SPECIES, ABUNDANCES, AND HABITAT PREFERENCES OF DIURNAL RAPTORS WINTERING ON CRAB ORCHARD NATIONAL WILDLIFE REFUGE

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ABSTRACT

The species, abundances, and habitat preferences of diurnal raptors on Crab Orchard National Wildlife Refuge (CONWR) were investigated during the winter of 1978-79 using the car strip census method. Ten species of raptors were observed. Red-tailed hawks (*Buteo jamaicensis)* and American kestrels (*Falco sparverius)* were most frequent and accounted for 65.2 and 14.3% of the observations, respectively. Preference values were calculated for each habitat and species based on the amount of habitat available and the number of observations in that habitat. Open terrestrial habitats, with exception of corn fields, were generally preferred by red-tailed, red-shouldered (*B. lineatus)*, and rough-legged (*B. lagopus)* hawks. American kestrels showed strong preference for milo fields. Observations of sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks (*A. cooperii),* and golden eagles (*Aquila chrysaetos)* were too few to calculate preference values. A single goshawk (*A. gentilis)* was observed, but this species is not a regular winter resident on CONWR. Two observations on ospreys (*Pandion haliaetus)*, probably of the same bird, were made; it is doubtful that this species remained on the Refuge throughout the winter due to the absence of open water. Bald eagles (*Haliaeetus leucocephalus)* preferred permanently flooded timber and Crab Orchard Lake.

INTRODUCTION

Declines in many species of raptorial birds have concerned conservationists for several years. White (1974) distinguished 5 major reasons for these declines: 1) reduction of habitat by humans; 2) reduction in the amount of food; 3) chemical pollutants, primarily chlorinated hydrocarbons; 4) direct mortality by shooting and electrocution; and, 5) exploitation for personal or economic gain. Of these factors, habitat destruction seems to have had the greatest detrimental effect (White, 1974).

The objectives of this study were to: 1) determine the species composition and abundances of diurnal raptors (Falconiformes) wintering on Crab Orchard National Wildlife Refuge (CONWR); and 2) determine the habitats preferred by wintering diurnal raptors on CONWR.

STUDY AREA

CONWR comprises approximately 17,390 ha located primarily in Williamson County, southern Illinois. The Refuge was created by Congress in 1947 for the purposes of providing wintering areas for migratory waterfowl, public recreation, agriculture, and industrial sites.

The study area was an 8,700 ha inviolate (i.e., closed to the public) portion of the Refuge consisting of a variety of well-interspersed habitats (Table 1). Croplands are farmed on a 4-year rotation plan with 2 years in corn or milo followed by 2 years in clover. Farmers leave 25% of the crop standing as food for wintering Canada geese (*Branta canadensis*). Pastures were grazed from 1 May through 31 September 1978. Industry occupies approximately 300 ha on the inviolate area.

METHODS

The car strip census (Craighead and Craighead, 1956) was used which consisted of counting raptors observed within an estimated 0.4 km strip on each side of the road while driving at a speed of 8 to 24 km/hour. The variability in speed was determined by visibility through and the density of a particular habitat.

Because raptors are frequently associated with open habitats and stay within restricted areas, a car census is usually practical and reliable. Two sources of error may occur, however. First, variation among counts may result from using observers with differing degrees of experience. To reduce this possibility, the same observers (Zoology graduate students) were used as often as possible. Second, some raptors may not have been seen in forested areas or on low perches. Repeated censuses reduced these problems as most diurnal raptors fly or perch high in trees except while capturing prey (Craighead and Craighead, 1956, pp. 47, 51). Following Craighead and Craighead (1956, p. 58), I applied a correction factor of 1.5 to the mean number of kestrels (*Falco sparverius*) observed/census to account for the small size and reduced visibility of these birds. I felt that this correction factor made the data more accurate although no attempt was made to determine if the factor was of the proper magnitude.

A 37.3 km snow-plowed census route representing the various habitats on the inviolate portion of the Refuge was chosen. Another correction factor was required to account for differences in amounts of the various habitats on the census route compared to those on the inviolate area as a whole. The areas of the habitats along the census route were determined and divided into the areas of the corresponding habitats for the entire inviolate area. The number of observations of raptors in a given habitat was then multiplied by the appropriate correction factor.

The 9 forest divisions in Table 1 were combined into a single category (forest) as it was difficult to identify the various forest types while censusing. Most of the forested areas did not contain large, mature trees. A mature hardwood forest in the eastern part of the inviolate area was not accessible by car and, thus, the number of woodland hawks (accipiters) was probably underestimated.

Oldfields were defined as those habitats consisting primarily of perennial herbs [e.g., goldenrods (*Solidago* spp.), broomsedge *(Andropogon virginicus)],* woody vines and shrubs [e.g., multiflora rose (*Rosa multiflora*), blackberry and raspberry (*Rubus* spp.)], and, in some cases, small trees [e.g., persimmon (*Diospyros virginianus*), sassafras (*Sassafras albidum*)].

Censuses were driven 20 times 12 January through 17 February 1979. Only fair weather days (i.e., clear to partly cloudy skies, wind velocity less than 24 km/hour, no precipitation, and temperature greater than -18°C) were utilized to maximize the number of sightings of raptors. Censuses began between 1000 and 1200 to allow a 3-hour period of sufficient light for accurate identification.

At least 1 observer other than the driver was present so that both sides of the road could be observed. The species, sex, and age (adult or juvenile) of raptors observed were recorded when possible using binoculars and spotting scopes. Short stops, generally less than 1 minute in duration, were made when needed for accurate identification. Individual characteristics, location, habitat where first sighted (or directly below flying birds), and activity (flying, perched, feeding, vocalizing) were noted.

Habitat preference values (HPV) were calculated in a similar manner as food preference ratings (see Petrides, 1975, The equation:

$$HPV = \frac{\%\text{ of observations of a particular species in a given habitat}}{\%\text{ of the given habitat available}}$$

leads to a preference value centering on 1.00. Habitats with preference values greater than 1.00 are preferred while those with values below 1.00 are avoided. A value of 1.00 indicates that a habitat is utilized in the same proportion as it is available. These values were calculated for species with at least 10 observations.

Table 1. Habitat divisions of the inviolate portion of Crab Orchard National Wildlife Refuge (U.S. Dept. of the Interior, unpublished data, 1966).

Habitat	*Area* (ha)	% of Total
Oak-hickory forest *Quercus* spp., *Carya* spp.	245	2.9
Lowland hardwood	1310	15.6
Upland hardwood	298	3.6
Pin oak *Q. palustris*	204	2.4
Pine *Pinus echinata, P. taeda*	248	3.0
Black locust *Robinia pseudoacacia*	55	0.7
Post oak-Black oak *Q. stellata, Q. velutina*	89	1.1
Cottonwood *Populus deltoides*	25	0.3
White Oak *Q. alba*	11	0.1
Permanently flooded timber	162	1.9
Brush	366	4.4
Sassafras-Persimmon *Sassafras albidum, Diospyros virginiana*	826	9.9
Corn[a]	890	10.6
Milo[a]	405	4.8
Clover[a]	971	11.6
Grazed[a]	1044	12.5
Water	1233	14.7

[a]1978 figures.

RESULTS AND DISCUSSION

Ten species of raptors were identified during the study (Table 2). Red-tailed hawks (*Buteo jamaicensis*) and American kestrels were most frequently seen, and accounted for 65.2 and 14.3% of the observations, respectively. These 2 species were the most frequently reported hawks on Illinois Christmas censuses from 1974 through 1978 (Illinois Audubon Bulletin, Spring issues 1975-1979) (summarized for the period 1903-1955 by Graber and Golden, 1960).

Buteos

Most open terrestrial habitats were preferred by the 3 species of buteos (Tables 3, 4). Insufficient ground cover to support small rodents on which these birds feed (Bent, 1937; Craighead and Craighead, 1956, p. 44) may have reduced use of corn fields.

Habitat partitioning became apparent when comparing maximum preference values for the buteos. Red-tailed hawks strongly preferred milo fields, whereas red-shouldered hawks (*Buteo*

Table 2. Diurnal raptors observed on the inviolate portion of Crab Orchard National Wildlife Refuge, by age class, 12 January through 17 February 1979.

Raptor	Number of observations			
	Immature	Adult	Unknown	Total
Red-tail hawk	143	263	42	448
Red-shouldered hawk	4	26	0	30
Rough-legged hawk[a]	—	—	18	18
Unknown buteo	—	—	32	32
Sharp-shinned hawk	0	4	0	4
Cooper's hawk	0	1	0	1
Goshawk	1	0	0	1
Unknown accipiter	—	—	2	2
American kestrel[a,b]	—	—	98	98
Osprey[a]	—	—	2	2
Bald eagle	20	14	—	34
Golden eagle	6	2	0	8
Unknown eage	—	—	9	9

[a]Plumage characteristics do not allow separation into age classes.
[b]Includes 47 males, 28 females, and 23 birds of unknown sex.

Table 3. Numbers of observations of diurnal raptors in different habitats on the inviolate portion of Crab Orchard National Wildlife Refuge, 12 January through 17 February 1979.

Raptor	Habitat[a]								
	OF	MI	CO	CL	GR	FO	FT	LA	Total
Red-tailed hawk	129	118	43	75	62	14	14	3	448
Red-shouldered hawk	19	3	1	5	0	0	0	2	30
Rough-legged hawk	1	2	0	6	7	1	0	1	18
Unknown buteo	9	5	2	7	1	5	2	1	32
Sharp-shinned hawk	2	0	0	0	0	1	0	1	4
Cooper's hawk	0	0	0	0	0	1	0	0	1
Goshawk	0	1	0	0	0	0	0	0	1
Unknown accipiter	0	0	0	0	0	2	0	0	2
American kestrel	35	24	8	22	9	0	0	0	98
Osprey	0	1	0	0	1	0	0	0	2
Bald eagle	2	2	3	2	1	0	8	16	34
Golden eagle	1	1	0	0	1	0	2	3	8
Unknown eagle	1	3	1	0	3	0	1	0	9

[a]Oldfield (OF), milo (MI), corn (CO), clover (CL), grazed (GR), forested (FO), permanently flooded timber (FT), and Crab Orchard Lake (LA).

lineatus) selected oldfields more than twice as often as any other habitat. Rough-legged hawks (*B. lagopus*) had nearly identical maximum preference values for clover and grazed habitats; this concurs with findings (Weller, 1964) that these hawks most often utilized pastures and meadows for hunting. This partitioning of habitats and, thus, available food supply, may help reduce interspecific competition as these 3 hawks are similar in size and anatomy and have similar food habits (Craighead and Craighead, 1956, p. 44; Schnell, 1968).

Southern Illinois is in the northernmost part of the wintering range of the red-shouldered hawk (Bent, 1937, p. 197). This, plus the reduced winter hardiness of the red-shouldered hawk compared to the red-tailed hawk (Bent, 1937, p. 180), may account for the difference in densities of these 2 hawks (Table 5). The lack of extensive open areas on CONWR is probably responsible for the low density of rough-legged hawks on the Refuge, as these hawks are primarily associated with large areas of open country (Peterson, 1947, p. 46; Bull and Farrand, 1977, p. 501).

A significant increase in the number of observations of red-tailed hawks/census occurred during the study period (Figure 1). This increase may be due to increased observers' experience and/or an influx of birds from other areas.

Accipiters

Observations of accipiters (*Accipiter* spp.) were too few to calculate preference values. Their numbers, however, were probably underestimated due to their association with woodland habitats where visibility was poor. Comparing foot census with car census data, Craighead and Craighead (1956, p. 58) found that multiplying the number of Cooper's hawks (*A. cooperii*) observed during the car census by 1.5 gave a better estimate of the population size. By applying this correction factor to the 3 species of accipiters observed in this study, 12 birds may have been in the area. This estimate was probably conservative, however, as visibility through forested areas was reduced considerably below the 0.8 km census strip width.

Although a goshawk (*A. gentilis*) was seen, this species is not normally a winter resident on CONWR for these birds generally remain in northern coniferous forests unless food shortages force them to move south (Bull and Farrand, 1977, p. 681). The most recent goshawk invasion into Illinois occurred in the winter of 1972-1973 (Burr and Current, 1974).

American kestrels

American kestrels selected milo fields more than twice as often as any other habitat. There was no significant difference in the number of observations of kestrels/census through the study period.

Census counts of kestrels were conservative, due primarily to the small size and reduced visibility of these birds. The adjusted density (Table 5) was lower than reported by Mills (1975) in central Ohio but higher than noted by Craighead and Craighead (1956) in Michigan and Enderson (1960) in east-central Illinois. This disparity may reflect differences of study areas and/or time.

Ospreys

The 2 observations of ospreys were in the same area on consecutive days and were probably of the same bird. Due to lack of open water, it is doubtful that this bird stayed on the Refuge throughout the winter, as ospreys are closely associated with aquatic habitats (Bent, 1937, p. 352; Bull and Farrand, 1977. p. 469).

Eagles

Observations of golden eagles (*Aquila chrysaetos*) were too few to calculate preference values. Although these birds are regular winter residents on CONWR (unpublished Refuge data), they are uncommon in eastern North America (Peterson, 1947, p. 48; Bull and Farrand, 1970, p. 640).

Table 4. Habitat preference values[a] of diurnal raptors wintering on the inviolate portion of Crab Orchard National Wildlife Refuge, 12 January through 17 February 1979.

	Habitat[b]							
Raptor	OF	MI	CO	CL	G R	FO	FT	L A
Red-tailed hawk	1.55	4.04	1.12	1.07	0.79	0.16	0.54	0.06
Red-shouldered hawk	3.40	1.54	0.39	1.07	0.00	0.00	0.00	0.58
Rough-legged hawk	0.30	1.70	0.00	2.14	2.24	0.26	0.00	0.47
American kestrel	1.92	3.76	0.95	1.44	0.53	0.00	0.00	0.00
Bald eagle	0.32	0.90	1.02	0.39	0.17	0.00	14.21	4.02

[a]See text for explanation.
[b]Oldfield (OF), milo (MI), corn (CO), clover (CL), grazed (GR), forested (FO), permanently flooded timber (FT), and Crab Orchard Lake (LA).

Table 5. Densities of diurnal raptors[a] wintering on the inviolate portion of Crab Orchard National Wildlife Refuge, 12 January through 17 February 1979.

Raptor	Density[b] (1 bird/−km^2)
Red-tailed hawk	1.3
Red-shouldered hawk	19.9
Rough-legged hawk	33.2
American kestrel	4.1 (2.7)[c]

[a]Eagles are excluded for reasons discussed in the text.
[b]Calculated only if > 10 observations were made.
[c]Adjusted to account for reduced visibility of these birds. See text for explanation.

Bald eagles (*Haliaeetus leucocephalus*) preferred permanently flooded timber and Crab Orchard Lake. Their numbers, however, were highly variable among locations. These birds appeared to move readily from 1 area to another, depending on availability of food.

The car census technique is probably not an accurate method of censusing eagles on CONWR for these birds move a great deal within the Refuge and probably between CONWR, Union County Conservation Area (38 km south of CONWR), Horseshoe Lake Conservation Area (72 km south of CONWR), and Rend Lake (40 km north of CONWR).

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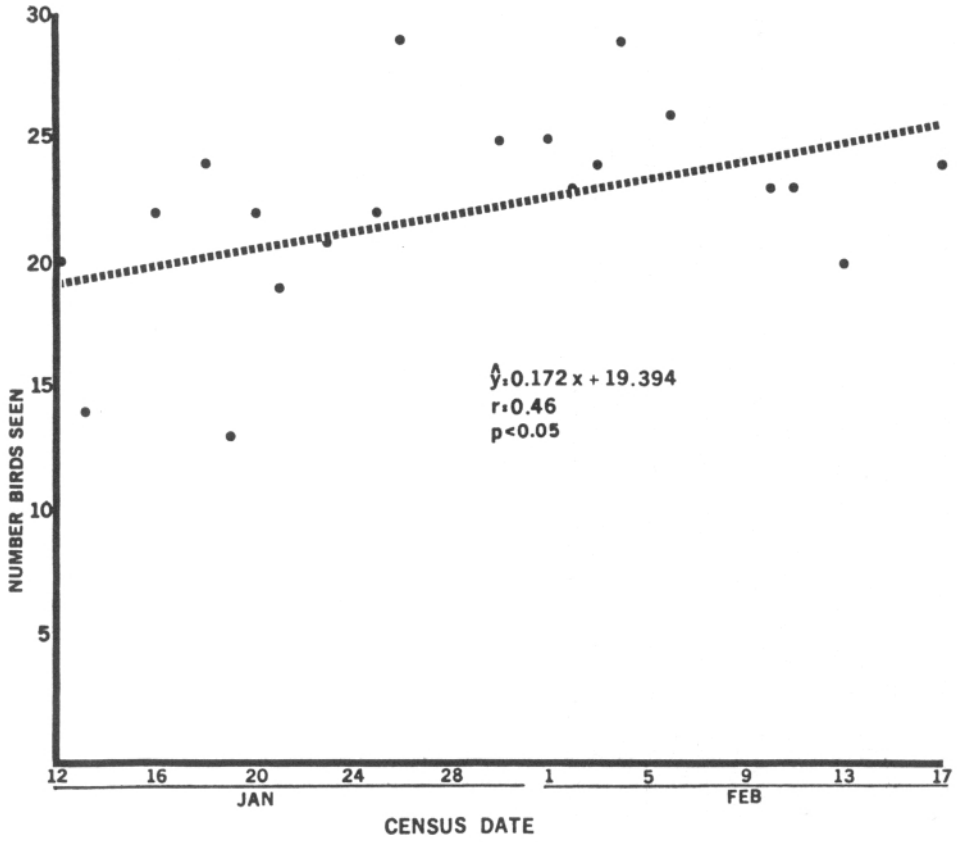

Figure 1. Change in numbers of observations of red-tailed hawks in the inviolate portion of Crab Orchard National Wildlife Refuge, 12 January through 17 February 1979.