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SEASONAL ABUNDANCE, HABITAT USE, AND PERCH SITES OF FOUR RAPTOR SPECIES IN NORTH-CENTRAL FLORIDA

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Roadside surveys are a convenient and efficient method for sampling widely dispersed and highly mobile raptor populations. Fuller and Mosher (1981) discussed the merit of roadside censuses for evaluating long-term population trends, distribution, and seasonal abundance of raptors. They also reviewed factors that potentially influence these counts, such as weather, season, and bird behavior. Roadside surveys have been used extensively in the midwestern and western United States to determine relative abundance (Enderson 1965, Johnson and Enderson 1972, Bildstein 1978, Craig 1978, Bauer 1982, Gessaman 1982), habitat preference (Bildstein 1978, Bauer 1982), and perch use (Marion and Ryder 1975, Bildstein 1978, Craig 1978, Stahlecker 1978, Bauer 1982) of various raptor species. However, few data are available from roadside surveys of Southeastern raptor populations, particularly those in Florida.

Florida raptor populations differ from those in many regions of the eastern United States in that the influx of winter migrants, together with the resident birds, results in high winter population densities. These are made possible by several unique characteristics of Florida habitats. Warm temperatures and long daylengths result in longer growing seasons and prolonged activity of both predator and prey populations. The abundance of evergreen and mast-producing plants provides a year-round food supply for prey populations (Harris 1980). Both average densities (birds/ha) and number of land bird species are significantly higher in winter than summer, with 154 terrestrial bird species present during summer and 228 species in winter (Harris and Mulholland 1983). Furthermore, density of herptile species in the Southeast is approximately 3 times greater than in the Northeast and 5 times greater than in the upper Midwest (Kiester 1971). Small mammal communities, however, include fewer species and numbers than populations in other regions, though some species (e.g., cotton rat, *Sigmodon hispidus,* and rice rat, *Oryzomys palustris*) may be seasonally and locally abundant (J. F. Eisenberg pers. comm., Layne 1974). Thus, Florida habitats contain abundant prey populations and favorable climatic factors for overwintering raptors.

Because migrant birds, including raptors, may spend 7 to 8 months of the year in Florida and only 3 to 4 months on the northern breeding grounds (Keast 1980), loss of overwintering habitat might have a serious impact on these populations. Human developments and increasing rates of habitat loss in Florida, therefore, necessitate efficient monitoring of its raptor populations over the state. This study was done to determine

TABLE 1. Linear distance and percent availability of habitat types along both sides of 24 16-km transects located in north-central Florida.

Habitat	Linear distance (km)	Percent occurrence
Open	265.7	34.2
Open with scattered trees	128.3	16.5
Longleaf pine-turkey oak (semi-open)	80.6	10.4
Hardwood forests	110.0	14.2
Pine flatwoods	187.8	24.2
Wetlands	3.6	0.5
	776.0	100.0

the relative abundance of 4 raptor species during one year of intensive surveys, and to evaluate their habitat and perch type preferences.

STUDY AREA AND METHODS

The study area included 9 counties and was comprised of the 3 ecological communities representative of northern peninsular Florida: pine (*Pinus* sp.) flatwoods, longleaf pine (*P. palustris*)-turkey oak (*Quercus laevis*) sandhills, and upland hardwoods. Much of the upland hardwoods community has been converted to pastures and agricultural areas. Communities were delineated using the General Map of Natural Vegetation of Florida (Davis 1967), and soil survey maps for Alachua (Soil Conservation Service 1980) and Marion (Soil Conservation Service 1979) counties.

Eight 16-km transects located on paved secondary roads were selected randomly in each of the 3 ecological communities (see Bohall 1984 for specific locations of transects). Man-made perches (e.g., fences, powerlines, etc.) were present along all transects. Each of the 24 transects was traversed once every 2 weeks (26 times) between 2 November 1981 and 31 October 1982. Two observers were present on each count and the same vehicle was used each time. The senior author directed every survey; though the second observer varied, 3 individuals assisted on about 90% of the surveys. We initiated surveys approximately 30 min after sunrise and drove at approximately 32 km/h (range: 30 to 35 km/h).

Specific land use categories and perch sites were recorded for each raptor observed along the transects. The 28 land use categories were later combined on the basis of vegetation structure (Table 1) to facilitate analysis of habitat use. Open habitats included pastures, clearcuts or newly-planted pine plantations, and bare, planted, or fallow fields. These areas were characterized by vegetation less than 1 m in height. Standing trees were few or absent. Open areas with scattered trees were similar to open habitats, but standing trees were more numerous. The longleaf pine-turkey oak habitat is an open woodland. Scattered pines form the

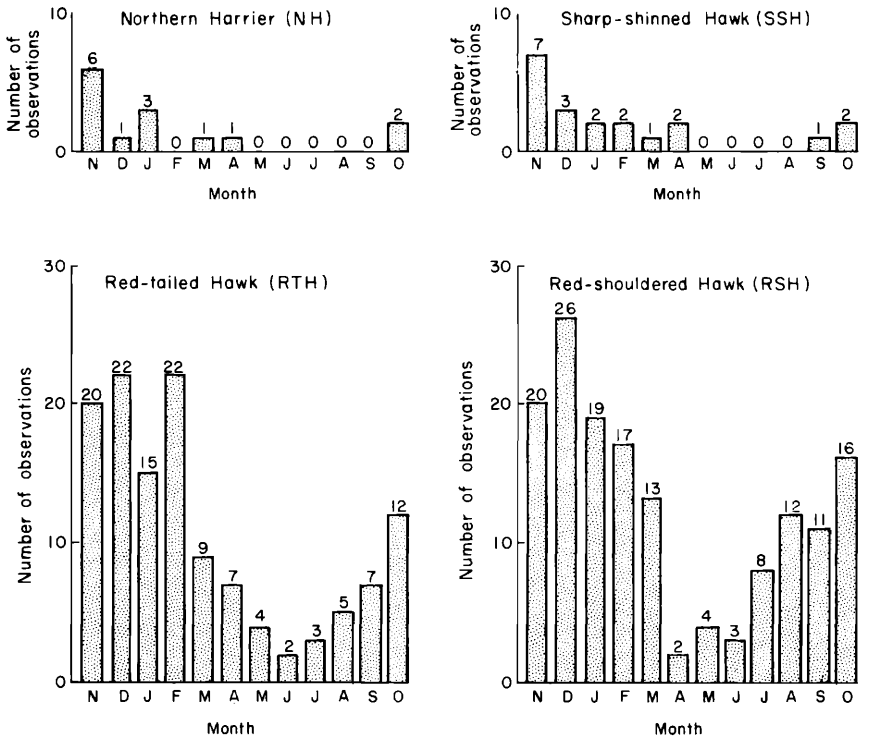

FIGURE 1. Monthly relative abundance of 4 raptor species sighted along 24 16-km transects in north-central Florida from 2 November 1981 to 31 October 1982.

overstory while scrub oaks are small understory trees. Ground cover is scattered and numerous bare areas of sand occur. Hardwood forests are readily identified by the dense stands of shade-tolerant hardwoods and few pines. The pine flatwoods habitat included natural or planted stands of pine greater than 2 m in height; 80% of this habitat was over 15 m in height. The structure of the understory varied from grasses and low shrubs to tall shrubs and small trees. Wetlands included freshwater marshes and lake margins.

We searched for both perched and flying raptors. For this paper, sex and age classes of each species are not distinguished. Since raptors are more observable in open areas, interiors of wooded areas were carefully searched. Censuses were not conducted during foggy conditions or heavy rain. The direction and order in which transects were driven were varied to minimize directional and time of day biases. Two seasons, summer (April through September) and winter (October through March), were delineated using mean monthly temperatures from 1979 to 1981 (National Oceanic and Atmospheric Administration 1979, 1980, 1981). The

TABLE 2. Summer and winter relative abundance and habitat use of 4 raptor species sighted along 24 16-km transects in north-central Florida from 2 November 1981 to 31 October 1982.[a]

Species	Habitat	Summer Apr–Sept	Winter Oct–Mar	Total number
Northern Harrier	Open	1	10	11
	Open with scattered trees	0	2	2
	Pine flatwoods	0	1	1
	Total	1	13	14
Sharp-shinned Hawk	Open	0	8	8
	Open with scattered trees	1	2	3
	Longleaf pine-turkey oak	1	2	3
	Hardwood forests	1	0	1
	Pine flatwoods	0	4	4
	Wetland	0	1	1
	Total	3	17	20
Red-shouldered Hawk	Open	27	67	94
	Open with scattered trees	6	25	31
	Hardwood forests	2	9	11
	Pine flatwoods	5	4	9
	Wetland	0	6	6
	Total	40	111	151
Red-tailed Hawk	Open	13	64	77
	Open with scattered trees	6	22	28
	Longleaf pine-turkey oak	2	4	6
	Hardwood forests	4	4	8
	Pine flatwoods	3	6	9
	Total	28	100	128

[a] H_0: Summer and winter relative abundance are the same.
NH: $\chi^2 = 9.80$, $P < .01$ RSH: $\chi^2 = 33.38$, $P < .001$
SSH: $\chi^2 = 9.80$, $P < .01$ RTH: $\chi^2 = 40.50$, $P < .001$.

average seasonal temperature for all 3 years combined was 25.8°C (78.4°F) in summer and 15.9°C (60.6°F) in winter.

The linear distance of habitat types on either side of the road was measured with an odometer and the percent availability of each habitat type was calculated (Table 1). Chi-square contingency and homogeneity tests (Remington and Schork 1970) were used, when adequate sample sizes were available, to test for differences in seasonal relative abundance, perch type, and habitat use.

RESULTS AND DISCUSSION

Relative abundance.—Significant increases in Northern Harrier (*Circus cyaneus*) (1200%), Sharp-shinned Hawk (*Accipiter striatus*) (467%), Red-tailed Hawk (*Buteo jamaicensis*) (257%), and Red-shouldered Hawk (*B. lineatus*) (177%) sightings occurred from summer to winter (Table 2).

Northern Harriers and Sharp-shinned Hawks are winter residents in Florida but typically occur in low numbers. From May through September no harriers were observed; Sharp-shinned Hawks were absent from May through August (Fig. 1). Throughout the southern states, harriers migrate north from mid-March through April and most return in the fall from late October to early November (K. L. Bildstein pers. comm.). In the Florida Panhandle, Weston (1965) reported that Sharp-shinned Hawks occurred from mid-September through mid-April.

Red-tailed Hawks migrate south from mid-September to late October (Bent 1937). Northward migrating Red-tails first arrived in Wisconsin in late February and numbers peaked in mid-March (Petersen 1979). On our study area, sightings of this raptor declined from 22 sightings in February to only 9 sightings in March, and remained low through September when migrants were absent (Fig. 1). Red-tailed Hawks remaining after February presumably were part of the breeding population in north-central Florida. Egg-laying dates in the southern states generally ranged from 18 February to 3 April (Bent 1937). Continued declines in sightings from April through June in this study coincided with the breeding season when individuals, particularly nesting females, were least conspicuous. Females often remain near the completed nest prior to egg-laying and, in addition, do most or all of the incubation (Brown and Amadon 1968). Low counts after the breeding season also may be attributed to hot weather when Red-tailed Hawks often seek shade (Brown and Amadon 1968).

Red-shouldered Hawks were the most common of the 4 species and accounted for 48% of all sightings. From April to June, an average of only 3 Red-shouldered Hawks per month were sighted (Fig. 1). As with the Red-tailed Hawks, these very low numbers coincided with the nesting season when breeding individuals were least conspicuous. Bent (1937) reported egg-laying dates for Red-shouldered Hawks in the South ranging from 20 January to 3 June. The earliest incubation observed in the Florida Panhandle was 7 March (Weston 1965). Late in the summer, Red-shouldered Hawk observations were more numerous; newly fledged young and early migrants likely contributed to this increase. These raptors were most abundant during winter (Fig. 1) when they often were seen on low perches as reported by Brown and Amadon (1968).

Habitat use.—Habitat use by Northern Harriers, Sharp-shinned Hawks, Red-tailed Hawks, and Red-shouldered Hawks was independent of season (NH: $\chi^2 = .29$, $P > .50$; SSH: $\chi^2 = 2.61$, $P > .30$; RTH: $\chi^2 = 5.98$, $P > .20$; RSH: $\chi^2 = 7.51$, $P > .10$). Summer and winter relative abundance values, therefore, were combined and analyses of habitat use versus habitat availability were performed. Sample size for Northern Harriers was too small for statistical analysis; however, of the remaining 3 species only Sharp-shinned Hawks used all habitat types in accordance with their availability (RTH: $\chi^2 = 52.31$, $P < .001$; RSH: $\chi^2 = 81.28$, $P < .001$; SSH: $\chi^2 = 1.55$, $P > .3$). Similarly, Evans (1982) concluded

TABLE 3. Number of observations of 4 raptor species on various perch types and in flight along 24 16-km transects in north-central Florida from 2 November 1981 to 31 October 1982.

	NH	SS	RTH	RSH	Total
Man-made					
Powerline wire			1	2	3
Utility pole			4	9	13
Fence post			2	16	18
Subtotal	0	0	7	27	34
Natural					
Live tree		2	14	16	32
Dead top of live tree			9	16	25
Bare tree/snag		5	36	60	101
Shrub/debris/ground				5	5
Subtotal	0	7	59	97	163
Flying	14	13	62	27	116
Total	14	20	128	151	313

that both wintering and migrating Sharp-shinned Hawks occurred in nearly all habitats containing trees or shrubs.

Of the 14 Northern Harrier sightings, 11 (79%) occurred in open habitats (Table 2). Bildstein (1978) in Ohio and Bauer (1982) in Colorado observed harriers in open habitats approximately 95% and 89% of the time, respectively. Of the occurrences in open habitats in this study, 8 were in fallow fields and 3 in pastures.

Red-tailed Hawks were observed in open habitats significantly more than expected based on habitat availability ($\chi^2 = 9.4$, $P < .01$). Of 77 sightings in open habitats, 57% occurred in pastures and 29% occurred in fallow fields. Both Bildstein (1978) and Bauer (1982) recorded a large number of these raptors in open habitats (88% and 86%, respectively). Cox (1976) found that Red-tailed Hawks in Kansas also showed a preference for pastures. Red-tails in this study also were observed significantly less than expected in hardwoods ($\chi^2 = 3.96$, $P < .05$) and pine flatwoods ($\chi^2 = 12.08$, $P < .001$).

Red-shouldered Hawks also occurred in open habitats proportionately more than expected based on availability ($\chi^2 = 12.32$, $P < .001$). Like Red-tailed Hawks, a greater proportion of the 94 Red-shouldered Hawks sighted in open areas were observed in pastures than in fallow fields (63% and 19%, respectively). Only 9 Red-shouldered Hawks were observed in pine flatwoods, significantly fewer than expected ($\chi^2 = 16.65$, $P < .001$) considering this habitat type comprised 24% of the total linear distance censused. Individuals observed in the pine flatwoods or hardwood forests often appeared to be hunting open areas while perched

on the woodland edge. Six (4%) were sighted in wetlands (Table 2) which comprised only .5% of the total linear distance of the available habitat types (Table 1). Though small sample size precluded statistical testing, this supports the wetland affinities commonly attributed to this species. Brown and Amadon (1968) stated that Red-shouldered Hawks in most areas prefer moist or swampy woodlands, though in Florida they frequent more open country. Portnoy and Dodge (1979) in Massachusetts and Bednarz and Dinsmore (1981) in Iowa also found a tendency for Red-shouldered Hawks to inhabit wet, lowland habitats.

Perch type.—All Northern Harriers sighted along transects were in flight. Cox (1976) reported that 88 of 89 (99%) harriers observed on roadside surveys in Kansas were observed in flight. Only 7 Sharp-shinned Hawks were perched when first sighted (35%), but all used live trees or bare trees/snags as perches (Table 3).

Only 27 (18%) of the Red-shouldered Hawks were observed in flight, while 62 (48%) of the Red-tailed Hawks were flying when first observed. Red-shouldered Hawks seldom soar as continuously as Red-tailed Hawks (May 1935) especially during the non-breeding season (Brown and Amadon 1968).

Natural perches were used more often than man-made perches by both Red-tailed Hawks (90%; $\chi^2 = 42.88, P < .001$) and Red-shouldered Hawks (78%; $\chi^2 = 39.52, P < .001$) (Table 4). Bare trees and snags were used significantly more often ($P < .001$) than other natural perches by both Red-tailed Hawks (61%) and Red-shouldered Hawks (62%). Similarly, Schnell (1968), Cox (1976), and Bildstein (1978) found Red-tailed Hawks perched most frequently in trees. The greater use of natural perches in this study, especially bare trees/snags, reemphasizes the importance of snags to raptor populations.

SUMMARY

Florida habitats are important overwintering areas for eastern raptor populations as evidenced by the significantly greater number of raptor sightings during winter. Abundance of Northern Harriers, Sharp-shinned Hawks, Red-tailed Hawks, and Red-shouldered Hawks combined increased 235% from 72 sightings in summer to 241 in winter. These four species of raptors showed no significant seasonal variation in habitat use. Overall, birds were sighted more frequently in open areas than in other habitat types. Perched raptors used natural perches significantly more than man-made perches.

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