

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.

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

In 1996 *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. 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 livetraps 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.

◆ RESULTS

The amount of snowfall and the water content of the snow were both above normal in early 1996. By the time the 1996 spring study period began, the ground was heavily saturated from the meltwater. Ordinarily, May is the wettest month in Grand Teton National Park; in late May of 1996 the rainfall was exceptionally heavy. Consequently, some of the study areas remained under water for the duration of the entire spring study period. Others drained well, however, a few hours of rain would be sufficient to completely inundate a meadow.

In the spring of 1996, *Microtus montanus* began breeding relatively late. Although late breeding can, indeed, retard population growth for a given year, in the spring of 1996 there was an indication that factors conducive to population growth were also present. To start with, there was abundant winter sign, indicating that a relatively large population had been present during the winter of 1995-96 and, consequently, a relatively large cohort would initiate breeding in the spring of 1996. Furthermore, the litter sizes were uncommonly large (an 18% increase over the sizes of the first litter recorded during the spring study period in 1995). For *Microtus montanus*, the first litter is always the smallest (Negus and Pinter 1965); based on size alone the first litter of the year in the spring of 1996 could readily have been mistaken for a second litter. However, none of the females was lactating, indicating they were all pregnant with their first litter.

In *Microtus montanus* the first litter of the season grows and matures quickly and invariably breeds in the year of its birth (Pinter 1986, 1988; Negus, Berger and Pinter 1992). Since the first litters were inordinately large in 1996 there was every indication that population density in 1996 should rise above the 1995 levels. However, the spring of 1996 was also inordinately wet; heavy precipitation in May has been correlated with population declines in *Microtus montanus* in Grand Teton National Park (Pinter 1988).

The exceptional wetness of the spring seemed, indeed, to have taken a considerable toll on the *Microtus montanus* population. By the end of the summer study period it became clear that the population density of *Microtus montanus* was lower

in 1996 than it had been at a comparable point in 1995. Furthermore, the summer of 1996 was exceptionally dry; the extent of the dryness of the vegetation was reflected in the litter sizes observed in individual study areas: females from the wettest study areas (i.e., from plots having the greenest vegetation) produced the largest litter sizes; conversely, females from the driest sites produced the smallest litters.

Regardless of the characteristics of individual study sites by the end of the summer study period, all cohorts remained reproductively active and even third cohort females were approaching sexual maturity. This was an indication that in 1996 the third cohort would breed in the year of its birth, resulting in continued population growth into late summer and early fall.

◆ CONCLUSIONS

The data from the 1996 study period underscore once again that climate plays a significant role in the population dynamics of *Microtus montanus*. The late onset of breeding on a population-wide basis could be correlated with a decline in population density, and the phenology of plants could be correlated with productivity (litter size) of the vole population.

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