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## RADIO HARNESS SYSTEM FOR BOBCAT KITTENS

Boyde H. Blackwell<sup>1</sup>, Grant T. Frost<sup>1</sup>, Jerran T. Flinders<sup>1</sup>, and Harry A. Barber<sup>1</sup>

**ABSTRACT.**—Eight bobcat kittens were fitted with a specially designed harness system supporting a radio transmitter. These kittens were the youngest known to be radio-instrumented. This system was used successfully through two seasons, from June 1989 to January 1991. Litters of kittens were located soon after birth for weighing, marking, and aging (by tooth eruption). During the first year when kittens were at least eight weeks old and six weeks old the second year, attempts were made to radio-instrument kittens in each litter. This harness system allowed litters to be located periodically until their death or dispersal. We were able to collect important data during the most crucial and least known weeks of the lives of bobcat kittens.

*Key words:* bobcat, *Felis rufus*, kitten, radio telemetry, behavior, mortality, break-away harness, Utah.

Little information has been generated concerning the first 48 weeks of life for bobcat kittens (*Felis rufus*). McCord and Cardoza (1982) and Jackson (1986) reported these first weeks of life were crucial to further development of hunting and predator-avoidance skills that enable the dispersal of experienced bobcat kittens. Our study of bobcats made it increasingly clear that habitat selection, location of prey, location of fresh water, and successful predator avoidance are all important factors directly related to survival of bobcat kittens.

Radio-instrumented collars have been used successfully to collect data on bobcats in many areas (Bailey 1974, Karpowitz 1981, Lawhead 1984, Jackson 1986, Litvaitis et al. 1986). However, due to the rapid growth of bobcat kittens in their first year, the fixed collar used for adult bobcats was not considered an option. Intraperitoneal-implanted transmitters were also not considered a safe option for kittens for fear that in recovering from surgery they would not be able to keep up with the normal movements of the litter and might have difficulty competing for food. Jackson et al. (1988) developed an expandable, drop-off harness for bobcat kittens five months or older, which he used in Colorado.

After our first year of study concerning the reproductive habits of female bobcats and their young in Utah, we felt it necessary to develop a radio-instrumented harness that

would fit smaller and younger kittens yet expand to fit juveniles. By modifying Jackson et al.'s (1988) design, we were able to develop a harness successfully used on bobcat kittens as young as six weeks old.

This study tested the hypotheses (1) that an expandable, drop-off, radio-instrumented harness could be successfully used on bobcat kittens as young as six weeks old and (2) that the harness would neither alter normal behavior nor contribute significantly to mortality.

### STUDY AREA

The Sheeprock and Tintic mountains of the Wasatch National Forest and adjacent private property, as well as lands administered by the U.S. Bureau of Land Management, were established by the Utah Division of Wildlife Resources as a study area in 1987. Most of the area is closed to all harvest and pursuit of bobcats. Included are portions of Tooele and Juab counties in northwest central Utah. Sagebrush-desert shrub, piñon-juniper, mountain brush, and montane mixed forest are the common vegetative zones (Johnson 1989). Average annual precipitation ranges between 15.2 and 25.1 cm, with amounts increasing with elevation. Elevations range from about 1600 m to 2827 m. These mountains are typical of the cold-desert portion of the northern Great Basin.

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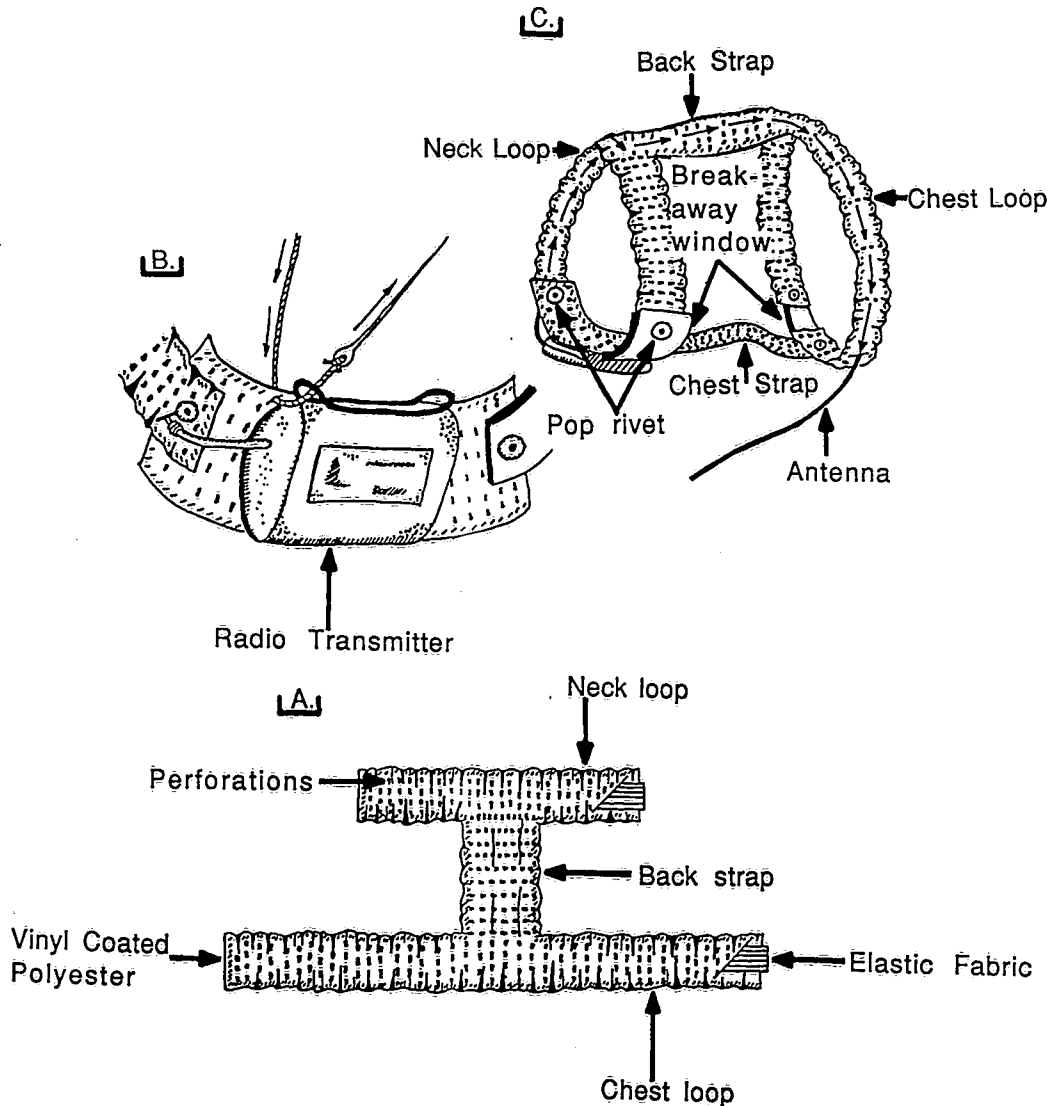


Fig. 1. An expandable, drop-off, radio-transmitter harness constructed for use on kittens at least six weeks old. (A) One-piece harness with elastic fabric before harness was assembled. (B) Attachment of radio transmitter to neck loop. (C) Completed harness; neck and chest loops are 1.5 cm wide and elastic fabric is encased in vinyl-coated polyester (VCP). Neck loop expands from 15.5 to 26 cm, chest loop from 24 to 54 cm. Back strap (3 cm long  $\times$  2 cm wide) and chest strap (6 cm long  $\times$  1.5 cm wide) are made of VCP. Antenna is encased by two sandwiched layers of VCP.

#### HARNESS CONSTRUCTION

Neck and chest loops, constructed of 1.3-cm-wide elastic fabric, were completely covered by a layer of brown vinyl-coated polyester (VCP) reinforced with imbedded woven nylon string (Fig. 1A). VCP is a perforated fabric and allows sunlight to penetrate to the rubber fabric, thus increasing potential for time-based disintegration. These perfora-

tions are approximately 2 mm  $\times$  1 mm (10 per 1 cm<sup>2</sup>). Neck and chest loops, as well as the back strap, were constructed in one piece in the shape of a capital H (Fig. 1A).

The VCP chest strap was pop-riveted to the chest loop and sewn to the neck loop with waxed upholstery cord. A small radio transmitter (Telonic's Inc. Model 070, Mesa, Arizona) was stitched, with waxed upholstery

cord, to a wider piece of VCP fabric inserted at the bottom of the neck loop (Fig. 1B). The antenna for the transmitter, encased in the VCP harness, protruded slightly from the chest loop at the bottom (Fig. 1C). The edges of the VCP harness were double stitched with nylon thread. The completed width of the chest and neck loops was 1.5 cm, the back strap was 2 cm wide  $\times$  3 cm long, and the chest strap was 1.5 cm wide  $\times$  6 cm long.

The neck loop circumference was 15.5 cm and expanded to 26 cm, while the chest loop was 24 cm and expanded to 54 cm. The average weight of the completed harness system was 46.5 g, less than half the weight of the harness used by Jackson et al. (115 g; 1988).

### RESULTS

To place the harness on the bobcat kitten, we stretched and pulled the neck and chest loops over the bobcat's head. The neck loop rests in front of the shoulders on the neck, with the transmitter under the chin (Fig. 2A). The chest loop fits behind the front legs, with the legs straddling the chest strap (Fig. 2B).

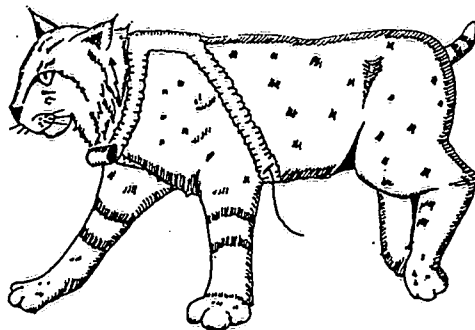
We radio-instrumented eight bobcat kittens (four males, four females) (Table 1). One male kitten harnessed at nine weeks wore the harness system for 28 weeks, at which time the harness was replaced with a regular one-piece collar worn by other adult bobcats. We found the harness in very poor condition, as we had expected. We estimated that the harness would have fallen off in approximately three to four more weeks. There were no abrasions or sores caused from wearing it.

The harnesses were worn by the kittens for a varied number of days (Table 1), the least being two days, the most 32 weeks. One kitten was able to free itself from the harness because elastic inside the VCP was purposefully cut when the harness was first placed on the kitten. One kitten apparently hooked the back strap on a branch of a prostrate juniper tree and in its struggle to free itself twisted the harness tighter around the branch and its neck.

### DISCUSSION

Only one kitten, which wore the harness for 32 weeks, was found to have harness-related sores present on the neck and in the chest loop

**A.**



**B.**

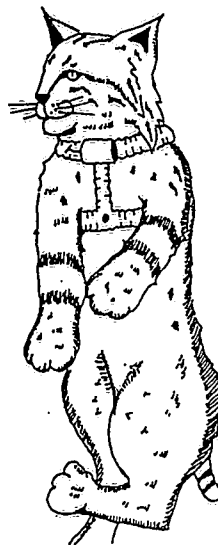


Fig. 2. (A) Side view of bobcat kitten wearing harness. (B) Bottom view of harness worn by bobcat kitten with front legs on either side of chest strap.

area. Because of this, we added two break-away windows (Fig. 1C) to the neck and chest loops, factors that will greatly increase the probability that the harness will break away before causing abrasive injury to the kitten.

Steigers and Flinders (1980) developed a break-away, expandable collar for mule deer fawns. We recommend this same type of break-away system for the bobcat kitten harness to ensure a complete and timely loss of the harness. Steigers and Flinders found

TABLE 1. Results of radio-instrumented harness system fitted to eight bobcat kittens, 1989–1990.

Bobcat kittens	Age (weeks)	Weight (g)	Harness use (weeks)	Results
17M male	9	1600	28/replaced	dispersed
22M male	18	3200	13	death/starvation
24F female	14	1900	16	death/predation
29F female	8	1480	4	radio stopped
30F female	8	1210	2 days	slipped harness
33M male	6	1100	7	death/natural
34F female	6	1050	3	death/harness
35M male	9	1610	32	collar broke away

that surgical tubing (0.318-cm wall thickness  $\times$  1.27-cm diameter) had an approximate life of 10–13 months and recommended thinner tubing for shorter life. We recommend 0.159-cm-thick tubing and are confident that this addition will meet our objectives for future use.

We have found that valuable data can be collected on mortality rates and behavior of young bobcats with this harness system. Not counting the harness-related death, there was a high natural mortality rate for the kittens. Two of the seven died of natural causes while wearing the harness. Two that grew large enough to wear adult radio collars were lost as juveniles: one died of starvation or disease, and the other disappeared during dispersal. Our data show there is a high mortality rate at all stages for young bobcats (Table 1).

By taking simultaneous readings of locations for collared dam bobcats and offspring with harnesses (and in one case between two siblings harnessed at the same time), we were able to study patterns of movement, home-range use, and family continuity. All kittens had a lower average daily minimum movement than their dams, confining their activities almost exclusively to the core area of the dams' home ranges (determined with Program Home Range, Ackerman et al. 1989). Kittens were found up to 1.5 km apart, but one would be with the mother and the other in a secure den. The mother was located with at least one of her kittens 50–80% of the time. When the mother was not with the kittens, she was found up to 2 km away. This suggests that estimates of kitten survival may not be very accurate if based on observations of kittens seen with their dams.

#### ACKNOWLEDGMENTS

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