A Tail-Mounted Radio Transmitter For Eastern Bluebirds

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The use of radio transmitters allows an investigator to follow individual animals and study activities that would be extremely difficult, if not impossible, to describe otherwise. Cochran (1980) and Kenward (1987) described many of the different types of radio transmitters and attachment procedures along with their advantages and disadvantages. While radio transmitters have been routinely used on numerous species of birds, I am aware of only two reports, Sloan and Carlson (1980) and Allen and Sweeney (1989), that describe their use on Eastern Bluebirds (*Sialia sialis*).

In their study of the home ranges of Eastern Bluebirds, Sloan and Carlson (1980) used radio transmitters that weighed 4 g (approximately 13% of the 30 g body weight of an Eastern Bluebird) and had 28 cm antennas. They attached each radio transmitter with epoxy glue to the middle of a bird's back. Three of their six radio transmitters were functional for three weeks while the other three radio transmitters either malfunctioned or came off of the bird after 1-2 weeks.

Allen and Sweeney (1989) radio-tracked Eastern Bluebirds wearing radio transmitter packages that weighed 2.4 g (8% of the body weight) including the harness, which was constructed of monofilament fishing line, and a 15 cm antenna. Like Sloan and Carlson (1980), they positioned the radio transmitter in the middle of the bird's back. They attached radio transmitters to 2 captive and 28 free-ranging birds, 16 of which were observed for 25 or more days. The batteries had sufficient power for approximately 30 days of transmission. While Allen and Sweeney (1989) believed that the weight of their radio transmitter package did not adversely affect the birds, the weight was above the 5% limit generally suggested for small birds (Cochran 1980). Allen and Sweeney (1989) observed that while the majority of their birds adjusted rapidly to the radio transmitter package, six of the birds experienced flight impairment. They also observed a case of entanglement when an antenna wedged in a crack at the entrance to the nest cavity. The antennas on three other birds were bent in a manner consistent with previous entanglement.

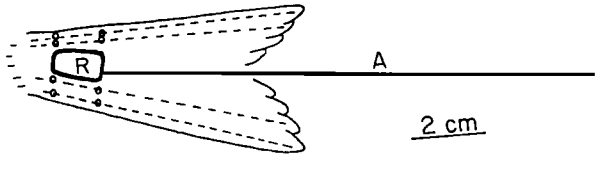
Caccamise and Hedin (1985) reported that small birds could carry radio transmitter packages weighing up to 4.0 g (13.3% of Eastern Bluebird body weight) without significant problems. However, Gessaman and Nagy (1988) detected adverse effects from radio transmitter packages weighing as little as 2.5% of the body weight. While both of the published studies involving telemetry of Eastern Bluebirds (Sloan and Carlson 1980; Allen and Sweeney 1989) described generally favorable results, some birds in each study did experience flight impairment or other problems that could be attributed to the radio transmitters. The weight of the radio transmitters or the method and site of attachment may have caused the problems.

I felt that a lighter weight radio transmitter and an alternate site of attachment were needed in order to minimize the effects of the radio transmitter on bluebird behavior. Also, I needed a radio transmitter package that could be installed by one person since I usually worked alone. After reviewing the literature (especially Cochran 1980, Perry et al. 1981, and Kenward 1987) and discussing the options with Robert R. Cohen (pers. com.) who used radio transmitters on Tree Swallows (*Tachycineta bicolor*), which weigh less than Eastern Bluebirds, I decided to use tail-mounted radio transmitters. In this paper I describe some of the advantages and disadvantages of such transmitters.

METHODS

I used radio transmitters that weighed 0.9-1.0 g, including the 13.3 cm antenna. They were manufactured by Holohil Systems Ltd. of Woodlawn, Ontario. Each radio transmitter was attached to an Eastern Bluebird on the ventral side of its tail at the proximal end of the central rectrices (Figure 1). Four pairs of threads (size 1, surgical cotton), one pair from each corner of the radio transmitter, were attached to the radio transmitter through tubing that had been incorporated by the manufacturer across the anterior and posterior ends of the radio transmitter. I attached the radio transmitter by wrapping and tying each pair of threads to each of two rectrices. I placed a drop of fingernail polish on each of the eight knots. I attached the radio transmitters while sitting in the seat of my truck (with the windows closed) and holding the bird in a cloth bag on my lap. With the bird positioned ventral side up and with only the tail protruding from the bag, I was able to attach a radio transmitter in approximately 15 minutes. Most birds were docile when their heads were covered with the dark bag, although some birds struggled and had to be restrained by lightly wrapping a cord around the bag at approximately the mid-region of the bird. Each bird was released at the site of its capture and then observed with binoculars and a spotting scope. The birds were radio-tracked with a TRX-10005 receiver (Wildlife Materials Inc., Carbondale, Illinois) and a hand-held three-element Yagi antenna. All of the observations reported here were made during 1987-1990 on my study area in Weakley Co., Tennessee.

Figure 1. Ventral view of Eastern Bluebird tail showing the position of an attached radio transmitter (R), the transmitter antenna (A), and points (o) whree threads from the transmitter are tied to feather shafts.



RESULTS

During this study I placed radio transmitters on 13 Eastern Bluebirds (4 females, 9 males) and radio-tracked each from 0-34 days. The initial reaction of a bluebird when released after attachment of a radio transmitter was to fly to a nearby perch and begin preening. This is the same type of response that normally occurs after a bluebird has been captured and released without a radio transmitter (Pitts, pers. obs.). After the bird preened, the radio transmitter was usually hidden by the tail coverts and the only visible evidence of the radio transmitter was the antenna which protruded beyond the tip of the tail by approximately 8.2 cm. I did not see any of the birds peck or pull at their radio transmitters. All birds with radio transmitters appeared to fly normally, even on their initial flight after release.

Two birds lost their radio transmitters less than three days after attachment. Two other radio transmitters became loose but did not fall off of the bird. I suspect that in each of these cases I had failed to completely cover one of more attachment knots with fingernail polish and the knots had subsequently loosened. The other radio transmitters remained attached in their original position. One bird carried a radio transmitter for 74 days before I was able to capture the bird and remove the radio transmitter which was still firmly attached and not causing the bird any apparent harm.

Before releasing a bird with its attached radio transmitter, I monitored the signal to verify that the radio transmitter was functioning normally. In spite of this precaution, I did not obtain any data from one bird because of a broken wire in the receiving antenna. The radio transmitter was transmitting properly when installed, but I discovered after releasing the bird that I could not detect the signal from distances greater than about 10 m. Unfortunately, the battery of this radio transmitter lost power before the problem was identified.

I was able to monitor 5 of the 13 birds until the radio transmitter stopped functioning due to the loss of power from the battery. One of these radio transmitters (constructed in 1987) was predicted to function for about 15 days, while the others (manufactured in 1988-1989) had a modified cir-

cuit which used less energy and had an estimated functional period of about 30 days. I was able to monitor the 1987 model for 16 days and the others for 31, 31, 33, and 34 days, respectively.

Four birds with radio transmitters disappeared. Two of the radio transmitters were functioning and two had stopped transmitting when the bird disappeared. I have no evidence about the fate of these birds or their radio transmitters. The birds may have died on the study area and remained undetected or they may have moved off of the study area and out of reception range.

Three of the 13 Eastern Bluebirds on which I installed radio transmitters are known to have died while the radio transmitters were still attached. In each case I found feathers, including the rectrices with the attached radio transmitter, scattered over a small area. This evidence is consistent with the actions of avian predators such as *Accipiter* spp., American Kestrels (*Falco sparverius*), and Eastern Screech-Owls (*Otus asio*) which were present on the study area. The remains of two of the dead birds were adjacent to barbed-wire fences. This location may be relevant in view of my observations of another bluebird with a radio transmitter. While I was watching this bird and its mate near their nest, the bird perched on a barbed-wire fence. When the bird attempted to fly, the antenna of the radio transmitter became wedged in a barb of the fence. The bird dangled upside down for about five seconds while it struggled to free itself, which it succeeded in doing as I watched. Later that day I recaptured the bird and removed the radio transmitter which no longer possessed an antenna.

Under ideal conditions, such as a bird in flight above vegetation and hills, the radio transmitter signals could be received from distances as great as 1.2 km. If the bird were perched lower, which was the usual situation, reception was generally less than 0.8 km. Since each of the birds usually remained near its capture site, I normally had little difficulty in detecting their signals. I had no problem with signal "bounce" (i.e., reflection from tall hills or mountains; see Mech 1983), probably because of the relatively flat terrain on my study area. On several birds, the radio transmitter antenna became bent, usually in a "J" shape. This was apparently due to the antenna having been caught, probably in barbed-wire, and then pulled free. While I did not investigate the effective ranges of radio transmitters with bent antennas and make comparisons with radio transmitters having straight antennas, it was my impression that reception from the radio transmitters with bent antennas was impeded.

DISCUSSION

The tail-mounted radio transmitters described here have some advantages over previously described radio transmitter packages used on Eastern Bluebirds. The tail-mounted radio transmitters and attachment threads weighed approximately 1.0 g in contrast to weights of 4.0 g (Sloan and Carlson 1980) and 2.4 g (Allen and Sweeney 1989) for radio transmitter packages previously used on Eastern Bluebirds. Birds receiving tail-mounted radio transmitters did not require a period of adjustment before regaining normal flight capabilities. The use of epoxy glue to attach a radio transmitter to the skin or feathers of a bird is a proven method (Sykes et al. 1990), but this method should not be used during cold months when the bird might suffer from heat loss. To attach a tail-mounted radio transmitter, removal of feathers is not necessary. Attachment of radio transmitters with a harness is also a frequently used and reliable method, but the installation and adjustment of the harness requires two persons while the tail-mounted radio transmitter can be attached by one person.

One of the disadvantages of using tail-mounted radio transmitters is that the rectrices are molted during late summer and early fall. If telemetry studies are planned during the period of molt, the radio transmitter should probably be attached by a harness; tail-mounted radio transmitters would be lost during the molt and attachment of a radio transmitter to the skin might interfere with the growth of new feathers. Another disadvantage of the tail-mounted radio transmitter is that its position is not at the center of gravity for the bird. By using a lightweight radio transmitter and placing it at the base of the tail, this problem is minimized. I did not observe any problems with balance, flight, or maneuvering in the birds with tail-mounted radio transmitters. However, heavier radio transmitters attached to the tail might hinder flight.

The major disadvantage I perceive with tail-mounted radio transmitters is the problem of entangling the antenna in barbed wire. Tail-mounted radio transmitters are nearer to the posterior end of the bird than are back-mounted radio transmitters. Consequently, when the tail-mounting position is used, a greater percentage of the antenna protrude beyond the tail of the bird. I know that in one case a bird became temporarily tangled in a barbed-wire fence because the antenna was lodged; I suspect that the bent antennas I observed on several other birds were a result of the antenna being pulled through a barb. The antenna probably became curved in the same way that flat ribbon becomes curled when it is pulled across the blade of scissors when making decorative bows for packages. I was able to duplicate the shape of bent antennas by placing an antenna over a barbed-wire fence and pulling the antenna through a barb.

I suspect that entanglement in a barbed-wire fence may have been a factor contributing to the death of two of the three birds that died with radio transmitters attached. The two birds whose remains I found beside barbed-wire fences may have had their radio transmitter antennas lodged in the barbed-wire and may have been unable to escape when a predator approached. Even if the bluebird were only momentarily restrained, the predator would have been more likely to capture the bluebird. Allen and Sweeney (1989) noted one case where the antenna of a bluebird with a backpack radio became wedged in a crevice at the nest cavity and they saw three other bluebirds whose radio transmitters had bent antennas, apparently as a result of entanglement. Jackson et al. (1977) recommended against the use of radio transmitters with antennas that protruded beyond the rectrices of Red-cockaded Woodpeckers (*Picoides borealis*) because the antenna frequently caught in the bark of trees.

I terminated my telemetry study because of the possibility that birds with radio transmitters had higher than normal mortality rates. While only three of the 13 Eastern Bluebirds with radio transmitters are known to have died during the study, two other bluebirds with radio transmitters may have died, and the bent antennas of additional birds indicated that they had been entangled. On the 32 ha cattle farm where my study was conducted, approximately 4.0 km of barbed wire fence (with more than 26,000 barbs) are present. These fences are frequently used as perches by bluebirds. Consequently, the probability is high that a bluebird with a radio transmitter would eventually have its antenna cross a barb of the wire and become wedged. Bluebirds without radio transmitters are rarely harmed by barbed-wire fences. In their review of avian mortality on barbed-wire fences, Allen and Ramirez (1990) did not find any records of Eastern Bluebirds that had been injured or killed as a result of collision or entanglement in barbed-wire fences.

Attachment of the radio transmitter on the dorsal, rather than ventral, side of the tail might reduce the probability of entanglement. The use of a shorter antenna could also reduce entanglement but would probably decrease the distance at which the radio transmitter signal could be received. While my observations indicate that tail-mounted radio transmitters can be used effectively on Eastern Bluebirds, I suggest that researchers consider alternate methods of attachment when working in areas where barbed-wire fences are common.

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