

RADIO TRANSMITTERS DO NOT AFFECT NESTLING FEEDING RATES BY FEMALE HOODED WARBLERS

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Abstract.—Few studies have examined the effects of radio transmitters on behavior, particularly of small passerines. Only recently have transmitters been made small enough for use on birds under 20 g. To determine if radio transmitters reduce activity levels, female Hooded Warblers (*Wilsonia citrina*) were fitted with transmitters while they were feeding nestlings. Females with transmitters and harnesses weighing 7–8.5% of body mass did not feed nestlings less frequently than did control females. Males mated to females with transmitters did not feed nestlings at different rates from males mated to control females. Brooding time and time spent perched on the edge of the nest did not differ significantly between tagged and control females. The finding that transmitters did not affect an energetically demanding activity such as feeding young suggests that other aspects of female behavior also were not adversely affected.

USO DE RADIOTRANSMISORES NO AFECTA LA TASA DE ALIMENTACIÓN DE PICHONES POR PARTE DE HEMBRAS DE *WILSONIA CITRINA*

Sinopsis.—Pocos estudios han examinado los efectos de radiotransmisores en la conducta de pequeños paserinos. Tan sólo recientemente los radiotransmisores se han hecho lo suficientemente pequeños para ser utilizados en aves de peso menor a los 20 g. Para determinar si los radiotransmisores reducen los niveles de actividad se le colocaron a hembras de *Wilsonia citrina* transmisores mientras éstas estaban alimentando a pichones. Hembras con arneses y transmisores cuyo peso resultó ser el equivalente entre 7–8.5% de su masa corporal no alimentaron a sus pichones con menor frecuencia que el grupo control. La pareja (machos) de las aves con transmisores tampoco alimentaron a los pichones con menor frecuencia que las parejas del grupo control. El tiempo de cubrir a los pichones, y el que pasaron posados en el borde del nido no fue significativamente diferente entre el grupo control y el experimental. El hecho de que los radiotransmisores no afectaron actividades de alta demanda energética (como alimentar a los pichones) en estas aves sugiere que otros aspectos de la conducta de las hembras tampoco fue afectada adversamente.

Radio-tracking is useful for the study of animals that are shy or elusive. However, caution must be used when employing these techniques because radio transmitters may influence behavior (Kenward 1987). Some studies have demonstrated adverse effects of radio transmitters on birds including a reduction in flying (Hooge 1991), courtship behavior (Ramakka 1972), flight speed (Gessaman and Nagy 1988, Gessaman et al. 1991), foraging (Massey et al. 1988, Perry 1981), reproductive success (Croll et al. 1996), and nesting behavior (Massey et al. 1988) whereas other studies have shown minimal negative effects (e.g., Brigham 1989, Gilmer et al. 1974, Hill and Talent 1990, Morris and Burness 1992). In order to determine if transmitters adversely affect behavior, the study animal must be observed with and without the transmitter. However, the precise reason a radio-tracking study is undertaken is to explore behavior that is difficult to otherwise observe. One way to determine if transmitters negatively

affect an animal is to examine an aspect of behavior that can be observed easily with or without the use of transmitters. Although not flawless, this method can show whether an animal functions within normal parameters in at least one aspect of behavior.

Hooded Warblers (*Wilsonia citrina*) are small (11 g) songbirds that breed in the eastern United States. Female Hooded Warblers are secretive and difficult to follow without the use of radio transmitters. In order to determine if females were affected adversely by transmitters, we examined nestling feeding rates, time females spent perched on the nest, and brooding time of females with and without transmitters. Feeding rates of females to their nestlings is easily observable and should be a good indicator of female physical condition.

METHODS

We conducted this study in Crawford County, Pennsylvania, USA (41°N, 79°W) from May–July of 1994 and 1995 as part of a larger study of the mating system of Hooded Warblers. The study site consisted of a 100-ha area of mixed hardwood forest where approximately 40 pairs of Hooded Warblers breed annually. We caught birds in mist nets and banded them with U.S. Fish and Wildlife aluminum bands and unique combinations of colored leg bands as they arrived on the study site in early May. Territories were mapped using mist-netting data, observations, and playbacks of male song. We found nests at the building stage whenever possible and monitored them through fledging or until they were depredated.

Female Hooded Warblers were caught with mist nets and fitted with Holohil BD-2A (0.8 g) or BD-2B (0.67 g) radio transmitters when nestlings were 3–5 d of age. We attached transmitters to females via a figure-8 harness made from flexible, light-weight tubing (see Rappole and Tipton 1991, for details of harness construction and attachment). We fitted the loops of the harness over the bird's legs so that the transmitter rested on the synsacrum. Transmitters had a 14-cm whip antenna angled slightly upward from the bird's tail. Total handling time of each bird was usually under 10 min. Transmitter and harness together weighed 7–8.5% of female body mass. Transmitters were not activated because we were interested in monitoring possible effects on female behavior rather than tracking female movements. We radio-tagged females the day before we conducted nestling feeding observations so the birds would have at least 24 h to become accustomed to the transmitter. We removed the transmitter within 3 d of completion of observations. None of the 9 tagged individuals in the present study or any of the 13 females radio-tagged in a previous study (Neudorf 1996) exhibited obvious physical injuries such as abrasions or feather wear from the presence of the transmitter or harness. As a control we observed feeding rates at nests where females were not radio-tagged ($n = 9$). We conducted a paired analysis to control for potentially confounding variables. Each pair consisted of a radio-tagged female and a control female at the same time in the season with the same number of nestlings of the same age. We did not deliberately catch and handle

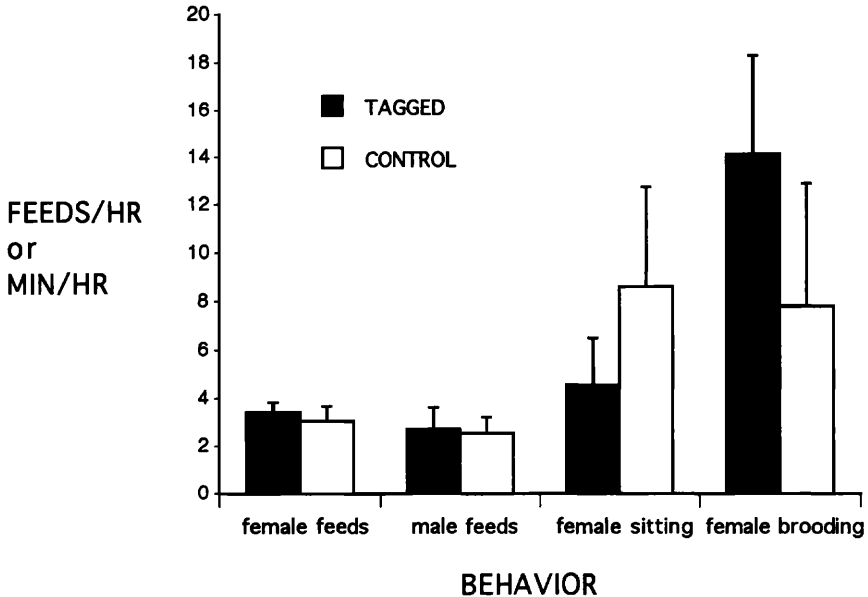


FIGURE 1. Comparison of behaviors ($\bar{x} \pm SE$) at nests of control and radio-tagged females ($n = 18$ nests). Female and male feeding rates were measured as the number of feeding trips per hour whereas sitting on the nest edge and brooding young were measured as the number of minutes per hour that females engaged in these behaviors.

the control females the day prior to video taping. However, all females were caught and handled during banding at least once prior to the experiment.

We recorded feeding trips and brooding behavior using JVC Super VHS (GR-SX90U) video cameras placed 1–2 m from Hooded Warbler nests for a continuous period of 3–5 h. Video tapes and batteries were changed every hour. We obtained feeding rates at nests where the young were 4–6 d of age and most of our observations took place in the afternoon between 1100 and 1700 h EST. From the video tapes we obtained the number of feeding visits to the nest by both parents and the amount of time females spent perched on the nest or brooding.

RESULTS AND DISCUSSION

Radio transmitters did not affect the rates that female Hooded Warblers fed nestlings over the short term. We found no significant difference in the nestling feeding rates of radio-tagged ($n = 9$) and control females ($n = 9$) (Fig. 1; Wilcoxon signed-rank test, $P = 0.55$). Furthermore, feeding rates were within the range of those determined previously for this species (Stutchbury et al. 1994). Male feeding rates were not affected by whether or not their mate was wearing a radio transmitter (Fig. 1; Wilcoxon signed-rank test, $P = 0.77$).

If females were stressed from wearing transmitters they may be expected to spend more time at the nest resting or brooding young. Pietz et al. (1993) found that Mallards (*Anas platyrhynchos*) with transmitters spent more time resting and less time feeding than control females. However, time spent sitting on the edge of the nest did not differ between control and radio-tagged Hooded Warbler females (Fig. 1; Wilcoxon signed-rank test, $P = 0.40$). Radio-tagged females showed a tendency to brood nestlings more than control females, although this difference was not significant (Fig. 1; Wilcoxon signed-rank test, $P = 0.16$).

Some studies have reported abandonment of nests in response to radio-tagging (e.g., Massey et al. 1988) whereas others have found minimal negative effects of transmitters on reproduction (e.g., Hill and Talent 1990). No females in our study abandoned their nests after they were radio-tagged. For the 16 nests that were monitored to completion, tagged and control females fledged similar numbers of young (control $\bar{x} = 3$, tagged $\bar{x} = 2.6$) and experienced similar levels of predation (1 of 8 control nests, 2 of 8 tagged nests).

We used transmitters that were 7–8.5% of Hooded Warbler body mass which exceeds the suggested maximum of 5% (Aldridge and Brigham 1988). Aldridge and Brigham (1988) showed experimentally that the addition of weight reduced maneuverability of bats (*Myotis yumanensis*), which could affect their foraging efficiency. However, few studies have tested the effects of radio transmitters on the foraging efficiency of small volant vertebrates (e.g., Brigham 1989, Hickey 1992). Lighter transmitters are always preferable, but depending on the species and type of study we suggest exceeding 5% may be acceptable. Sykes et al. (1990) found no negative impact of transmitters weighing 8% of body mass on flying, feeding, hopping and interacting behaviors in captive Common Yellowthroats (*Geothlypis trichas*).

Radio-tracking techniques provide opportunities for more intense study of several aspects of songbird behavior, particularly in the area of mating systems. For example, radio transmitters can be used to monitor males and females in the pursuit of extra-pair copulations (Chandler et al. 1994, Neudorf 1996). We conclude that nestling feeding rates of female Hooded Warblers were not adversely affected by radio tags over the short term. Females were able to maintain a physically demanding behavior despite the presence of a transmitter, supporting the assumption that other behaviors such as territory defense and the pursuit of extra-pair copulations are also not likely to be affected. However, more studies of the impact of radio tags on small flying vertebrates are necessary in order to detect potential adverse effects on behavior.

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