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Effects of radio transmitters on the behavior of Red-headed Woodpeckers

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ABSTRACT. Previous studies have revealed that radio-transmitters may affect bird behaviors, including feeding rates, foraging behavior, vigilance, and preening behavior. In addition, depending on the method of attachment, transmitters can potentially affect the ability of cavity-nesting birds to use cavities. Our objective was to evaluate effects of transmitters on the behavior of and use of cavities by Red-headed Woodpeckers (*Melanerpes erythrocephalus*). Using backpack harnesses, we attached 2.1-g transmitter packages that averaged 3.1% of body weight (range = 2.5–3.6%) to Red-headed Woodpeckers. We observed both radio-tagged ($N = 23$) and nonradio-tagged ($N = 28$) woodpeckers and determined the percentage of time spent engaged in each of five behaviors: flight, foraging, perching, preening, and territorial behavior. We found no difference between the two groups in the percentage of time engaged in each behavior. In addition, we found that transmitters had no apparent effect on use of cavities for roosting by radio-tagged woodpeckers ($N = 25$). We conclude that backpack transmitters weighing less than 3.6% of body weight had no impact on either their behavior or their ability to use cavities.

SINOPSIS. **Efectos de radio transmisores en el comportamiento de *Melanerpes erythrocephalus***

Estudios anteriores han revelado que radio transmisores pueden afectar el comportamiento de las aves, incluyendo tazas de alimentación, comportamientos de búsqueda de alimento, vigilancia, y acicalamiento. Adicionalmente, dependiendo del método de colocación, los transmisores pueden potencialmente afectar la habilidad del uso de las cavidades por parte de las aves que anidan en cavidades. Nuestro objetivo fue evaluar los efectos de los transmisores en el comportamientos y uso de las cavidades por *Melanerpes erythrocephalus*. Usando arneses en forma de mochila, pegamos radio transmisores de 2.1-g que promediaron 3.1% del tamaño corporal (rango = 2.5–3.6%) de *Melanerpes erythrocephalus*. Observamos carpinteros con radio transmisores ($N = 23$) y sin radio transmisores ($N = 28$) y determinamos el porcentaje del tiempo que pasaron en cada uno de los cinco comportamientos: vuelo, buscando alimento, perchado, acicalándose, y comportamiento territorial. No encontramos diferencias entre dos grupos en el porcentaje de tiempo que pasaron realizando cada comportamiento. Adicionalmente, encontramos que los transmisores no tienen un efecto aparente en el uso de cavidades para dormir por parte de los carpinteros que tenían radio transmisores ($N = 25$). Concluimos que los transmisores tipo mochila que pesan menos de 3.6% del peso corporal del ave no tienen impacto en el comportamiento o en la habilidad de usar cavidades por parte de *Melanerpes erythrocephalus*.

Key words: behavior, cavity, effects, *Melanerpes erythrocephalus*, radio-transmitters, roosting

Radio-transmitters can provide useful information about movement patterns, habitat use, and survival that would often be difficult or impractical to obtain by other means, but they may also have adverse effects on birds. In addition to impacts on flight (Gessaman and Nagy 1988, Hooge 1991), survival (Marks and Marks 1987, Cotter and Gratto 1995), and reproductive success (Foster et al. 1992, Whidden et al. 2007), several investigators have reported that transmitters may affect behavior, including feeding rates, foraging behavior, vigilance, and preening (Massey et al. 1988, Hooge 1991, Pietz et al. 1993, Ritchison 1997, Bowman and Aborn 2001). However, effects may vary with the transmitter weight and attachment method, and some transmitter packages reportedly have little or no apparent effect on bird behavior (Nesbitt et al. 1982, Hooge 1991, Bowman and Aborn 2001, Woolnough et al. 2004). In light of this uncertainty, we examined the possible effects of transmitters on the behavior of Red-headed Woodpeckers (*Melanerpes erythrocephalus*).

Transmitter-attachment methods reported as effective for woodpeckers include tail-mounts (i.e., glued to central rectrices; Pasinelli 2000, Wiktander et al. 2000, Covert-Bratland et al. 2007), leg-loop harnesses (Robles et al. 2007), and backpack harnesses (Nesbitt et al. 1982, Bull et al. 1992). However, backpack harnesses

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can potentially affect the ability of woodpeckers and other cavity-nesting birds to use cavities. For example, Rolstad and Rolstad (1995) used backpack harnesses to attach transmitters to seven Great Spotted Woodpeckers (*Dendrocopos major*) at four active nests and found that one male had difficulty exiting his nest cavity and two nests were abandoned. Although acknowledging that abandonment may have been due to the stress of capture rather than the transmitters, these authors suggested that backpack transmitter packages might limit cavity ingress and egress. In contrast, Bull et al. (1992) used backpack harnesses on 22 Pileated Woodpeckers (*Dryocopus pileatus*) and always found them roosting in cavities ($N = 443$ monitoring attempts), suggesting no effect of harnesses on cavity use. Additional work is needed to determine if backpack harnesses affect the ability of medium-sized woodpeckers to use cavities. Thus, another objective of our study was to examine the possible effects of backpack transmitters on the use of cavities by Red-headed Woodpeckers.

METHODS

Our study was conducted on the Savannah River Site, a 78,000-ha National Environmental Research Park in Aiken and Barnwell counties, South Carolina. Our study sites were mature (50–60 yr old) loblolly pine (*Pinus taeda*) forests with scattered hardwoods (e.g., *Quercus* spp. and *Carya* spp.) and many standing dead trees. Midstories were open and understory conditions ranged from sparse grass to dense shrub cover.

We captured Red-headed Woodpeckers during May–August in 2005–2007 using ground-level and elevated (10–20 m high) mist nets (3 × 12 m, 3 × 20 m, and 9 × 30 m; 38-mm mesh), and, at cavities, using a telescoping pole (12 m) with a net attached. To elevate nets into the midstory and canopy, we cast the fishing line with an 85-g lead weight over the upper branches of pine trees, attached 0.64-cm nylon rope to the fishing line, and pulled the rope over the limb. We then attached mist nets to the suspended ropes.

We weighed and aged (Pyle 1997) captured woodpeckers and banded them with a USGS aluminum band and color bands to facilitate individual identification. Because Red-headed Woodpeckers cannot be sexed in the hand (Pyle 1997), we collected breast feathers for DNA-sexing (conducted by Avian Biotech International, Tallahassee, FL). Using a 1-mm elastic string as the harness material, we attached a 1.9-g transmitter (16-week battery life; Holohil Systems, Ltd., Carp, ON, Canada) to woodpeckers using a backpack harness. This was passed through mounting tubes on the anterior and posterior ends of the transmitter and around the bird's wings. To ensure stability and limit transmitter movement, we used hollow aluminum crimping beads, crimped at the opening of each mounting tube. We used a standard harness size for all birds, with 39 mm of exposed elastic string on each side. The transmitter–harness package weighed 2.1 g. We did not radio-tag both members of a pair.

We observed both radio-tagged ($N = 23$) and nonradio-tagged ($N = 28$) woodpeckers during the breeding seasons (May–August) of 2006 and 2007. We observed each individual only once. We relocated radio-tagged woodpeckers by homing, using receivers (Telonics, Mesa, AZ) with H- or 3-element yagi antennas. Non-radio-tagged birds had not been captured and, therefore, had no markers for individual identification. Eleven of the nonradio-tagged birds observed were mates of radio-tagged birds whose territory boundaries and nest locations were known, thus allowing us to avoid repeat observations on these individuals. For the remaining 17 nonradio-tagged birds, we avoided repeat observations of the same individual by locating birds in different areas (territories) at least 200 m apart (the mean diameter of woodpecker territories in our study was 190.6 m, unpubl. data). We made observations throughout the day (07:30–18:00), and maintained a distance of about 20–30 m from focal birds to avoid influencing their behavior. After locating a bird, we maintained visual contact as long as possible for up to 60 min. If visual contact was lost, we attempted to relocate the bird and, if successful, resumed observation. However, the total duration of observation sessions for any bird from first visual contact until last, including search time, was limited to 2 h. For each bird, we summed all observation time, including only continuous direct observations of at least 2 min. We then included in our sample only birds with a total observation time of at least 5 min.

During observations, we described all behaviors and movements using a microcassette

or digital sound recorder. Behaviors included (1) perching (sitting, resting, and vigilance), (2) flying, (3) foraging (fly-catching, climbing, pecking, feeding, and eating), (4) preening, and (5) territorial behavior (vocalizing, drumming, and interactions with conspecifics). Interactions with conspecifics included territorial defense (e.g., chasing and other aggressive behaviors) and interactions with mates (e.g., courtship and copulation). We transcribed behaviors and recorded times using a stop watch. If the duration of a behavior was less than 1 s, we rounded up to the full second. For each bird observed, we determined the proportion of time engaged in each behavior. We transformed the data (arcsine) and used equal variance *t*-tests to compare the proportion of time radio-tagged and nonradio-tagged birds spent engaged in each behavior.

Due to the difficulty of observing nonradio-tagged woodpeckers at dusk, we were unable to compare the cavity use of radio-tagged and nonradio-tagged woodpeckers. However, we examined the use of roost sites by radio-tagged woodpeckers ($N = 25$) to determine if transmitters affected their ability to enter and use cavities. From July to September 2005, we located birds at night by homing. We conducted night checks during the period from 1 h after official sunset until 02:00. We checked each bird for one to four nights for a total of 62 checks. The first check on each bird was no sooner than the second night after capture, but was at least 1 week postcapture for most birds ($N = 21$) and averaged 20 days postcapture.

Three woodpeckers apparently flew from their roost sites as we approached, and we were unable to determine their roost locations. For birds that did not flush, we assumed that those tracked to snags with cavities were in the cavity and those tracked to live trees were not in a cavity. Although Red-headed Woodpeckers use cavities in dead portions of live trees (Smith et al. 2000), all cavities used by birds in our study were in pine trees. Large dead branches or snags on live loblolly pine trees are rare due to the pattern of self-pruning in the species. In addition, we observed several birds at dusk that settled, apparently for the night, on live branches and remained there until darkness precluded further observation. Nevertheless, for any bird determined to be in a live tree, we subsequently returned during daylight to confirm that no cavity was present. To assess cavity use by radio-tagged birds, we determined the percent of times each was found roosting in a cavity, and we report mean percentages among birds.

RESULTS

During 2006–2007, we captured and radio-tagged 23 Red-headed Woodpeckers ($N = 14$ males and 9 females). The mean mass of captured woodpeckers was 68.2 ± 1.2 (SE) g and transmitters averaged 3.1% (range = 2.5–3.6%) of woodpecker body mass.

We observed 51 Red-headed Woodpeckers ($N = 28$ nonradio-tagged woodpeckers; $N = 23$ radio-tagged woodpeckers) for a total of 1127.4 min. Total observation time for nonradio-tagged woodpeckers was 568.9 min (mean per bird = 24.3 ± 2.2 [SE] min) and for radio-tagged woodpeckers was 558.5 min (mean per bird = 20.3 ± 2.0 [SE] min). Of 34 known-sex birds (23 radio-tagged, and 11 mates of radio-tagged), 19 were male and 15 were female, and all but 3 had active nests or fledglings. We found no differences between radio-tagged and nonradio-tagged woodpeckers in the proportion of time spent in any behavior (perching: $t_{48} = 0.1$, $P = 0.93$; flying: $t_{48} = 0.3$, $P = 0.70$; foraging: $t_{47} = 0.01$, $P = 0.99$; preening: $t_{48} = 1.4$, $P = 0.18$; territorial behavior: $t_{32} = 0.9$, $P = 0.41$; Fig. 1).

During 2005, we captured and radio-tagged 25 Red-headed Woodpeckers to examine the use of roost sites. These included 16 males (12 breeding and 4 nonbreeding) and 7 females (6 breeding and 1 nonbreeding). Insufficient DNA was obtained from two birds (one breeding and one nonbreeding) to determine sex. All nonbreeding woodpeckers were second-year birds and all breeding woodpeckers were after-second-year birds. Mean incidence of cavity use by breeding woodpeckers (75.0%; $N = 40$ checks of 19 birds) was greater than that by nonbreeding woodpeckers (19.5%; $N = 20$ checks of six birds), and cavity use by breeding males (95.8%; $N = 24$ checks of 12 birds) was greater than that by breeding females (29.2%; $N = 12$ checks of 6 birds). All breeding males roosted in their nest cavity during at least one check. Nonbreeding males were found in cavities 29.5% of the time, whereas the single nonbreeding female was never found roosting in a cavity ($N = 4$ checks).

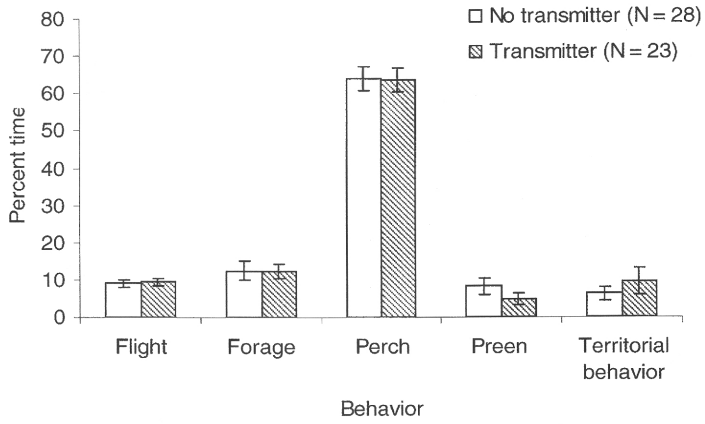

Fig. 1. Mean (±SE) proportion of time engaged in five behaviors by radio- and nonradio-tagged Red-headed Woodpeckers on the Savannah River Site, South Carolina, 2006–2007.

DISCUSSION

Our results indicate that backpack transmitters did not affect the behavior of Red-headed Woodpeckers. We found no differences in the proportion of time spent by woodpeckers with and without transmitters in any behavior. Foraging, preening, and flying are behaviors most often affected by transmitters. For example, Florida Scrub-jays (*Aphelocoma coerulescens*) with backpack transmitters spent less time foraging than jays without transmitters (Bowman and Aborn 2001). Among woodpeckers, Hooge (1991) reported that Acorn Woodpeckers (*Melanerpes formicivorus*) with transmitters spent less time flycatching, working acorn stores, flying, and moving, but more time eating, sitting, and preening than birds without transmitters. Similarly, Ritchison (1997) reported that Downy Woodpeckers (*Picoides pubescens*) with transmitters spent less time engaged in high-energy behaviors (flying, moving, drumming, pecking, and calling) than birds without transmitters. However, effects were limited to transmitters that were at least 4.5% of body weight (5.1–5.9%, Hooge 1991; 4.5%, Ritchison 1997). When transmitters were 4% or less of body weight (3.5–3.9%, Hooge 1991; 3.5–4.0%, Ritchison 1997), no impacts were evident. Such results are consistent with those of our study because transmitters we used were 2.5–3.6% of the body weight of Red-headed Woodpeckers.

Although we did not compare the effects of different attachment methods, backpack harnesses appeared to be a suitable attachment method for Red-headed Woodpeckers. Hooge (1991) found that transmitters attached to Acorn Woodpeckers using glue did not influence their behavior. However, Acorn Woodpeckers with the same transmitters attached using a backpack harness spent less time in flight and flycatching and more time preening and sitting, indicating that the harnesses did impact their behavior (Hooge 1991). However, the harness used by Hooge (1991) had wing loops sewn together over the breast. No part of the harness used in our study crossed over the breast, possibly limiting irritation caused by the harness. In addition, the added weight of the harness material used by Hooge (1991) might have increased total package weight above the impact threshold. Regardless of possible reasons for differences between our results and those of Hooge (1991), Red-headed Woodpeckers in our study did not appear affected by the presence of transmitters. Thus, we believe that our results, in combination with those of previous studies (Hooge 1991, Ritchison 1997), indicate that transmitters weighing less than 4% of body weight and attached with wing-loop backpack harnesses do not affect behavior and are, therefore, appropriate for use on medium-sized woodpeckers.

In apparent contrast to Great Spotted Woodpeckers (Rolstad and Rolstad 1995), radio

transmitters did not prevent Red-headed Woodpeckers in our study from entering cavities. Rather, nighttime cavity use by Red-headed Woodpeckers appeared to be influenced more by sex and breeding status than by radio transmitters. Most breeding males in our study were found in nest cavities during night checks, whereas breeding females and nonbreeding birds of both sexes usually did not roost in cavities. Similarly, Jackson (1976) reported that male Red-headed Woodpeckers incubate or brood young at night, and that some individuals are known to occasionally roost outside of cavities (J. Jackson, pers. commun.). Although little is known about the differential use of cavities by male and female Red-headed Woodpeckers, we believe that the low incidence of nighttime cavity use by breeding females was not due to the presence of transmitters because we saw females with transmitters entering cavities regularly during the day to incubate, brood, and provision nestlings (pers. observ.). Because we did not examine cavity use by nonbreeding woodpeckers without transmitters, we cannot rule out the possibility that cavity use by nonbreeding birds might have been affected by transmitters. However, transmitters did not affect the ability of Red-headed Woodpeckers in our study to enter cavities for brood-rearing activities. Because the behavior and cavity use of Red-headed Woodpeckers were not affected by transmitters in our study, we suggest that their survival and reproduction might have been similarly unaffected. However, an additional study is needed to test this hypothesis.

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