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A DISSOLVING LEG HARNESS FOR RADIO TRANSMITTER ATTACHMENT IN TREECREEPERS

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We modified a leg harness designed for radio transmitter attachment in birds so that it could be used on species without long exposed thighs and so that it would automatically fall off after several months. Using this harness, we attached radios to 68 treecreepers (Climacteridae) to follow their dispersal movements. Harness life was quite variable and females were more likely to break the harness loops and shed transmitters prematurely. Nonetheless, most harnesses remained intact for at least three months. This harness provides a safe alternative to gluing for non-permanent attachment of radio transmitters and may be more reliable than gluing for a wide variety of species.

INTRODUCTION

Radio telemetry has become a frequently used tool in ornithology, permitting the study of territoriality (Jansen 1999), foraging patterns (Pyke and O'Connor 1993; Brothers *et al.* 1998), mating behavior (Neudorf *et al.* 1997), habitat selection (Badyaev *et al.* 1996; Whittingham *et al.* 2000), migration (Brodeur *et al.* 1996), responses to habitat disturbance (Parker 1998), juvenile movements (Anders *et al.* 1998), and dispersal (Runciman *et al.* 1995; Plissner *et al.* 2000) in greater detail than was previously possible. As the technology continues to improve, with radio transmitters now weighing less than 0.5 grams and satellite transmitters weighing as little as 15 grams (F. Anderka, Holohil Systems Ltd., pers. comm.), the use of transmitters will certainly increase. However, the primary problem for most researchers remains the attachment method. A variety of techniques have been developed, including harnesses, necklaces, sutures, tail clips, implants, and gluing, but most techniques suffer from one or more problems (see Kenward 1987; Cochran 1980 for reviews). Some attachment methods restrict the manoeuvrability of the bird, either by preventing the full range of movement (particularly wing extension) or by altering the bird's center of gravity. Other techniques, particularly harnesses and necklaces, may snag on vegetation or fences. The duration of attachment may also pose a problem for researchers. With some methods, transmitters fall off after only a short period of time, while longer-lived attachment methods are often permanent, requiring animals to incur the costs of carrying a radio for their entire lives if they cannot be recaptured.

By the early 1990s, most researchers had abandoned backpack-style harnesses for all but the largest birds, advocating gluing based on the technique of Raim (1978) as the safest attachment method for small and medium-sized birds (Gaunt and Oring 1997). However, most adhesives hold for a very limited length of time, usually less than two weeks. Glues may be particularly ineffective in Australia, either because of feather characteristics or environmental conditions, as a number of researchers have noted that half or more of their glued radios were shed within four days (O'Connor *et al.* 1987; Ford *et al.* 2000, pers. obs.).

As an alternative, many radio-tracking studies now employ a leg harness (Rappole and Tipton 1991). The original design consists of two loops, one around each leg of the bird at the proximal end of the external portion of the thigh, letting the transmitter sit on the synsacrum. Attachment is very quick because the loops are fixed on the transmitter in advance, and are just slipped around the bird's bent legs. The harness is somewhat loose in its final position, and relatively long external thighs are required to keep it from slipping over the tibiotarsal joint. Advantages of this method are that radios do not fall off prematurely, attachment time is greatly reduced, the transmitter sits close to the bird's center of gravity, and it does not interfere with wing movement. Two major disadvantages of the leg harness are that it can only be used on species that have relatively long external thighs, and it is permanent so birds may have to carry transmitters for their entire lives.

In 1995, we began a five-year project investigating the dispersal tactics of Brown Treecreepers *Climacteris picumnus* and White-throated Treecreepers *Cormobates leucophaeus* in Warraderry State Forest, an open *Eucalyptus*/*Callitris* forest in the central west of New South Wales. We needed to use radio transmitters to follow dispersing individuals for one to two months. Initially, we trialed several different adhesives, but none held for longer than four days. We wanted to use the Rappole and Tipton leg harness, but treecreepers have short external thighs, and we were concerned about birds potentially carrying the transmitters for their entire lives. So we developed a modified version of the leg harness that is shed after several months and can be used on a wide range of species with varying lengths of exposed thigh.

DESCRIPTION OF LEG HARNESS AND USE

Modified leg harness

Our first modification was to use absorbable (dissolving) suture as our harness material. We used the thickest suture available (0.5 mm diameter coated vicryl tie; Ethicon, Johnson and Johnson Medical, Sydney) to reduce potential irritation, as harness materials thinner than 0.5 millimetres have been known to cut through skin (Gaunt and Oring 1997).

Though designed to dissolve after about three weeks of exposure to internal moisture, it takes three or more *months* of exposure to environmental moisture for the suture to dissolve, probably depending on environmental conditions. This ensured that any costs associated with carrying a transmitter would be imposed for only a short period.

Our second modification was to make the harness loops adjustable, so we could tighten them on each bird and provide a slightly tighter, more customized fit. Our transmitters were prepared with teflon tubes at the top and bottom through which we could thread harness material. We passed the suture through the bottom tube, then crossed the two suture ends through the top tube and knotted the ends to keep them from slipping out. We ensured that the harness loops were much larger than they would be once finally adjusted (Fig. 1). After slipping the loops over each of the bird's legs, one person held the bird by its legs while the other pulled on the ends of the suture to tighten the harness, ensuring that the loops did not slip over the tibiotarsal joint. We tightened it until it felt snug on the bird, but we could still insert a 2 millimetre wide toothpick in between the transmitter and the bird's back. We then knotted the suture on top of the transmitter, glued the knot, and cut off the extra suture. Finally, we gently teased some of the feathers out from under the harness loops so that the transmitter package would sit underneath the feathers. This would eventually happen naturally, but beginning the process ourselves allowed us to tie the harness tighter and helped to hide the harness loops, making it almost impossible for them to snag.

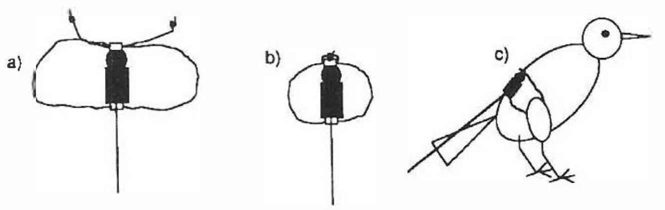

Figure 1. *a) Radio transmitter with harness prior to attachment. b) Transmitter with harness tightened after attachment. c) Bird showing placement of radio and harness (modified from Rappole and Tipton 1991).*

Use on treecreepers

We used this design to attach 0.75-0.95 gram radio transmitters (4–9 weeks battery life; Holohil Systems Ltd., Ontario, Canada) to 33 Brown Treecreepers *Climacteris picumnus* and 35 White-throated Treecreepers *Cormobates leucophaeus* to follow their dispersal movements. Attachment took about 15 minutes, longer than for the original Rappole and Tipton technique but shorter than many gluing methods. Occasionally, we made a harness too tight, but the bird would be unwilling to fly away and could easily be grabbed for harness retying. Upon release, all birds preened around the transmitter briefly, but began foraging and engaging in normal social interactions almost immediately. In two of our 68 birds, we observed extended preening around the transmitter several weeks later, after which both birds shed their transmitters. Otherwise, no bird was observed preening or pulling at the transmitter excessively. Five of our 68 birds were depredated while their transmitters were active. For three of the five birds, we recovered remains with the transmitter and harness still intact and undamaged, suggesting that the harness and transmitter had not directly contributed to the predation. Furthermore, this equates to an annual mortality rate of approximately 40 per cent which is reasonable for dispersing juveniles and is lower than the annual mortality rate of 67 per cent experienced by juvenile male Brown Treecreepers from 1999–2000 (n = 3), when we monitored the population but did not attach radio transmitters.

The majority of harnesses remained intact throughout the life of the transmitter batteries (Table 1), although female Brown Treecreepers were more likely to break the harness loops and shed the transmitter prematurely compared with males ($\chi^2 = 9.717$, df = 1, $P < 0.002$). The same sex difference appeared in White-throated Treecreepers, but was not statistically significant ($\chi^2 = 1.524$, df = 1, $P > 0.2$). Given that the two birds we observed preening around the transmitter after several weeks were both female Brown Treecreepers, it is possible that the harness is slightly more irritating to females, and they actively break harness loops to shed transmitters before the suture dissolves. Even when transmitters were shed prematurely, the harnesses still remained intact for a minimum of 10 days and an average of 25 days, which is longer than most adhesives will hold a transmitter.

TABLE 1

Numbers (percentages), and final harness life (if known) of harnesses that either remained intact throughout the life of the radio transmitter (4–9 weeks), or broke or slipped off before the radio battery died. Excludes five birds that were depredated while their radios were active.

	Harness intact	Shed prematurely	Total
Brown Treecreepers *Climacteris picumnus*			
Males	18 (95%)	1	19
Females	6 (46%)	7	13
White-throated Treecreepers *Cormobates leucophaeus*			
Males	12(100%)	0	12
Females	15 (79%)	4	19
Totals	51	12	63
Harness Life — Mean ± s.d.	149 ± 89 days	25 ± 9 days	
Harness Life — Range	28–280 days (n = 13)	10–47 days (n = 12)	

It was difficult to determine actual harness life, because most harnesses were still intact when transmitter batteries died and it became difficult to relocate birds. However, because some individuals (particularly male Brown Treecreepers) remained in the natal region long after transmitter batteries were dead, we were able to resight some birds regularly until suture loops dissolved and transmitters were shed. Among these non-dispersers (n = 13), 85 per cent of harnesses remained intact for at least three months, with a mean harness life of 149 days (Table 1).

DISCUSSION

As the use of radio telemetry increases, methods of radio attachment must continue to improve, becoming more widely applicable and less costly to the birds that carry them. We modified the Rappole and Tipton leg harness design to make it suitable for a wider range of species, not just those with long external thighs, and to make it less permanent, thus reducing the potential costs of carrying a radio package. A few other researchers have used organic materials to construct harnesses assuming they would eventually degrade and release the transmitter (Powell *et al.* 1998; Haramis and Kearns 2000), or to construct weak links in the assumption that they would break if the harness snagged (Karl and Clout 1987; Stephenson *et al.* 1998). But this was the first attempt of which we are aware to use a harness material specifically designed to dissolve after a particular period of time.

A potential disadvantage of the self-removing leg harness is that the length of time the suture remained intact was much more variable than we expected. However, it did remain intact longer than most adhesives, the primary non-permanent alternative. In addition, custom fitting the harnesses may not be suitable for birds with very little or no exposed thigh and additional modifications may be required (see Haramis and Kearns 2000). Nevertheless, our modified dissolving leg harness proved to be a successful method for attaching radio transmitters to treecreepers, and it may be equally successful with a wide range of Australian species.

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