Capture and radio-transmitter attachment techniques for Roadrunners

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As part of a two-year study on the behavior and breeding physiology of Roadrunners *(Geococcyx californianus)*, a variety of techniques were employed to capture the birds and to attach radio transmitters. In this paper we describe these techniques and evaluate their relative success. The study was conducted at the Camp Pendleton Marine Corps Base Reserve, about 10 miles north of Oceanside, San Diego County, California. The Roadrunners in this area were very shy and wary, presumably due to the occasional appearance of Marine troops and heavy vehicles. The birds preferentially nested in the largest clumps of prickly pear *(Opuntia)* cactus. *Opuntia* was typically located in dense aggregations on south-facing slopes. Seven active nests were found during one breeding season by systematically searching these areas.

Traps

Raptor trap

This trap is a modified version of the Bal-chatri or live-baited footnoose trap (Berger and Mueller, 1959). We use an 18″ square piece of ½″ mesh hardware cloth as a base and attach a 12″ × 8″ × 1½″ cage of ¼″ hardware cloth to it. The finer mesh of the bait cage is necessary to prevent the bait from escaping and to prevent the Roadrunner from injuring the bait. The trap is then spray-painted a flat black to improve visibility of the bait. Nooses of medium-gauge (40 lb. test) monofilament fishing line are tied to the top of the base and cage. Noose loops of 2″ to 3″ in diameter placed about 3″ apart work best. The traps are relatively light, and several can be stacked together for transport, but they tend to become entangled. White laboratory mice are the most effective type of bait; brown or black mice are less conspicuous, wild mice are much less active, and lizards are generally cryptic and inactive. The mice did not perish when left in the traps without food and water and in full sunlight for the entire morning.

This trap is placed either along trails and roads frequented by Roadrunners or near nests. A bird that encounters a trap is usually attracted by the mouse, walks and jumps on the trap to peck at it, and eventually gets its feet caught in the nooses. It usually takes several minutes of active lunging at the bait before a bird becomes snared. Occasionally birds will work at a trap for 15 minutes without being caught, then lose interest in it. It is essential to monitor the trap continuously. If the bird is not caught securely, it can work its way out of the noose in a few seconds, and if it is securely caught, it can injure its legs if left in the trap longer than a few minutes. The trap is light enough to be dragged a short distance by the bird, but does not need to be staked.

This trap is inexpensive and easy to construct. Many can be set out simultaneously, and one person can monitor 3 to 4 traps if they are carefully placed. However, the trap has 2 major disadvantages. The first is the low encounter rate of birds with traps, resulting in poor efficiency of trapping effort. We spent approximately 12 man-hours monitoring traps per captured Roadrunner. Secondly, the trap selectively caught small males in our study area. None of these birds were seen again, and the few that were radio-tracked disappeared from the study area within a few days of capture. We surmised that these were young dispersing or itinerant birds, and that their interest and persistence at the traps reflected their inexperience, unfamiliarity with the area, and reduced foraging success. Known breeding birds, especially females, actively avoided the trap or made a single lunge at the mouse, then continued on their foraging route. Traps placed near nests were never successful.

Treadle trap

This trap employs a treadle-activated, spring-loaded door to capture foraging Roadrunners. It consists of an 18″-high band-shell-shaped body of ¼″ or ⅛″ hardware cloth attached to a flat 12″ × 18″ wooden base (Fig. 1). The fine mesh is necessary to prevent the captured bird from injuring its bill. A small mouse cage is attached to the inside back wall of the shell. A rat trap is attached to the base to supply the closing mechanism. A wire shaped the same as, but a bit larger than, the mouth of the shell is connected to the closing spring of the rat trap. Restraining "L's" are put on the rat trap spring to

keep the wire frame from closing past the mouth of the shell. Heavy black netting is sewn loosely to the wire frame to complete the door. A "T" of wood attached to the trigger of the rat trap forms a large treadle. The wire that holds down the spring and attaches to the trigger must be reshaped to sustain the added weight of the treadle. The entire trap is spray-painted black. When the trap is set, the wire hoop door lies flat on the ground and the treadle is elevated inside the shell. A white laboratory mouse is used as bait.

This trap was placed along Roadrunner foraging trails where birds leaving their nests were known to pass. Birds attracted to the mouse hit the treadle at the first lunge, thereby quickly snapping the door shut. The trap was developed toward the end of our study and was therefore employed only a few times, but it successfully captured all birds that encountered it. It worked especially well on breeding females. The primary disadvantages are its large size and heavy weight, making it difficult to store and carry. Roadrunners have been known to enter the commercially available, collapsible, squirrel-sized treadle traps, but we believe that the higher and shorter home-made trap with the flexible door is more effective for tall birds.

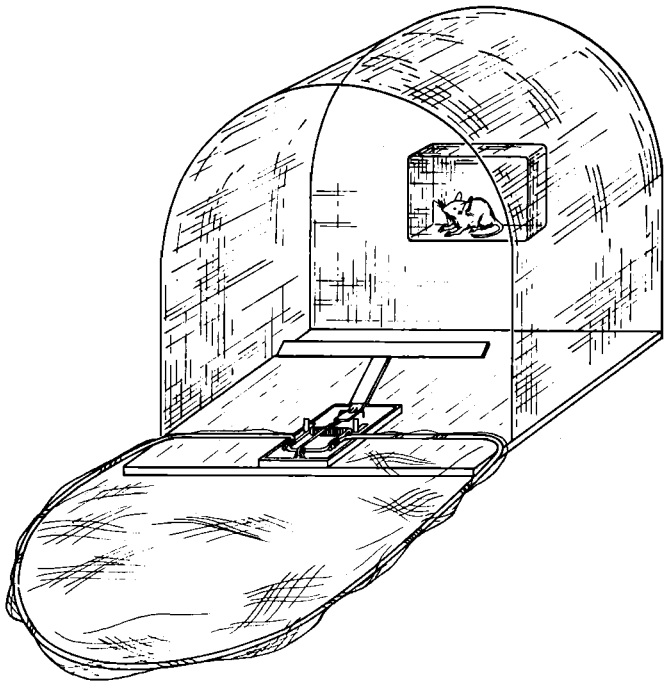

Figure 1: A home-made treadle trap employing a rat-sized snap trap for the closing mechanism.

Mist net

A standard heavy gauge 4" mesh mist net was used to net nesting Roadrunners. The net was either mounted on poles in the standard manner in the vicinity of known nests, or gently draped around the cactus clump containing a nest. (The latter procedure did not destroy the net.) In general the net was placed on the downhill side of the nest. The bird was then flushed off the nest from the uphill side, whereupon it glided or ran into the net. This method successfully captured all birds at active nests, and failed only at nests that were later discovered to be abandoned. The disadvantages of the method are: 1) the large amount of time involved in searching for nests, and 2) a high probability that the adults will abandon their nest as a result of the disturbance.

Rock net

This trap was designed to capture birds that habitually perch on rock outcroppings for displaying or sunning. It consists of a 3'-square piece of heavy black netting, weighted on four corners, and covered with monofilament nooses similar to those used in the raptor trap. It was draped over a rock where a male was seen giving courtship calls several times. His feet were caught in the nooses the next time he returned to the rock, but he slipped out before we could reach him. This trap seems to work about as well as the raptor traps, but since it contains no bait, it must be placed in a commonly used site.

Foot noose on a stick

This trap consists of a monofilament noose attached to the end of a 6' stick. The noose is opened and placed in a nest over the eggs, with the stick directed towards the outside of the nest clump. After the bird has settled onto the nest, the stick is pulled by a hidden person, closing the noose around the incubating bird's feet. A similar trap is described by Gartshore (1978).

The noose stick was successful the one time we used it, but it caused a great deal of trauma to both the bird and the investigator. The bird dove into the surrounding cactus and became entangled there. The investigator was therefore forced to wade into the cactus as well. The nest site was damaged, and the extreme disturbance caused abandonment of the nest.

Summary of trapping methods

For studies requiring the capture of breeding Roadrunners, it is much more productive to search for nests, observe the movements of the breeders, then trap the birds away from the nest in a treadle trap or foot noose

trap. As discussed, trapping birds directly at the nest risks abandonment, and randomly trapping foraging birds and hoping to follow them to their nests via radio-tracking is inefficient because of the large proportion of non-breeding birds captured.

Radio-tracking and attachment techniques

Types of radios

Three types of radio-transmitters were used on the Roadrunners: 1) a standard externally mounted radio for monitoring movements and home ranges, 2) an externally mounted radio with an internally implanted thermistor lead for monitoring both movements and internal body temperature, and 3) an internally implanted thermistor radio. All transmitters were constructed following the design of Bradbury *et al* (1979). Each radio operated at a unique crystal-controlled frequency in the 148 mHz range. Several modifications were introduced. A 100 K ohm thermistor in series with a 150 K ohm resistor replaced the 220 K ohm resistor in all temperature-sensitive units. Miniature crystals available from Sentry Manufacturing Co., Chickasha, Oklahoma, and miniature transistors (Siemens BFS 20) were substituted in the implanted radios to reduce their size. Receivers from AVM Co., Dublin, CA, with hand-held Yagi antennas, were used to follow the radio-instrumented birds.

All externally mounted radios possessed a whip antenna, and were sealed in wax and potted with dental acrylic; finished weight ranged from 10 to 15 gm, depending on the size of the battery and the amount of potting. Implanted radios had no antenna, and were dipped in a special wax available from Mini-Mitter, Indianapolis, Indiana; finished weight was between 1 and 2 gm (dimensions 8 mm by 15 mm). The pulse interval of the temperature-sensitive units decreased with increasing temperature. The interval was monitored with either a homemade pulse timer that directed continuous output into a Rustrak strip chart recorder, or a commercially available pulse timer from AVM which had no provision for automatic recording. Temperature-sensitive radios were calibrated in a slowly cooling water bath between 30°C and 45°C using a Schulteis fast-reading thermometer. A final check on the thermistor's accuracy was made after implantation by comparing the radio reading to the measured cloacal temperature of the bird.

Methods of attachment

All externally mounted radios were harnessed to the birds with ¼" cotton twill. Two long lengths of twill were tied around the radio after the wax-sealing step, and potted in with the dental acrylic so that they emerged from the 4 corners of the radio package. A soft vinyl pad was glued to the back of the radio to prevent chafing of the skin. The radio rested on the bird's back between the scapular tracts with the antenna pointing posteriorly. The top straps were placed over the bird's shoulders and the bottom straps went around the rib cage under the wings. Several methods of tying the straps over the chest were attempted with varying success. Following Dunstan (1972) and Godfrey (1970) we tied the 2 shoulder straps straight across the upper chest and the 2 underwing straps straight across the rib cage, with a short perpendicular piece connecting the straps at the midline. A second method was to criss-cross the shoulder and under-wing straps to form an "x" on the chest. With both of these methods, the birds managed to get their lower mandible permanently caught under the straps, and these methods are therefore emphatically not recommended. The only successful harness technique was a "back-pack" design, in which only the under-wing straps were tied across the chest. The shoulder straps were connected to the un-

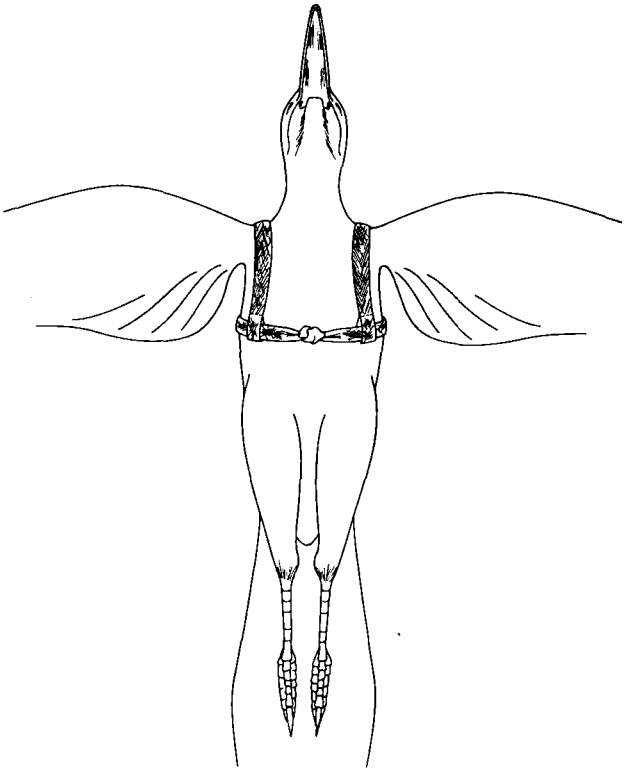

Figure 2. Ventral view of the "backpack"-style harnessing technique recommended for all long-billed birds.

der-wing strap on the same side of the body (Fig 2). The shoulder straps were cut to the correct length and looped at the end in advance, so that the under-wing straps could be pulled through these loops and then tied together. The final position of the shoulder straps could therefore be adjusted to comfort by the bird. This method of attachment was very quick and avoided the problem of stuck bills.

The externally mounted thermistor radio was harnessed to the bird in the manner described above. The thermistor lead extended about 5 cm beyond the radio package and was encased in silastic surgical tubing and sealed at the tip with medical silastic cement. A small incision was made in the skin on the back under the radio package. A standard laparotomy incision (Risser, 1971) was then made on the left side under the last rib. A wire with a loop on the end was passed from this second incision under the skin up towards the first incision, and the thermistor lead was looped through the hook and pulled under the skin. The thermistor was directed into the peritoneum, sutured in place to a rib, and the laparotomy incision sutured shut. A local anesthetic (Xylocaine ointment) and Neosporin antibiotic ointment were spread on all incision points.

To insert the internally mounted radio into the peritoneum, standard laparotomy techniques were employed (Risser, 1971). The incision was only slightly larger than that needed to view the gonads. The small wax-embedded radio was coated with Neosporin antibiotic ointment and gently pushed into the peritoneum. The muscle layer and skin layer were sutured separately. No anesthetic was necessary, the entire procedure was very quick, and the birds did not appear stressed.

Comparison of internal and external thermistors

The externally mounted thermistor radios had the important advantages of long-range transmission (1 km) due to the presence of the whip antenna, and long radio life (3-6 months) due to the larger battery mounted to the back. However, the surgery was very difficult to perform in the field, and the apparatus is undoubtedly more uncomfortable for the bird. More importantly, the externally mounted thermistors did not give accurate readings of body temperature. This appeared to be due to the fact that the radio body was itself somewhat temperature sensitive, causing a shift in the calibration curve when the radio was placed on the bird's body. The miniaturized, implantable thermistors were therefore developed to alleviate this problem. While they did give accurate readings of body temperature, they had the distinct disadvantages of short transmission range (25-50 m) due to the lack of an antenna, and short life (1-2 weeks) due to the necessarily small battery.

Discussion

In this section we attempt to evaluate the effects of the various trapping and tracking procedures on the behavior of the Roadrunners. Roadrunners appear to be very sensitive to such disturbance and many nests were abandoned. We therefore hope that future students of Roadrunner behavior and physiology can avoid many of the mistakes we made.

A total of 22 birds were caught in traps placed in foraging areas. Five of these were females (4 of these clearly in breeding condition) and 17 were males (breeding condition uncertain, but only 5 were within weight range of known breeding males). Of 20 birds released in the study area, 9 were banded only, and 11 were banded and outfitted with radio transmitters. Only 1 of the banded and released birds was ever seen again, and all of the radio-equipped birds disappeared within 2-14 days. Thus we were not able to detect any noticeable difference in behavior between radio-equipped and non-radio-equipped birds. Further, birds which received thermistor radios requiring surgery did not differ in disappearance rate from birds receiving standard external radios. We therefore suspect that the high disappearance rate of these birds is due to a highly mobile non-breeding population rather than to the disturbance of capture and tracking.

Nine additional birds were captured following discovery of their nests. Seven were caught with mist nets or traps in the immediate vicinity of their nests and 2 were caught in traps placed along predetermined travel routes well away from their nests. Four of these birds remained with their nests, despite receiving type 2 or 3 thermistor radios, and 5 abandoned their nests but remained on their territories following either surgical implants or standard radios. Thus some birds did not abandon even though they were captured on the nest and underwent surgery, whereas others captured on the nest but not unnecessarily handled did abandon. The male and female of a mated pair abandoned their first nest following capture in a mist net at the nest, but did not abandon their second nest following capture well away from the nest. We therefore conclude that it is capture near the nest that most disturbs the breeding Roadrunners, and not the surgical or radio-tracking procedures.

Having overcome most of the problems of trapping and monitoring Roadrunners, we have been able to quantify the relative parental efforts of male and female breeders and to obtain diurnal/noctural measurements of male, female, and non-breeder body temperatures. These data are reported elsewhere (Vehrencamp, in press). In general, we have found the Roadrunner to

be a very difficult and inefficient subject for a study involving manipulation of free-ranging nesting birds.

Summary

As part of a study on the behavior and breeding physiology of Roadrunners, a variety of capture and radio transmitter attachment techniques were devised and tested. Capture procedures included: a modified Balchatri footnoose trap, a home-made treadle trap, a mist net, an unbaited footnoose trap for rock perches, and a footnoose on a stick. Several types of radio-transmitters and attachment procedures were also used: an externally-harnessed thermistor radio with temperature-sensitive leads implanted in the body cavity, and an internally implanted thermistor radio. The relative success of these methods and their effects on the birds are evaluated. Capture of breeding birds could be guaranteed only by first locating a nest, but capture techniques involving the nest often caused abandonment. Only one harnessing technique for externally mounted radio transmitters proved successful. Internally implanted thermistor radios gave more accurate body temperature readings than externally mounted thermistors but had a much shorter transmitting range. The presence or absence of surgical manipulation did not appear to affect the probability of abandonment by the bird.

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Bird Banding in Alberta. Martin K. McNicholl (Editor). 1981. The Alberta Naturalist, Special Issue No. 2, 73 pp. Available from: Federation of Alberta Naturalists, Box 1472, Edmonton, Alberta T5J 2N5, Canada. $3.50 Canadian.

A compendium of 13 contributions dealing with bird banding in Alberta and produced to commemorate the meeting of the American Ornithologists' Union in Edmonton, this issue was designed to provide an historical perspective for the current active banding program in this province. (Special issue No. 1, also issued in 1981 is entitled "The history of the Federation of Alberta Naturalists and its corporate member clubs.") Special Issue No. 2 includes a few articles previously published in other outlets, some dating back to 1928-1940, as well as new information presented for the first time.

The paper by William Rowan, "The scientific aspects of bird-banding" is every bit as applicable today as when it was originally written in 1928! This paper, produced by one of the pioneers in migration studies and banding, is an eloquent plea for accuracy and experimental design in banding as well as a condemnation of the type of "picnic banding" which we call "ring-and-fling" today! W. Ray Salt's paper on recoveries of Ferruginous Hawks banded in Alberta and Kathleen Salt's lighthearted contribution on the trials and tribulations of a bander's wife are similarly ageless and do not reflect that they were written decades ago.

The recent studies address an array of topics; papers by M. McNicholl and R. Fyfe and U. Banasch provide overviews of banding and raptor banding in Alberta while other authors provide new data on the local movements of color-marked gulls, chickadee populations, and sex determination of dippers to mention a few. No discussion of banding in Alberta would be complete without mention of the activities of Edgar T. Jones whose name is familiar to all perusers of the WBBA annual report since 1972. His impressive contributions to the banding program are summarized here as are the many activities of the late Ken Trann, a most enthusiastic young Alberta bander whose biography is included.

All in all, this is in fact a special issue, a very thorough and enjoyable introduction of banding in Alberta, its stated goal, and a fitting tribute to Ken Trann to whom it is dedicated. I can recommend it to all and at today's prices it is indeed a bargain.

Charles T. Collins