

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montane voles (Microtus montanus) in Grand Teton National Park were made in 1961, and from 1966 through 1968 (Pinter, unpublished observations).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.

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 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 1979 field observations in Grand Teton National Park were carried out over two study periods : spring (24-30 May) and summer (12 July - 13 August).

### Results

In 1979 spring meltoff in the study area took place approximately a week earlier than in 1978. It is interesting that breeding also commenced earlier in 1979 - during the first and second week in May. The mean litter size (5.8) was among the highest of the litter sizes recorded for this population in May. There was no evidence that breeding had taken place during the winter: all Microtus trapped were adults, and all females were pregnant with their first litter.

The summer of 1979 was exceptionally dry. The soil was parched. All herbaceous vegetation was very short, dry and brittle. Voles were apparently feeding extensively on Equisetum, a phenomenon usually not observed until August when timothy and bluegrass begin to fruit and dry.

The effects of this drought were reflected in the reproductive performance of the animals. Mean litter size for subadult females was 4.5, for adult females 5.0. The mean litter size for subadult females approaches the lowest ever recorded for this population. The mean litter size for the adults coincides with the lowest value recorded previously (1971 and 1974) in this study. Furthermore, resorption of embryos was found in subadult as well as in adult females. In all cases the embryo being resorbed was one of a potential litter of five. Consequently, the resorption of an embryo could not be correlated with an excessively high litter size or with the age or parity of the female.

Population density had increased above that recorded for 1978. This increase marked the end of the continuous decline in population density that had occurred-unexpectedly - over two consecutive years (1976-77, and 1977-78). The increase in population density might be attributable, in part, to the early onset of breeding in 1979. Furthermore, the spring breeding season appeared to be highly successful - every one of the females trapped was reproductively active (pregnant or lactating). Also, as stated above, the litter sizes observed in the spring of 1979 approached the highest litter size ever observed for the spring breeding effort. These circumstances (early widespread breeding, high litter sizes) contributed to the 1979 population not only a large number of animals, but also a large number of breeders. Consequently, in spite of the impaired reproductive success in the summer, the breeding population was large enough to effect a dramatic increase in population density.

### Conclusions

A continuous two-year decline in population density of Microtus was reversed in 1979. Early and widespread spring breeding contributed to the buildup in numbers of voles in the northern end of Jackson Hole. It is expected that an increase in population density will continue in 1980. At the present it appears that the timing in the onset of spring breeding is one of the most influential factors determining the trends in population dynamics of these rodents in a given year.

### Acknowledgments

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The following is a list of publications and abstracts resulting from work done at the UW - NPSRC. The list is updated through December 1979.

Pinter, Aelita J.

1965 Effects of nutrition and photoperiod on reproductive physiology of Microtus montanus. Amer. J. Physiol., 280:633-638. (With N. C. Negus)

Litter sizes of Microtus montanus in the laboratory. J. Mammal., 46: 434-437. (With N.C. Negus)

1966 Responses of Microtus montanus to plants and plant extracts in the diet. J. Mammal., 47: 596-601. (With N.C. Negus)

1968 Effects of diet and light on growth, maturation and adrenal size of Microtus montanus. Amer. J. Physiol., 215: 828-832.

1970 Hereditary hairlessness in the montane vole, Microtus montanus. J. Heredity, 61: 112-114. (With A.K. McLean)

1971 Coat color mutations in two species of the vole (Microtus montanus and Microtus ochrogaster) in the laboratory. J. Mammal., 52: 196-199. (With N. C. Negus)

1973 Pink-eyed dilution in a natural population of the Uinta ground squirrel. J. Hered., 64: 106.

1974 Some aspects of population dynamics in the montane vole, Microtus montanus (Rodentia). First International Theriological Congress, Moscow, USSR, 6-12 June, 1974 (abstract).

1976 The weight of the spleen, adrenals and gonads during a chronic Trypanosoma brucei gambiense infection in laboratory-reared

Microtus montanus. Amer. Midl. Naturalist 96: 379-390. (With J. R. Seed, P. U. Ashman, S. Ackerman, and L. King)

1978 Comparison of organ weights of wild and laboratory-reared Microtus montanus infected with Trypanosoma brucei gambiense.

Population dynamics of Microtus montanus over nine years. Second International Theriological Congress, Brno, Czechoslovakia. 20-27 June, 1978 (abstract).

1979 Environmental variables and multiannual cycles in population density of the montane vole, Microtus montanus, in Grand Teton National Park - a preliminary report. Proc. First Conf. Sci. Res. Natl. Parks, New Orleans, La., 9-12 November 1976, 1: 279-285.

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1979 Erroneous report of extreme dilution ( $c^e$ ) in Microtus pennsylvanicus. J. Heredity, 70: 213-214.

Dominant spotting from a natural population of the vole, Microtus montanus. J. Heredity, in press.

Please note: the updated version does not merely represent additions of papers to the list that appears in the 1977 report. Deletions from that list as well as additions to it have been made here.

Also, when the list is being typed - the spelling "montane" is correct, it is not a misspelling of "mountain".