TELEMETRY TRACKING OF SUMMER TRANSPLANTED ELK IN SOUTH CENTRAL WYOMING

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Summary Transplanting elk into regions where the native elk population is low is relatively common practice. Generally, these releases have been made in winter. This paper discusses the telemetry system developed for use on elk, and the behavior of elk transplanted during the summer. An optimum time for transplanting of elk appears to be during the rutting season.

Introduction Transplanting elk has been practiced for over 60 years. Most of present herds throughout the Rocky Mountains have originated from elk trapped during the winter from the Jackson Hole and Yellowstone Park region. Many of these elk were transplanted to areas where native populations did not exist, or if herds were already established, had low populations. The plantings have been made during the winter when elk could be trapped.

Several authors have reported the movements of transplanted elk, and the distances elk moved from their release site.[1] [2] [3] [4] In Virginia, Jackson reported a cow elk moving 225 miles in less than six years. Janson, in Montana, reported an average air-line distance of 9.6 miles for transplanted elk from release site to their death site.

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[1] Allred, W. J., Re-establishment of seasonal migration through transplanting, N. Am. Wildl. Conf. Trans. 15:597-610, 1950.

[2] Anderson, C. C., The elk of Jackson Hole--A review of Jackson Hole elk studies, Wyo. Game and Fish Commission., Bull. 10, 184 p., 1958.

[3] Jackson, H., Transplanted elk wanders, J. Mammal. 22(4):448, 1941.

[4] Janson, R., Movements of transplanted Yellowstone elk in west-central Montana, Proc. Am. Conf. W. Assoc., State Game and Fish Comm., Butte, Montana. 46:107-109, 1966.

Past studies used neck-banded or ear-tagged elk to identify transplanted animals, and were mainly concerned with distance moved. Behavioral differences of the native and transplanted elk were not studied.

With the development of telemetry systems to help identify and locate an individual animal, a method has been provided to obtain detailed data on the behavior and movement of transplanted elk. This paper describes the telemetry system and presents results from following two small groups of telemetered elk that were transplanted to the Pole Mountain District of the Medicine Bow National Forest during the summers of 1970 and 1971.

Elk used in this study were supplied by the Wyo. Game and Fish Commission from their Sybille Research Unit. Adult cows, originally trapped from the Jackson Hole area, had been used on feeding tests at the Sybille Unit for at least three years.

Telemetry System The telemetry system used in this study is a pulsed type system. The output is a series of 10 ms RF bursts which occur once per second. This type of signal seems to be best suited for wildlife tracking applications. Fig. 1 is a block diagram for the transmitter located in the collar around the elk's neck. Timing is obtained by the use of a cross-coupled astable multivibrator, while the duty cycle is obtained by the use of a monostable multivibrator keying a crystal controlled squegging oscillator.[5] The output of the oscillator is frequency doubled and power amplified to supply power to the antenna.

Figure 2 is a diagram of the astable multivibrator and the monostable multivibrator. This circuit operates on a 9-volt power supply and draws a total of 20 µa.

The circuit diagram for the transistor switch, the squegging oscillator and the power amplifier is shown in Figure 3. The oscillator is actually a Colpitts type transistor oscillator in which the crystal acts as the inductor in the oscillator tank circuit. The LC tank circuit in the collector of the transistor must be tuned above the crystal frequency (86 MHz) so that it appears to be capacitive. The other capacitance required in the Colpitts circuit is the stray capacitance between base and ground. Signal to the power amplifier-frequency doubler is obtained by the transformer coupling from the oscillator LC tank circuit. The power amplifier is a push-push type of power amplifier and is used in order to eliminate the fundamental component of energy from the antenna.

The squegging oscillator is keyed by the monostable multivibrator output. This means of keying the oscillator is the most efficient when both lowduty cycle and crystal-controlled operation is necessary. In this crystal oscillator, there is a significant time delay (tens of ms) between keying on of the oscillator circuit and the time at which oscillations begin.

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[5] Cochran, W. W. and R. D. Lord, Jr, 1963. A radio tracking system for wild animals. Wildl. Manag., 27:9-24.

The squegging oscillator has the property that, during the delay time prior to the beginning of oscillations, no significant collector current flows in the transistor. By the selection of the base resistors and the base capacitor in the oscillator, the pulse width for the duration of oscillation is adjusted to 10 ms. The monostable multivibrator period is 50 ms, which allowed one and only one pulse of the squegging oscillator. During the period of oscillation, the oscillator draws approximately 20 ma. Transformer coupling to the power amplifier is adjusted so that approximately 30 ma flow in the power amplifier during the 10 ms pulse.

The design goal for the life expectancy of these collars was 12 months. This was achieved by using 6 alkaline C cells with a 5,000 ma capacity and an average current drain of approximately .5 ma. The alkaline batteries were chosen because of their high ampere hour capacity, their size, and their good low-temperature performance characteristics.

The entire circuit operates over a voltage range from 5 to 10 volts, and over a temperature range of -20° to +80°F without a serious change in frequency, output power, or pulse rate.

Two types of antennas were used in this study. A whip antenna was used on the first transplant while a loop antenna imbedded in the collar was used on the second transplant.

The whip antenna was a 1/4 wave whip (172 MHz operating frequency) mounted in the center of a partial ground plane which consisted of a thin copper strap 1 1/2 inches wide and 18 inches long secured to the top of the belt. In air, this antenna had a driving point impedance represented by 390 ohms in parallel with 9 pf. When this collar was placed around the neck of one of the experimenters, the impedance characteristics changed to a resistance of 130 ohms in parallel with 12 pf. The range of this system was greater than 10 miles when the antenna was in free space. The signal strength, measured at 1/2 mile, was attenuated approximately 25% when the collar was placed on the neck of a domestic animal (horse).

The loop antenna used in the second transplant was a circular half-wave dipole (a half-wave dipole that had been circularly layed around the collar). Fortuitously, the half-wave length at 172 MHz turned out to be the circumference of the collar required for a mature cow elk. These loop antennas tend to have good radiation efficiency. The measured input characteristics of this antenna were 310 ohms resistive in parallel with .1 µh inductance when measured in air. When the antenna was wrapped around the chest of a large dog measuring 27 inches in circumference, it measured 430 ohms resistive in parallel with .6 µh inductive. The signal strength of this antenna was measured at approximately 1/2 mile distance and was found to be affected by a factor of two or three between the free air signal strength and the signal strength when the collar was placed around the neck of an animal. In free space, this antenna also had a range in the neighborhood of 10 miles. When installed on elk, the range was reduced to about three miles.

The electronic circuitry was constructed on small p-c boards; the total package measured 1 inch by 7/8 inch by 5/8 inch high. The electronics were protected from shock by encapsulation in styrofoam and then waterproofed by dipping them in a latex-based sealing compound.

On the collars used for the first transplant, the final packaging covered the electronics and the batteries with several layers of fiberglas cloth coated with resin (Fig. 4 and 5). The final collars (Fig. 5) had whip antennas made of .040 inch dia stainless steel wire. For the second set of collars, the entire battery-electronics package was potted into a solid brick of resin. This brick was reinforced with a layer of fiberglas cloth epoxied to the outside of the brick. These transmitters were equipped with loop antennas built into the collars (Fig. 6).

The neck bands used for all collars were 1 1/2-inch-wide leather belts stapled and cemented into continuous loops. The leather was protected by covering the belts with heat shrink tubing. This tubing also helped to secure the various interconnecting wires to the leather belt.[6]

The receiver used in this study was a Drake SPR4 operated in the cw mode. The incoming 172 MHz signal was mixed down to 27.5 MHz by means of a frequency converter supplied by D. Beaty, Mesa, Arizona. A signal level of 0.01 µv was detectable to the ear.

Results

First Transplant On September 16, 1970, the first group of elk (three cows and their three calves) was transported by covered truck and unloaded in Horse Creek Pasture No. 4 on the Pole Mountain District of the Medicine Bow National Forest. The cows had not been bred when released. Before loading at Sybille, telemetry collars equipped with whip antennas were put on two of the cows. For the first four days, these elk were radio tracked closely using the vector method to obtain a fix. Mechanical destruction of the whip antenna by the elk (discussed later) made tracking impossible after the sixth day, so visual observation with spotting scopes was used until the two telemetered cows were killed during the regular hunting season on Oct. 5 and 6.

At daylight on the day after being released, a 5-point bull was herding the six Sybille elk around the area within 1/2 mile of the planting site. It took three attempts before the bull

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[6] Weeks, R. W., A. L. Ward, J. J. Cupal, A telemetry system for studying elk behavior in the Rocky Mountains, 9th Annual Rocky Mountain Bioengineering Symposium Proc., May, 1972, p. 177-181.

could force the Sybille elk to jump a barbed-wire fence. This fence had a broken top wire so it was only about 30 inches high. Since the Sybille elk had been enclosed in elk-tight fences at Sybille, they were reluctant to go over the fence. Through persistence and considerable herding, the bull forced them over the fence. This same morning, six bulls, a cow and two calves from the native elk herd were seen within 1 mile of the transplanted elk.

On the 26th of Sept., a bow-hunter saw the Sybille elk in the forest cover about 1 mile east of the release site. They stayed in this area for another day and then moved west beyond the release site. The 5-point bull was still with the Sybille elk, but the other native elk seen in the area had not joined the group. The transplanted cows had all gained weight and were in good condition compared to their condition when released.

On the evening of Oct. 3, the Sybille elk plus a large cow, a yearling cow and a calf from the native herd were seen feeding together near the release site. The native elk became very nervous when approached by the tracking team and left the area. The Sybille-elk followed the native elk when finally approached to within 50 yards.

On Oct. 4, at daylight, the Sybille elk were with a large 6-point bull and a yearling cow from the native herd. The 6-point had taken them over as his harem. The 5-point bull was not seen.

Opening morning of the hunting season, Oct. 5, a hunter killed a bull with the Sybille elk as he crossed a fence about ;I mile north of the release site. The bull had 5 points on one side and 4 on the other. This meant that three separate bulls had taken over the Sybille elk as a harem. Rutting season, then, appears to be a good time to transplant cow elk, if acceptance into the native herd is desired.

During the first two days of the five-day hunting season, both telemetered elk were harvested and the collars recovered. Several developments caused disruption of the transmission. Destruction of the whip antennas by the elk was verified; the elk had bent the stainless steel wire with their molar teeth. Moisture had moved down the antenna into the transmitter. The heatshrink tubing was beginning to wear through where it came into contact with the elk's neck at the top. The covering over the batteries was cut, which resulted in moisture-caused corrosion of the battery pack. This damage to the battery pack was apparently caused by the animal striking at the transmitter with its hoofs.

Second Transplant On May 21, 1971, five cows and three spike elk from the Sybille Unit were transplanted to the Crow Creek Pasture No. 3 of the Pole Mountain District. Four cows were equipped with transmitters at Sybille before being loaded in the covered truck. These collars had loop antennas encased in the neck band.

After release, the elk were located on 20 separate days using telemetry tracking during the period June 21 until Oct. 60,1971. They stayed in a group and were observed to be joined only once by a native calf elk on Oct. 6, even though native elk were observed within 2 miles of them on four different days. They were seen on six days between Aug. 23 and Oct. 4 (the normal rut period for this range), but there was never a large bull with them.

Since they had been at Sybille for some time, these elk were accustomed to people. They showed their trust by traveling 3 miles east from the release site to the area around upper North Crow Reservoir where they spent most of the summer. Many fishermen saw them and were amazed how tame they were. They would let people approach within 100 yards without alarm. Perhaps this was the reason there were no native elk seen with them.

This group of Sybille elk showed no signs of aversion to Hereford cattle. On two occasions, the two species were seen feeding within 100 yards of each other.

The elk, even though they had been held inside 8-foot fences at Sybille, were very adept at jumping the 4-strand barbed-wire fences. They were seen on the other side of one of these fences within five days after release.

Three of the cows gave birth to calves sometime around July 12. Their breeding season had evidently been delayed while in captivity at Sybille, since the native elk on this range have their calves around the first week in June. It was possible, with the late calving, that these cows did not come into estrus the same time as the native herd, and thus there was no interest from a harem bull.

Three of the telemetered cows and one of the transplanted spikes were killed during the hunting season in early Oct. The transmitters, with their improved mechanical construction, were in good physical condition. Some wear was apparent on the heat-shrink tubing along the top of the collar. One recovered transmitter had failed due to corrosion of the printed circuit board. The cause of this corrosion was unknown, but could have been a result of moisture traveling down the antenna from openings in the heat-shrink tubing. The transmitter on the remaining cow had also failed for some unknown reason. The other two recovered transmitters continued to function properly until they were dismantled approximately 6 months after construction.

Conclusions The results illustrate the necessity of a rugged and durable transmitter for use on elk. Elk are very sociable and curious animals and are attracted to foreign objects attached to another individual. This habit apparently caused the destruction of the first set of transmitters. Likewise, because of this preening habit, an external antenna such as the whip is unsuitable for use on elk. An antenna enclosed within the collar is necessary.

From the history of the two elk group transplants, native herds and transplants may become mixed much faster if the transplants are released near a bull during the rutting season. The surviving cow from the first transplant could be recognized by an old white collar. This elk was seen a few times during the spring and summer of 1971, and exhibited all the timid characteristics of her native elk associates. The group taken over by a native bull elk became wild much faster than the group that remained isolated from the native herd.

Acknowledgments Among the many individuals who contributed to the study, we wish to thank the following: Floyd Blunt, Director, Sybille Research Unit; E. Tom Thorne, D. V. M. Research Veterinarian, Wyoming Game and Fish Commission; Al Lea, Technician, Rocky Mountain Forest and Range Exp. Stn., U. S. Forest Service.

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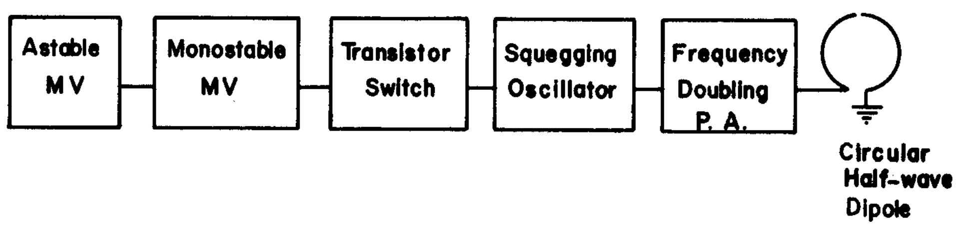

Fig. 1 - Transmitter Block Diagram

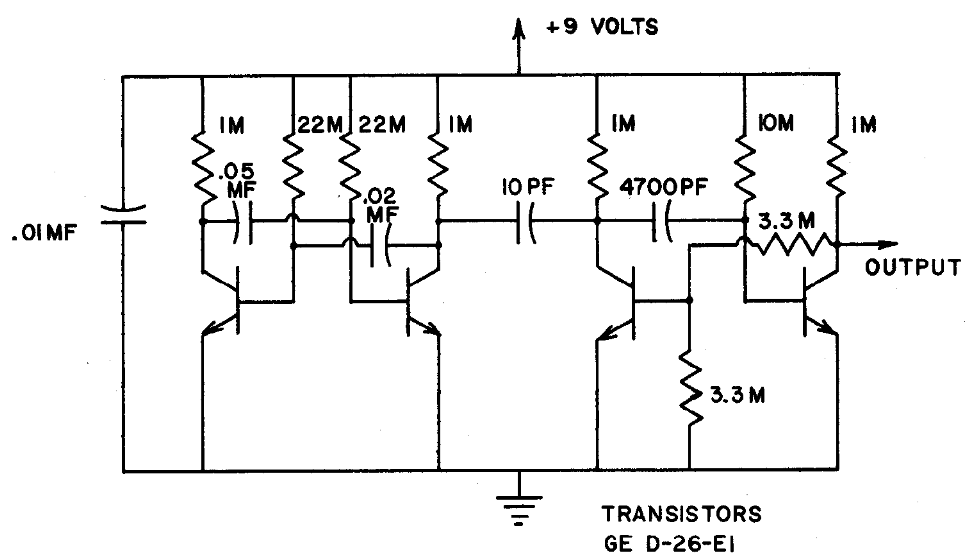

Fig. 2 - Timing Circuit Diagram

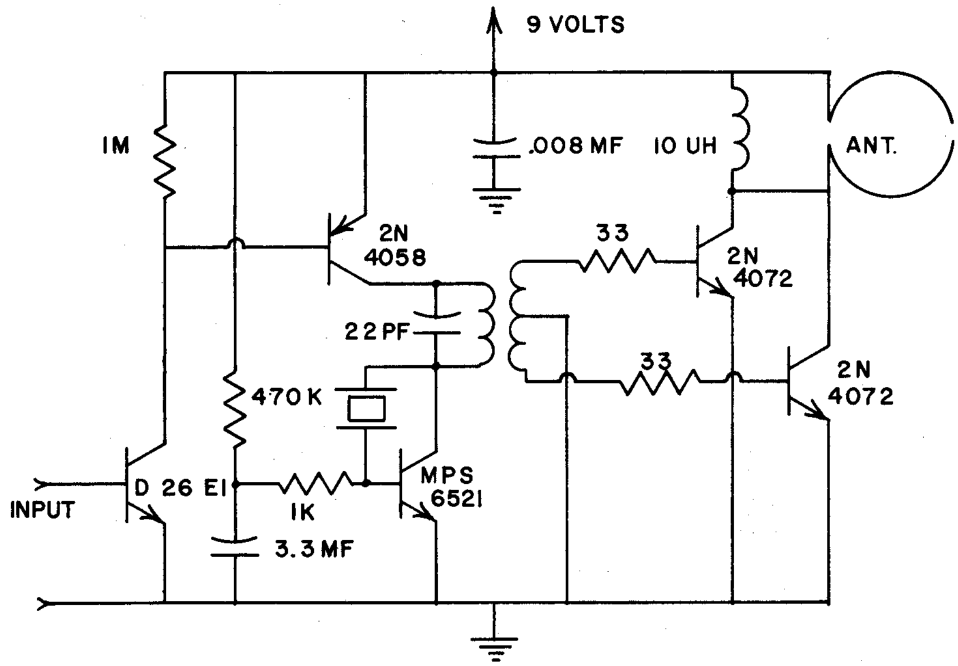

Fig. 3 - Oscillator-Power Amplifier Circuit Diagram

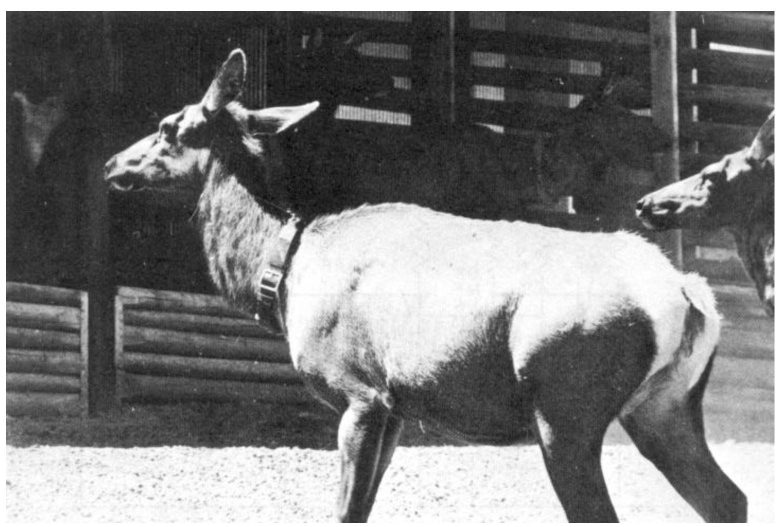

Fig. 4 - Cow Elk at the Sybille Research Unit Wearing a Radio Collar with a Whip Antenna. The Bent Whip was Caused by Chewing by Other Curious Elk

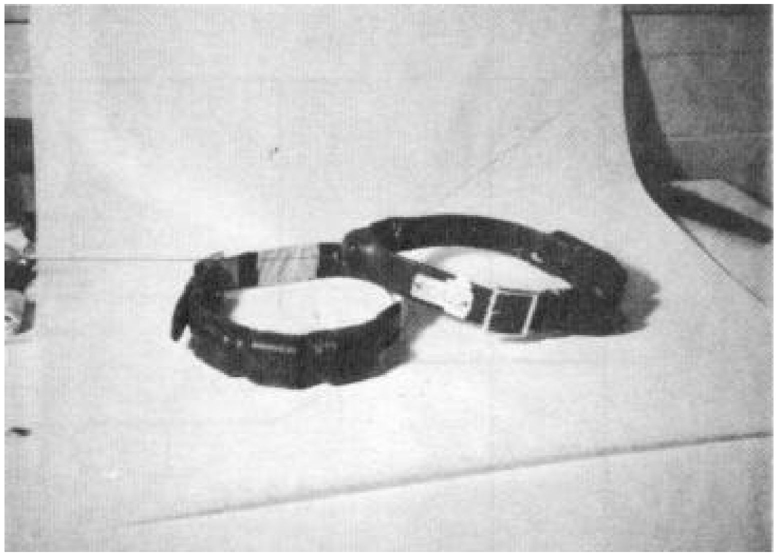

Fig. 5 - Two Collars with Whip Antennas Ready for Installation on Cow Elk Prior to Transplantation

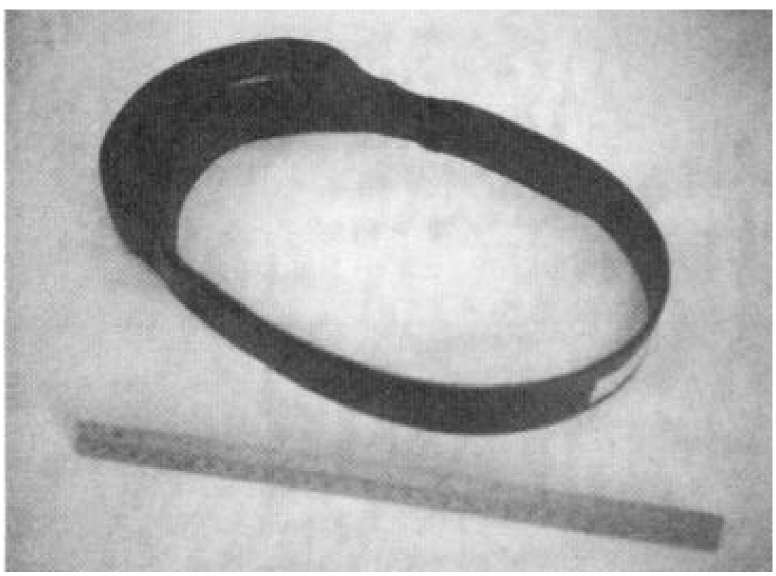

Fig. 6 - Finished Transmitter With Loop Antenna Built into the Neckband. A One Foot Ruler is Shown in Foreground.