1959

Habitat of Red-Backed Vole

Harvey L. Gunderson

RED-BACKED VOLE HABITAT STUDIES IN CENTRAL MINNESOTA

BY HARVEY L. GUNDERSON

During a study of small mammal populations at Cedar Creek Forest, Anoka County, Minnesota, an attempt was made to determine some factors affecting the local distribution of the red-backed vole, *Clethrionomys gapperi*. Cedar Creek is a research area originated by the Minnesota Academy of Sciences and is now administered by the University of Minnesota. It straddles the Anoka-Isanti county line 4 miles east of Bethel, Minnesota. The work was done in that part of the forest which is in Anoka County.

Cedar Lake makes this forest distinctive. The lake was probably originally formed by an ice block depression in the Anoka Sand Plain (Cooper, 1935) and the area around it is now considered to be a late senescent bog (Lindeman, 1941). In this bog there are many plants usually found either farther to the north or at higher elevations.

Lindeman (1941) discussed the vegetational succession surrounding Cedar Lake. The "sedge mat" surrounding the lake is composed of *Typha latifolia, Phragmites communis, Decodon verticellatus*, sedges, grasses, other herbs, ferns and mosses.

The first tree to invade the sedge mat at Cedar Creek Forest is tamarack (*Larix laricina*). This is followed by the white cedar (*Thuja occidentalis*) rather than black spruce (*Picea mariana*), which is associated with a more acidic bog. Swain and Prokopovich (1954) gave a pH range of 7.1 to 7.6 in fifteen samples taken along a stratigraphic section through the bog and lake.

The tamarack-white cedar area of the bog has fair populations of the red-backed vole. In the surrounding upland area of maple-basswood or northern pin oak (*Quercus ellipsoidalis*) red-backed voles are rarely taken during the summer (Gunderson, 1949, 1950). This site marks the southern limits of the voles' geographic distribution in Minnesota in any numbers.

Description of trapping area.—The trapping area was 468 feet square and contained 5.0 acres. This included half the width of the grid on all sides. The trap stations, numbering 81, were spaced 52 feet apart.

The tamarack-white cedar area was superficially homogeneous but for the purpose of this study was divided into finer categories. Two maps were made of the area. One was based on vegetation, the other was based on the distribution of stumps, logs and "blowdowns." A "blowdown" as used in this report was a tree leaning at an angle due to wind action. Its root system was partly exposed, and the tree might remain alive for several years. The root systems of the trees in the bog spread laterally rather than vertically. The result, when a tree was blown over, was that the exposed network of roots formed a matrix which was filled with soil mostly in one plane and leaning at about a 45° angle. This was quite a different habitat from that formed by a root system rotting in the ground.

The eastern edge of the area and the southern half of the western edge were white cedar with sparse undercover. Extending north through the middle of the area was a tract of mixed tamarack-white cedar. Toward the northern edge of the area this tract became narrow and extended northwesterly.

Between the white cedar with sparse undercover and the tamarack-white cedar mixture was white cedar with medium undercover. This undercover consisted of grasses, carexes, other herbs, mosses and ferns. Within this tamarack-white cedar area were wet open areas with cattails. Extending west between stations 27 and 28 was a small area of tamarack.

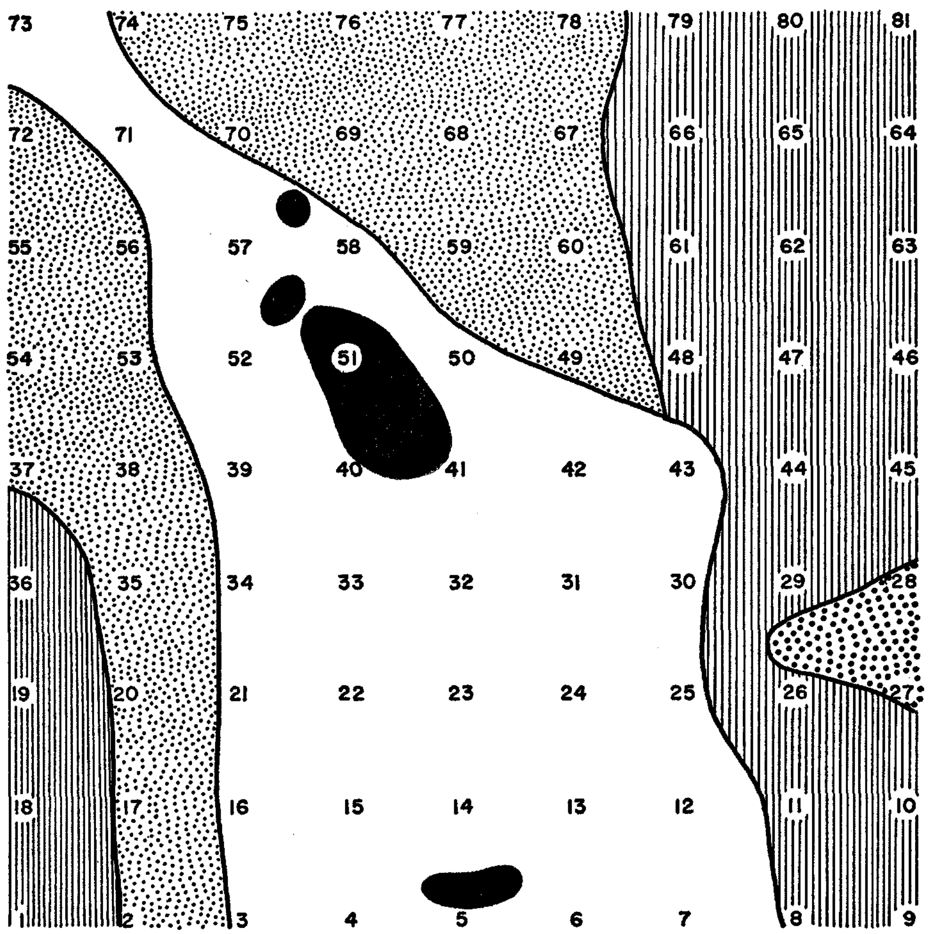
The white cedar area had sparse undercover but a heavy covering of forest litter and many stumps and logs. Blowdowns were most common in the tamarack-white cedar area. The vegetational cover is shown in Fig. 1.

Methods.—Live traps used were the same as in an earlier study (Gunderson, 1950). They were made of ½-in. California redwood. The inside dimensions were $2 \times 2\frac{1}{2} \times 8$ inches. An inward sloping, hinged piece of aluminum formed the entrance. There were two entrance sizes, 1 and 2 inches high. Hardware cloth covered the rest of the front end of the trap. The door at the back end was a piece of aluminum fitted into slots.

When live traps are examined only once a day, I find less mortality in wooden traps than in metal ones. Cotton was placed in the live traps not only for nesting material but as extra insulation, needed in extremely hot as well as cold weather. Rolled oats was used as bait.

Trapping periods were at regular intervals beginning the first part of May and ending early in October; they were of four nights each. During the first four years trapping periods were every third week. During the last three years they were adjusted to get a sample at the end of winter, at the two peak periods of emergence of young, and at the end of summer. Actual periods of trapping during each year are indicated in Table 1.

The mammals were marked by toe clipping as used by Burt (1940), Quimby (1951), Gunderson (1950) and others. Beginning with the clipping of only one toe, 18 individuals can be marked. Only four toes were used on each of the front feet. The inner toe on each front foot is so small that it would be easily overlooked if it were clipped. After No. 18 has been used, two toes must be clipped. Nearly 200 individuals can be marked in this manner without repeating the series. In this study it was necessary to repeat the series, but enough time



White cedar with sparsest undercover
White cedar with sphagnum, grasses and carexes
White cedar and tamarack mixture with luxurious herbaceous growth
Wet, open areas with cattails, carexes and grasses
Tamarack

FIG. 1.—Vegetational cover map of trapping site.

TABLE 1.—*Beginning dates of the four-day trapping periods during each of seven years*

MONTH	1949	1950	1951	1952	1953	1954	1955
May	11, 30	1, 24	7, 11, 28	13	5	11	2
June	28	13	19	3, 25	23	22	20
July	26	11	10, 31	—	15	27	19
August	23	7	21	5, 25	—	—	30
September	20	5, 26	11	15	1	15	—
October	18	17	2	7	6	5	4

elapsed so that it was felt no longevity data were lost. The marking was begun in May 1949, and the series was not repeated until October 1950. In all, 428 individuals were marked. There were 25 dead, unmarked individuals.

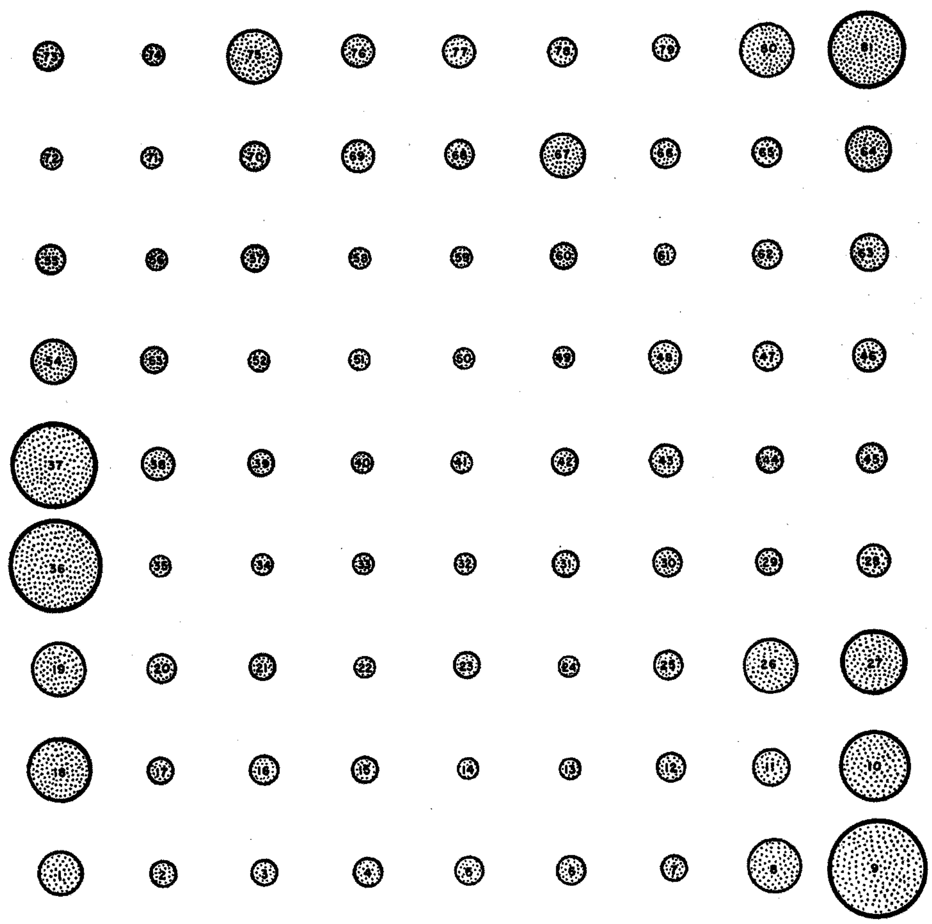


FIG. 2.—A map of trapping area showing frequency indices of each station. Numbers in circles represent trap stations. Size of circles indicates frequency index; e.g., in top row, from left to right, they represent indices of 40–60, 1–20, 120–140, 60–80, 60–80, 40–60, 20–40, 120–140, and 182.

Results.—The method of showing habitat "preference" was one used in an earlier study (Gunderson, 1950). A frequency index was computed for each trapping station. This index was determined by multiplying the number of individuals caught at a station by the number of years in which they were caught. Thus, the length of time an area was occupied, which presumably would be a characteristic of a more favorable habitat, entered into the index. These frequency indices were grouped by 20's, except the highest numbers which were not grouped. Corresponding sizes of circles represent these frequency indices on a map, Fig. 2. By comparing the frequency index map with the maps in Fig. 1 and Fig. 2, some factors affecting the distribution could be demonstrated.

We know that the availability of food and water influences distribution. With regard to food, Seton (1909) said of the red-backed mouse: "In food habits it is omnivorous." Merriam (1884) wrote that "It feeds upon beechnuts and a variety of seeds, berries, and roots, and also, at certain times in the winter season, upon the bark of shrubs and trees."

A need for water is evidently very important for *Clethrionomys.* Butsch (1954) wrote, "Local distribution appears to be controlled by the availability of free water rather than suitable food." Within the trapping site at Cedar Creek Forest, free water was available throughout the area—if not on the surface,

PLATE I

Photograph taken at station No. 9 which had the highest frequency index.

within a few inches of it. This seems to justify the conclusion that availability of free water was not a limiting factor at Cedar Creek Forest during the period of this study.

Comparison of the frequency index map with the vegetational map showed that the stations with the highest frequency indices were in the white cedar area with sparse herbaceous cover. The station with the highest frequency index was No. 9 (Pl. I) with a frequency index of 350 (7 × 50). Other stations in the white cedar area of the southeastern corner with high frequency indices were No. 8 (120), 10 (168), 11 (126), 26 (126) and 27 (154).

In the white cedar along the southern half of the western edge, station No. 36

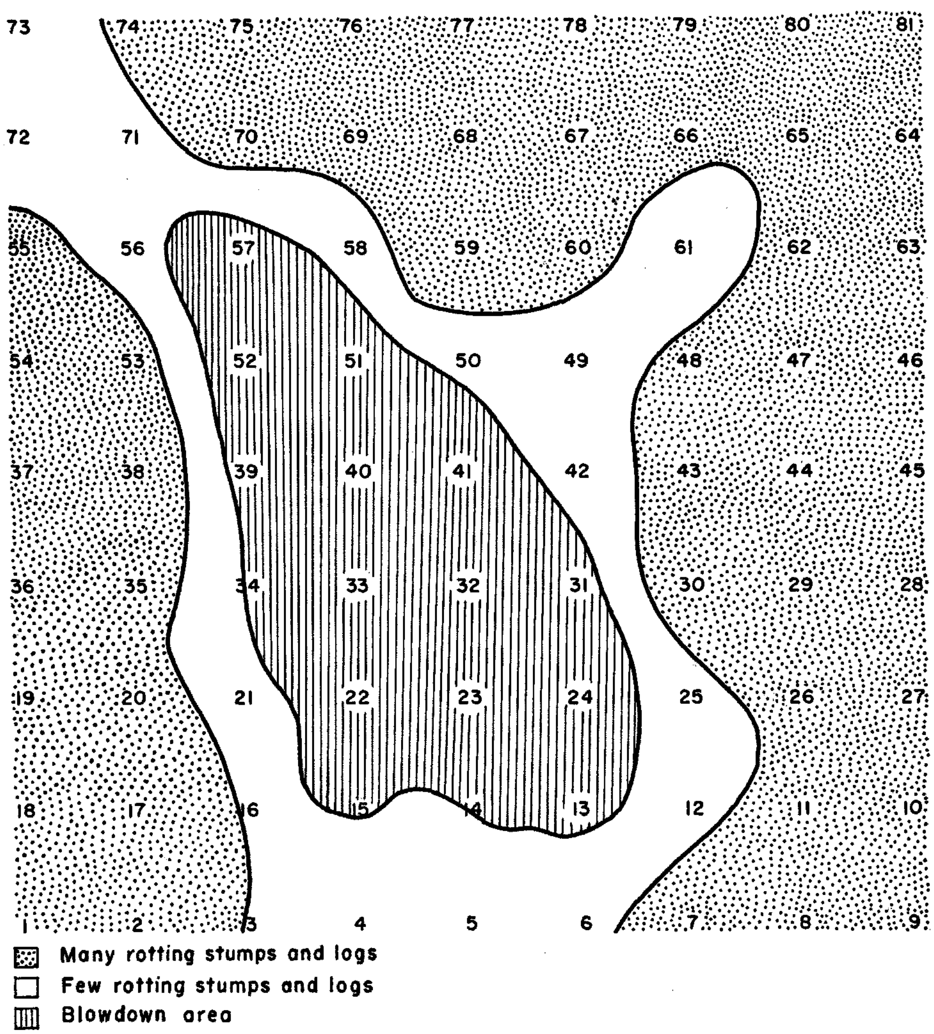


FIG. 3.—A map of trapping area showing distribution of stumps, logs and blowdown area.

had the highest frequency index (294) and No. 37, 216. Other stations in this area with high indices were No. 1 (115), 18 (140), 19 (132) and 54 (119).

In the northeastern corner, also with white cedar cover, station No. 81 had the highest frequency index, 182. Stations No. 46 (80), 63 (90), 64 (102) and 80 (132) also had high indices. Stations No. 75 (125), 76 (72), 77 (80) along the northern border of the trapping area, but outside the white cedar cover also, had fairly high indices.

Although the vegetative cover was sparse in all these areas, there was some slight variation. To find a closer correlation between some distribution factor and the frequency indices a third map was used. Figure 3 is a simplified map of the distribution of logs, stumps and down or partly down trees. I found (1950) that "The distribution of the Red-Backed Vole . . . indicated the preferred area was white cedar with sparse to medium cover. Apparently they did not find the luxuriant growth necessary for their runways, but used old roots and logs and runways along the roots and logs which penetrated or were buried in the forest floor." Burt (1940) and Davis, Emlen and Stokes (1948) believed that an important function of home range was protection against predators. At Cedar Creek Forest the roots of trees and stumps extended laterally (not vertically) into the peat and mosses. The soil is not tightly packed around the roots and this provided either ready-made runways and cover or easily excavated runways. Comparison of this map and the frequency index map show a close correlation. All stations with high frequency indices were in the area of most rotting stumps and logs. The stations with the lowest frequency indices were in the area of tamarack-white cedar with rather heavy undercover.

SUMMARY

These data are a part of a study of small mammal populations at Cedar Creek Forest, Anoka County, Minnesota. The live-trapping area of 5.0 acres, with 81 traps spaced 52 feet apart, was in a tamarack-white cedar bog. The study extended over a period of 7 years (1949–1955). Trapping periods of five days (four nights) extended from early May to the first part of October. In all, there were 14,580 trap-nights. A total of 428 voles were marked and weighed; data on 25 dead unmarked individuals are also included.

A frequency index was calculated for each station. This index was arrived at by multiplying the number of individuals caught at a station by the number of years they occurred at that station. These indices were grouped and represented on a map. *Clethrionomys* occupied mostly the white cedar area with sparse to medium cover. Within this area their distribution was most closely correlated with the presence of stumps, rotting logs and root systems in loose forest litter and sphagnum.

ACKNOWLEDGMENTS

This study was supported by Graduate School grant number 214-3201-219 of the University of Minnesota. Permission to work at Cedar Creek Forest was granted by A. N. Wilcox, director of Cedar Creek Forest. Appreciation for their assistance is expressed to W. J. Breckenridge, Bruce Hayward and John Jarosz for help in laying out the area; Bruce Hayward, John Jarosz and Gerald Robinson for helping from time to time with trapping, marking and recording; and Franklin Willis who did all the trapping during the author's absence in June, July and August of 1953, and who helped in the trapping at other times during the period of study. I should like to express my appreciation to Mrs. Helen S. Chapman, Museum Artist, who made the three figures.

LITERATURE CITED

BURT, W. H. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Misc. Publ. Mus. Zool., Univ. Mich., 45: 1–58.

DAVIS, D. E., J. T. EMLEN AND A. W. STOKES. 1948. Studies on the home range in the brown rat. Jour. Mamm., 29: 207–225.

BUTSCH, R. S. 1954. The life history and ecology of the red-backed vole, *Clethrionomys gapperi gapperi* Vigors, in Minnesota. Unpublished Ph.D. dissertation, Univ. of Mich.

COOPER, W. S. 1935. The history of the upper Mississippi in late Wisconsin and postglacial time. Minn. Geol. Sur., Bull. 26: 1–116.

GUNDERSON, H. L. 1949. Mammals of Cedar Creek Forest, Anoka County, Minnesota. The Flicker, 21: 96–100.

————. 1950. A study of some small mammal populations at Cedar Creek Forest, Anoka County, Minn. Univ. Minn. Mus. Nat. Hist., Occas. Pap. No. 4: 1–49.

LINDEMAN, R. L. 1941. The developmental history of Cedar Creek bog, Minnesota. Amer. Midl. Nat., 25: 101–112.

MERRIAM, C. H. 1884. The vertebrates of the Adirondack region, northeastern New York. Trans. Linn. Soc. N.Y., 2: 173.

QUIMBY, DON C. 1951. The life history and ecology of the jumping mouse, *Zapus hudsonius*. Ecol. Monogr., 21: 61–95.

SETON, E. T. 1909. Life-histories of northern animals. Charles Scribner's Sons, N.Y. Vol. 1, p. 511.

SWAIN, F. M. AND N. PROKOPOVICH. 1954. Stratigraphic distribution of lipoid substances in Cedar Creek bog, Minnesota. Bull. Geol. Soc. Amer., 65: 1183–1198.

Museum of Natural History, Univ. of Minnesota, Minneapolis. *Received October 6, 1956.*