

Russian Original Vol. 5, No. 5, September-October, 1974

July, 1975

SJECAN 5(5) 403-506 (1974)

THE SOVIET JOURNAL OF

ECOLOGY

ЭКОЛОГИЯ/ÉKOLOGIYA

TRANSLATED FROM RUSSIAN



CONSULTANTS BUREAU, NEW YORK

EXPERIMENTAL STUDY OF THE BEHAVIORAL RESPONSES OF SMALL RODENTS IN NATURAL POPULATIONS

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UDC 591.5

The interrelationships of species are usually judged according to the presence or absence of competition for territories and shelter, according to the change in the numbers of species living together and other characteristics. Substantially more rarely, the peculiarities of behavioral responses are used for this purpose, which is largely explained by the absence of simple methods permitting work with animals under field conditions.

We made an attempt to use a number of methods used in investigations of laboratory animals to evaluate the behavioral responses of a number of species of small rodents in natural populations.

The work was conducted in the summer of 1972 in the Orenburg region (in the vicinity of the village Kashkuk). The basic investigations were conducted on rodents trapped in the flood plain of the river Sakmary. The dominant species here are the woodmouse (40.5% of the total number of animals caught), the red-backed vole (32%), and the common vole (about 10%).

Experiments on the local extermination of the rodent population have shown that there are pronounced competitive territorial interrelationships among these species, primarily between the red-backed vole and the woodmouse. It should be noted that the region where the work was conducted belongs to the southern boundary of the range of the red-backed vole. At the boundaries of ranges, the competitive interrelationships among species are frequently more distinctly manifested.

The following were studied in the live-trapped rodents: the orientative motor activity, the ability to develop an elementary conditioned reflex (passive avoidance), and an evaluation of aggressiveness.

The orientative motor activity was investigated by the "open field" method. The animal was placed in the center of a plastic box (40 × 40 × 30 cm), the bottom of which was divided into 25 squares, and the number of intersected lines (horizontal activity) and the number of risings (vertical activity) in a 3 min stay in the setup were recorded.

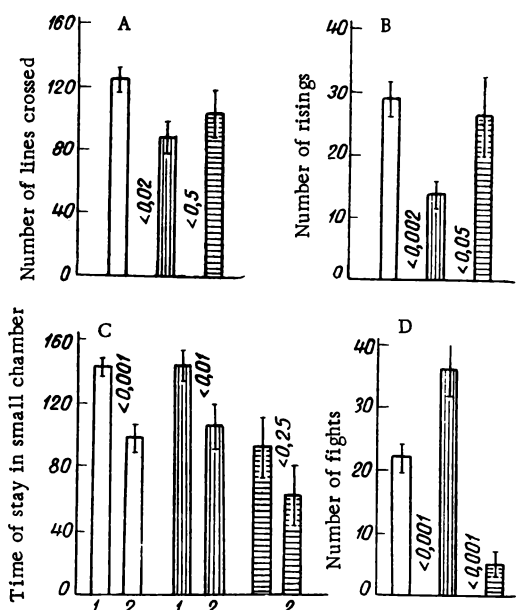


Fig. 1. Horizontal (A) and vertical (B) motor activity, passive avoidance response (C), and aggressiveness (D) of three species of small rodents. Light column: woodmouse, column with vertical shading: red-backed vole, column with horizontal shading: common vole. 1) Time of stay of animal in chamber before electrostimulation; 2) after electrostimulation.

Institute of the Ecology of Plants and Animals, Urals Scientific Center of the Academy of Sciences of the USSR. Translated from *Ékologiya*, No. 5, pp. 83-85, September-October, 1974. Original article submitted March 16, 1973.

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The ability to develop an elementary conditioned reflex, the so-called passive avoidance, was investigated according to the method described by J. Bureš et al. (1964). The animal was placed in a lighted chamber (20 × 20 × 30 cm) of a setup connected by an opening to a small dark chamber (10 × 10 × 10 cm), and the time that the animal spent in the latter was recorded (total time 3 min). After this the animal was placed in a small chamber, the exit from which was covered, and it received electrostimulation for 1 min through a floor grid (alternating current 50 Hz, 10–15 V, 1 sec at 2 sec intervals). After 3 h the first procedure was repeated. The difference in the time spent in the small chamber before and after the "punishment" procedure served as an index of the ability to "recall" this procedure — the development of a passive avoidance response. The 3 h interval was selected because "recall" did not occur in the case of a longer interval.

The evaluation of aggressiveness was performed by placing a pair of animals of the same sex in a chamber (20 × 20 × 30 cm) with electrodes mounted in the floor. After 3–5 min of stay of the rodents together in the chamber, an electric shock was delivered through the electrodes (alternating current 50 Hz, 10–20 V, 5 sec at 5 sec intervals). The number of fights that arose from 100 shocks was recorded.

The following were studied: woodmouse 60 specimens, red-backed vole 31 specimens, common vole 12 specimens. All the animals were of approximately the same age — sexually mature animals born in the current year.

The results of the investigations are cited in Fig. 1 in the form of averages with the error of the mean. The probability of differences was determined with the Student t criterion (Bailey, 1964). No sex differences were detected.

From Fig. 1A it is evident that the greatest horizontal activity was noted in the woodmouse, the least in the red-backed vole; the differences in the activity of the red-backed and common voles were insignificant. With respect to degree of vertical activity, the woodmouse and common vole surpassed the red-backed vole (Fig. 1B).

The woodmouse and red-backed vole developed a passive avoidance response; for the common vole the difference in time of stay in the small chamber before and after the "punishment" procedure is statistically insignificant. It is noteworthy that the control time spent by these animals in the small chamber is significantly shorter than the time that the woodmouse and red-backed vole spent there (Fig. 1C).

From Fig. 1D it is evident that the red-backed vole is the most aggressive, the common vole the least aggressive.

The results outlined show certain differences in the degree of expression of behavioral responses of individuals from natural populations of the woodmouse, red-backed vole, and common vole. At the boundary of the range, the red-backed vole is distinguished by pronounced aggressiveness and a well-expressed ability to develop an elementary conditioned reflex. This, in our opinion, permits it to compete successfully with other species.

The greater aggressiveness of the red-backed vole in comparison with the common vole is distinctly manifested when a pair of rodents of these species is placed together. The red-backed vole attacks the common vole, which assumes a submissive posture. If the common vole was placed behind the transparent partition, the red-backed vole emitted threatening sounds, assumed an attacking posture, and made attempts to overcome the obstacle separating them.

The woodmouse is characterized by a more pronounced level of orientative motor activity, both horizontal and vertical, which is in good agreement with the peculiarities of its biology — greater mobility in comparison with the voles, greater daily movements over area, larger individual territories (Nikitina and Merkova, 1962). Investigations conducted by the co-workers of our laboratory on the movements of marked woodmice and red-backed voles in this region have shown that free territories are first settled by woodmice, and then the red-backed voles penetrate into them.

Thus, a study of the peculiarities of the behavioral responses of rodents, even using rather simple methods, permits an understanding of the mechanisms of the interrelationships among species in mutual habitats.

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