THE JOURNAL OF RAPTOR RESEARCH

A QUARTERLY PUBLICATION OF THE RAPTOR RESEARCH FOUNDATION, INC.

VOL. 28 MARCH 1994 NO. 1

J Raptor Res. 28(1):1–3
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PRODUCTIVITY AND NESTING CHRONOLOGY OF THE COOPER'S HAWK AND SHARP-SHINNED HAWK IN MISSOURI

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ABSTRACT.—Sharp-shinned hawk (*Accipiter striatus*) and Cooper's hawk (*A. cooperii*) nests were studied in Missouri during 1985 and 1986 to determine productivity and nesting chronology. The nesting season for Sharp-shinned hawks extended from May to August, with most young fledging by August. The Cooper's hawk nesting season extended from May to July. Mean clutch size and number of young reaching banding age (≥14 days) per successful nest for Sharp-shinned hawks were 4.5 ($N = 8$) and 3.2 ($N = 5$), respectively. Mean clutch size and number of young per successful nest for Cooper's hawk were 3.8 ($N = 12$) and 3.5 ($N = 20$). No differences were detected ($P \geq 0.73$) in clutch size, brood size, or number of young per successful nest for Cooper's hawk in pine (*Pinus* spp.) versus oak-hickory (*Quercus* spp.-*Carya* spp.) hardwood habitats.

KEY WORDS: Accipiter cooperii; A. striatus; *clutch size*; *Cooper's hawk*; *Missouri*; *nesting*; *sharp-shinned hawk.*

Productividad y cronología de nidificación de *Accipiter striatus* y *Accipiter cooperii* en Missouri

RESUMEN.—Los nidos de *Accipiter striatus* y *A. cooperii* fueron estudiados en Missouri durante 1985 y 1986, con el fin de determinar la productividad y la cronología de nidificación. La estación reproductiva de *A. striatus* se extendió desde mayo hasta agosto. La mayoría de los juveniles volantones se concentró en agosto. La estación de nidificación de *A. cooperii* se extendió desde mayo hasta julio. El tamaño medio de la nidada y número de jovenes que alcanzan 14 días de edad por nido exitoso de *A. striatus* fue 4.5 ($N = 8$) y 3.2 ($N = 5$), respectivamente. El tamaño medio de la nidada y número de jovenes por nido exitoso de *A. cooperii* fue 3.8 ($N = 12$) y 3.5 ($N = 20$). No se detectaron diferencias ($P > 0.73$) en el tamaño de la nidada, tamaño de cría o número de jovenes por nido exitoso de *A. cooperii* en hábitat de *Pinus* spp. versus hábitat de asociaciones de *Quercus* spp.-*Carya* spp.

[Traducción de Ivan Lazo]

Cooper's hawks (*Accipiter cooperii*) and sharp-shinned hawks (*A. striatus*) use both oak-hickory hardwood and pine stands as nesting habitat in Missouri (Wiggers and Kritz 1991). However, the availability of pine habitat is low, <5% of the state's forest cover. The frequent use of pine plantations by Cooper's hawks (Wiggers and Kritz 1991) indicates it may be an important nesting habitat (Rosenfield et al. 1991). However, productivity of these accipiters in this region of North America are poorly documented and have not been studied to determine if there is a benefit in using a particular habitat. To better understand their biology in this region, we studied the nesting chronology and productivity for the Cooper's hawk and sharp-shinned hawk and compared productivity for Cooper's hawk nests in hardwood and pine habitats.

STUDY AREA AND METHODS

We searched for accipiter nests primarily in the Ozark and Ozark border natural divisions which together occupy about 51% of the state's area and hold more forest cover than any other natural divisions (Thom and Wilson 1980). Major forest types in both natural divisions are oak-hickory hardwoods, shortleaf pine (*Pinus echinata*), and shortleaf pine-oak plantations. Elevation ranges from about 60–550 m (Thom and Wilson 1980).

We used a mailed questionnaire to solicit current and historic (pre-1985) nesting sites and systematically searched

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forest stands to locate accipiter nests. The questionnaire was mailed to about 400 wildlife biologists, foresters, conservation agents, park naturalists, falconers, and birdwatchers. Forests searched for hawk nests included stands where cooperators reported multiple sightings during the nesting season, historic nesting areas, and areas thought to contain suitable nesting habitat based on occupied and historic sites. Search efforts were concentrated in pine plantations because most historic nests occurred in this habitat (Wiggers and Kritz 1991). This emphasis resulted in a disproportionate amount of pine habitat being searched relative to its occurrence in the state.

Before searches began, recorded calls of sharp-shinned and/or Cooper's hawks or great horned owls (*Bubo virginianus*) were broadcast into the stand using a cassette tape player (Fuller and Mosher 1981, Rosenfield et al. 1985, 1988). If accipiters responded to the tape, their vocalizations and/or flights were followed to their origin, which was usually near the nest. If there was no response to the taped calls, the stand was searched until either a nest was found or the stand was completely searched. All nesting areas found in 1985 were revisited in 1986. In 1986, taped calls were initially broadcast at the 1985 nest tree and all forest habitat within a 300-m radius of this tree was searched.

Nests were monitored by climbing a tree adjacent to the nest tree when possible or by climbing the nest tree. Cooper's hawk nests were checked an average of four times and sharp-shinned hawk nests an average of three times prior to fledging to determine reproductive information. In some instances we did not locate a nest until the chicks had hatched or young had fledged. In other instances we were unable to monitor a nest often enough to obtain an accurate count of the number fledged. Therefore, mean values for clutch and brood sizes (number in nest on first visit) were calculated based on the number of nests for which data were available for these parameters. Further, we classified a nest as successful if at least one young reached banding age (≥14 d), and calculated the mean number of young per successful nest for each species. Mean number of young per successful nest was used instead of the mean number of young per active nest, because the number of nest checks was inadequate to determine the outcome for all nests.

Values for most productivity variables were not normally distributed; therefore, Mann-Whitney *U*-tests were used to examine whether productivity data differed between years within species and between habitats within species. Productivity parameters for sharp-shinned hawks were not tested for significant differences between years or habitats because of small sample sizes. Habitat categories were pine (>50% of the overstory trees were pine), hardwood (>50% of the overstory trees were oak and hickory), and mixed (>25% of the overstory trees were pine and oak-hickory but neither category alone made up >50%).

RESULTS

We searched 394 forest stands for accipiter nests. All sharp-shinned hawk nests and most (95%) Cooper's hawk nests were found in the Ozark and Ozark border natural divisions. Two Cooper's hawk nests were found in the Osage plains natural division in southwest Missouri.

The first and last dates we observed eggs in sharp-shinned hawk nests in 1985 and 1986 were 30 May and 26 June ($N = 3$) and 5 May and 9 July ($N = 14$), respectively. Sharp-shinned hawks fledged between 12 and 18 July in 1985 ($N = 3$) and between 11 July and 24 August 1986 ($N = 14$). The first and last dates we observed eggs in Cooper's hawk nests were 15 May and 16 July ($N = 17$) in 1985 and 24 May and 25 June ($N = 26$) in 1986. Cooper's hawks fledged between 1 and 28 July 1985 ($N = 17$) and between 24 June and 30 July 1986 ($N = 26$).

The mean clutch size for sharp-shinned hawks pooled across years and habitats was 4.5 ± 0.4 ($\bar{x}$ ± SE; $N = 8$) with a range of 3–6 (Table 1). Means for brood size and young per successful nest pooled for both years and habitats were 3.5 ± 0.6 (range = 1–5, $N = 6$) and 3.2 ± 0.7 (range = 1–5, $N = 5$), respectively (Table 1).

The mean clutch size for Cooper's hawks pooled across years and habitats was 3.8 ± 0.2 (range = 3–5, $N = 12$; Table 1). The pooled mean brood size was 3.5 ± 0.2 (range = 2–5, $N = 23$), and the pooled mean number of young per successful nest was 3.5 ± 0.2 (range = 2–5, $N = 20$). The number of Cooper's hawk young per successful nest was greater ($U = 2.01$, $P = 0.04$) in 1986 than 1985 ($\bar{x}$ = 4.0 ± 0.3 and 3.2 ± 0.2 for 1986 and 1985, respectively). There were no significant differences in clutch and brood sizes between years ($U = 1.81$, $P = 0.07$ and $U = 1.89$, $P = 0.06$, respectively) although both measures were greater in 1986 than 1985 ($\bar{x}$ clutch size = 4.2 ± 0.3 vs. 3.3 ± 0.2 and $\bar{x}$ brood size = 3.9 ± 0.3 vs. 3.2 ± 0.2). Also, there were no significant differences in clutch sizes ($U = -0.35$, $P = 0.73$), brood sizes ($U = 0.17$, $P = 0.87$) or the number of young per successful nest ($U = 0.19$, $P = 0.85$) for Cooper's hawk nests located in pine versus hardwood habitats (Table 1).

DISCUSSION

Nesting chronology and productivity measurements for both species were within the range of values reported in other studies (Bent 1937, Craighead and Craighead 1956, Hennessey 1978, Reynolds and Wight 1978, Lee 1981, Janik and Mosher 1982, Clarke 1984, Henny et al. 1985, Asay 1987). Because no nests were continuously monitored, our nesting dates represent minimum lengths for each nest stage. We are unsure why there were a greater number of Cooper's hawk young reaching banding age in 1986 than 1985. However, temporal changes in prey abundance and weather conditions can result in seasonal variations in productivity (Newton 1979, Asay 1987). We were unable to detect differences in productivity between Cooper's

Table 1. Mean ± standard error (*N*) for three productivity parameters for sharp-shinned hawks and Cooper's hawks in three habitats in Missouri.

		COOPER'S HAWK		SHARP-SHINNED HAWK	
PARAMETER	YEAR	HARDWOOD	PINE	MIXED[a]	PINE
Clutch[b]	1985	3.3 ± 0.3 (3)	3.3 ± 0.3 (3)	—	5.0 (1)
	1986	4.0 ± 0.6 (3)	4.3 ± 0.3 (3)	5.0 (1)	4.3 ± 0.5 (6)
Brood[b]	1985	3.3 ± 0.3 (3)	3.1 ± 0.2 (9)	—	4.0 ± 0.6 (3)
	1986	4.0 ± 1.0 (2)	3.9 ± 0.3 (9)	1.0 (1)	4.0 ± 0.0 (2)
Bandable young[c]	1985	3.3 ± 0.3 (3)	3.1 ± 0.2 (9)	—	3.7 ± 0.9 (3)
	1986	4.0 ± 1.0 (2)	4.0 ± 0.4 (6)	1.0 (1)	4.0 (1)

[a] Mixed pines and hardwoods.
[b] Number of nest checks were insufficient to determine clutch and brood sizes for all nests.
[c] Expressed as the mean number per successful nest. Successful nest = ≥ 1 young ≥ 14 d of age.

hawk nests in pine or hardwood habitats. These two habitats provide similar vertical structure (overstory and understory canopy cover, ground cover, and canopy height); and therefore, might provide similar concealment cover for nests from ground and avian predators (Wiggers and Kritz 1991).

ACKNOWLEDGMENTS

We thank the Missouri Department of Conservation, U.S. Department of Agriculture, Mark Twain National Forest, and the Missouri Department of Natural Resources for providing information, maps, and assistance with the fieldwork. Funding was provided by the Missouri Department of Conservation, Missouri Agricultural Experiment Station, the E. Sydney Stephens Fellowship, and the Missouri Cooperative Fish and Wildlife Research Unit. J. Barber and M. Sutton provided helpful comments on earlier drafts of this manuscript. This is publication 12079 of the Missouri Agricultural Experiment Station.

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Received 20 July 1992; accepted 12 November 1993