# COMPARISON OF HOME RANGE ESTIMATING TECHNIQUES FOR THE COTTON RAT (*SIGMODON HISPIDUS*): FLUORESCENT TRACKING VS. LIVE TRAPPING

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Abstract: A comparison of home range size estimation techniques for cotton rats (*Sigmodon hispidus*) was conducted in a native grassland ecosystem in Central Kansas. The fairly recent method of fluorescent powder tracking was compared to the time-tested method of using recapture data from live trapping.

The area of fluorescent trails was analyzed by drawing the trail on a grid map then tracing that trail on onion skin paper and weighing the paper on an analytical balance. The live trapping data were analyzed in two ways. First, the formula for minimum area of a polygon was used, then, as a control, the live trapping data were also drawn on onion skin paper and weighed as with the fluorescent powder data. The results show there is no significant difference between the areas of home range estimated using the minimum area and the fluorescent powder tracking method.

There are many factors in natural ecosystems which can affect the home range of small mammals. Cameron and Kincaid (1982) suggest interspecific and intraspecific interactions affect the home range as does reproductive status and sex of the small mammal (Cameron and Spencer, 1981). It has also been suggested that home range size can change over time (Spencer et al., 1990). Despite these complicating factors, much work is being done in the area of home range estimation in small mammal populations with hope that in the future we will fully understand the role small mammals play in our complicated world.

Several methods exist for estimating home range sizes (Hoagland, 1993) and scientists disagree over the effectiveness of the existing methods (Stickel, 1954; Jennrich and Turner, 1969; Laundre et al., 1987; Mullican, 1988; Boonstra et al., 1992; McShea and Giles, 1992). The purpose of this research is to compare two of the existing methods of estimating home range size to see if a significant difference exists between them. The first method, introduced by Lemen and Freeman (1985), uses fluorescent powder to mark movement of small mammals over a short period of time (5 to 6 hours). The second method involves analysis of repeated recaptures of the same animals and determining the areas of minimum convex polygons enclosed by the recapture data.

The cotton rat (*Sigmodon hispidus*) was chosen for this study because they are abundant, readily captured, and easily handled. Cotton rats have a range extending from Kansas south to Panama (Cameron and Spencer, 1981). Adult cotton rats generally range in size from 110 to 225 g for males and 100 to 200 g for females.

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## MATERIALS AND METHODS

This study was conducted on a native grassland habitat approximately 1 mile east and a half mile north of McPherson, Kansas. The animals were live trapped on a 42 by 42 m grid using Sherman live traps (7.5 by 9 by 23 cm) spaced at 7 m intervals. Traps were baited with scratch grain and set during the afternoon. They were then checked during the early evening hours (around 9:00 PM). This seems to be when cotton rats are most active (personal observation). Animals captured were toe clipped for identification purposes and released.

Some of the animals were marked then dropped in a plastic bag containing fluorescent powder (Radiant Color Co.), after which they were released to leave their trails. The fluorescent trails were then followed within three nights after powdering by using an Eveready Indoor/Outdoor Commander Fluorescent Lantern equipped with a 6-W ultraviolet tube. Surveyors tape was tied to grasses and shrubs every 1 to 2 m so the trail would be permanently marked. Within a few days of marking, the trails were measured for length and transferred to a scaled down map of the grid. If the trails went off the grid (as they often did), they were drawn on to the back of the paper and later transferred to another grid map. The field study lasted from September through late December, 1992. After December, no cotton rats were captured.

Powder trails were drawn to scale on a map of the grid, and the beginning and ending points of the trail were connected by a straight line in order to enclose the area inside the trail. The trail was then traced onto 9 lb. 25% cotton onion skin paper. Each traced home range was weighed on an analytical balance to the nearest ten thousandths of a gram. A square of onion skin paper, representing a 7 by 7 m quadrant, was also weighed (0.0243 g). All paper weights were converted to area measurements using this conversion factor.

The live trapping data were analyzed by calculating the area of a minimum convex polygon using the map makers formula (Jennrich and Turner, 1969). As a control, the live trapping data were also analyzed using the onion skin paper method. The means of the data gathered by fluorescent tracking and the live trapping methods were compared using a student's t-test.

## RESULTS

Homerange size estimates varied among individuals from less than 25 $m^2$ to greater than 400 $m^2$ (Table 1). The average estimates derived from the mapmakers formula and paper-weight methods for the recapture data were not significantly different (t-test, $p=0.09$). The mean homerange size derived from recapture data (132.9 $m^2 \pm 95.3$) was not significantly different from the estimate derived from powder-tracking data (139.9 $m^2 \pm 129.8$; $p = 0.88$). However, the actual movements are substantially different from estimated movements (Figure 1).

Table 1. Homerange size estimates for *S. hispidus* inhabiting a native prairie habitat in McPherson Co., KS. Sizes are derived from minimum convex polygon estimates from recapture data and powder-tracking methods. See text for discussion of methods used to estimate home range size. All values are in $m^2$. Different animals were used for the polygon method and the powder-tracking method, except for the data marked with an asterisk. This animal's homerange is depicted in Figure 1.

| Minimum Convex Polygon | | |
|---|---|---|
| Formula | Paper-weight | Powder-tracking Paper-weight |
| 392.0 | 365.4 | 409.0 |
| 220.5 | 223.8 | 204.0 |
| 220.5 | 204.7 | 186.0 |
| 205.5 | 214.0 | 60.0 |
| 196.0* | 186.0 | 239.0* |
| 196.0 | 182.5 | 49.0 |
| 143.5 | 137.5 | 45.0 |
| 122.5 | 114.7 | 37.0 |
| 98.0 | 100.8 | 30.0 |
| 98.0 | 91.0 | |
| 73.5 | 77.4 | |
| 73.5 | 75.0 | |
| 49.0 | 51.4 | |
| 49.0 | 50.4 | |
| 49.0 | 49.0 | |
| 49.0 | 47.4 | |
| 24.5 | 23.6 | |

## DISCUSSION

The results of this study clearly indicate live trapping and powder-tracking are very comparable methods when used to estimate homerange sizes of *S. hispidus*. However, it is clear by viewing Figure 1 that the powder tracking method gives a much more accurate record of an animals exact movements. The powder-tracking method can also be used for other studies such as determining where cotton rats live, what they eat, or which cotton rats are interacting. The drawback of the powder-tracking method is that it is very time consuming. The first might is spent catching and powdering animals, the second night is spent marking the trail, and the third day is spent measuring and mapping the trail. The live trapping method on the other hand is very easy to perform and takes much less time to complete but it fails to reveal precise movements.

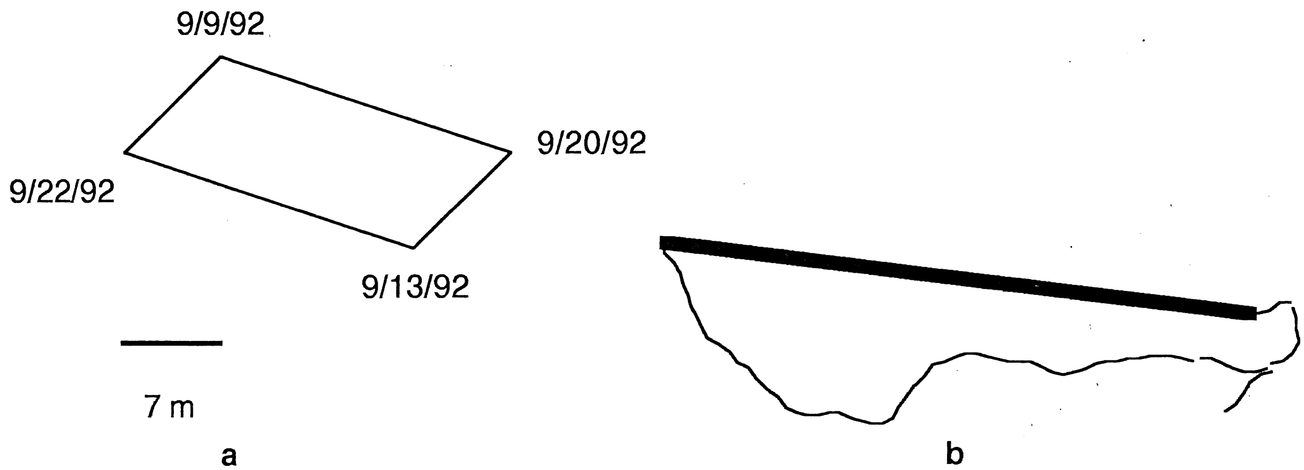


Figure 1. a. Homerange for *S. hispidus* estimated from recapture data. This 175 gram adult male was recaptured four times during September 1992. The area encompassed by the polygon is 196 $m^2$. b. Homerange estimated from the same animal derived from powder-tracking data. The area encompassed by this reconstruction is estimated at 239 $m^2$. The heavy solid line represents an artificial connection between the two ends of the powder trail.

An alternative method of estimating homeranges in small mammals involves radiotelemetry. A small radiotransmitter is attached to an animal, location points are obtained on a regular schedule, and movements are plotted. Several problems also occur with this method, the first of which is the expense incurred with such a project. Additionally, this method is believed by some to be less accurate than powder-tracking (Laundre, et al., 1987; Mullican, 1988; Schmutz and White, 1990).

There are numerous theories as to why *S. hispidus* disappears in the winter. The most notable of which seems to include the influence of climate (Sauer, 1985; Langley and Shure, 1988). Since Kansas is on the northern border of the cotton rats' range, it is likely that cotton rats may die out or disperse during particularly harsh winters, such as was experienced in Kansas during the 1992-1993 year.

The results of this research support the hypothesis that fluorescent powder-tracking and live trapping give very similar results when used to estimate home range size of the cotton rat. Although this study suggests similarities in results, much more research in this subject needs to be done before any conclusions are made on the average size of a cotton rat's home range. Knowing the movements and habits of small mammals can lead to a better understanding of their participation in such events as seed dispersal and crop damage. It is to our advantage that we learn as much as we can about the creatures we share this earth with to help us better understand both our role as well as theirs.

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