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A TECHNIQUE FOR CONTINUOUSLY LOCATING SMALL MAMMALS IN FIELD ENCLOSURES
CFSH PRICES

by W. J. Graham

MASTER

H.C. 3.10; MN .65

Laboratory of Vertebrate Biology, The University of Michigan, Ann Arbor

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Continuous records of the location of individual small mammals in the field are essential for a complete understanding of their home range and locomotor activity patterns. The technique reported in this paper was developed to determine the periods of daily activity of the meadow vole (Microtus pennsylvanicus) in a natural habitat. Radioisotopes have been used to locate small mammals throughout their home ranges (Godfrey 1953, 1954, 1955; Kaye 1960, 1961; Ambrose 1962) but these manual methods require that an investigator always be present. Barbour (1963) has been able, by placing a survey meter and recorder near the burrow of a ^{60}Co tagged vole, to determine when an individual vole is present or absent in its underground nest. The present paper describes an automated recording device for periodically locating a radioactively-tagged vole in a 30 ft. diameter enclosure. The enclosure is in a rich cover of bluegrass (Poa pratensis) on a 3.5 acre tract of floodplain meadow on the grounds of The University of Michigan Botanical Gardens.

The device consists of three functional parts concerned with 1.) detection, 2.) rotation, and 3.) recording. The detection portion consists of a scintillation probe mounted on an aluminum boom and connected to a log-scale ratemeter. The rotation of this boom is powered by a large synchronous motor mounted in a stationary base. The continuous signals from the ratemeter are fed into a Rustrak recorder along with a pulse which indicate when the boom points due north.

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Radiation, both background and from the radioactive source in the vole, is constantly being detected. As the probe approaches the tagged vole, the amount of radiation picked up by the probe increases. As the probe moves away from the vole, the radiation intensity decreases. This produces a peak on the record each time the probe passes the vole. The position of the peak in relation to the north reference marks indicates the radius of the enclosure on which the vole is located, and the height of the peak is inversely proportional to the distance of the vole from the probe. From these records, the position of a resting vole can be determined to within 1 foot.

MATERIALS:

The 30 ft. diameter circular enclosure (fig. 1) has sides of 3' wide galvanized sheet metal sunk 18" into the ground. In the center of the enclosure a 1' x 1' x 2' base constructed of 3/4" plywood supports a rotating platform. Both a Nuclear-Chicago Linear/log ratemeter (Model 8731), within an insulated plywood box, and a 15 ft. aluminum boom are mounted on this circular platform (fig. 2). As it rotates, the scintillation probe at the outer end of the boom describes a circle midway between the edge and the center of the enclosure and 2' above the ground. The probe consists of a 1" x 1" Harshaw thallium-activated NaI crystal (4Pa-4) coupled optically to an RCA 6199 photomultiplier tube and sealed in an 8" x 2 1/4" diameter aluminum tube. The platform is rotated by a 3 RPM synchronous motor (Bodine B-2270-600G) through a set of Boston spur gears giving a reduction of 18:1. Thus the boom makes one revolution each 6 minutes.

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The 60 lb. weight of the platform, boom, ratemeter, and box rests on a Timken roller bearing (3 1/4" diam.). A 3/4" OD pipe attached to the platform passes down through the center of the bearing and carries 4 wires from the ratemeter to the upper half of the "commutator" in the center of the boom base. This device consists of two 4" x 1/2" plastic discs, the upper one being attached to the bottom of the pipe and contains 4 heavy plug tips which project below the disc. Each projecting tip lies in a circular 3/16" x 1/4" oil-covered, mercury-filled groove in the stationary lower disc and thus rotates in its own canal of mercury. In this way, 120 v. 60 cycle power is supplied to the ratemeter and the output signal is carried back to the non-rotating base. This signal activates a 0-100 microampere galvanometer, shunted to reduce its sensitivity, in a Rustrak recorder (Model 146) located outside the enclosure. A cam on the upper, rotating disc activates an event recorder in the Rustrak recorder, producing a reference mark each time the boom passes north.

Since the ratemeter is sensitive to both high and low temperatures, a 75-watt bulb in series with lower stage of a Penn 6219T2X thermostat was installed in the ratemeter box to maintain an ambient temperature of approximately 80° F. Cooling in the summer is accomplished by a small, shuttered Rotron exhaust fan in series with the upper stage of the thermostat.

¹⁸²Tantalum was used to tag the voles because most of its emission is high-energy gamma radiation with only small amounts of beta radiation, its half-life of 115-120 days makes it ideal for a 3 week study, and it is considered to be biologically inert. A 50-75 microcurie source (1 cm. x 18 ga. ¹⁸²Tantalum wire) is injected subcutaneously into an anesthetized vole.

The amount of radiation from that animal (in a wooden trap) is recorded at the edge of the enclosure, under the probe, and near the boom base for several revolutions to determine radiation intensities at known distances in the enclosure. The vole is then released near the boom base and the enclosure is not entered during the recording periods except for occasional, brief maintenance.

ANALYSIS:

The chart paper would appear as in A of Figure 3, if a vole were resting at the south edge of the enclosure, indicated by X. The peak on the chart is exactly midway between the marks which indicate when the boom was pointing due north, showing that the vole was on the 180° radius of the enclosure. The intensity of the radiation from the isotope decreases as the square of its distance from the probe. Since the ratemeter is operated on the log scale setting, the signal at the recorder changes linearly and proportionally with the distance.

If the vole remains in that spot, the next revolution of the boom will produce a record exactly like the previous one, as in B. If the vole should then move to point Y and remain there during the next revolution of the boom, the chart record would look like C. Likewise, if it then moved to point Z, the next record would look like D. Although points X and Z are almost the same distance from the probe, they can be distinguished on the record by the height of the trough between the peaks. The differences in trough height are due to the differences in radiation intensity detected by the probe when it is on the opposite side of the enclosure from the vole. Movement of the animal as the boom passes over it results in a skewed peak, which may not allow the

vole to be located precisely. . This technique is ideal for determining the daily activity periods of small mammals in 30-40 ft. diameter enclosures.

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Fig. 3. -- The position and motion of the boom in the enclosure is represented by (1). The three positions used to calibrate each radioactive vole are X, Y, and Z. The chart records which would result from a vole being present in these 3 positions are shown in (2). A and B are from position X, C is from position Y and D is from position Z.

APPENDIX

Form A

Date _____

Mouse # _____ 9 6

Enclosure # _____

Hour	#	Radius in °'s	Intensity			
			High	Next low		
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

	1					
	2					
	3					
	4					
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	10					

	1					
	2					
	3					
	4					
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	6					
	7					
	8					
	9					
	10					

Form C

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		2	6																					
		2	7																					
		2	8																					
		2	9																					
		3	0																					
		3	1																					
		3	2																					
		3	3																					
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		4	9																					
		5	0																					