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 Krebs and Myers 1974, Finery 1980, Taitt and Krebs 1985). However, none of these hypotheses, alone or in combination, can 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 1988 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 sacrificed as soon as possible after capture. Age estimation for all animals was based on 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 also 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 5m apart, forming a square, 11 stations (i.e., 50m) on a side. Each station is marked with a stake. Trapping in this grid was carried out only during the summer study period. Unbaited Sherman livetraps, one per station, were set no further than 0.3m from each stake. Additional trapping was carried out in nearby meadows. In these areas,however, traps were not set in a regular pattern; rather, they were placed only in locations showing recent pattern; rather, they were placed only in locations showing recent vole activity (cuttings, droppings). The purpose of trapping at these additional sites was to obtain additional females for litter size determination, since in years of low density the sample sizes from the grid alone were small.

During the spring study period trapping was carried out in a number of sites, all of them well removed from the permanent grid. The reason for this was to leave populations at the grid site as undisturbed as possible since the grid is the major source of information on population density. The main purpose of the spring study period was to determine (on the basis of embryo size) the onset of reproduction on a population-wide basis.

Results

Reproduction in Microtus montanus began relatively early, although not as early as in the spring of 1987. All females trapped were either pregnant or lactating. As in 1987, most of the females trapped during the spring study period were pregnant with the second litter. Consequently, litter sizes were larger than usual for this time of the year, reflecting the fact that in M. montanus the second litter is significantly larger that the first (Negus and Pinter 1965). Since there was relatively little precipitation in May the reproductive success of the voles was probably very high (Pinter 1988). The potential for a considerable increase in population density was therefore already evident by the end of the spring study period.

By the end of the summer study period the population density had, indeed, risen above the levels recorded in 1987. However, the increase was not as great as might have been anticipated, probably reflecting the effects of the severe drought of 1988. Furthermore, the extent of the increase appeared to be a function of the habitat. For example, in one study area where the vegetation was extremely short and sparse the increase was only by a factor of 1.3. In another study area with dense, albeit dry, vegetation the population density of M. montanus had increased by a factor of 2.4.

Although it is common for the reproductive output of M. montanus to decrease toward the end of the summer, the decrease was particularly acute in 1988. Furthermore, litter sizes were unusually small in the summer of 1988. This impairment of productivity might have been a reflection of the drought; however, it might also have been a function of the cycle phase of the population since early cessation of breeding (Krebs and Myers 1974) and small litter sizes (Pinter 1986) are characteristic of high density populations. However, sexual maturation of the animals born in 1988 was also being delayed; indeed, an unusually large number of the 1988-born animals would not mature in the year of their birth. Such animals constitute the breeding population for the next spring (Pinter 1986). Consequently, the initial breeding population for 1989 (the K-O cohort) could potentially be unusually large.

During the course of a typical summer Microtus montanus tend to shift their food habits. In essence, they abandon food plants as these senesce and dry and shift to plants that have not yet dried. As might have been expected, the drought had hastened this shift. For example, ordinarily Microtus montanus begin to cut Equisetum toward the end of the summer study period, i.e., in August. In 1988, Equisetum was already being cut in the first part of July, indicating that their preferred food plants were already drying at this time.

Conclusions

The rise in population density of 1988 above the 1987 levels was probably due to two major factors: (1) an early onset of reproduction and (2) a relatively dry spring. The explosion of vole populations that occurred in 1988 throughout Wyoming, Montana and Colorado supports the hypothesis that climate is an important contributor to population fluctuations of these rodents (Pinter 1988).

Note: during the summer study period a mutant montane vole was trapped in the permanent grid. The mutation, pink-eyed dilution, had appeared earlier in our Jackson Hole-derived laboratory colony of M. montanus (Pinter and Negus 1971). This is the first time, however, that the mutation was seen in a natural population. Pink-eyed dilution has also been observed in a natural population of the Uinta ground squirrel (Spermophilus armatus) in Grand Teton National Park (Pinter 1973).

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