

EFFECTS OF ENVIRONMENTAL VARIABLES ON  
SOME PHYSIOLOGICAL RESPONSES OF MICROTUS MONTANUS  
UNDER NATURAL CONDITIONS.

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Objectives

Several microtine species exhibit multiannual fluctuations in population density. These fluctuations have been described as occurring with sufficient regularity to be called "cycles". This phenomenon has been known since antiquity. However, despite the extensive work that has dealt with this problem, the facts underlying these fluctuations remain largely unknown.

Preliminary field observations of populations of montane voles (Microtus montanus) in Grand Teton National Park were made in 1961, and from 1966 through 1968 (Pinter, unpublished observations). At about the same time laboratory studies began to reveal the remarkable sensitivity of the reproductive system of these rodents to environmental variables. However, little was known to what degree environmental factors and reproductive responses of these rodents contributed to the cyclicity of their population density. Consequently, in 1969 a long term study was initiated. The purpose of the study was essentially fourfold. First, to characterize the environmental variables that might affect Microtus in different seasons of the year. Second, to record the growth, maturation, and reproductive activity of Microtus montanus under natural conditions. Third, to determine the maturational as well as the seasonal pelage changes of these rodents. Fourth, the data resulting from the execution of the first three objectives would be correlated in an attempt to determine the causes underlying the multiannual fluctuations in population density of these microtine rodents.

Procedures

Microtus montanus were livetrapped and sacrificed as soon as possible after capture. Age estimation for all animals was based on weight, total length, and pelage characteristics. Reproductive organs, the spleen, and the adrenal glands were collected from the animals and preserved in Lillie's buffered neutral formalin for further histological study. Flat skins were prepared from all animals. All tissues are currently being processed at the Department of Biological Sciences, University of New Orleans.

In 1978 field observations in Grand Teton National Park were carried out over two study periods: spring (24-30 May), and summer (13 July-19 August). The third study period, planned for the fall (1-8 October) had to be cancelled due to the illness of the principal investigator.

## Results

Although there was abundant sign of winter activity, spring trapping yielded a very small number of animals. However, spring estimates of population density are notoriously difficult in this region. Flooding as a result of melt-off tends to drive the animals into some areas and to exclude them from others. The latter areas are doubtless repopulated after the floodwaters recede. However, melt-off occurs at widely varying times from year to year. Yet, spring trapping in this long term study takes place at virtually the same time every year. This means that trapping may take place one year at a time when the animals are still clumped in their distribution. In another year they might have had a chance to disperse if flooding had occurred well in advance of the spring trapping period.

Weather records for Grand Teton National Park in the region of the study area indicate that all snow did not disappear from the weather station until 12 May. Consequently, it was not surprising to find that breeding on a population-wide basis did not begin until the second or third week in May - slightly later than the average time for this event. Only adult animals were reproductively active. These presumably were individuals that were born in 1977 and that had overwintered. There was no evidence that any winter breeding had occurred in the winter of 1977-78, a common situation for this particular population. All females were pregnant with their first litter. The mean litter size (5.7) was in agreement with spring litter sizes generally recorded at this time of the year at the north end of Jackson Hole.

Midsummer was usually dry in the study area. Nevertheless, the population remained reproductively active. Subadult females had a relatively high mean litter size (6.0). Adult females, on the other hand, exhibited no more than an average litter size (5.7). It is also noteworthy that ordinarily the mean litter sizes are larger for the adult than for the subadult females. No explanation can be offered at this time for the reversal in this pattern during the summer of 1978. However, a similar phenomenon occurred in the summer of 1971, and, possibly, in 1976.

The population density was intermediate between the densities observed in 1971 and 1972. However, the population density for 1978 did not even approach the extremely low (post-crash) levels observed in 1971. Nevertheless, in the summer of 1978 the population density had declined somewhat below the 1977 levels (which, in turn, were lower than the 1976 levels). In other words, the population showed a continued decline in density for the second consecutive year. The reasons for this cannot be suggested at the present time. However, it is noteworthy that this is the second time such a phenomenon has been observed for this particular population. There was a similar decline encompassing two consecutive years between 1973 and 1975. However, this pattern is not necessarily characteristic of the populations being studied here. For example, the crash of 1969-70 was followed by a progressive increase in the population density over the ensuing years. Findings such as these reemphasize the need for long term studies of the phenomenon of multiannual fluctuations in population density. The generally accepted patterns of "peak-crash-increase-peak-crash" may, indeed, be more prevalent, however, the other

increase-peak-crash" may, indeed, be more prevalent, however, the other pattern ("peak-crash-further decline-increase-peak-crash") may also occur with relative frequency. These two patterns must be correlated with other parameters (e.g., environmental variables, reproductive responses). This, in turn, may facilitate our understanding of factors that regulate multiannual population cycles of microtine rodents.

### Conclusions

For the second time since this long term study began, a population decline over two consecutive years occurred in the populations of Microtus montanus at the north end of Jackson Hole. However, the same populations have also exhibited another pattern in their population dynamics. Namely, a decrease ("crash") that is immediately followed by several years of gradually increasing population density. It is suggested that the population density of these rodents should continue to be monitored. The existence of the two different patterns of abundance is noteworthy. A correlation of each of these patterns with other parameters should yield new insights into factors controlling population densities.

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