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# EVALUATION OF A RADIO TRANSMITTER FOR WOOD DUCK DUCKLINGS

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Abstract.—Studies of radio-marked ducklings are few, and none have examined the effect of radio transmitters on survival and body mass of Wood Duck (*Aix sponsa*) ducklings. We evaluated the effect of 1.6-g prong transmitters on survival and mass of captive reared, wild-strain Wood Duck ducklings during their first 2 wk of life. No differences in either survival ($P > 0.9$) or body mass ($0.20 \leq P \leq 0.34$) were detected between radio-marked and unmarked ducklings. This transmitter and attachment method seem to be a viable technique for radio-marking free-ranging Wood Duck ducklings.

**EVALUACIÓN DE RADIOTRANSMISORES EN PATITOS (*AIX SPONSA*)**

Sinopsis.—Se han hecho pocos estudios de radiotelemetría en patitos, y ninguno ha examinado el efecto de los transmisores en la supervivencia y la masa corporal de patitos de *Aix sponsa*. Evaluamos, durante las primeras dos semanas de vida, el efecto de transmisores de 1.6 g. en la supervivencia y el cambio en peso de patitos criados en cautiverio pero de padres silvestres. No se encontró diferencia entre el periodo de supervivencia ($P > 0.9$) y cambio en masa corporal ($0.20 \leq P \leq 0.34$) entre el grupo experimental y el control. El tipo de transmisor utilizado y la tecnica de montaje parecen adecuadas para estudios con patitos silvestres de la especie en discusión.

Although radio-transmitters of various sizes and methods of attachment have been widely used to study adult waterfowl (Dwyer 1972, Korschgen et al. 1984, Rotella et al. 1993), estimates of duckling and brood survival are needed for population modeling and harvest management (Cowardin and Johnson 1979, Orthmeyer and Ball 1990, Mauser and Jarvis 1994). Because ducks are secretive during brood rearing (Sedinger 1992:121, Bellrose and Holm 1994:312), duckling survival, chronology and causes of prefledging mortality, total brood loss, duckling adoption, and brood amalgamation cannot be determined accurately by marking and monitoring adult females only (Ringleman and Longcore 1982, Eadie et al. 1988, Orthmeyer and Ball 1990).

Few studies have evaluated effects of transmitters on duckling and brood survival (Houston and Greenwood 1993). However, investigators have used transmitters to study survival of Mallard (*Anas platyrhynchos,*

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Mauser and Jarvis 1994) and Canvasback (*Aythya valisineria,* Korschgen et al. 1996) ducklings, and to evaluate the effect of implanted transmitters on Mallard thermoregulation (Bakken et al. 1996).

Researchers also have used radiotelemetry to study movements and habitat use of free-ranging Wood Duck hens and their unmarked ducklings (Hepp and Hair 1977, Gammonley 1990:16, Vrtiska 1991:22). Without radiotelemetry, however, accurate estimates of Wood Duck brood size and survival are difficult to obtain in forested wetlands, the primary habitat of the species (Bellrose 1976, Drobney and Fredrickson 1979, Gammonley 1990:67). To our knowledge, no previous studies exist of radiomarked Wood Duck ducklings or other duck species of similar size at hatch (20–25 g; Bellrose and Holm 1994). Moreover, currently available transmitters for duckling species of the size and smaller than Wood Ducks exceed the recommended transmitter to body mass percentage (i.e., <5% of body mass, Samuel and Fuller 1994). Therefore, we attached microtransmitters to 1-d old Wood Ducks in captivity to evaluate the transmitters' effect on ducklings before using them to study survival of free-ranging Wood Duck broods (Davis 1998:73–124). We tested the null hypothesis that duckling survival and body mass were independent of radiomarking during ducklings' first two weeks of life, a critical period for prefledging survival (Sedinger 1992:109).

## METHODS

We collected Wood Duck eggs in April–June 1995–1996 from nest boxes at Noxubee National Wildlife Refuge (NNWR) in east-central Mississippi, and then incubated and hatched eggs at Mississippi State University (MSU). MSU Institutional Animal Care and Use Committee approved of hatching and rearing procedures, as well as surgical attachment of transmitters (Protocol 96-018).

We used a prong and suture type duckling transmitter (Model 377, ATS Inc., Isanti, Minnesota), weighing 1.6 ± 0.04 g (SE, $n = 9$) and measuring 17 × 7.5 × 8.8 mm, with a 10-mm long stainless steel prong (Mauser and Jarvis 1991:489). A 9.8-cm, nylon-coated stainless steel wire antenna extended from the rear of each transmitter. Radio transmitters were ap-

TABLE 1. Body mass (g) of radio-marked and unmarked (control) captive, wild-strain wood duck ducklings, Mississippi State, Mississippi.

| | Radio-marked | | | Control | | |
|---|---|---|---|---|---|---|
| Age | $\bar{x}$ | SE | $n$ | $\bar{x}$ | SE | $n$ |
| Hatch | 22.9A[a] | 0.37 | 35 | 22.5A | 0.32 | 40 |
| 1 week | 43.8A | 1.81 | 25 | 40.9A | 2.05 | 32 |
| 2 weeks | 89.8A | 3.67 | 27 | 85.0A | 3.72 | 32 |

[a] Means within rows sharing a letter did not differ ($P > 0.05$) by ANOVA.

proximately 7% of mean body mass of wood duck ducklings at hatch (Table 1).

We retained ducklings in an incubator for 1–3 h after hatch, then transported them to a laboratory for transmitter attachment. We randomly selected ducklings from a group of available 1-d-old individuals and then randomly assigned them to either radio-marked or control groups. We assumed this double randomization process would provide relatively unbiased estimates of duckling survival and body mass during early life, regardless of ducklings' sex and their mass at hatch. Each duckling was weighed (±1 g) and web-tagged for individual identification.

We disinfected surgical instruments, radio transmitters, and a surgery table with isopropyl alcohol before radiomarking each duckling. We applied alcohol to ducklings' backs at the site of transmitter attachment to sterilize the area. This also facilitated the surgical process by matting ducklings' down and exposing their skin. Alcohol dried quickly and did not impair plumage development.

We inserted a 20-gauge needle subcutaneously along the dorsal midline between the birds' wings. The needle created the insertion for the prong of the transmitter. With needle under the skin, we inserted the prong below the needle and then withdrew the needle. We gently maneuvered the transmitter until the prong and its shank were subcutaneous and positioned medially between ducklings' wings. We used a cutting needle and 3-0 polydioxanone violet monofilament suture to secure the prong to the skin, with a single suture tied to both the prong and the rear of the transmitter. Following transmitter attachment, we applied antibacterial gel to the integument at the suture points, and secured the transmitter to the ducklings' back with cyanocrylate glue.

We placed ducklings within two compartments (101 × 66 × 24 cm) of an artificial brooder immediately following marking. The room containing the brooder had a screened window less than 2 m from the brooder, which kept the brooder temperature and humidity similar to outdoor ambient conditions. Ducklings received only natural light that filtered through the screened window and a glass window in an exterior leading door. We confined ducklings in compartments between 15 May and 15 Jul. 1995 and 1996; both radio-marked and control ducklings were housed together within the same compartments.

Number of ducklings/compartment ranged from 6–15 during each 2-wk trial, depending on number of ducklings hatched/week and subsequent mortality. We confined ducklings that hatched ≤1 d apart together in the same compartment. Inside each compartment, we initially confined ducklings for 18–24 h after hatch in a vinyl tub filled with wood shavings and nest down. This procedure was necessary to prevent newly hatched ducklings from drowning, and their under-developed legs or feet from becoming entangled in the wire mesh of the brooder floor. We removed ducklings from the tub after this period and allowed them to move about freely in the brooder.

We provided ducklings a commercial chick ration (>30% crude pro-

tein, >2.5% crude fat, and ≤6% crude fiber) and water ad libitum. We fed and watered ducklings, and cleaned the brooder daily. We weighed ducklings at hatching and at 1 and 2 wk of age. We deemed the 2-wk experimental period of adequate duration, because no ducklings >10 d of age died during this or a pilot study in 1995, and duckling mortality is usually greatest during first 2 wk of life (Ball et al. 1975, Orthmeyer and Ball 1990, Davis 1998:85).

*Statistical analyses.*—We used a *t*-test (PROC TTEST; SAS Inst., Inc. 1997:1633) to test the null hypothesis of no differences in daily ambient temperature and humidity during periods of duckling confinement (May–July) between 1995 and 1996. We used the Kaplan-Meier (Kaplan and Meier 1958) method (PROC LIFETEST; Allison 1995:29) to estimate survival rates for radio-marked and control ducklings, and to test effects of radio-marking and year on duckling survival rates. We used analysis of variance (PROC ANOVA; SAS Inst., Inc. 1997:209) to test the effects of radio-marking and year on body mass of ducklings at hatch, 1 wk, and 2 wk of age. Significance was set a priori at $\alpha = 0.05$.

## RESULTS

*Ambient conditions of brooding environment.*—Average daily temperatures during periods of duckling confinement, May–July, were 25 C (±SE = 0.67, $n$ = 92 [range 17–34 C]) in 1995 and 26 C (±SE = 0.58, $n$ = 92 [range 17–33 C]) in 1996. No differences ($-1.49 \leq t \leq 1.24$; df = 58; $0.14 \leq P \leq 0.25$) were detected between years for May, June, and July temperatures. Average daily humidity was 77% (±SE = 0.77, $n$ = 92 [range 74–79%]) in 1995 and 74% (±SE = 0.79, $n$ = 92 [range 69–79%]) in 1996. Mean daily percent humidity differed between years in May ($t = 4.61$; df = 58; $P \leq 0.001$), but not in June ($t = -0.690$; df = 58; $P = 0.49$) or July ($t = 0.825$; df = 49; $P = 0.41$).

*Survival.*—There was no effect of radio-marking ($\chi^2 = <0.01$, df = 1, $P > 0.9$) or year ($\chi^2 = 0.09$, df = 1, $P = 0.77$) on duckling survival at 2 wk of age. Survival was 0.77 ± 0.07 (SE[27 of 35]) for radio-marked and 0.80 ± 0.06 (SE[32 of 40])for control ducklings at the end of 2 wk (Fig. 1). Two ducklings were right-censored after losing transmitters 1 and 4 d after being marked in 1995. Mean longevity for ducklings that died was 2.8 + 0.45 d (SE, $n$ = 8, range = 1–4 d) for radio-marked ducklings and 2.9 + 0.58 d (SE, $n$ = 8, range = 1–6 d) for control ducklings. Dead ducklings were not necropsied to determine cause of death, because our objective was to test for relative differences in survival between radio-marked and unmarked ducklings.

*Body mass.*—We detected no effect of radio-marking on duckling body mass (hatch: $F_{1,56} = 1.70$, $P = 0.198$; 1 wk: $F_{1,56} = 1.66$, $P = 0.203$; 2 wk: $F_{1,56} = 0.94$, $P = 0.337$) (Table 1). No year effect on duckling body mass was detected at hatch ($F_{1,56} = 1.0$, $P = 0.321$) or at 2 wk ($F_{1,56} = 0.48$, $P = 0.493$) of age. Duckling mean body mass at 1 wk of age was greater in 1996 than 1995 ($F_{1,56} = 5.59$, $P = 0.022$), but we detected no interaction

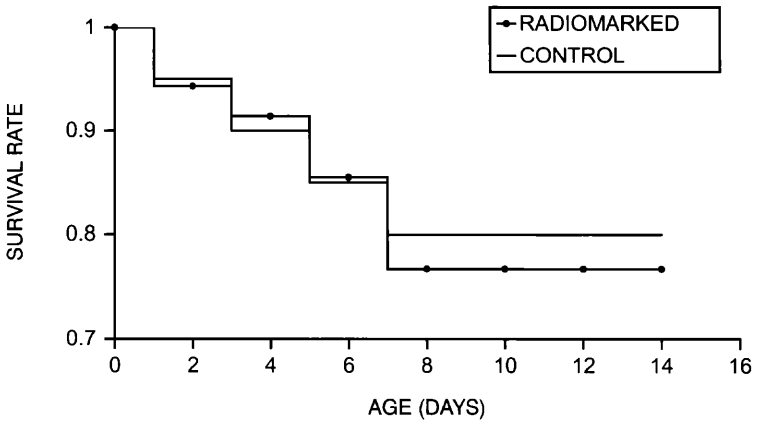


FIGURE 1. Survival of radio-marked ($n$ = 35) and unmarked ($n$ = 40) captive, wild-strain Wood Duck ducklings, 1995–1996.

($F_{1,56} \geq 0.32$, $P \geq 0.322$) of radio-marking and year on duckling body mass during any period.

## DISCUSSION

We did not detect an effect of transmitter and the method of attachment on survival and body mass of captive, wild-strain Wood Duck ducklings. Importantly, survival and body mass did not differ between marked and unmarked ducklings, even though the transmitter to body mass percentage slightly exceeded recommendations (Samuel and Fuller 1994). Although this experiment did not mimic natural environmental conditions, we believed it was a necessary prerequisite to any research involving free-living ducklings. If we had detected a significant effect of transmitter and the attachment method in captivity, application of the technique in the wild would be unjustified.

Our captive ducklings had ad libitum food and water, and perhaps lower energetic costs than free-ranging ducklings. Nevertheless, all duckling mortality in this experiment occurred <6 d after hatching, which is similar to mortality patterns for free-ranging ducklings (Ringleman and Longcore 1982, Mauser and Jarvis 1994, Davis 1998:85). Daily observations of ducklings during husbandry suggested that marked and unmarked ducklings behaved similarly. Also, no lesions were found on the backs of radio-marked ducklings when transmitters were removed after 2 wk.

Loss of two transmitters from ducklings in 1995 probably resulted from not pushing the prong under the skin sufficiently before suturing. These two transmitters were among the first attached; hence, our technique probably was not perfected. In our study and that of Mauser and Jarvis (1991), nearly all posterior sutures broke; only the prong and anterior suture remained steadfast. Glue initially aided retention of the transmitter

(1–2 d), but its effectiveness diminished as feathers developed (Mauser and Jarvis 1991). We recommend refining transmitter attachment procedures by practicing on dead ducklings or chicks before working with live individuals.

Ideally, transmitters should be attached to ducklings while their downy plumage is moist to facilitate seeing and attaching transmitters to integument. Because ducklings do not completely dry for several hours after hatch (Afton and Paulus 1992:81), researchers may have opportunity to radio-mark ducklings before plumage dries. Because most young waterfowl exit the nest on the morning following hatching (Afton and Paulus 1992:83), radio-marking ducklings one day before nest exodus may afford them a period of acclimation to the transmitter.

We believe that use of prong and suture transmitters is justified for study of free-ranging Wood Duck ducklings. Thirty-day survival of free-ranging Wood Duck ducklings in Mississippi, marked with these transmitters, was as high as 0.64 ± 0.13 (SE) (Davis 1998:86). This survival estimate was higher than most previous estimates reported for unmarked Wood Duck ducklings (Gammonley 1990, Bellrose and Holm 1994:316). This technique, coupled with radio-marking brood hens, enables researchers to estimate survival of ducklings, investigate timing and causes of mortality, and assess relative importance of various covariates related to survival of wild ducklings (Heisey and Fuller 1985; Mauser and Jarvis 1991, 1994; Flint et al. 1995; Davis 1998).

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