BARK CONSUMPTION BY VOLES IN RELATION TO MINERAL CONTENTS

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Abstract—Recent field experiments with impregnated wooden sticks have demonstrated a pronounced use by small rodents of mineral supplies, especially sodium, and such findings seemed related to vole damage to forestry seedlings. Consumption of the bark of experimentally introduced aspen twigs and of sodium-impregnated sticks by voles (mainly or only Microtus agrestis) correlated significantly on clear-cuts but not on unmanipulated abandoned fields. Such a correlation appeared when abandoned fields were cut continuously in summer. At vole peak densities, bark of pine seedlings experimentally fertilized with sodium was consumed but not bark of seedlings fertilized with calcium or control seedlings. Field pine seedlings attacked by voles had significantly higher levels of calcium, sodium, and phosphorus than the nearest untouched seedling. However, sodium and phosphorus contents correlated strongly. Sodium and calcium supply to voles in laboratory feeding trials did not diminish the moderate interest in pine bark. Such conditions are, however, assumed to mimic a situation of bark sampling in low-density populations. Sodium, and possibly also calcium, requirements are concluded to be partial determinants of the destructive bark consumption by voles at the peaks of their multiannual population cycles.

Key Words—Sodium, calcium, phosphorus, vole, Microtus agrestis, bark consumption, field experiments.

INTRODUCTION

Voles, such as Clethrionomys glareolus and Microtus agrestis, have a diversified diet in summer (Stenseth et al., 1977, Hansson, 1985). The winter diet consists of just a few plant species but is often supplemented with bark from tree seedlings (e.g., Hansson, 1988). North Scandinavian voles fluctuate
strongly in numbers, with density peaks every three or four years (Hansson and Henttonen, 1985). Bark is consumed especially by the cyclic peak populations, e.g., on clear-cut and regenerated forest land (Hansson, 1989). Considerable damage can occur in Scandinavian forests during peak years, especially by *M. agrestis* (Myllymäki, 1977).

Voles on Swedish clear-cuts eagerly seek sodium (and sometimes also calcium), especially in strongly cyclic populations and in peak winters (Hansson, 1990). Thus, bark and sodium and/or calcium interest may be related. Bark is especially high in sodium (Lichens and Borman, 1970), and voles may seek both energy and minerals in their bark attacks during winter food shortages. Other minerals, such as phosphorus, also may be involved as they have been shown to be in generally short supply in certain models of nutrient acquisition (Barkley et al., 1980). However, field experiments failed to demonstrate any important role for phosphorus (Hansson, 1990). Laboratory experiments demonstrated that extra sodium and calcium, but not phosphorus, improved microtine reproduction (Batzli, 1986).

The hypothesis that bark consumption is due partly to a deficit in sodium or other minerals was tested by: (1) supplying both bark and sodium in various types of vole habitat—correlations in utilization would indicate some common factor behind these types of consumption; (2) fertilization of tree seedlings with preferred minerals—bark attacks on seedlings treated with a specific mineral would indicate that this is preferred or in deficit; (3) analyses of mineral contents of field seedlings debarked and untouched by voles—differences in mineral contents would indicate deficiencies; and (4) laboratory feeding of bark together with access to mineral solutions—diminished bark consumption with the supply of a certain mineral would indicate that bark consumption was stimulated by specific mineral requirements.

**METHODS AND MATERIALS**

**Bark vs. Na Consumption.** Twigs, 1 m long, taken from the top of one aspen (*Populus tremula*) clone growing at Uppsala and hence genetically identical, were put out on clear-cuts and abandoned fields in south-central and northern Sweden in 1986 and 1987. As sampling units, two twigs (ca. 1.5 cm diam.) were located 1 m from a 10 × 3 × 1-cm spruce stick impregnated with 1 M NaCl for 24 hr (cf. Weeks and Kirkpatrick, 1978; Hansson, 1990). The stick was placed under a wooden shelter. Twigs and sticks were distributed in autumn in randomly selected patches of dense shrubby vegetation on clear-cuts, interspersed with nival space in winter. The placement on more generally sheltered abandoned fields was completely random. The Na sticks could have attracted