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

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✦ OBJECTIVES

A variety of hypotheses has been proposed to explain multiannual fluctuations in population density ("cycles") of small rodents (for reviews see Finerty 1980, Taitt and Krebs 1985). Doubtless, such cycles – known since antiquity (Elton 1942) - result from an interaction of a multitude of factors. However, the inability of extant 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 the long-term study of population dynamics of the montane vole, *Microtus montanus*, in Grand Teton National Park. Earlier observations (Pinter 1986, 1988) indicate that environmental variables might contribute to the population density cycles of these rodents, possibly by influencing their growth and various aspects of their reproduction.

✦ METHODS

In 2005 *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. They 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 neutral buffered formalin for further histological study. 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 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 away from the grid to obtain additional females for litter size determination.

During the spring study period trapping was carried out at a number of sites, all of them well removed from the permanent grid. The purpose of this was to leave the grid site as undisturbed as possible since the grid was the major source of information on population density. The main objective of the spring study period was to determine (on the basis of embryo size) the onset of reproduction on a population-wide basis. This information is very important for two major reasons: (1) onset of reproduction in *M. montanus* in Grand Teton National Park can vary by as much as 40 days among years, and (2) the time at which reproduction begins has significant repercussions on the productivity of the population for the year.

Weather data were obtained from records at the Jackson Lake Dam. Although Moran 5WNW is

not a Class A weather station, it is located less than 2 km from the permanent grid. Data collected included temperature, precipitation, and the date of complete spring melt-off.

✦ RESULTS AND DISCUSSION

In the summer of 2005 montane voles *(Microtus montanus*) declined to approximately 50% of the population densities recorded in 2004. The decline had occurred during the winter of 2004-2005 since at the onset of the spring study period there was very little sign (cuttings, droppings) of vole activity. However, during the spring study period it also became apparent that early reproduction would be extremely successful. In 2005 the onset of spring (i.e., meltoff, growth of new herbaceous vegetation) was uncommonly early and, as expected, vole reproduction also began unusually early. Indeed, at the onset of the spring study period (last two weeks in May some females were already pregnant with their second litter (i.e., palpable embryos in lactating females). Such early breeding indicates that the first as well as the second litter would definitely breed in the year of their birth. In other words, a very large number of breeders was being added to the population and all observations suggested that vole populations should increase in density in Grand Teton National Park. However, the importance of green vegetation to vole reproduction was dramatically demonstrated in the summer of 2005.Vole populations tend to fluctuate synchronously over remarkably wide geographic regions although asynchrony can occur among populations separated by only a few kilometers. During the summer study period a dramatic difference became apparent between two local populations, based apparently on microhabitat differences. Whereas one (in a relatively xeric environment) had declined in density as compared to 2004, the other (in a more mesic area) increased dramatically over the 2004 levels. Furthermore, as reproduction had virtually ceased by the end of the summer study period in the former, it continued in the latter. The continued reproductive activity was characterized not only by the large percentage of breeding females but also by the production of large litter sizes. Consequently, by the end of the 2005 field study period two populations, separated by less than twenty kilometers, exhibited diametrically opposing patterns of population dynamics. Such observations indicate that, whereas climatic conditions over large geographic areas can synchronize population dynamics of voles, microclimate and microhabitat (Negus, Berger and Pinter 1992) can override the effects of large-scale weather patterns.

Microclimate and microhabitat may exert an effect on vole populations in a number of ways. For example, they may influence the degree and severity of parasitism experienced by *Microtus montanus*. It now appears that microclimate within burrow may determine the rates at which an endoparasite (*Hepatozoon* sp.) infects these rodents (Watkins, Moshier and Pinter 2006).

✦ CONCLUSTIONS

The data collected in the 2005 field season exemplify the extreme sensitivity of *M. montanus* to environmental vicissitudes and reinforce the point that climatic variables play an extremely important role in their reproductive processes. Furthermore, these data also demonstrate the surprising speed with which climatic change can shape the population dynamics of these animals. In turn, population dynamics of voles result in major consequences for the ecosystem. Montane voles constitute a major prey base for a variety of predators. Unexpected shifts in the reproductive responses and population dynamics of these rodents must therefore also have significant repercussions on population parameters of their predators.

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