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Accepted 18 August 1975.

A TELEMETRY TECHNIQUE FOR MONITORING DIEL WATERFOWL ACTIVITY

A technique for monitoring waterfowl activity is needed to aid researchers in studying the response of birds to changes in environmental factors and to define diel activity rhythms in greater detail (Warner 1963, Folk 1971, Nilsson 1972, Winner 1972). The feeding ecology of different waterfowl species has not been studied continuously over a 24-hour period. Night vision scopes are useful (Swanson and Sargeant 1972, Tamisier 1972), but visual observations are time consuming and require that the subject remain in view of the observer. A continuous record of feeding activity cannot be obtained routinely through visual observations.

A telemetry monitoring technique was developed over a 6-year period through combined efforts of researchers from the University of Minnesota and Northern Prairie Wildlife Research Center to provide continuous information on the activity of breeding mallards (*Anas platyrhynchos*) held on experimental ponds under different limnological conditions. The purpose of this note is to describe the equipment and some of the results obtained.

A miniature radio transmitter with two transmission modes, one continuous and one pulsing, was sealed in a head-piece fabricated of dental acrylic and mounted on the bill of a mallard hen with a nasal pin and two metal clasps that curved over the nail of the bill (Fig. 1).

We used standard dental laboratory techniques to fabricate the acrylic head-piece from a wax likeness affixed to a dental stone model of a mallard's head. The stone model was processed from an impression of the head of a hen mallard with a conventional dental impression material. A small mercury switch was mounted perpendicularly on the apex of the head-piece (Fig. 1) so that the continuous transmission mode was activated when the bird's head was upright. When the head was lowered, as in feeding, the pulsing mode was activated.

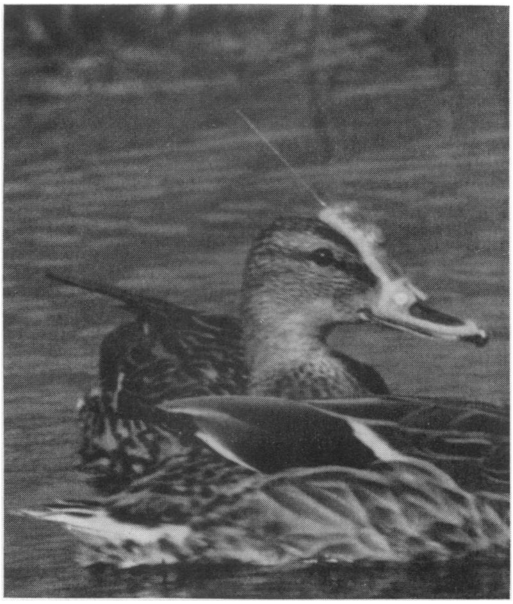

Fig. 1. Female mallard carrying a 9-g acrylic head-piece.

The dual mode transmitter was constructed with readily available subminiature components. The use of these components rather than the larger sizes normally used in constructing animal transmitters resulted in only a fractional savings in component weight but greatly reduced bulk, an important factor in a head mount.

The radio signal was received by a modified lock-in receiver employing a yagi antenna. The signal was transferred to an Esterline Angus event recorder set to record at a rate of 1.9 cm/hour. Recordings were divided among three types: continuous signal, pulsing or intermittent signal, and no signal. A continuous signal was recorded as a straight line with pen held in the non-deflected position. Activation of the pulsing transmitter mode deflected the recording pen with each pulse. An extended loss of signal produced a straight line with the pen held in the deflected position. Circuitry diagrams are available on request from the authors. Use of brand names does not imply endorsement of commercial products by the federal government.

Results of a continuous 10-day record from an accelerometer-equipped hen mallard placed on a 0.04-ha experimental pond at the Research Center are shown in Fig. 2. The composite activity pattern located at the base of the x-axis was constructed by summing the number of pen deflections that occurred during identical 8-minute (2.5-mm spaces on the recorder paper) intervals of each diel period. Signal losses were infrequent; the most noticeable period of continuous deflection occurred during the morning of the ninth day. As depicted in the composite activity pattern, the bird was active during all diel periods. Peak activity occurred following sunset (1910) and just prior to sunrise (0737). The pattern of activity was one of short periods of intense movement, usually less than 1 hour in duration, followed by periods of little or no movement. There was, however, considerable variation among diel periods.

Observations of the treated and control birds and of additional birds that were fitted with head-pieces during development of this equipment suggested that birds so equipped behaved normally with respect to feeding activity. The activity record (Fig. 2) largely reflected vigorous head movement and/or lowering of the head which was required to activate the pulsing transmission mode. Visual observations revealed that the bird could swim or remain alert without activating that mode. The complete system (accelerometer, receiver, and recorder) required little maintenance in spite of variable climatic conditions that occurred during the test. Temperatures fell below 0 C on some nights, and there were periods of strong wind. The system was capable of operating without maintenance for at least 5 days when powered by a standard size, 12-V car battery.

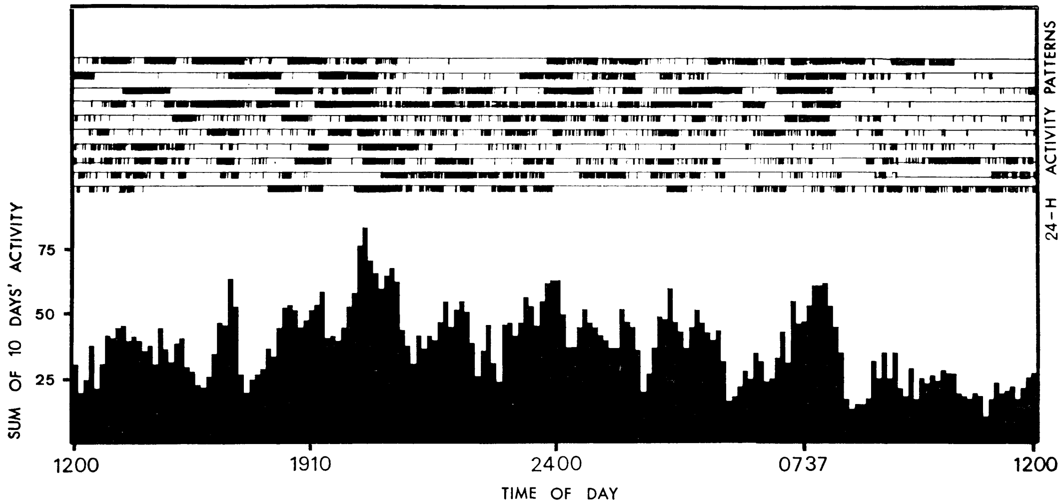

Fig. 2. Selective activity pattern of an accelerometer-equipped mallard hen during a 10-day period in October. A composite activogram equals the sum of pen deflections that occurred during identical 8-minute intervals of each diel period. Continuous activity during identical time periods for each day would sum to 100.

The dual-mode transmitter proved reliable and was easily mounted on the head-piece. The lock-in capability of the receiver was particularly useful, because after initial adjustments practically no tuning was required to insure continuous signal reception.

The value of activity rhythm information is well-known, and several investigators have employed telemetry techniques to obtain this type of data (Knowlton et al. 1968, Gilmer et al. 1971). Telemetry methods have an advantage over other methods in that data can be obtained without human interference or the need to observe the subject. Telemetry technology for studying wild animals, however, is relatively new, and many improvements in equipment and its uses can be expected in the near future.

The head-piece was accepted readily by the birds and did not appear to inhibit feeding. The dual-mode transmitter was especially valuable, because it allowed separation of periods when no signals were received from periods when data of the two desired types were received and recorded. This would not have been possible with a single mode transmitter, because periods of data loss would appear the same as a recorded continuous signal. The mercury switch was an adequate motion detector, but other types also may prove to be as good. The lock-in capabilities of the receiver greatly reduced need for regular maintenance of the system, and the event recorder was a practical way to record data. The strip chart facilitated use of various interpretative methods. Use of the transmitter permits partitioning activity in addition to measuring gross activity. There is considerable potential for this approach in studying waterfowl activity rhythms.

The head mount as a means of attaching telemetry equipment appears to have some potential and will prove to be a more acceptable method of attachment as the technology related to miniaturization continues to improve. Acceptance of the head mount by adult mallard hens was encouraging. Care must be exercised, however, when the nasal pin is inserted, to avoid unnecessary pressure against the top of the nasal area. The nasal area should not be covered but should be well aerated to avoid softening of the bill.

Although the head of the bird was chosen as an area for attachment in our testing of the activity equipment, other types of attachments such as the standard back or breast mount may prove to be equally acceptable or superior for monitoring specific types of activity.

Acknowledgment.—Appreciation is extended to R. A. Reichle and R. J. Schuster for assistance in developing the radiotelemetry gear and to D. S. Gilmer, T. J. Dwyer, and D. A. Davenport for critically reviewing the manuscript.

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Accepted 28 August 1975.

THE DESIGN OF A DIRECTIONAL, TREADLE-ACTUATED ANIMAL MOVEMENT RECORDER

Numerous investigators have used treadles in conjunction with an event recorder to determine activity patterns of mammals. Until now, however, it has not been possible to record the direction of movement of an animal in a simple and reliable manner. We have developed a treadle and associated circuitry system that permits a directional record to be made, and it is well suited to both laboratory and field use.

The system consists of a treadle assembly, the electronic circuit assembly, and a multichannel strip chart event recorder. The directional treadle, which may take whatever form is appropriate to the experimental situation, consists of a pair of platforms onto which the animal steps while traveling across the mechanism. The weight of an animal on a platform closes a switch contact to complete an electrical circuit.

The electronic logic circuit is an assemblage of integrated circuit logic elements and other common electronic components that function to determine the order of