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SUTURE AND GLUE ATTACHMENT OF RADIO TRANSMITTERS ON DUCKS

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Abstract.—Unwaxed dental floss (linen) sutures and cyanoacrylate glue worked well in attaching radio transmitters to the backs of wild ducks during the breeding seasons of 1983 and 1984. Radio transmitters were retained for 31–78 d ($\bar{x}$ = 50) on Blue-winged Teal (*Anas discors*) and for 19–51 d ($\bar{x}$ = 39) on Mallard (*A. platyrhynchos*) during the nesting and brood rearing periods. Retention of transmitters attached with a suture/glue method was comparable to those attached with neck/body harnesses or elastic wing harnesses on Blue-winged Teal, and was better for Mallards. Radio attachment with suture/glue did not appear to affect behavior, molt or feather growth. Ducks with suture/glue-attached transmitters suffered less predation than those with harness-attached radio transmitters.

ATADURA DE TRANSMISORES A PATOS UTILIZANDO SUTURA Y PEGAMENTO

Sinopsis.—Suturas de hilo dental sin encerar (lino) y pegamentos de cianoacrilatos trabajaron muy bien para atar radio transmisores a la espalda de patos, durante la época de reproducción de 1983 y 1984. Durante los periodos de anidamiento y crianza, los transmisores fueron retenidos de 31–78 d ($\bar{x}$ = 50) por el zarcel *Anas discors*, y de 19–51 d ($\bar{x}$ = 39) por individuos de *A. platyrhynchos*. La retención de los transmisores con sutura/pegamento, en el caso del zarcel, resultó comparable a la utilización de arneses cuerpo/pescuezo o arneses de ala elásticos. En el caso de *A. platyrhyncos* los resultados fueron superiores cuando se hicieron comparaciones similares a las antes mencionadas. Las ataduras con sutura/pegamento parecieron no afectar la conducta, muda o el crecimiento del plumaje. Los patos con transmisores atados con sutura/pegamento sufrieron menos depredación que aquellos que tenían arneses.

Various techniques have been used to attach radio transmitters to ducks and other birds. Most telemetry studies of ducks have used body harnesses (Dwyer 1972) or wing harnesses (Godfrey 1970), which utilize wire or elastic loops to attach the transmitter to the bird. These attachment techniques have been found to affect both the physical condition and behavior of ducks. Greenwood and Sargeant (1973) found neck and body loop attachments caused feather wear and skin irritation on Mallards (*Anas platyrhynchos*) and Blue-winged Teal (*A. discors*). Increased preening and comfort movement by radio equipped ducks have been documented in other studies (Gilmer et al. 1974, Greenwood and Sargeant 1973).

Adhesives have been used to attach transmitters to the skin or feathers of Mourning Doves (*Zenaida macroura*) (Perry and Carpenter 1981, Sayre et al. 1980), American Robins (*Turdus migratorius*) (Graber and Wunderle 1966), Starlings (*Sturnus vulgaris*) and Red-winged Blackbirds (*Agelaius phoeniceus*) (Bray and Corner 1972, Cochrane 1980). Retention of these transmitters varied from days to months. A combination of gluing and suturing transmitters to the skin of Red-winged Blackbirds was judged to produce better retention than glue alone (Martin and Bider 1978).

This paper describes the use of sutures and cyanoacrylate adhesive to attach transmitters to Mallards and Blue-winged Teal and compares retention of transmitters attached with this method to that of transmitters attached with body and wing harness. Feather and skin problems caused by harnesses, transmitter losses and observed behavioral changes during a previous waterfowl study in Wisconsin (Wheeler et al. 1984) prompted the testing and comparison of the various techniques. Implanting transmitters (Korschgen et al. 1984) was not tried due to the length of time required to implant transmitters in the field.

STUDY AREA AND METHODS

Field studies were conducted during 1979–1984 (Wheeler 1985, Wheeler et al. 1984) on public waterfowl production properties in southeastern Wisconsin. Specific sites were the Horicon Marsh Wildlife Area (HMWA), the Horicon National Wildlife Refuge, the Grand River Marsh Wildlife Area, and federal Waterfowl Production Areas in Dodge, Columbia and Dane counties. Data on transmitter retention were collected while studying hen movements and brood mortality on these waterfowl breeding areas. Observations of captive birds were conducted at the HMWA in 1983–1984.

Suture/glue attachment techniques.—Penned birds were anesthetized with methoxyflurane (Martin and Bider 1978, Smith et al. 1980) prior to transmitter attachment using the following procedures. One ml of methoxyflurane was introduced into a 1-liter chamber of clear plastic enclosing the duck's head. The duck was retained in the chamber until no reflexes were seen (approximately 30 s). Care was taken to monitor the bird for a steady heart rate during processing. This treatment rendered the duck unconscious for 2–4 min.

Transmitters were attached to the back using one of two techniques: 1) cyanoacrylate glue only bonding the radio (Nesbitt et al. 1982, Perry and Carpenter 1981) directly to the feathers; or 2) a combination of glue and two unwaxed dental floss (linen) sutures to the skin at the front and back of the transmitter (Fig. 1) (Martin and Bider 1978). Needles and suture material were sterilized prior to attachment. Loose suture ends were glued to the transmitter and the transmitter was also glued to the back feathers with cyanoacrylate glue.

Captive study.—A captive study was conducted in a flight pen (30.5 × 6.0 × 2.5 m) at HMWA during the spring of 1983–1984. Male Blue-winged Teal were captured in swim-in bait traps (Hunt and Dahlka 1953), fitted with transmitter packages (10 g) and released in the flight enclosure. Five transmitters were glued directly to the feathers and 16 were affixed with the suture/glue method (Fig. 1). All ducks were observed for 1 h daily while undisturbed on the water and shore and then flushed to determine any impacts of the transmitters on behavior and flight. The ducks were also examined periodically for abrasions, feather loss, and the condition of suture and glue attachment.

Field study.—Three methods of transmitter attachment were used dur-

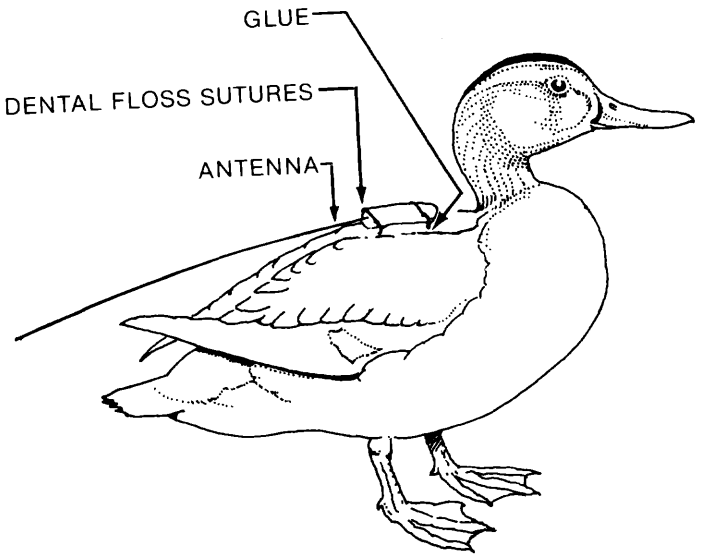

FIGURE 1. Radio transmitter attached with unwaxed dental floss (linen) sutures and cyanoacrylate glue.

ing two separate field studies: 1) body harnesses (Dwyer 1972); 2) wing harnesses (Godfrey 1970); and 3) glue/suture. Female Mallards and Blue-winged Teal were captured late in incubation on nests with hand nets or bow nets (Salyer 1962) and fitted with transmitters. Body harnesses were used in 1979–1980, wing harnesses in 1981, and glue/suture attachments in 1983–1984 (Fig. 1). When sutures were used to attach transmitters, birds (22 Blue-winged Teal, 4 Mallards) were anesthetized and handled the same manner as captive birds during transmitter attachment. Eight Blue-winged Teal and five Mallards received suture/glue transmitters without anesthesia later in the studies. I felt the handling period could be shortened and two needle punctures may be less traumatic than being placed in the anesthesia chamber. These hens all returned to their nests and hatched their clutches. Total radio package weights averaged 18 g and 25 g in 1979–1980; 16 g and 21 g in 1981; and 11 g and 11 g in 1983–1984, for Blue-winged Teal and Mallards, respectively. The heaviest packages equalled 4–7% and 2–3% of the Blue-winged Teal and Mallard body weights, respectively. The 11-g packages made possible in 1983–1984 by improved batteries of lighter weight and greater longevity, were 3% and 1% of the Blue-wing Teal and Mallard body weights, respectively.

Hens were radio-tracked and observed in the field until the radios became detached, the transmitters failed, or the ducks migrated from the study area. Daily ground and boat searches were supplemented with periodic aerial searches to locate operating transmitters.

Comparisons of proportions among groups were carried out using the likelihood ratio G-test.

RESULTS AND DISCUSSION

Captive study.—Pen observations of the 21 male Blue-winged Teal fitted with dummy transmitters (suture/glue and glue only) were of shorter duration than was desirable because all the ducks were killed by an unknown predator within 6–39 d of transmitter attachment. The five transmitters attached with only cyanoacrylate glue all became detached from the ducks within 7 d. Three were shed within 24 h of attachment, one after 5 d and one after 7 d. All transmitter losses were due to feather pulling as evidenced by the feathers remaining attached to the transmitter. The glue-only technique was not tested further because of these poor initial results. In 1983, all four Blue-winged Teal tested with the suture/glue technique retained their dummy transmitters during the 33–39 d of observation. The ducks all flew well and there were no signs of skin irritation or infection. Nine Blue-winged Teal were observed for 13–16 d and 3 for only 6–8 d in 1984. One of these birds lost its dummy transmitter at 12 d. The portion of skin to which the suture was attached was separated from the duck; loss of this transmitter may have been the result of a collision with the pen wire. A second dummy transmitter was lost at 8 d when the floss suture material was severed. I believe this was also the result of a pen-wire collision. The sutures on the remaining 14 ducks showed no evidence of wear, skin separation, or irritation. No adverse effects of the suture/glue attached packages on flight were detected. In summary, the pen study suggested the suture/glue technique produced no adverse effects. This technique eliminates problems such as feather wear and skin irritations (Greenwood and Sargeant 1973) and initial erratic flight on release of harness-equipped birds caused by weight shifts of the radio package or wing interference, which I observed in 1979–1981.

Field study.—Suture/glue radio attachment also worked well on ducks in field studies. Thirty-seven of the 39 females (30 Blue-winged Teal and 9 Mallards) trapped at 16–23 d into incubation and equipped with radios using this method returned to their nests. The remaining two hens (one Blue-winged Teal and one Mallard) abandoned their nests. Thirty-two radio-equipped hens hatched broods and five others had nests destroyed by predators. Transmitters appeared to have no adverse effects on incubating hens. The transmitter-equipped hens with broods also were able to lead their broods to water. Three hens (all Blue-winged Teal) wearing transmitters were killed later on the water; one brood hen by an avian predator and one by a mink, and one broodless hen by a mink. Predation (10%) did not appear abnormally high. Only two of 39 transmitters (both on Blue-winged Teal) became detached during the observation period. One of these was lost 14 d after attachment when a suture was broken or cut and the other pulled out of the skin, intact; the bird was shot by a hunter 70 d later. A second transmitter was found after 37 d with

TABLE 1. Minimum retention time of transmitters attached to free-ranging female Blue-winged Teal and Mallards.

Species	Year	Method of attachment	Known length of attachment (d)[a]	
			Mean	Range
Blue-winged Teal	1983–1984	Suture/glue (19)[b]	50	31–78
	1981	Elastic wing harness (15)	34	1–72
	1979–1980	Neck/body harness (24)	47	5–153
Mallards	1984	Suture/glue (8)	39	19–51
	1981	Elastic wing harness (17)	75	7–194
	1979–1980	Neck/body harness (16)	52	4–104

[a] Represents time receiving radio signals as well as observations indicating an attached radio, but does not include hunter reports of shot birds (suture/glue = 106 d, 115 d, body harness = 153 d, 151 d) with non-operating attached transmitters.

[b] Does not include those not tracked adequately due to predation, radio failure or egress from the study areas.

sutures intact with an attached area of skin that had been sloughed off with the transmitter; the fate of the bird was unknown.

In 1983, all seven radio-tagged, Blue-winged Teal hens still being monitored after breeding remained on the study area, molted and regained flight while carrying their suture/glue attached transmitters. In 1984, all 10 post-breeding Blue-winged Teal hens tracked were known to molt and regain flight while wearing their transmitters. However, two of those left the study area to molt and were shot later elsewhere in Wisconsin still wearing their transmitter. In both years, all Mallard hens left the study area or their radios failed before molt information could be collected. This attachment technique appeared to have had little effect on feather replacement by, or survival during molt of Blue-winged Teal.

The periods transmitters were known to have remained attached with suture/glue are minimum estimates because the radio signals were usually lost before the package was shed. Transmitters remained attached to hens an average of 56 d, a period sufficiently long to track hens from late in incubation through brood rearing (Table 1).

I obtained additional retention information from waterfowl hunters. Three hens still retaining transmitters were shot by hunters. One transmitter remained attached to a Blue-winged Teal for 106 d and was removed by a hunter after shooting the bird in Illinois. Two other transmitters remained on Mallards that were harvested by hunters in Wisconsin in October, 115 and 141 d after attachment. Three Blue-winged Teal, recovered by hunters by fall, had lost their radios leaving no evidence of prior radio attachment. One Blue-winged Teal was recaptured on a nest the year after being radio tagged. Examination revealed no evidence of radio attachment such as scarring or abnormal feathering.

Comparison of three attachment methods.—Loss rates of transmitters (8–9%) attached by all three methods on Blue-winged Teal were similar (G^2

TABLE 2. Transmitter loss from radio tagged Mallard and Blue-winged Teal hens, 1979–1984.

Number radio-equipped	Mean transmitter wt. (g)	% Lost from monitored hens (*n*)		
		Neck/body harness (1979–1980)	Elastic wing harness (1981)	Suture/glue attachment (1983–1984)
Blue-winged Teal				
40	18	8 (3)	—	—
22	16	—	9 (2)	—
24[a]	11	—	—	8 (2)
Mallards				
22	25	27 (6)	—	—
13	21	—	15 (2)	—
9	11	—	—	0 (0)

[a] Six of 30 hens' batteries/radios failed early.

= 0.05, $P = 0.98$) (Table 2). The loss rates of transmitters from Mallards appeared to vary among methods of attachment (Table 2). None of the transmitters attached by suture/glue were lost whereas loss rates for those attached by neck-body harnesses and elastic wing harnesses were 27% and 15%, respectively. This suggests differences in transmitter loss due to attachment methods for Mallards; however, the retention rates are not statistically different ($G^2 = 4.78$, $P = 0.09$). Therefore, the suture/glue attachment was found to retain radios at least as well as the other two methods of attachment.

Transmitter weights varied during the study years, but I do not believe this variation affected retention rates. Mallard transmitters in all five years were ≤3% of the birds' body weights, well below the 4% tolerance level of birds described by Cochrane (1980). My observations of released birds indicated Mallards carried 11 and 25 g transmitters equally well. Therefore, I feel the higher rates of transmitter loss for Mallards with harnesses are related to the problem of fitting harnesses to the birds, a problem that suture/glue attachments eliminated. Harness attached transmitters for Blue-winged Teal with batteries capable of the necessary 45–50 d of service averaged weights of 5–2% of body weight. Blue-winged Teal with these heavier harness-attachment transmitters did not appear to suffer any greater transmitter loss. Again, as with Mallards, the range of weights used on Blue-winged Teal did not appear to have had affected retention rates greatly, but may have affected flight during an adjustment period. The problems of fit and weight shift inherent in harness attachment appeared to have significant effects on the flight of Blue-winged Teal when radio weights exceeded 4% of the hen's body weight. Blue-winged Teal released with harness-attached radios sometimes exhibited erratic flight or landed after only a short flight. This behavior was not noted later when birds had had a chance to become accustomed to the

TABLE 3. Predation rates of radio-tagged nesting Mallard and Blue-winged Teal hens, 1979–1984.

Number[a]	Mean transmitter wt. (g)	% Kill by predators (*n*) Neck/body harness (1979–1980)	Elastic wing harness (1981)	Suture/glue attachment (1983–1984)
Blue-winged Teal				
27	18	33 (9)	—	—
16	16	—	56 (9)	—
22	11	—	—	9 (2)
Mallards				
15	25	13 (2)	—	—
8	21	—	13 (1)	—
8	11	—	—	0 (0)

[a] The number of hens does not include those whose radios failed, left the study area or lost transmitters before predation could be assessed.

package. Conversely, Blue-winged Teal released with suture/glue attached packages exhibited no flight or balance problems.

Predation rates on hens equipped with transmitters attached with suture/glue were low compared to the other two methods. Suture/glue transmitter-equipped hens suffered predation rates of 9% and 0% for Blue-winged Teal and Mallards, respectively (Table 3). These same rates for those with neck/body harnesses were 33% and 13% and for those with elastic wing harnesses were 56% and 13%, for Blue-winged and Mallards, respectively. Predation rates among the three attachment methods were not statistically different for Mallards ($G^2 = 1.90$, $P = 0.39$) but were for Blue-winged Teal ($G^2 = 10.54$, $P = 0.005$). Small sample sizes are a problem in testing the Mallard predation rates. Again, differences in transmitter weights among attachment types may contribute to differences in predation rates to an unknown degree. These field studies were not designed to test for weight effects and further studies may be needed.

CONCLUSION

The suture/glue attachment of transmitters should prove useful for waterfowl studies, particularly short-term nesting or brood-rearing studies. This technique eliminates or minimizes harness weight, fitting problems, adjustment periods and the possibility of entanglement inherent in harness attachments techniques. It provides suitable package retention and alleviates the possibility of wing or leg interference by the harnesses. This procedure appears to have no adverse effects on incubation, brood-rearing, or molting of breeding Mallards or Blue-winged Teal. Predation rates on hens with suture/glue transmitters tend to be lower than those with transmitters attached by harnesses.

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