

We had two major objectives relative to our radiotracking research relative to our Atomic Energy Commission. These were (1) further ~~protection~~ ^{for} of our radiotracking system and (2) the gathering of ecological information on big game species, specifically, the elk using radiotracking and biotelemetry techniques. Some of the specific objectives pursued ~~relative to~~ ^{for} perfecting the tracking system were:-

1. The development and improvement of the directional properties of the tracking system
2. The extension of ~~transmitter~~ ^{transmitter} battery life
3. New or revised antenna designs to give greater directional precision and better reception
4. Better cold weather performance of receivers
5. Testing of cold weather performance of transmitters and, finally,
6. Work toward telemetering certain physiological ~~parameters~~ ^{parameters} from free roaming wild animals.

Some of the improvements made in the tracking system were as follows:

- (1) ^{were} Changes made in the new receivers and some old receivers were altered or redesigned. In general, the receivers were made more foolproof so that they could be used by untrained personnel. Their sensitivity was increased and their cold weather performance improved. One new type receiver was constructed with rechargeable nickel cadmium batteries. These are good for about 30 hours of operation between charges.
- (2) ^{Insert Page 7 - Joel's report}
^{Insert Page 8 - Joel's report}
Extended life transmitters were developed and field tested on elk. The basic continuously pulsing transmitter was altered by the addition of a ~~gear~~ ^{keyer} circuit used to turn the transmitter on for ten seconds and off for twenty seconds. By varying the number of pulses in the ten second interval, the individual transmitters could be identified and, thus, the animal to which they were attached could also be identified. The number of pulses in the ten second interval varied from ~~six~~ ^{sixteen} to twenty-six. The life expectancy of these transmitters is ~~six~~ ^{one year} ~~months~~ ^{Insert Page 5 - Joel's report}
- (3) The development of long-life transmitters controlled by accutron timers. By controlling the on-off period of the pulsed transmitters, it was possible to extend the life of a single transmitter and battery pack to a year or more. One transmitter with accutron timer was set ^{to transmit} for three minutes ~~on~~ every half hour and two others were set to transmit for three minutes every fifteen minutes.
- (4) ^{was} An antenna diplexer designed for use with a load switching system which uses two ~~3-3~~ ³⁻³ antennas to obtain both high resolution and high gain. This system provided more accurate bearings than we were able to obtain with the single three-element ~~3-3~~ ³⁻³ antennas formerly in use. The two antennas were mounted on a common cross member and skewed slightly so that their patterns overlapped. When the antenna array is rotated, the signal from one of the antennas becomes weaker while the other becomes stronger. These signals are compared by the diplexer unit which in conjunction with the receiver generates a 1 kc audio tone that nulls when the two signals are equal and increases when they are unequal. Field tests revealed that the nulls of this load switching method were quite pronounced and that the bearings could be made more accurately than those taken from a single antenna. The prototype antenna system proved successful enough that a ~~permanent~~ ^{permanent} antenna installation is now being constructed.

- from whence it moved into Jackson Hole. This was a movement from the montain grounds of the Northern Yellowstone elk herd into the montain grounds of the southern herd. Single migration was unusual if not unique thus the movements of this animal are of special interest.*
- (5) The field life of the regular continuously pulsed transmitters with the mercury cell battery packs was increased considerably. The ~~former~~ ^{former} operational life of a single transmitter and battery pack increased from ~~a former~~ ^{former} of 74 days to 110 days. The longer life was in a large part due to better ^{battery} packaging of the coating of battery packs with Solastic and the other included the coating of the battery packs with paraffin.
 - (6) ^A The second cubex quad antenna (27 mc) was altered for 32 mc reception. It was also altered so that it could be readily taken apart and put together for portable use in back country. The wire elements were reduced and were made from #20 stranded copper insulated wire. ^{one and a half inch} high gear clamps were used to fasten the fiber glass rods to metal spiders. ~~In addition to this antenna improvement,~~ ^{it was found that} the operation of the sense antenna on the portable receivers depends on the direction of the loop winding, that is, whether the winding is clockwise or counter clockwise. ^{If differently wound loops are used on the same receiver the direction of strongest signal will be reversed.}
 - (7) Tests were conducted on the automatic recording of data using tape recorders and oscilloscopes. Both methods show promise and will be incorporated into the overall biotelemetry system.
 - (8) Improvements were made in the packaging or potting of the transmitter collars. Fiberglassing the collars to make them shock proof and water proof and then later encasing in plastic hose were time consuming steps. Consequently, a rubber mold was prepared. The object of this was to use the mold for pouring a fiberglass ^{resin or other} plastic coating around the transmitter and, thus, greatly reducing the time needed to prepare a finished collar. ^{Results are promising but an optimum plastic is still being sought.}
 - (9) For some aspects of behavioral studies it is desirable to be able to record animal sounds and calls from a distance. To facilitate this a 27 mc citizens band voice transmitter was designed and tested. This can be placed miles from a receiving station and set so as to pick up the voices, or noises of various types of birds or animals. ^{The tests with this are still in progress.}

The second major objective of the Atomic Energy Commission research was to instrument a number of elk, possibly, ten and gathering information on their migration, movements, the daily and nocturnal activities, feeding habits and general behavior. In order to obtain this information, six different elk were instrumented - one in the Elk Refuge at Jackson Hole. The migratory movements of this elk were studied as it moved up into the Teton wilderness area and on up into Yellowstone Park in the vicinity of Chicken Ridge. This animal had formerly been ^{collar} marked in the Lamar Valley in the northern part of Yellowstone Park. ⁹ In late January three different elk were instrumented in the Old Faithful area. One of these was instrumented with the temperature sensitive transmitter and was tracked and studied from January 30 to February 18 at which time the collar was removed. Another one was instrumented with an accutron timer from February 1 to September 22. This transmitter was set to go on for 3 minutes every half hour. This time interval proved too long for efficient field tracking. The second accutron timer ^{that} was placed on this animal was set to transmit for 3 minutes every 15 minutes. This time period proved to be much more suitable for tracking ^{large} animals. The Old Faithful elk herd was thought to be a non-migratory band of elk as compared to the migratory elk that was instrumented in Jackson Hole. Another group of elk at Norris in Yellowstone Park were also thought to be a non-migratory group ^{and} a cow was instrumented in this area. Two different cows were instrumented in ^{this} area. The first one ^{was} with a continuously pulsed transmitter which was removed continuously for over 110 days before ^{replaced with another one that functioned} removed from the elk. At this time a

second cow was instrumented and this time with one of the extended life transmitters. In order to obtain a maximum amount of information on the radio-tagged elk, it was necessary to ~~collar~~^{collar} mark those animals closely associated with the instrumented animal. Five different elk were marked in the Old Faithful area. This included 3 cows and 2 calves. Of these two calves one was a bull and the other a cow. At Norris, ~~three~~^{three} cows and one harem bull ~~had~~^{have} been marked so that they can be identified in the future. The tracking and studying of these instrumented and marked elk began on January 30, 1965 and has continued to date, December 1, 1965. The regular pulsing transmitters, the extended life transmitters and the accutron-controlled transmitters were all tested on the elk and, in addition to this, the improved versions of the tracking receivers were used in the work. The results in terms of ecological data obtained from a radio-tagged elk was significant and encouraging. These results will be treated separately. The equipment improvements greatly increase the capability of the biotelemetry or radiotracking system. These enabled us to track elk continuously for a period as long as a year and to accurately locate these animals whenever we wished to find them or to move in close and observe them. The transmitters were found to operate well at low temperatures, that is, temperatures well below zero and improvements were made in the receivers so that they too operated better at low temperatures. However, there is still room for improvement in the receiver performance at low temperatures ranging from -10° to -40° ~~below zero~~^{below}. A temperature sensitive transmitter whose pulse rate was regulated by a thermistor was placed on an elk. This telemetered the environmental temperature as modified by the animal's body and other influencing factors. Field experiments conducted in January and February revealed that changes in collar temperature could be correlated with certain environmental conditions or with changes in animal activities. This and other work with the temperature sensitive transmitter paved the way for the development and testing of equipment that will be employed to telemeter body temperatures from free roaming animals.



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Dear Frank:

Enclosed is a copy of the magazine you requested. The article appears on page 11.

The editor of the magazine said Nat Reed was furious when he read it. She said he called and ranted and raved for the better part of an hour. If there was ever any doubt that he was guilty of malfeasance, it should be erased now. He's hypersensitive because he knows in his heart that he is wrong and that he has wronged both you and the bears in Yellowstone.

You asked about details concerning my being fired from Defenders. Do you remember a letter I sent you in which I complained about how Reed was behaving? I believe I predicted - not to your surprise of course, that this grizzly controversy was going to be a long and hard fight and that Reed just might have a tough time of it.

Unknown to me, Dick Pough, Margaret Owings and others on DOW's Board were conspiring with Reed. They ordered the Executive Director, Mary Harris, to send them copies of my correspondence. My letter to you found its way into their hot little hands and apparently frightened them. These staunch defenders of our wildlife heritage frighten easily you know. Their next step was to demand that Miss Harris fire me. Old, senile and insecure, Miss Harris did their bidding

The actual order to have me fired came from Pough. Miss Harris even showed me his letter. She also told me that it was Reed who was behind my being ousted.

Later at a meeting of the Humane Society of the U.S., at which Reed was principal speaker, one of the Society's employees asked him about his involvement in my being fired from DOW. He admitted that he had complained to Pough, Owings and others on the DOW Board about the unfair treatment he was receiving from me on the grizzly controversy. Naturally, he claimed that he didn't want me without a job, he was merely trying to get someone to set me straight.

So that's how it happened Frank Reed's interference in DOW affairs got me the boot.

Of course, the real blame lies with Pough, Owings and Steele. If you remember, it was Steele who commissioned A. Stephen Johnson to write that egregious article which later appeared in DOW's magazine. It was possibly the most inaccurate, biased article I have ever had the misfortune ^{to} read ~~it~~.

Anyway, all that is in the past now. Some time when you are in D.C., give me a call. Perhaps we can get together over lunch or dinner.

Hope you and your family have a nice holiday season.

Best of Luck,
Steve Seater