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

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✦ OBJECTIVES

Multiannual fluctuations ("cycles") in population density of small rodents doubtless result from the interaction of a multitude of factors, as evidenced by the variety of hypotheses proposed to explain the phenomenon (for reviews see Finerty 1980, Taitt and Krebs 1985). However, the inability of these hypotheses - alone or in combination - to explain the causality of cycles rests in no small measure with the fact that long-term studies of the phenomenon are notoriously uncommon.

The objectives of this project are to continue a long-term study of the population dynamics of the montane vole, *Microtus montanus*, in Grand Teton National Park. On the basis of earlier observations (Pinter 1986, 1988) particular emphasis will be placed on how environmental variables, possibly acting through reproductive responses, contribute to the population density cycles of these rodents.

✦ METHODS

In 1997 *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 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.

✦ RESULTS

In addition to the record snowfall in the winter of 1996-97 there was heavy precipitation during the spring study period. Furthermore, unusually heavy precipitation occurred throughout the entire summer, making it one of the wettest summers in the past 30 years. The abundance of moisture was reflected in an unusual luxuriance of the herbaceous vegetation throughout the region.

In the study areas, *Microtus montanus* began breeding during the first half of May. All females trapped were pregnant with their first litter; none was lactating. Litter sizes were extremely large, even exceeding the unusually large litter sizes observed during the spring study period of 1996. Since the first cohort invariably breeds in the year of its birth, the reproductive potential during the spring of 1997 suggested that a large increase in population density could be expected by the end of the 1997 season.

Whereas the size of the first spring litters was indeed large, climatic conditions may well have prevented the survival of many of these young. Characteristically the study areas drain very rapidly. For example, in spite of the large amount of meltwater present in the soil, there are always patches within a habitat that are dry and suitable for *Microtus* burrows. The problem arises if the soil, waterlogged from meltwater, receives a large amount of precipitation - especially if such precipitation occurs over a short period of time. Under these conditions even the dry patches in a meadow can become inundated in a matter of hours, resulting in the drowning of any juvenile *Microtus* too young to leave the nest independently. Theoretically, then, large spring litter sizes point to the possibility of a dramatic increase in population density; in reality, a large portion of such potential may not be realized.

By the end of the summer of 1997 population densities of *Microtus montanus* had risen significantly above those recorded at a comparable time in 1996. The 1997 increase in population density was a reflection not only of unusually large litter sizes but also of an unusually large number of reproductively active females. Furthermore, an increase in the population density (over the 1996 levels) was recorded from all study sites, in contrast to 1996 when densities increased in some study areas and decreased in others. However, the summer of 1996 had been very dry and a decrease in population density occurred in some of the marginal habitats. However, the summer of 1997 was extremely wet and even marginal habitats produced abundant vegetation.

Usually, by the end of the annual study period, there is a decline in reproductive output by the voles. However, by the end of the summer of 1997 there was no decline either in the very large litter sizes or in the percentage of reproductively active females. There was every indication that a large number of animals would be entering the winter of 1997-98. It also appeared that reproduction may continue well into the late summer and early fall, further augmenting the potential for a large population.

✦ CONCLUSIONS

Precipitation, acting directly (i.e., inundation of nests in a wet spring) or indirectly (sustaining luxuriant plant growth throughout the summer) contributed significantly to population dynamics of *Microtus montanus* during the 1997 study period. Inundation of some of the spring nests (and the consequent death of young in these nests) was offset by the exceptionally large litter sizes characteristic of the spring 1997 study period. Near-record precipitation during the summer maintained abundant herbaceous vegetation well into the late summer. This resulted in unusually widespread reproductive activity, characterized not only by an unusual number of reproductively active females but also by large litter sizes. These observations support the hypothesis that climate is a major contributor to population dynamics of small rodents.

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✦ LITERATURE CITED

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