

## EFFECTS OF BACK-MOUNTED RADIO PACKAGES ON BREEDING WOOD DUCKS

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**Abstract.**—The effects of back-mounted radio transmitters on reproductive effort and return rates of pre-nesting pairs and incubating female Wood Ducks (*Aix sponsa*) were investigated. Twenty of 22 pre-nesting pairs remained together after capture and radio-marking, but only two females from radio-marked pairs attempted to incubate, and none were captured in nest boxes during the subsequent 2–3 breeding seasons. Nest success, duckling survival and return rates did not differ significantly between a sample of females radio-marked during incubation and those leg-banded only, but statistical power was low (0.11–0.32). Detrimental effects of back-mounted radio transmitters may preclude their use in studies of pre-nesting Wood Duck pairs, but back-mounted transmitters appear to have minimal effects on incubating and brood-rearing females.

### EFFECTO DE RADIOTRANSMISORES MONTADOS EN LA ESPALDA, EN LA REPRODUCCIÓN DE *AIX SPONSA*

**Sinopsis.**—Se estudió el efecto de radiotransmisores montados en la espalda en el esfuerzo reproductivo y tasa de regreso de parejas por anidar y hembras incubando de *Aix sponsa*. Un total de 22 parejas de patos que estaban por anidar permanecieron unidos luego de ser capturados y equipados con radiotransmisores, pero sólo dos hembras intentaron incubar, y ninguna fue capturada en cajas de anidamiento durante las 2–3 épocas de anidamiento subsiguientes. El éxito de anidamiento, supervivencia de los patitos y la tasa de regreso no se diferenciaron significativamente entre una muestra de hembras con radios, marcadas durante la incubación, y hembras que tan sólo fueron anilladas durante el mismo período (aunque el poder estadístico fue bajo [0.11–0.32]). Los radiotransmisores montados en las espaldas parecen tener un efecto mínimo en hembras que incuban o que crían patitos. No obstante, parecen tener un efecto detrimental en parejas por anidar.

Waterfowl studies commonly involve radiotelemetry, because anatids often are highly mobile, secretive and/or use densely vegetated habitats, precluding direct observation. For example, pair bond length, habitat use, and movements of pre-nesting Wood Ducks (*Aix sponsa*) are difficult to determine (Fredrickson 1990), but radio-tracking both members of pre-nesting pairs may provide this information. Similarly, Wood Duck brood habitat use, movements and survival have been studied by tracking radio-marked females during brood-rearing (Ball et al. 1975, David 1986, Robb and Bookhout 1990). Radio packages may influence waterfowl behavior, survival and reproduction, however, and these effects may vary with type of transmitter (Houston and Greenwood 1993, Pietz et al. 1993, Rotella et al. 1993). We describe reproductive effort of Wood Duck pairs marked with back-mounted radio packages prior to nesting, and we compare nest success, duckling survival, and return rates between females

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marked with back-mounted radio packages during incubation and females without radio packages.

#### METHODS

We conducted the study in Mingo Swamp (36.95°N, 90.15°W) in southeastern Missouri (Heitmeyer and Fredrickson 1990). In March and April 1988 and 1989, we captured Wood Duck pairs in decoy traps ( $n = 4$ ) (Sharp and Lokemoen 1987) and rocket nets ( $n = 18$ ) (Day et al. 1980). We placed decoy traps where pairs were previously observed, and we verified pair bonds of birds captured with rocket nets through observations of behavioral displays (Fredrickson 1990). We weighed, banded (U.S. Fish and Wildlife Service leg-bands, permit #09673), radio-marked, and released captured pair members simultaneously at the capture site. We attached a 16–19 g back-mounted (Dwyer 1972) radio package to each bird, and we located each pair twice daily using telemetry.

We checked nest boxes in Mingo Swamp ( $n = 241$ – $244$ ) throughout the nesting season (April–August), and recorded nest success ( $\geq 1$  egg hatched in successful nests) for each nest. We leg-banded all unbanded females captured in nest boxes, and in 1988 and 1989 we radio-marked a random sample of incubating, leg-banded females ( $n = 74$ ), including yearlings and older birds, females using nest boxes placed throughout Mingo Swamp, and early- and late-nesting females. We continued nest box checks in 1990 and 1991. The proportion of females we recaptured in nest boxes in subsequent years provided a measure of survival and philopatry (return rate) for leg-banded females with and without radio packages.

For radio-marked broods, we estimated duckling survival by dividing the number of ducklings surviving to age class II (Bellrose 1980) by the number of ducklings present at hatch. For unmarked broods, we divided the number of class II ducklings by the mean brood size at hatch in the unmarked population. We did not count unmarked broods of similar age and size inhabiting the same wetland as individual broods unless we observed them simultaneously. We excluded from survival estimates broods of radio-marked females that did not survive to age class II, because we could not account for total brood losses by unmarked females.

We used two-tailed  $t$ -tests on arcsine-transformed data to compare duckling survival, and chi-squared tests of independence to compare nest success and return rates between radio-marked and unmarked females (SAS Institute, Inc. 1989). We estimated statistical power for all tests at a significance level (type I error) of 0.10, using procedures and tables in Cohen (1977).

#### RESULTS AND DISCUSSION

*Pre-nesting pairs.*—Twenty of 22 radio-marked pre-nesting pairs remained together for 15–90 d following release ( $\bar{x} = 28.4 \pm 18.5$  SE). Only two of these females, however, incubated clutches, one of which was already laying when captured (we could not determine whether other

TABLE 1. Reproductive variables and return rates (percentages) for leg-banded female Wood Ducks captured during incubation, with and without radio packages. Sample sizes are in parentheses.

Variable	Year	Radio-marked	Unmarked	<i>P</i>	Power
Nest success	1988	90.0 (40)	93.3 (75)	0.32	0.28
	1989	91.7 (34)	94.3 (106)	0.69	0.32
Duckling survival	1988	50.2 (13)	52.5 (21)	0.84	0.11
	1989	54.2 (16)	51.5 (34)	0.98	0.12
Return rate	1988	60.0 (40)	54.7 (75)	0.58	0.28
	1989	41.2 (34)	44.3 (106)	0.75	0.32

females were laying, but none had incubation brood patches). We could not compare our results for radio-marked pairs to a control group, because we had no way to determine pair-bond length or nesting effort by unmarked pairs. Our results suggest, however, that radio-marking both members of pre-nesting pairs may adversely affect Wood Duck breeding effort. Similar results occurred in a Minnesota study, where Wood Duck "pairs" marked with back-mounted radio packages separated after release, with some forming new pair bonds and others leaving the study area (Gilmer et al. 1974). In contrast, when male pair members were not radio-marked in Illinois (David 1986) and Indiana (Robb and Bookhout 1990) studies, pre-nesting females that were captured and marked with back-mounted transmitters nested successfully.

We did not recapture any females from radio-marked pairs in nest boxes during the subsequent 2–3 breeding seasons. Densities of suitable natural nest cavities are low in Mingo Swamp (Weier 1966; pers. observ.), and most Wood Duck nesting occurs in nest boxes, so it is unlikely that we would not recapture any of these females that returned to nest during subsequent breeding seasons.

*Incubating females.*—We found no differences in nest success, duckling survival, or return rates between unmarked female Wood Ducks and those we radio-marked during incubation, but power was low for all comparisons (Table 1). Duckling survival was also similar among radio-marked and unmarked females in a Minnesota study of Wood Ducks and Mallards (*Anas platyrhynchos*; Ball et al. 1975). Return rates of incubating females radio-marked in 1988 were actually slightly higher than females in the unmarked population (Table 1). Most (72%) recaptured females lost their radio packages between the end of brood-rearing and the next year's breeding attempt; such losses likely minimized any potential adverse impacts of radio packages.

*Implications for telemetry studies.*—We caution against radio-marking both members of pre-nesting Wood Ducks, although further experimental information is needed on the specific detrimental effects of back-mounted radio packages during this period (e.g., interference with courtship displays or copulation). When information on both sexes of pre-nesting pairs is a

study objective, we suggest that methods other than radiotelemetry, or other types of radio packages, such as implants (Rotella et al. 1993), be considered. In contrast, back-mounted transmitters placed on incubating females appeared to have minimal impacts on subsequent reproductive success and survival, but losses of back-mounted radio packages may limit collection of telemetry data beyond the brood-rearing period.

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