A COLLAR FOR ATTACHING RADIO TRANSMITTERS TO RABBITS, HARES, AND RACCOONS

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Abstract: A durable, waterproof transmitter-collar cast in a mold and made of dental acrylic has proven successful in field tests on cottontail rabbits (Sylvilagus floridanus), snowshoe hares (Lepus americanus), and raccoons (Procyon lotor). It is fitted to the individual animal and attached around the neck, rather than over the head. With modification, it can probably be adapted for use with many other species.

The development of miniature radio transmitters and effective radio-tracking techniques has created a need for methods of attaching transmitters to various species of animals. An ideal attachment device would have the following characteristics:

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(1) minimum weight, (2) minimum effect on the animal, (3) maximum protection for the transmitter, (4) permanence of attachment, and (5) maximum protection of transmitter from animal-mortality factors such as predation and accident.

Attempts to attach transmitters to mammals have met with varying degrees of success. Marshall et al. (1962) reported a successful attachment technique for porcupines (*Erethizon dorsatum*), Verts (1963) for skunks (*Mephitis mephitis*), Tester et al. (1964) for white-tailed deer (*Odocoileus virginianus*). Cochran and Lord (1963: 18) reported that "a collar attachment has been applied to raccoons . . . and skunks in the field with satisfactory results," but they did not provide details. They also discussed collar and harness attachments that were unsatisfactory for skunks and cottontail rabbits. For raccoons, Ellis (1964) used a collar attachment that in some cases did not adequately protect transmitter components from damage by the animals. Slagle (1965) experienced difficulty in keeping a transmitter on a raccoon, but he did devise a harness that worked for at least 4 days on one animal. Storm (1965) used Verts' (1963) technique successfully on red foxes (*Vulpes fulva*), although the short transmitter lives he obtained in some cases may have been attributable to inadequate protection of components. Transmitters were successfully attached to rats (*Rattus* spp.) by Sanderson and Sanderson (1964), using a modification of Verts' (1963) method. Craighead and Craighead (1965) experienced partial success in maintaining functional transmitters on grizzly bears (*Ursus arctos*).

This paper reports on field-tested transmitter-collars that have functioned satisfactorily for cottontail rabbits, snowshoe hares, and raccoons. They were developed by Mech and Kuechle, in collaboration with W. W. Cochran.

**METHODS AND PROCEDURES**

The most important features of these collars are their durability, resistance to moisture, and custom fit. Preliminary trials were made with epoxy-resin-coated collars (EcoBond 26) large enough to slip over a rabbit's head. Two rabbits scratched through the epoxy resin and into the transmitter components, and one caught its front leg in a collar and died. A snowshoe hare with a similar type of collar had a front leg stuck in its collar when retracted.

The present rabbit–hare collars overcome these problems. Each is cast in a polyethylene mold (Fig. 1) with the inside circumference equal to the circumference of a rabbit's or a hare's neck. In winter, one size fits most rabbits and snowshoe hares. The outside circumference is large enough to include the transmitter (Cochran and Lord 1963), two No. 401 batteries, and a ½-inch-wide, tuned copper loop antenna. To prevent damage to the heat-sensitive components during potting, the transmitter is turned off by separating
the overlapping ends of the antenna with tape. Blocks of polyethylene are arranged at this joint and at a point diametrically opposite (Fig. 1) to prevent the potting material from filling these two locations, which will become a hinge and a joint in the hardened collar.

The transmitter-collar is potted in a thin mixture of translucent acrylic (commercial preparation Perm, multipurpose, cold-cure, dental acrylic, available from Hygienic Dental Mfg. Co., Akron 10, Ohio), which consists of a powder and a liquid and can be mixed to any consistency. The working time of the material is about 5 minutes and hardening time about 30 minutes. Although the reaction is exothermic, the resulting temperature increase will not damage heat-sensitive parts so long as no current is flowing in the transmitter. The acrylic is merely poured into the mold around the entire transmitter, batteries, and antenna. Coating the mold with petroleum jelly before casting aids removal of the hardened collar.

The edges of the collar can be rounded on a grinder or with a round file, but a high-speed portable grinder with flexible shaft and cylindrical grinding point is an ideal tool for this. Since the hardened acrylic is translucent, one can avoid grinding into the components.

Before the collar is attached to the animal, the tape should be removed from the antenna ends and the transmitter tested. Tinning of the ends of the loop expedites soldering during attachment. The animal should first be subdued before attaching a collar. We physically restrain rabbits and hares and anesthetize raccoons (Mech 1965), and then place a cloth over the animal’s neck to hold down its fur. The collar is hinged open and then closed around the animal’s neck, and the overlapping ends of the antenna are soldered together. A doughy mixture of acrylic applied to the hinge and joint and bound with plastic tape completes the attachment.

Raccoon collars are made and applied in the same way except that one Mallory RM12T2 battery is used and is situated beside the transmitter and outside the loop antenna. Thus the mold must be cut to a different shape. Since raccoon neck sizes vary considerably, several sizes of molds are necessary for this species. It is especially important that any bubbles or openings into the electronic components, resulting from poor potting, be patched with acrylic to insure that the entire collar be as waterproof as possible.

The finished rabbit and hare collars (Fig. 2) weigh about 50 grams each, and the raccoon collars (Fig. 3) vary from 100 to 130 grams. The acrylic composes about a third of the weight of the rabbit collars and half the weight of the raccoon collars. Although this weight is undesirable, the advantages of the acrylic potting far outweigh this disadvantage. The acrylic is waterproof, cold resistant, and hard.
enough to withstand scratching and clawing (its Vicker's hardness index is 18.5). When fixed solidly around the electronic components, it prevents flexing of otherwise flexible parts and minimizes the possibility of mechanical problems. This rigidity might cause difficulties from factors such as thermal expansion, but there has been no indication of this. A depleted battery can be removed with the cutting tip of a soldering iron. The entire collar then can be placed in a mold, and the new battery repotted. One pound of acrylic (at $12.50) will pot eight raccoon collars.

RESULTS AND DISCUSSION

Evaluation of the success of a transmitter collar is complicated by several factors: (1) the collar may never be retrieved and examined, (2) an animal may leave the range of the tracking system and give the impression that the transmitter stopped, (3) transmitter failure may be caused by any of several factors or a combination of them, and (4) the expected life of a battery at low current drain and low temperature has not been determined. A transmitter-collar can be judged, however, by its total life span and by whether or not it outlasted its battery life.

On the basis of these criteria, the rabbit, hare, and raccoon collars are a success. The average life span of the eight electronically sound rabbit–hare transmitters tested from January to May, 1964, was 37 days, varying from at least 23 days to 46 days. Although our records are incomplete for some of these transmitters, the two retrieved for examination had stopped transmitting because of depleted batteries. The lives of those dying from unknown causes were not significantly different. Several transmitter-collars continued to transmit after rabbits and hares had been killed and eaten by foxes and avian predators.

![Finished raccoon collar ready for attachment.](image)

The mean transmitter life of seven raccoon transmitter-collars tested between September, 1964, and February, 1965, was 77 days, with extremes of 56 and 106 days. Thirteen others were still transmitting at the time of writing, three of which have continued for over 85 days. All three of the transmitter-collars that have been retrieved had stopped transmitting because of depleted batteries. These plus two functioning transmitter-collars examined after 3 months on animals showed no sign of damage by raccoons; even the plastic tape used around the joints was intact. We have not observed any detrimental effects of the collars on the raccoons. In one case, an animal lost its collar over its head, but this individual had lost half its weight—no doubt a result of its inactivity throughout the winter.

In summary, these transmitter-collars fulfill most of the characteristics recognized above. We believe that with modification, this technique of packaging can be used for many other species.
LITERATURE CITED


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