

EFFECTS OF ENVIRONMENTAL VARIABLES ON SOME PHYSIOLOGICAL RESPONSES
OF MICROTUS MONTANUS UNDER NATURAL CONDITIONS
(summary for 1977)

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Objectives

Multiannual cycles in population density have been reported for a number of microtine rodents. However, factors that govern various phases of the cycle are poorly understood if not totally unknown. In other words, little is known to what degree environmental factors and physiological responses of the animals contribute to such cyclicity. The purpose of the present study was essentially fourfold:

1. Characterization of environmental variables that might affect Microtus populations at three or four different times of the year.
2. Investigation of growth, maturation, and reproductive activity of Microtus montanus under natural conditions.
3. Study of maturation molts and seasonal pelage changes in Microtus montanus in relation to sex, age, and reproductive status.
4. A correlation of the information obtained in #1-3 above. It is hoped that the results will help to elucidate causes underlying the multiannual fluctuations in population density of microtine rodents.

Materials and Methods

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 and preserved in Lillie's buffered neutral formalin for future 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.

Field Observations

In 1977 field observations were carried out at the Research Station over three study periods: spring (23-30 May), summer (10 July - 10 August), and fall (9-14 October).

Results and Discussion

1. Spring study period.

Spring began unusually early in 1977. Weather records for the study area indicate that in the open meadows snow had melted off by 18 April (by comparison, snow did not melt off in this area until 15 May in 1976, and not until 30 May in 1975). However, in an average year melt-off is complete in the study area within the first or second week in May.

At the time of the spring study period reproduction was well underway in the Microtus population. Data indicate that breeding had begun during the third week in April. Indeed, fifty per cent of all females trapped were pregnant with their second litter. In fact, estimated conception dates for the second litters in 1977 coincided with the estimated conception dates for first litters in an ordinary spring. These findings have enormous implications at the population level. It had been demonstrated earlier in the study that young born before the first week in July will mature and breed in the year of their birth. In other words, early onset of reproduction in a given year adds not only more litters - and more individuals - to the population; - early onset of reproduction adds more breeders to the population for that year (Pinter 1974). In 1977 Microtus would apparently produce (before the first week in July) one more litter than they would in a usual year. Furthermore, laboratory data have demonstrated that litter size in Microtus montanus increases with each successive litter, up to the fifth litter (Negus and Pinter 1965). The impact of this phenomenon was already being felt during the spring study period in 1977. Judging from placental scars the litter size of the first litter was very similar to that seen in other years (mean litter size = 5.3). However, it must be kept in mind that by mid-May of 1977 fifty per cent of the females were already carrying their second litter which is much larger (mean = 7.6!). Furthermore, the largest litter size (10) ever encountered during the study - and not seen since the peak year of 1969 - was once again found during the spring of 1977. In addition, the Microtus population had attained relatively high densities in 1976. Although data on winter mortality were not available, it seemed that a relatively large overwintering population was now entering the 1977 breeding season. The prediction brought forth in the 1976 annual report seemed to be becoming a reality: spring conditions indicated that Microtus populations had enormous potential for attaining peak densities in 1977.

2. Summer study period.

The outcome of the summer study period totally shattered all predictions made on the basis of the spring data. The severe drought which afflicted the valley during the summer of 1977 exerted severe repercussions on Microtus populations. Mean litter sizes for both, subadult and adult females, were among the lowest recorded during the entire study. In fact, the data closely resembled those collected in the summer of 1974. That summer was also unusually dry in Jackson Hole; however, the drought was not nearly as severe as that seen in 1977. Furthermore, as in 1974, the population density in the

summer of 1977 also showed a decline below the density recorded for the preceeding summer. This decline in population density was probably the result of several factors. As indicated above, decreased reproduction rate was one of the factors. Another, however, might have been the vulnerability of these rodents to predation. As a result of the drought the vegetation was extremely poor in all meadows. In fact, it was not unusual to find patches of totally bare ground, barely supporting a short, thin and crumbling dry vegetation. Microtus were not merely being deprived of the green vegetation they favor as food. They also did not have adequate cover. Consequently, predation pressure in the summer of 1977 might have been unusually severe.

3. Fall study period.

By the time the fall study period began, reproduction in the Microtus population had virtually ceased. Based on counts of placental scars, mean litter size of the last litters of the year was 4.1. As usual, the last breeders of the season were only the adults (one female trapped during the fall study period was still lactating). All subadult animals were reproductively quiescent; indeed, there was no evidence that they had ever attained sexual maturity. Again, it appeared that animals born after the first week in July did not enter the breeding population in the year of their birth.

The drought in Jackson Hole was broken at the end of the summer. This might have had a positive effect on the reproductive success of the voles since the population density had increased over that found during the summer study period. Indeed, the fall population density was very high when compared to densities observed during other fall study periods.

Conclusions

There were two unusual climatic events in Jackson Hole during 1977: a very early spring, and a summer characterized by a severe drought. The immediate physiological responses of Microtus to these conditions serve to illustrate the sensitivity of these rodents to environmental variables. This long term study is also beginning to reveal that the length of the multiannual cycles in population density of microtine rodents can vary considerably. Indeed, in the light of my data of the past years I am now seriously questioning whether the term "cycle" can justifiably be applied to these fluctuations. The current study is also beginning to pinpoint specific variables whose interaction leads to the multiannual fluctuations in population density of microtine rodents.

Literature cited

Negus, N.C. and A.J. Pinter. 1965. Litter sizes of Microtus montanus in the laboratory. *J. Mammal.* 46:434-437.

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