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



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✦ OBJECTIVES

Multiannual fluctuations in population density ("cycles") of small rodents have been known since antiquity (Elton 1942). Numerous hypotheses have been proposed to explain this phenomenon (for reviews see Finerty 1980, Taitt and Krebs 1985). However, none of these hypotheses, alone or in combination, has been able to explain the causality of cycles, although recently removal of parasites was shown to prevent population cycles in the red grouse, *Lagopus lagopus scoticus* (Hudson et al. 1998).

The objectives of this long-term study are to determine whether environmental variables, possibly acting through reproductive responses, contribute to the multiannual fluctuations of the montane vole, *Microtus montanus*.

✦ Methods

Microtus montanus were live trapped 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 killed with an overdose of Metofane as soon as possible after capture. Animals were aged using weight, total length and pelage characteristics. The digestive tract and the liver were examined for the presence of parasites. Reproductive organs, the spleen and the adrenal glands were collected from all animals and preserved in Lillie's buffered neutral formalin for further histological study. Flat skins were prepared from all animals.

Population density was estimated on the basis of the trapping success in a permanent grid (established in 1970). The grid consists of 121 stations placed in a square, 5 m apart, 11 stations (50 m) on a side. Each station is marked with a stake. Trapping in this grid was performed only during the summer study period. One unbaited Sherman livetrap was set at each station. Additional trapping was carried out in nearby meadows to obtain additional females for litter size determination. In these areas, traps were not set in a regular pattern; rather, they were placed only in locations showing recent vole activity (cuttings, droppings).

During the spring study period trapping was carried out in a number of sites, all well removed from the permanent grid. The objective of trapping during the spring study period was to determine (on the basis of embryo size) the onset of reproduction on a population-wide basis. The reason for not trapping the grid during the spring study period was to leave the site as undisturbed as possible since the grid is the major source of information on population density. In order to ascertain the effects of habitat/density on population dynamics of *M. montanus* in Grand Teton National Park, populations of these rodents were monitored in both, optimal and marginal habitats.

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RESULTS AND DISCUSSION

Microtus montanus had overwintered at rather high densities in all of the study areas. There were numerous holes in the mats of dead grass and numerous winter runways. Furthermore, runways in use in the spring of 1999 were deeply rutted, indicating heavy current use. During the spring study period all females were pregnant with their first litter. Reproduction had begun during the second half of May, which was approximately three weeks later than in 1998. A noteworthy exception to this was one study site where, as in 1998, reproduction began almost two weeks earlier than in all the other study sites. This site, however, always has a much warmer microclimate, with earlier snowmelt and no seasonal flooding due either to snowmelt or to heavy May precipitation. Grass also starts growing here earlier than at any other study site. The delay in spring reproduction was doubtless due to the exceptionally heavy snowpack in the spring of 1999, since the unusually heavy snow cover had delayed vegetative growth in all study areas. This situation was reversed rapidly with the arrival and persistence of much higher temperatures in the third week of May. Nevertheless, the delay (by 3 weeks) in the onset of the breeding season in 1999 (as compared to 1998) would have significant repercussions on population densities in 1999. Such late onset meant that one less litter would be produced by M. montanus in 1999. Although the size of the first litters in 1999 was significantly larger than that recorded for the first litters in 1998, the higher litter sizes would not compensate entirely for the decrease in the number of litters produced in 1999.

As expected, population densities of M. montanus during the summer study period were lower than those recorded for 1998. Indeed, at the beginning of the summer study period, females produced as part of the first litter of 1999 were only now pregnant with their first litter. In other words, these animals were just now beginning to enter the breeding population - a significant delay in their contribution to population numbers (Pinter 1986, 1988). Furthermore, these firsttime breeders constituted 50% of all breeding females in the summer of 1999. In M. montanus the first litters are significantly smaller than the successive litters (Negus and Pinter 1965; Negus, Berger and Pinter 1992). Consequently, the overall mean litter size for the breeding population of 1999 was also lower than that seen in 1998. The combination of a late onset of reproduction, a reduced and delayed recruitment of the young of the year into the breeding population, and a lower mean litter size all contributed to the reduced population levels in 1999.

In 1998 the population cycle at one of the study sites had become desynchronized from all of the others. This asynchrony continued into 1999; while the asynchronous population nearly doubled its density, the synchronous populations all showed a decline in density. In spite of this asynchrony, however, all populations still maintained their cyclic character.

The increase in density of the asynchronous population also had repercussions on populations of *Microtus pennsylvanicus* in the area. *M. pennsylvanicus* invaded this study site in 1998 when the population of *M. montanus* collapsed. In 1999, the rebounding of the *M. montanus* population resulted in a disappearance of *M. pennsylvanicus* from this site. This phenomenon has been observed in previous years: population dynamics of *M. montanus* can influence the local distribution of *M. pennsylvanicus*.

Another unusual phenomenon, observed in 1998, recurred in 1999. There was no parasitism of any of the animals by cuterebrid flies. This was an unexpected finding since the vegetation was unusually short by the end of the study period, a situation that in the past had been correlated with the incidence of cuterebrid parasitism (Pinter, Watkins and Moshier 1997).

CONCLUSIONS

Although there was asynchrony among study sites in the population dynamics of *Microtus montanus*, all populations retained their cyclicity. The asynchrony could not be correlated with any parameters of the microhabitat or the microclimate. Nevertheless, reproduction itself was clearly influenced not only by overall climatic features but also by microclimatic differences. The continued asynchrony by one of the populations is an extremely valuable feature since it can help in the identification of factors that control population dynamics in *M. montanus*.

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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. 234 pp.
- Hudson, P.J., A.P. Dobson and D. Newborn. 1998. Prevention of population cycles by parasite removal. Science, 282: 2256-2258.
- Negus, N.C., P.J. Berger, and A.J. Pinter. 1992. Phenotypic plasticity of the montane vole (*Microtus montanus*) in unpredictable environments. Can. J. Zool. 70:2121-2124.
- Negus, N.C. and A.J. Pinter. 1965. Litter sizes of *Microtus montanus* in the laboratory. J. Mammal. 46: 434-437.

- Pinter, A.J. 1986. Population dynamics and litter size of the montane vole, *Microtus montanus*. Can J. Zool. 64:1487-1490.
- Pinter, A.J. 1988. Multiannual fluctuations in precipitation and population dynamics of the montane vole, *Microtus montanus*. Can. J. Zool. 66:2128-2132.
- Pinter, A.J., R.A. Watkins and S.E.Moshier. 1997. Incidence of myiasis in *Microtus montanus*: role of population density and habitat. 77th Ann. Mtg. of the Amer. Soc. Mammal. Oklahoma State Univ., Stillwater, OK, 14-18 June.
- Taitt, M.J. and C.J. Krebs. 1985. Population dynamics and cycles <u>In</u>: Biology of New World *Microtus*. R.H. Tamarin, ed. Spec. Publ. Amr. Soc. Mannual. 8:567-620.

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