

EFFECTS OF DIFFERENT RADIO TRANSMITTER HARNESES ON THE BEHAVIOR OF FLORIDA SCRUB-JAYS

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Abstract.—We evaluated the effect of two harness techniques for attaching radio transmitters to Florida Scrub-Jays by observing both captive and free-flying individuals with attached radios. Observations were made of birds with backpack harnesses and hip-pack harnesses, of control birds without radios, and of birds after the backpack harnesses were removed. Birds with backpack harnesses tended to be less vigilant and foraged and preened less than birds with hip-pack harnesses or controls. They appeared to prefer to hop and walk rather than fly short distances, although the harness did not appear to physically constrain flight. They also tended to separate themselves from other family members within their group. The behavior of scrub-jays with backpack harnesses appears to be consistent with previous observations of sick or injured birds. However, after backpacks were removed the behavior of these birds did not differ from birds without transmitters. Hip-pack harnesses did not appear to alter behavior of scrub-jays.

Radio telemetry has proven a useful tool for answering a variety of questions in behavioral ecology (e.g., Craighead and Craighead 1972, Rothstein et al. 1984, Cochran and Kjos 1985, Rolando and Carisio 1999, and many others). Transmitters and the method of their attachment may have adverse effects on the behavior (Perry et al. 1981, Massey et al. 1988, Hooge 1991, Pietz et al. 1993), survival (Marcström 1989, Paton et al. 1991, Paquette et al. 1997), and reproduction (Rotella et al. 1993, Dzus and Clark 1996, Paquette et al. 1997) of the study animals. Experimental methods have been useful for evaluating the effects of radio-tagging on a few species (Wanless et al. 1989, Klaassen et al. 1992, Morris and Burness 1992, Wanless 1992), but these methods require careful design and consideration of statistical rigor (White and Garrott 1990) and have been used relatively infrequently. This approach may not be viable for listed species, especially if treatments result in adverse effects, such as observed in Spotted Owls (*Strix occidentalis*; Paton et al. 1991). Another approach that may be suitable for listed species is the observation of captive individuals of the study species (Perry et al. 1981, Smith and Gilbert 1981) or of a surrogate species (Sykes et al. 1990). Careful review of previous studies on congeners, other closely related species, or species with similar life histories or ecology may be useful in evaluating potentially adverse methods.

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We used radio-telemetry to study the dispersal behavior of Florida Scrub-Jays (*Aphelocoma coerulescens*) that occur in a human residential development in Lake Placid, Highlands County, in south-central Florida, approximately 8 km N of Archbold Biological Station. Field work was initiated in June 1998. The Florida Scrub-Jay has declined state-wide by more than 90% over the last 100 years (Woolfenden and Fitzpatrick 1996) and is federally-listed as Threatened. Here, we review our procedures to determine the method of attaching radio-transmitters least likely to have an adverse effect on the behavior of scrub-jays and report on adverse effects associated with backpack harnesses.

Transmitters (Holohil Systems, Ltd., Woodlawn, Ontario) weighed 1.6 g, approximately 2% of the body mass of an adult scrub-jay. Components were encased in a roughly cylindrical shape (0.25 cm \times 2.0 cm) with a (17.3 cm) whip antennae. Under field conditions, the transmitters had a life of approximately 12 weeks. We reviewed previous radio-tagging studies to evaluate attachment techniques. We considered backpack and hip-pack harnesses, tail mounts, and glue-on attachment techniques. We eliminated the latter two techniques because we concluded that glued-on transmitter likely fall off within 2-3 weeks under hot and humid conditions and tail-mounted transmitters were likely to be shed during molt, which occurs during July and August, one of the peak dispersal periods. Initially, we chose a backpack harness because previous studies on Blue Jays (*Cyanocitta cristata*) (Tarvin 1997, Adkinson, unpubl. data) and scrub-jays (Stith 2000) used this harness without apparent adverse effects on the study animals.

The backpack harness was made of lightweight elastic and slipped over the wings and tied across the bird's chest, with the transmitter sitting in the interscapular region. To test this harness on scrub-jays, we captured four birds sequentially and housed each in a 2.2 m \times 1.5 m \times 2.2 m flight aviary at Archbold Biological Station. Each bird was released into the flight cage with transmitter attached and observed periodically during daylight hours over 24 h. All birds persistently preened and pecked at the harness and the transmitter antenna. The first bird caught its bill on the harness so we removed the transmitter and released the bird at the capture site. The second bird stopped pecking the harness and antenna within 3-4 hours and eventually preened the transmitter into its back feathers. After 24 h, we removed the transmitter and released the bird at its initial capture location. The last two birds also accepted the transmitter and were released early the next day at their initial capture location with the transmitter attached.

After release, both scrub-jays pecked and preened at the harness, but stopped within 4-5 hours, although both continued pecking the antenna. We observed both birds continuously; however, their behavior

appeared aberrant throughout the day of and the day following their release. Although fully capable of flight and with no obvious physical impairment due to the harness or the transmitter, both scrub-jays seemed far less active than scrub-jays without transmitters. Both birds appeared reluctant to fly and often would hop from a perch to the ground and then back up again rather than fly. Both appeared to be segregated from other members of their group and, overall, gave the impression of being ill. Out of concern for the first bird, we retrapped it within two days and removed the transmitter. We made quantitative observations of the second bird, recording behavior continuously following the approach of Altmann (1974). For comparison, we made concurrent 15-minute focal behavioral observations (Altmann 1974) of five scrub-jays without transmitters every 1-2 hours. All control birds were banded, but they varied in sex, age, and social status. Within two days of release, the second bird had tangled its bill and tongue in the harness, so we recaptured it, removed the transmitter, and released it.

Because of these apparent affects on behavior and the threat of entanglement, we next opted for the hip-pack harness (Rappole and Tipton 1991). One loop of the harness is pulled up as far as possible on the proximal end of the bird's right thigh, the transmitter is held over the synsacrum, the opposing leg is bent at the tibiotarsal joint, and the other loop pulled up to the proximal end of the left thigh. We used the same lightweight elastic as the backpack harnesses for the hip-pack harnesses. Again, we captured two scrub-jays sequentially and released the birds in a flight cage with transmitter attached. After no obvious abnormal behavior, both birds were released early the next morning with transmitters attached. We made concurrent focal behavioral observations of these birds and six jays without transmitters for 4-8 h/day for seven days. Two of the control birds were the same as those observed during backpack harness trials.

To determine if the behavioral effects were related to the radio-transmitter or an artifact of our small sample sizes, we repeated our focal behavioral observations on three of the jays that had been fitted with the backpack harness, after the harnesses were removed. We compared their behavior with the control birds and with themselves when they were wearing backpacks.

Behavior of scrub-jays with backpack harnesses differed from jays in the other groups ($\chi^2 = 19.21$, $df = 2$, $P < 0.001$), spending less time foraging and being vigilant, and more time quietly perching than birds with the hip-pack harnesses, controls or the same birds after their backpack harnesses were removed (Table 1). The quiet perching time was often spent in dense foliage, relatively low in oak shrubs, often relatively distant from other members of their family group (Table 1). The behavior of scrub-jays with hip-pack harnesses did not differ from con-

Table 1. Behavior of Florida Scrub-Jays with different radio-harness treatments. Percentages are the proportion of time engaged in individual behaviors over the entire observation period. Not all behaviors are included, so percentages do not sum to 100%. Data for perch height and distance to jays are means \pm 1 SD of observations recorded during focal observations.

Behavior	Back-pack (n = 2)	Hip-pack (n = 2)	Control (n = 9)	Back-pack removed (n = 3)
% time foraging	11%	16%	21%	21%
% time perching	33%	2%	2%	1%
% time vigilant	50%	76%	65%	71%
Perch height	1.71 \pm 1.90	3.32 \pm 7.88	2.88 \pm 1.84	2.34 \pm 2.02
Distance to jays	18.85 \pm 21.96	4.62 \pm 8.22	5.03 \pm 12.51	3.08 \pm 3.30

trols or with the birds after backpacks had been removed. However, the behavior of birds with backpacks was significantly different after their backpacks were removed ($\chi^2 = 12.12$, $df = 2$, $P < 0.01$; Table 1).

Standards have been developed for the appropriate weight of the transmitter relative to body mass (Samuel and Fuller 1994, Aldridge and Brigham 1988) or wing-loading (Pennycuik 1969, Caccamise and Heddin 1985) to decrease deleterious effects; however, determining the effects of different attachment methods requires careful, species-specific evaluation. In Florida Scrub-Jays, the hip-pack harness appeared to be a better transmitter attachment method than the backpack harness. Although our behavioral data were limited, the patterns seemed to be reasonably consistent. Our past observations of scrub-jays suggest that sick birds often reduce their foraging and vigilance, and perch quietly, often at some distance from other members of their family group. Backpack harnesses do appear to alter the behavior of scrub-jays, much in the same manner that the behavior of sick birds is altered. The use of backpack harnesses in studies of dispersal or movements in scrub-jays using radio telemetry would undoubtedly bias the results. We feel our decision of abandoning backpacks in favor of hip-packs was well justified. We observed no aberrant behavior after many hundreds of hours of observing jays during the course of our subsequent studies. Non-harness methods also may be suitable depending on the goals of the study.

Although rigorous experimental methods may be preferable when evaluating the effects of different attachment techniques, they may not always be appropriate, especially for listed species. Although our sample sizes were small, we evaluated several alternatives to assess the effect of the harness, rather than expose more individuals of a listed species to a potentially dangerous method. Our data were not statistically rigorous; however, they enabled us to detect and avoid an inappropriate harness technique for our study species.

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