

ENVIRONMENTAL FACTORS, REPRODUCTIVE SUCCESS AND POPULATION
DYNAMICS IN THE MONTANE VOLE, MICROTUS MONTANUS

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Objectives

Multiannual fluctuations in population density ("cycles") have been known since antiquity (Elton 1942). Numerous hypotheses have been proposed to explain this phenomenon (for reviews see Krebs and Myers 1974, Finerty 1980, Taitt and Krebs 1985). However, none of these hypotheses, alone or in combination, can either explain the causality of cycles or predict their dynamics.

The ultimate objectives of this long-term study are to answer two questions: (1) What causes multiannual fluctuations in the population density of microtine rodents?; and (2) How can cycles be predicted? The proximate objectives are to determine to what extent environmental variables - acting through reproductive responses of Microtus montanus - contribute to the population density cycles of these rodents.

Methods

Microtus montanus were livetrapped at two times of the year, the second half of May (spring study period) and mid-July to mid-August (summer study period). Animals were sacrificed shortly after capture. Age estimation for all animals was based on weight, total length and pelage/molt stage characteristics. Reproductive organs, the spleen, the adrenal glands and brown adipose tissue were preserved in Lillie's buffered neutral formalin. Flat skins were prepared from all animals.

Population density was estimated on the basis of trapping success in a permanent grid (established in 1970). The grid consists of 121 stations, placed 5m apart, forming a square, 11 stations (i.e., 50m) on a side. Each station is marked with a stake. Trapping in this grid is carried out only during the summer study period. Unbaited Sherman livetraps, one per station, are set no further than 0.3m from each stake. Additional trapping was carried out in nearby meadows. In these areas, however, traps were not set in a regular pattern; rather, they are placed only in locations showing recent vole activity (cuttings, droppings). The purpose of trapping at these additional sites is to obtain additional females for litter size determination, since in years of low density the sample sizes from the grid alone were small.

During the spring study period trapping was carried out in a number of sites, all

of them well removed from the permanent grid. The reason for this was to leave populations at the grid site as undisturbed as possible since the grid is the major source of information on population density. The main purpose of the spring study period was to determine (on basis of embryo size) the onset of reproduction on a population-wide basis.

Results

The most remarkable observation in 1986 was the precipitous decline ("crash") in the population density of the voles. Generally, a trough in the population density of these rodents occurs in Grand Teton National Park every 3-5 years (Pinter 1986a). However, a decline of this magnitude has not been recorded since 1970 (the 1970 decline was actually even more severe than that seen in 1986). The animals were still relatively abundant during the spring study period, although the density was lower than that seen in the spring of 1985. All trapped females were pregnant, but litter sizes were small, indicating that the first cohort (K1) for 1986 would, therefore, also be small. Consequently, a low population density might have been expected for the summer study period. Nevertheless, there was nothing to suggest the impending near-record crash.

As indicated earlier, the summer population density was extremely low. It is difficult to evaluate the reproductive success (in terms of litter size) of the population since very few females were trapped. The summer litter sizes were small; however, this may be due to the fact that most of the females trapped were from the K1 cohort, pregnant with their first litter (in Microtus montanus the first litter is the smallest - Negus and Pinter 1966).

A comparison was made between the populations of 1970 and 1986 in an attempt to identify features common to both "crashes". The only similarities were in the relative abundance of the animals during the spring study period and in the precipitation patterns of both of these years. Apparently, in both cases the crash occurred in the late spring; evidence suggests that climatic factors may have significantly contributed to both declines. However, there also were marked differences between the two years: the 1970 crash followed a year 1969 of high population density (Pinter 1986a); the 1986 crash followed a year (1985) of relatively low density. The onset of reproduction was early in 1986 and late in 1970. Consequently, factors that are responsible for microtine population crashes remain unknown.

Although the population of M. montanus had crashed in the study areas, a high-density population of the voles was found elsewhere in Grand Teton National Park. However, the habitat of this population was very different from that in the study areas. Characteristics of microhabitats/microclimates may be a significant factor in the population dynamics of small mammals.

The population density of weasels (Mustela erminea and M. frenata) was essentially the same as in 1985, although there might have been a slight decline in their abundance. There appeared to have been a slight decline in the population density of the pocket gopher, Thomomys talpoides, in the study area.

Conclusions

Populations of Microtus montanus underwent a dramatic decline ("crash") in population density in 1986. This is the first time since 1970 that a decline of this magnitude has been recorded in Grand Teton National Park. Since there was a similarity in the precipitation pattern in 1970 and 1986, it is suggested that climatic factors may contribute significantly to microtine population dynamics. The latter possibility is currently under investigation (Pinter 1986b).

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Literature Cited

- Elton, C. S. 1942. Voles, mice and lemmings, Clarendon Press, Oxford, 496 pp.
- Finerty, J. P. 1980. The Population ecology of cycles in small mammals. Mathematic theory and biological fact. Yale Univ. Press, New Haven and London, 234 pp.
- Krebs, C. J. and J. H. Myers. 1974. Population cycles in small mammals. Adv. Ecol. Res., 8:267-399.
- Negus, N. C. and A. J. Pinter. 1965. Litter sizes of Microtus montanus in the laboratory. J. Mammal., 46:434-437.
- Pinter, A. J. 1986a. Population dynamics and litter size of the montane vole, Microtus montanus. Can. J. Zool., 64:1487-1490.
- Pinter, A. J. 1986b. Population cycles in the montane vole, Microtus montanus: a reflection of environmental variables? 66th Ann. Met. Amer. Soc. Mammal., Madison, WI, 15-19 June (Abstract).
- Taitt, M. J. and C. J. Krebs. 1985. Population dynamics and cycles. In Biology of New World Microtus. R. H. Tamarin, ed. Spec. Publ. Amer. Soc. Mammals., pp. 567-620.