

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, have 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 1991 *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 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 livetrapp 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

♦ RESULTS

A very large population of *Microtus montanus* had survived the winter: during the spring study period it was easy to find exceptionally well-defined, deeply rutted runways and abundant cuttings. Many

of these runways were beneath a very heavy mat of dead vegetation - the latter a reflection of the unusually luxuriant growth of herbaceous vegetation during the summer of 1990. The potential for a dramatic rise in the population density of voles in 1991 was thus presaged by the high survivorship of these rodents during the preceding winter. Furthermore, all females trapped during the spring study period were pregnant with their first litter. Although the onset of breeding in 1991 was later than in 1990, the litter sizes of the first litter in 1991 were larger than those in 1990. The first litter of the year invariably becomes reproductively active in the year of its birth (Pinter 1988). Consequently, the very high potential for an increase in the population density of *Microtus montanus* in 1991 was signalled by the production of large numbers of large litters. More importantly, this meant the addition of a large number of animals to the breeding population of 1991.

During the summer of 1991, the vole population achieved near-record densities (i.e., of densities recorded since the onset of this study). In marginal habitats the 1991 density had increased over the 1990 level by a factor of 1.5; in optimal habitats the increase was by a factor of 5. The final densities achieved in the optimal habitat were 4.5 times higher than those recorded from the more marginal habitats. This dramatic rise in population density can be attributed, in part, to the large size of the initial breeding cohort and the large first litters produced. However, there may also have been some reduction in predation pressure since no weasels (long - or short-tailed) were trapped during the 1991 study period.

The population of shrews (*Sorex vagrans*) that had "exploded" during 1990 also remained high in 1991, although there was a reduction in the number of gophers (*Thomomys talpoides*). In 1991 there was also a dramatic increase in the numbers of meadow voles (*Microtus pennsylvanicus*). No effort had been made to trap specifically for *M. pennsylvanicus*: they had expanded their range into one of the *M. montanus* study plots. Although the montane and the meadow voles occupied distinctly separate areas, there was an overlap of at least 10 m between the two species along their zone of contact.

A mutant *Microtus montanus* was trapped during the spring study period. Although this animal (an adult female) has the normal agouti pelage it also has

a mask of white hairs extending from the eyes to the ears. Attempts are now being made to breed this animal in our laboratory colony to determine the mode of inheritance of this mutation. This is the fourth mutation I have found in *Microtus montanus* from Grand Teton National Park [the others are pink-eyed dilution (Pinter & Negus 1971), hairless (Pinter & McLean 1971), and dominant spotting (Pinter 1979)]. Pink-eyed dilution was also found in the Uinta ground squirrel, (*Spermophilus armatus*) (Pinter 1973).

◆ CONCLUSIONS

As in previous years, the population dynamics of *Microtus montanus* in Grand Teton National Park were similar to those observed in other parts of Wyoming. Such geographic synchrony continues to support the hypothesis that climate plays a significant role in the regulation of population "cycles" of small rodents (Pinter 1988; Negus et al. 1991). Consequently, the principal aim of this long-term study is how to uncover the proximal factors (e.g., Pinter 1986, Watkins et al. 1991) that underlie these "cycles."

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