17.8	100.0	50.7 - 100.0	
Winnebago County						
39	TV	2.8	0.0 - 7.9	100.0	0.0 - 100.0	
	RTH	22.9	10.7 - 35.0	62.9	30.0 - 95.9	
	CH	5.1	0.0 - 10.7	98.5	0.0 - 100.0	

Table 6. Probability of detection (PD) and area occupied (AO) values calculated for study areas* with ≥ 50% forest cover and study areas with < 50% forest cover within 12 study areas throughout Illinois in 1991 including the Winnebago County routes.

Percent Forest cover	Species	PD (%)	CI (%)	% Stop Detection	AO (%)	CI (%)
≥ 50	TV	12.4	5.5 - 19.3		68.8	35.1 - 100.0
	CH	5.6	0 0 - 17.8		47.7	0.0 - 100.0
	RSH	20.7	7.4 - 34.1		34.2	13.8 - 54.6
	BWH	7.3	0.0 - 15.5		48.8	0.0 - 100.0
	RTH	17.9	11.9 - 23.9		70.4	54.5 - 86.3
< 50	TV	16.1	10.7 - 21.5		70.2	54.3 - 86.0
	CH	40.0	0.0 - 100.0		20.0	0.0 - 53.4
	RSH	N/D				
	BWH	18.2	0.9 - 35.5		29.3	0.0 - 64.5
	RTH	13.7	7.7 - 19.8		60.6	41.0 - 80.2
≥ 50 including Winnebago County	TV	11.3	5.3 - 17.3		63.3	36.0 - 90.6
	CH	4.9	0.6 - 9.1		72.1	0.0 - 100.0
	RSH	20.5	7.3 - 33.7		34.2	15.2 - 53.2
	BWH	7.4	0.0 - 15.7		48.8	0.0 - 100.0
	RTH	19.6	14.3 - 24.9		71.2	59.0 - 83.4

* using data collected on primary routes only
List counties in each category----------