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**Nest-site fidelity in Red-headed and Red-bellied woodpeckers.**—Numerous studies demonstrate the propensity for birds to nest at the same location in successive years (Kendeigh 1941, Werth 1948, Austin 1949, Greenwood 1980). Such nest-site fidelity may occur in either migratory (Gauthreaux 1982) or non-migratory (Harvey et al. 1979) species. Studies that substantiate this phenomenon in woodpeckers, however, are relatively few. Jackson (1978, 1987) and Hooper et al. (1980) report that Red-cockaded Woodpeckers (*Picoides borealis*) commonly use the same nest cavities in consecutive years. The Hairy Woodpecker (*P. villosus*), a species whose investment in cavity excavation is less than that of the Red-cockaded Woodpecker, also often returns to the same nest tree (Kilham 1960). Among migratory species, the Northern Flicker (*Colaptes auratus*) and the Yellow-bellied Sapsucker (*Sphyrapicus varius*) exhibit nest-site tenacity (Lawrence 1967). The extent to which Red-headed and Red-bellied woodpeckers (*Melanerpes erythrocephalus* and *M. carolinus*) return to previous nest sites is unclear. Short (1982) suggests that resident Red-headed Woodpeckers may use previously excavated winter roost holes as nests, but mentions nothing of whether migratory individuals return to nest in previously occupied trees. Bent (1939) reports that Red-bellied Woodpeckers often excavate nests in limbs used during a previous year and occasionally nest in the same cavity. The potential effects of European Starling (*Sturnus vulgaris*) competition on woodpecker nest-site fidelity and the extent to which reproductively successful Red-headed and Red-bellied woodpeckers return to previous nest sites is equally ambiguous. Thus, the three objectives of this study were to determine: (1) if either Red-headed or Red-bellied woodpeckers reuse old nest cavities or nest in the same tree or immediate area during consecutive years, (2) whether nest-site fidelity is influenced by the previous reproductive success of returning individuals, and (3) whether starling competition for nest cavities influences whether or not Red-headed or Red-bellied woodpeckers return to previous nest sites.

**Methods.**—From mid-July 1984 through August 1987, adult and juvenile Red-headed and Red-bellied woodpeckers were captured on the Mississippi State Univ. (MSU) campus, the MSU south farm, and in the city of Starkville, in Oktibbeha County, Mississippi. Most frequently, nestlings were taken from nests with the use of a noose (cf. Jackson 1977). Adult birds were captured on nests using a pole equipped with a net on the end. Adult and juvenile woodpeckers were captured away from the nest with the use of a mist net, recordings of woodpecker distress calls, and plastic decoys. Each captured woodpecker was fitted with a U.S. Fish and Wildlife Service aluminum band and a unique color-band combination to permit individual recognition.

To determine the extent to which Red-headed and Red-bellied woodpeckers returned to previous nest sites, I visited such locations in subsequent breeding seasons in search of active nests. If color-banded nesting woodpeckers were not detected in the same tree or immediate area (circular plot of 400 m<sup>2</sup>; radius = 11.3 m), I thoroughly searched a circular plot of approximately one ha around the cavity tree. In addition, I explored new areas in the last three years for other nesting woodpeckers. All observations were made with either a 15–45 zoom spotting scope or 7 × 35 binoculars.

**Results.**—Of 114 Red-headed Woodpeckers color-banded during this study, 45 were banded as adults and 69 as nestlings. No individuals banded as nestlings returned to nest in subsequent years in the same 1-ha circular plot around the cavity tree. Of the 45 adults (all of which nested in areas of starling overlap), 15 returned to nest in the same tree or immediate area (Table 1). The Chi-square test revealed that significantly more Red-headed Woodpeckers returned than would have been expected assuming that individuals were not

TABLE 1  
NEST-SITE FIDELITY OF RED-HEADED WOODPECKER IN 1984-1987 BASED ON 15  
COLOR-BANDED ADULT INDIVIDUALS. A = MALE THAT RETURNED TO A PREVIOUS NEST  
SITE, B = FEMALE THAT RETURNED, C = MATED PAIR THAT RETURNED, AND D =  
INDIVIDUAL OF UNKNOWN SEX THAT RETURNED

Number of years returned	Same cavity	Same tree	Same 400-m <sup>2</sup> plot	Same one-ha plot
1	A, C	A (5) <sup>a</sup> , B	A, D	A (2), D
2	—	A (2)	—	—

<sup>a</sup> Two of these individuals returned to nest in the same one-ha plot in the year prior to the two-year sequence of nesting in the same tree. A third individual nested in the same one-ha plot in the year following the two-year sequence of nesting in the same tree.

nest-site tenacious ( $\chi^2 = 50$ ,  $P < 0.001$ ,  $df = 3$ ). In two instances, banded woodpeckers returned to nest in the same cavity during consecutive years. In six additional instances, either the male or female returned to nest in the same tree during two consecutive years, and in two cases, males returned to nest in the same tree during three consecutive years (Table 1). To a lesser extent I observed adult Red-headed Woodpeckers return to nest in other trees within the same 400 m<sup>2</sup> or one-ha circular plot around the cavity tree in consecutive years (Table 1).

All returning banded Red-headed Woodpeckers had been successful at fledging at least one young during the previous year. Five pairs with at least one color-banded individual successfully reared two broods in one year and a single brood in the other. Five other pairs raised one brood in each of two years. However, at six locations, banded individuals that fledged at least one young did not return to nest in the same area (one-ha circular plot) the following year (at two of these locations the cavity tree was cut down between nesting seasons).

All returning banded Red-headed Woodpeckers nested in areas of starling overlap, although competition for cavities between the two species was minimal (cf. Ingold 1989). Only one pair lost its cavity to starlings. At three locations, pairs with at least one color-marked individual nested concomitantly with starlings in the same tree or pole for two consecutive years (cf. Ingold 1990). One additional pair returned to nest in a tree after having nested simultaneously with starlings in the same tree during the previous year.

Sixty-seven Red-bellied Woodpeckers were color banded during this study. Sixty-one

TABLE 2  
NEST-SITE FIDELITY OF RED-BELLIED WOODPECKERS IN 1984-1987 BASED ON FIVE  
COLOR-BANDED ADULT MALES (A)

Number of years returned	Same cavity	Same tree	Same 400-m <sup>2</sup> plot	Same one-ha plot
1	—	A <sup>a</sup>	—	A (2)
2	—	A	A	—

<sup>a</sup> This male nested in the same one-ha circular plot in the year prior to the two-year sequence of nesting in the same tree.

individuals were banded as nestlings, while only six birds were banded as adults. Red-bellied Woodpeckers in this study were less aggressive than Red-headed Woodpeckers (cf. Ingold 1989) and were difficult to lure into a mist net. In addition, the height and angle of many Red-bellied Woodpecker cavity entrances made it difficult to capture adults on the nest. Of the 61 Red-bellied Woodpeckers banded as nestlings, I detected none that returned to nest within a 400-m<sup>2</sup> circular plot around the cavity tree in which they were reared. However, I located two individuals that nested in the same one-ha circular plot in which they were reared at least two years after they were banded. Of the six individuals banded as adults, five returned to nest in the same tree or immediate area (Table 2). A Chi-square test revealed that significantly more Red-bellied Woodpeckers returned than would have been expected assuming that individuals were not nest-site tenacious ( $\chi^2 = 8.67$ ,  $P < 0.05$ ,  $df = 3$ ). Two of these individuals nested in the same tree for two and three consecutive years, respectively. A third male nested within the same 400-m<sup>2</sup> area for three consecutive years, while two additional males nested in the same one-ha circular plot for two consecutive years (Table 2).

Four of five Red-bellied Woodpecker pairs in which color-banded males returned to the same nest sites were exposed to starling competition. Three of these pairs lost freshly excavated cavities to starlings in two consecutive years. Two of these three pairs fledged young from single nest efforts after starlings were no longer starting nests in at least one of the two years. A fourth pair, exposed to both starling and Red-headed Woodpecker harassment (cf. Ingold 1990), fledged young from at least one brood in each of two years. This particular Red-bellied Woodpecker pair nested simultaneously in the same tree with Red-headed Woodpeckers during the second year (Ingold 1990). The single Red-bellied Woodpecker pair not exposed to starling or Red-headed Woodpecker competition successfully raised two broods in each of the first two years, but lost its brood to a gray rat snake (*Elaphe obsoleta spiloides*) in the third year.

*Discussion.*—One of the selective advantages of nest-site fidelity in birds is that they undoubtedly have an increased and continuing familiarity with local conditions, thus potentially enhancing their reproductive success (Freer 1979, Gavin and Bollinger 1988). My observations of banded woodpeckers suggest that both Red-headed (migratory or semi-migratory) and Red-bellied woodpeckers (resident) often return to nest at specific locations during consecutive years. Nest-site fidelity in Red-headed Woodpeckers appears strong. Red-headed Woodpeckers returned to nest in the same tree, snag, or utility pole during consecutive years more frequently than did Red-bellied Woodpeckers. This may have been due in part to the likelihood that the availability of snags and old poles (in which Red-headed Woodpeckers tend to nest) is limited relative to the availability of dying branches in healthy trees (in which Red-bellied Woodpeckers often nest) (cf. Ingold 1989). In addition, such snags and poles in open areas are more likely to dry out faster and decay more slowly, thus making them habitable for a longer time.

All of the Red-headed Woodpeckers that returned to either the same tree, pole, or one-ha circular plot around such a tree or pole, and 80% of the Red-bellied Woodpeckers that returned, fledged at least one young during the previous year. The results of several studies show that reproductively successful birds (those that fledged at least one young) in a variety of altricial, migratory species tend to return to previous successful breeding locations more often than unsuccessful ones (Shields 1984, Blancher and Robertson 1985, Gavin and Bollinger 1988). Exposure to starling competition during a previous breeding season appeared to have little effect on whether or not individuals of either species returned. Red-headed Woodpeckers experienced minimal starling competition for cavities (cf. Ingold 1989), and all nest-site tenacious pairs had been successful at fledging at least one young during the previous year. However, not all reproductively successful Red-headed Woodpeckers

returned to old nest sites. Herein lies an inherent problem in nest-site fidelity studies most applicable to those with larger sample sizes (cf. Gavin and Bollinger 1988). How does one distinguish between winter bird mortality and an apparent lack of nest-site fidelity? Red-headed birds that were successful at fledging young at given locations appeared to have been influenced by their success when deciding whether or not to return. However, it is difficult to speculate on the extent to which unsuccessful birds failed to return because they were unsuccessful. In addition, because most banded Red-headed Woodpeckers I observed were males, I could not determine the potential effects that sex may have had on Red-headed Woodpecker nest-site fidelity.

Although Red-bellied Woodpeckers observed in this study were exposed to extensive starling competition for nest sites (cf. Ingold 1989), they often returned to nest in the same tree or 400-m<sup>2</sup> circular plot during consecutive years. Twice, male Red-bellied Woodpeckers returned to previous nest sites despite each having lost at least one nest cavity to starlings during the previous season. Although each pair was forced to forego two nesting efforts early in the season, they were both successful in fledging at least one young later in the season. These data suggest that Red-bellied Woodpeckers that are able to fledge at least one young during a given season, regardless of the intensity of starling harassment, may return to the same site the following season. Unfortunately, due to the small sample size of color-banded adult Red-bellied Woodpeckers, I was unable to adequately examine the extent to which unsuccessful nesters showed nest-site tenacity.

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**Yellow-bellied Sapsuckers feeding at Red-cockaded Woodpecker resin wells.**—Yellow-bellied Sapsuckers (*Sphyrapicus varius*) excavate rows of holes into the cambium of various tree species and feed on the exuded sap (Kilham 1956, Tate 1973). Several other species including Red-bellied Woodpecker (*Melanerpes carolinus*), White-breasted Nuthatch (*Sitta carolinensis*), Tufted Titmouse (*Parus bicolor*), and Ruby-throated Hummingbird (*Archilochus colubris*) have been observed feeding at sapsucker excavations (e.g., Foster and Tate 1966; Kilham 1953, 1958, 1983; Southwick and Southwick 1980). We have observed typical sapsucker feeding excavations in longleaf (*Pinus palustris*), loblolly (*P. taeda*), and shortleaf (*P. echinata*) pines near Red-cockaded Woodpecker cavity trees. Red-cockaded Woodpeckers (*Picoides borealis*) consistently excavate resin wells adjacent to their roost and nest cavities (Ligon 1970, Dennis 1971). The resin exuded from these wells is an effective barrier against predation by rat snakes of the genus *Elaphe* (Rudolph et al. 1990). To our knowledge there are no published observations of Red-cockaded Woodpeckers or other avian species feeding on the exudates of these resin wells. However, we have observed Red-cockaded Woodpeckers removing drops of resin from cavity entrances and their immediate vicinity on numerous occasions. Resin drops were either released with a rapid flick of the head or wiped on bark surfaces, often on an adjacent tree.

Twice we have observed interactions between resident Red-cockaded Woodpeckers and wintering Yellow-bellied Sapsuckers that focused on the Red-cockaded Woodpecker roost cavity and the associated resin wells. At 10:15 EST on 27 October 89, a male sapsucker landed at the entrance of a Red-cockaded Woodpecker's roost cavity in a longleaf pine. The