BRIEFER ARTICLES

A DEVICE FOR MONITORING RADIO-MARKED ANIMALS

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Abstract: A simple, portable, and economical recording system consisting of a receiver, signal conditioner, recorder, and power source is described. The system was designed to monitor the signal strength from a radio-marked animal at a particular location. Information is stored on recorder chart paper. Radio-marked ducks have been successfully monitored at nest sites, potholes, and other locations.

Within the last 10 years, radiotelemetry as a technique to study wild animals has developed rapidly. Because most field telemetry projects are not designed to obtain data on a continuous basis, as described by Cochran et al. (1965) and Cochran (1967), a large proportion of the available information is not collected. Our recording system was developed to monitor radio-marked animals at particular locations in field studies when ruggedness, portability, and cost of the recording system were of primary concern. Williams and Williams (1970) briefly described a recording system for monitoring the presence and relative activity of radio-marked bats. A recording device for monitoring the presence of radio-marked seals on the surface of sea ice was mentioned by Siniff et al. (1969).

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MATERIALS AND METHODS

The recording system, block-diagrammed in Fig. 1, consists of a receiver, signal conditioner, recorder, and power source. The receiver produces an audio output from an incoming signal. A signal conditioner converts the receiver output into a d-c current activating the recorder stylus. Stylus movement of a single channel d-c recorder (Model No. 288, recorder paper Style A, Rustrak Instrument Division, Gulton Industries Inc., Manchester, New Hampshire) is recorded on pressure-sensitive paper.

The receiver is tuned aurally by using headphones to select the desired frequency and by observing the recorder to obtain the desired deflections of the stylus. Range of the system can be varied by adjusting the *rf* gain of the receiver or antenna gain. Selection of the type of antenna will depend on the relative positions of the antenna and the animal to be monitored. If the antenna can be placed near the center of the area to be monitored, a nondirectional antenna is the best choice. When the antenna must be

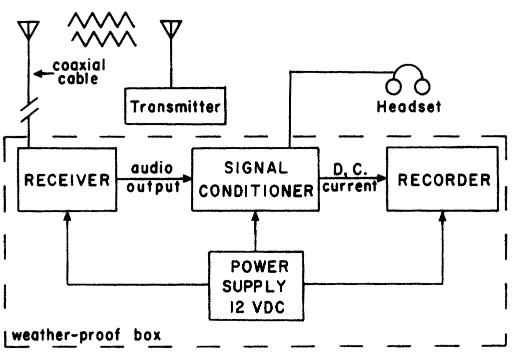

Fig. 1. Block diagram of a radio transmitter and the recorder system.

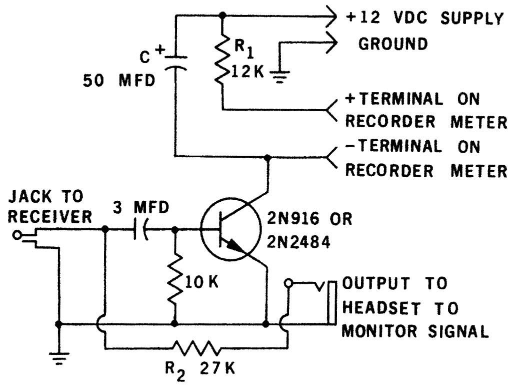

Fig. 2. Schematic diagram of the signal conditioner.

placed away from the animal, a directional antenna should be used.

The receiver, signal conditioner, and recorder are powered by a single 12-volt source. A freshly charged, 60-ampere-hour automotive storage battery will operate the system for approximately 3 weeks. Two 6-volt lantern batteries (connected in series) will last for approximately 72 hours. The system, including the two 6-volt dry-cell batteries and a weatherproof box made of marine plywood, weighs approximately 20 pounds.

A signal conditioner is not available from commercial sources; however, it can be constructed from the schematic diagram (Fig. 2). Component values and layout are not critical. The transistor acts as a switch allowing a variable amount of current to flow through the meter, depending on signal amplitude and pulse width if the signal is pulsing. Almost any audio NPN transistor will work. Resistor R_1 serves to limit the maximum current through the recorder meter. It can be chosen using the relationship $R_1 = Vs/Imax - R_m$, where Vs is the supply voltage; $Imax$, the full-scale meter reading; and R_m, the meter resistance (which can be neglected if the full-scale reading is 500 microamperes or more). Capacitor C prevents the stylus from *fluttering* when a signal from a pulsing transmitter is being recorded. Resistor R_2 isolates the headset so that it can be inserted and removed without affecting the meter reading. The 27K-ohm resistor is suitable for 2000-ohm headsets; its value should be increased if the meter level is affected by the headset and reduced if the audio level in the headset is insufficient. Any receiver having sufficient audio output to drive a headset is satisfactory; otherwise, an additional stage of audio gain should be used. The receiver should have sufficient bandwidth so that minor shifts in the receiver or transmitter frequency will not have significant effect on the chart record.

Recorders are available with different meter movements and drive motors. Interchangeable gear-train assemblies permit a wide range of chart speeds. We regarded a 0- to 1-ma movement and an unregulated drive motor as the best choice considering cost and versatility. Other movements will work if R_1 is changed accordingly. Chart speed for an unregulated motor was accurate to within ±3 minutes per hour as long as battery voltage was maintained above 11.5 volts. Improved speed regulation can be achieved by using a recorder with speed regulation or a voltage-regulated power supply. Cost of the recorder with an unregulated motor is about $140; cost with speed regulation is about $210. Estimated cost for signal-conditioner components is $10.

This recording system was used successfully during two field seasons where temperatures ranged from 29 F to 88 F. It was used primarily to record the presence and the activity of nesting mallards (*Anas platyrhynchos*) and wood ducks (*Aix sponsa*), but it was also used to monitor radio-marked ducks on small potholes and hens with broods. Once the specific area to be monitored (nest, pothole, river segment, or similar area) was determined, the recording system was positioned to permit periodic maintenance of the recorder without disturbing the animal. System checks were usually made daily to correct small errors of time in the recorder, to retune the receiver if necessary, and to review the record of the monitored animal. Coaxial cable was used to connect the recording system and the antenna, which may be remote from the system. Good results were obtained using a small whip antenna positioned within several feet of a nest. A directional loop antenna could be located as far as 30 yards from a nest, and a Yagi antenna would permit the monitoring of an animal from several hundred yards.

An attempt was always made to position the antenna and adjust the receiver so that if the animal left a designated area the recorder would indicate a zero reading. Each recording will probably be slightly different, and the system should be carefully installed and tested under conditions and ranges anticipated in the field. The investigator should also be aware that discrepancies in the chart record may occur

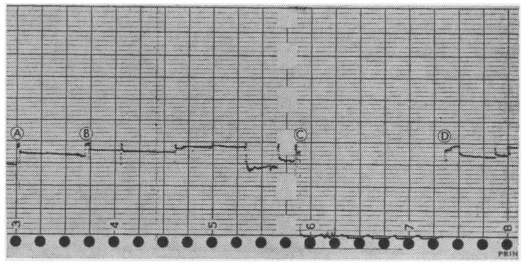

Fig. 3. Five-hour recording of the activity of an incubating wood duck hen on July 3, 1970. Examples of movements inside the cavity are indicated at A (3:00 pm) and B (3:40 pm). Departure from the cavity is indicated at C (5:50 pm) and arrival at D (7:20 pm). The chart speed of this recorder was 1 inch per hour, and the chart roll lasted 31.5 days.

if the transmitting antenna produces a sharp null.

No major effort was made to distinguish graphic records produced by different types of activity such as feeding, preening, and courtship display. However, comparisons of graphic records and visual observations may indicate that certain types of activity exhibit distinct graphic records.

RESULTS

A 5-hour recording of activity of an incubating wood duck, equipped with a breast-mounted transmitter with body loop antenna, is shown in Fig. 3. Time of arrival and departure at a nest cavity as well as various movements of the hen while in the cavity are indicated. Note that departure of the wood duck from the cavity is indicated at about 5:50 PM and its return at about 7:20 PM. The system was adjusted to indicate a zero reading when the bird left the general vicinity of the cavity. Several movements of the animal while it was in the nest cavity are indicated by minor stylus excursions. Two of these are noted in Fig. 3 at A and B.

Monitoring an animal with the recording system provided much useful information on the activity schedule of the animal.

Overall tracking efficiency was increased with the knowledge of the approximate time an animal could be expected to depart from a given location.

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THE SWEDISH GOSHAWK TRAP

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Abstract: Hawk and owl predation at game farms was successfully controlled by the use of the Swedish goshawk trap. The raptors are caught alive and uninjured. Comparisons are made between live-trapping, pole-trapping, and shooting. Trap construction is described.

Concentrations of game birds found at state and private game farms are usually vulnerable to avian predation. Shooting and pole-trapping are the control methods generally employed, and most of the raptors are inevitably crippled or killed. In this age of enlightenment, better conservation practices should be encouraged. There are many ways by which hawks and owls can be caught alive, but most are costly and time-consuming. Perhaps the best answer is the Swedish goshawk trap (Meredith 1953). It does not require constant attendance, and the birds caught in it are not injured and can be released elsewhere.

R. L. Bard, W. H. Robinson, and I have redesigned, modified, and improved the older version of the Swedish goshawk trap. It can be transported in a station wagon.

MATERIALS AND CONSTRUCTION

The trap consists of two parts, the trap proper and the bait cage. The trap is made of redwood lumber using 1- × 6-inch, 1- × 3-inch, and 1- × 2-inch stock. Redwood was chosen for its resistance to warping and to weather and because of its dark color. Painting is, therefore, not necessary.

The bait cage is made of 1- × 1-inch galvanized welded wire, and its overall dimensions are 3 × 3 × 1 foot. An access door about 10 inches wide is cut into one of the sides.

To construct the trap proper, four 3-foot pieces of 1- × 6-inch redwood are cut. Two of these are then shortened by two board thicknesses and fastened together with long wood screws. Throughout the construction of the trap, wood screws are used, and all holes are predrilled to prevent splitting. The finished base is a 3-foot square.

Next, four pieces 25 × 1 × 3 inches are cut with 45-degree angle points at their ends. These are screwed to the base square as shown in Fig. 1. One piece, 1 × 3 inches, is then attached to the inside of each peak