Los Alamos

Environmental Restoration
Records Processing Facility

ER Record I.D.# 62927

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION
Records Processing Facility
ER Records Index Form

ER ID NO. 62927 *Date Received:* 4/7/99 *Processor:* YCA *Page Count:* 9

Privileged: (Y/N) N *Record Category:* P *Record Package No:* 0

FileFolder: N/A

Correction: (Y/N) N *Corrected No.* 0 *Corrected By Number:* 0

Administrative Record: (Y/N) Y

Refilmed: (Y/N) N *Old ER ID Number:* 0 *New ER ID Number:* 0

Miscellaneous Comments:

REFERENCE CITED

3561

62927

ROCKY MOUNTAIN MAMMALS

A Handbook of Mammals of Rocky Mountain National Park and Vicinity

REVISED EDITION

by David M. Armstrong
Natural Science Program and University Museum
University of Colorado, Boulder

with drawings by Bill Border

COLORADO ASSOCIATED UNIVERSITY PRESS
in cooperation with
ROCKY MOUNTAIN NATURE ASSOCIATION

Published by Colorado Associated University Press
in cooperation with the Rocky Mountain Nature Association
International Standard Book Numbers 0-87081-168-1 (cloth) and
0-87081-169-X (paper)
Library of Congress Catalog Card Number 87-70011
Printed in the United States of America

Northern Pocket Gopher
Thomomys talpoides

Description.–The northern pocket gopher is a rather small, stocky animal, its architecture suiting its ecological role as a biological excavation service. Total length is 200 to 230 mm and the sparsely-haired tail is 50 to 70 mm long. Adults weigh about 120 to 150 grams. Males are somewhat larger than females, especially in cranial dimensions. In our area, northern pocket gophers are brownish in color, grayish to medium brown on the Eastern Slope and darker brown to nearly black west of the Continental Divide. The underparts and tail are paler in color than is the back and they are more sparsely furred. The most distinctive feature of the animals is their large, yellowish-orange incisors, always in view because the lips close behind them. The cheekpouches open externally, rather than into the mouth cavity, and they are lined with fur. The limbs are short and powerful and the forelimbs are strongly clawed. *Field Recognition.*–Moderate size, short tail; exposed incisors; shallow burrows marked with ridge of earth, and with conspicuous entrance mounds.

Distribution and Habitat.–The northern pocket gopher is a mammal of the Mountain West and the Northern Great Plains. In Colorado this is mostly an animal of the mountains; other species of pocket gophers inhabit western valleys and the eastern plains. Northern pocket gophers occur throughout Rocky Mountain National Park in open situations with well-drained soils. Pocket gophers inhabit all open habitat-types in the Park, but reach greatest abundance in meadows, where perennial forbs provide a rich food supply. In ranchlands adjacent to the Park, hayfields are favored habitat. Pocket gophers also occur in grassy parks and above timberline. Their burrows are conspicuous in the alpine tundra along Trail Ridge Road.

Natural History.--Northern pocket gophers, known simply as "gophers" or sometimes as "moles" (quite incorrectly, because moles are insectivores and do not occur in the mountains of Colorado), are the most highly evolved burrowers in our local fauna. Only rarely are they seen above ground. The external ears and the eyes are greatly reduced, further adaptations to their digging behavior. Seemingly, no soil is too rocky, or hard, or shallow for them. I have seen evidence of gophers burrowing beneath the thin subalpine sod covering a large, flat rock. The soil—probably trapped from the wind by pioneer plants—was less than 3 cm deep. The gopher simply pushed its way along between rock and sod, leaving an arch of turf overhead. As satisfactory a burrow might have been built between a livingroom floor and a carpet; the effect was much the same. The lips purse behind the incisors, so the mouth can be closed while rocks and soil are carried with the teeth. The burrow system of a pocket gopher may be over 150 meters in length, usually from 10 to 45 cm below the surface. This represents the excavation of nearly 3 tons of soil. Side tunnels and chambers are filled with food or feces or are used for nesting. Excess soil is thrown out in characteristic loose mounds. Only rarely does one find an obvious entrance, because openings are plugged when not in use. Abandoned burrows are preempted by a variety of animals, including other rodents, salamanders, toads, snakes, and insects.

The diet consists exclusively of plant material. During the spring and summer, foliage and stems are eaten, forbs more than grasses. Vegetation is clipped at night from around the mound, and it may be stored in subterranean chambers. During the winter, the animals subsist largely on roots, bulbs, or tubers. Some foraging occurs above ground in snow tunnels, either on the surface of the soil, or in the snowpack itself. In spring, nest chambers may be built high in the snowpack, because tunnels in the ground are saturated with melt-water. Snow tunnels are packed with soil brought up from below ground. After snowmelt in spring, these sinuous winter casts (sometimes called "gopher garlands" or "eskers")—which are 5 to 10 cm across and may be several meters in length—are conspicuous features of the mountain landscape. Their presence suppresses the growth of some plant species and thus influences plant succession.

Badgers and coyotes excavate pocket gophers and prey on them. Weasels also capture some and owls take a toll, especially dispersing young, which tend to move above ground. Ticks, mites, lice, and fleas affect pocket gophers as they do most mammals. Endoparasites include both roundworms and flatworms.

Under good conditions, populations may reach densities of 50 or more individuals per hectare (20 per acre). The soil in such situations may be so completely undermined that it gives away underfoot. Often it is impossible to say where one burrow stops and the next begins, although underground there is little or no overlap between adjacent gophers. On rangelands and in cultivated areas, especially where natural predators have been limited by humans, pocket gophers may be significant pests. Their mounds damage mowing equipment and livestock can be injured by stepping into burrows. Sometimes gophers burrow through ditchbanks, giving the rancher unsolicited assistance with the irrigation program. However, they are very important agents in the soil-building process. Fortunately, pocket gophers (and all other wildlife) have free rein in the National Park to perform their unique roles in the continual evolution of ecosystems.

Adult pocket gophers breed in the spring, beginning as yearlings. Mating occurs in April or May and three to ten (average, four to six) young are born in April or June. A single litter is produced each year. The young mature rapidly and are above ground as early as late June. From July to September the young leave the maternal burrow to establish residence on their own.

Selected References.—Hansen (1960); Hansen and Ward (1966).

Family Castoridae—Beavers

There are two living species of beavers, comprising a single Holarctic genus (*Castor*). The family is less diverse today than it once was; 14 extinct genera are known as fossils.

Beaver
Castor canadensis

Description.—The beaver is the largest rodent in Rocky Mountain National Park, and indeed, the largest in North America north of Panamá. Adults are about a meter in total length, of which the broad, flat tail comprises about one-third. Large old males may weigh over 25 kilograms. The animals are a rich brownish color above, paling somewhat to golden brown beneath. The dense underfur is grayish brown. The scaly, nearly naked tail and feet are black. *Field Recognition.*—Large size, flat tail; sign: dams, lodges, waterways, gnawed tree stumps.

Distribution and Habitat.—The beaver ranges throughout most of North America north of México, except for parts of the Arctic Slope, the Desert Southwest, and peninsular Florida. This is a familiar mammal throughout Rocky Mountain National Park, wherever permanent streams of moderate grade provide suitable habitat.

Natural History.—Certainly the beaver is among our most familiar and fascinating native mammals. The fur trade, with the beaver as a mainstay, was responsible for the early exploration of much of North America.

MAPPING POCKET GOPHER BURROW SYSTEMS WITH EXPANDING POLYURETHANE FOAM

MARK FELTHAUSER and DAVID McINROY, Group LS-6, MS-K495, Los Alamos National Laboratory, Los Alamos, NM 87545.

Previous studies of small-mammal burrow system configurations have been based primarily on measurements of ground-surface soil casts (Reid et al. 1966, Richens 1966, Hansen and Morris 1968, Gunderson 1976, Vleck 1981). However, surface indications of burrow system dimensions are not adequate when precise data are needed on burrow physiognomy.

The impetus for this study arose from the need to isolate buried chemical and radioactive waste from burrowing animals. In a study of barrier materials that inhibit burrowing by pocket gophers (*Thomomys* spp.) into waste material, it was necessary to map tunnel systems as a function of depth and soil type. We wanted a method of mapping burrow systems that would be economical, portable, useful in a variety of soil types, and give accurate, permanent records of burrow configurations. This paper describes a method for injecting an expanding polyurethane foam to map burrow systems in situ.

INJECTION APPARATUS

The device used to map burrow systems was developed for injecting insulating foam into closed building spaces (Fig. 1). The foam is initially in 2 components: an isocyanate and a resin. Freon added to these components causes the foam to expand when mixed and exposed to air. Pressurized nitrogen is used to force the 2 components into a gun assembly where mixing takes place. The resulting foam is expelled in a stream that, depending upon the nitrogen pressure, can travel several meters in air. Nitrogen pressure of about 60 p.s.i. produced good results when mapping extensive burrow systems. The residue remaining in the gun after an injection is flushed from the nozzle with a methylene chloride solvent. Each component tank holds 67.5 kg of chemical. A

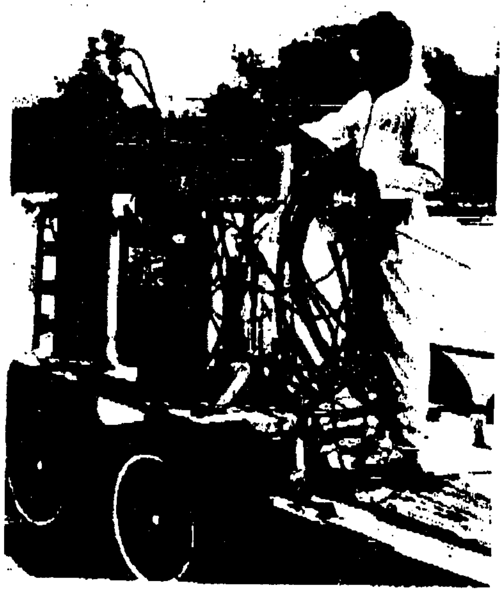

Fig. 1. Apparatus used to inject foam into pocket gopher burrow systems. The unit was placed in a truck for transport to field sites.

yield of 9–18 m^3 of foam results from 135 kg of the 2 chemicals. Yield varies with temperature, atmospheric pressure, and restrictions placed on the expanding foam (e.g., size and shape of the burrow). When we used the foaming apparatus, the ambient air temperature was between 10 and 32 C. Good results were obtained within this temperature range. Because soil temperatures vary less than air temperatures, quality foam casts could probably be made in considerably colder and warmer aboveground conditions than we tested.

The entire apparatus was mounted on a metal cart and weighed about 450 kg. A forklift was required to lift the assembly into a truck. To maximize accessibility to field sites, a 4-wheel-drive vehicle was used to transport the apparatus.

The foam components and cleaning solvent are potentially hazardous if contacted by skin or eyes. Therefore, safety goggles, gloves, and protective clothing must be worn during the injection process.

FIELD TESTING

The foam injection apparatus was tested under a variety of natural and experimental conditions involving several soil types. Fifteen pocket gopher tunnel systems occurring under natural conditions were injected with foam to determine applicability of the technique to different soil types. Tunnel systems were examined in a sandy alluvium, a sandy-loam disturbed by heavy equipment, an undisturbed sandy-loam, and a gravel.

The apparatus also was tested in 4 different soil profiles (60 cm of top soil over bentonite clay, crushed tuff [a sandy-loam], gravel, or cobble-gravel) in 4 metal culverts (1.8 m diam, 2.1 m ht). One pocket gopher was placed in each culvert; the gophers were maintained for 4 months and then removed. The burrow system that had been constructed by each gopher was then injected with foam. Under natural conditions no gophers were trapped in the foam cast. We assumed that our disturbance on the surface caused them to leave their burrows or to retreat to a tunnel end and plug the passage with soil.

The injection procedure that provided the best results consisted of attaching a 2.5-cm-diameter tygon hose, about 45 cm long, to the gun nozzle. Tunnel systems that were observed to branch near the entrance point were injected separately to facilitate filling of all burrows. After inserting the hose into an entrance, soil was tamped around the hose and entrance to prevent back-flow of the foam. Foaming of the tunnel system was continued until back-flow or foam eruptions at remote tunnel entrances prevented further flow.

After the foam was injected, it expanded into an exact cast of the tunnel system and hardened in about 15 minutes. The foam was then excavated manually with a shovel and trowel. Four to 8 man-hours were required to inject, excavate, and reassemble each tunnel system. Occasionally, a tunnel cast could be removed intact, although breakage of a cast occurred frequently. Broken casts were easily reassembled on the ground surface (using wire rods for support) to provide a 3-dimensional model of the tunnel system.

The maximum length of a single branch of a burrow mapped by the foaming technique was 15 m. The maximum volume of an injected burrow system was 0.15 m^3 (10 cm diam × 19.1 m total length); the maximum depth of a burrow, as measured by the foam cast, was 1.5 m.

Factors that limited the amount of tunnel system that was mapped by a single injection included (1) a plugged tunnel resulting from a cave-in or from the digging by a gopher, and (2) increased viscosity of the foam as the expanding and hardening process began. Excavation of the cast started at the tunnel entrance and proceeded along the path of the foam. When an end of a tunnel cast was encountered, the surrounding soil was excavated to determine if the foam had reached a short soil plug or a tunnel end. Continuations of tunnel systems beyond the cast were mapped by re-injecting the remaining tunnel with foam. Operating experience suggested that a continuing tunnel system should be re-injected as soon as possible to reduce tunnel cave-ins that would prevent further mapping.

The performance of the foaming apparatus in creating tunnel casts in all soil types except those containing rocks was excellent as judged by the ease of tunnel-cast excavation and reassembly. The technique did not perform well in gravel or cobble-gravel soil types because the relatively large pore spaces between the rocks

Fig. 2. Foam cast from a pocket gopher burrow in a natural, sandy alluvial soil. The bubble in the upper right is from backflow at the injection point. Storage chambers can be seen at the bend in the longest branch. The longest branch is about 8 m long.

filled with foam (regardless of nitrogen pressure). Thus, the exact dimensions of the pocket gopher burrows were obscured.

Burrow systems in surface soil, sandy soil, and sandy-loam were completely mapped in 3 dimensions by the foam. All features of the burrows were apparent from the cast, including food-storage and nest chambers (Fig. 2).

DISCUSSION

The polyurethane foam injection technique provided a relatively easy, accurate method of mapping pocket gopher burrow systems. Features of the burrows that were readily identified or measured included the length, depth, and volume of the tunnel system as well as food-storage and nest chambers.

May 1982 prices for a gun, hoses, solvent tank, and pressure valves totaled about $2,000.00 (available from Olin Chemicals, 120 Long Ridge Road, Stamford, CT 06904). Two full 67.5-kg tanks cost an additional $525.00 (also from Olin). About 6 m^3 of nitrogen is ample for 135 kg of foam and can be obtained locally for less than $20.00. A full set of tanks could map 60–120 burrow systems.

The unit we used was the smallest of its kind available from the commercial foam industry. Smaller units are manufactured that are self-pressurized, solvent-less, and disposable (available from Foam Craft Inc., P.O. Box 15246, Sarasota, FL 33579). Three sizes are available weighing 1, 17, and 30 kg each. Foam yields (under ideal conditions, according to Foam Craft) are 0.024, 0.45, and 1.5 m^3, with May 1982 prices of $22.25, $283.00, and $583.00, respectively.

These small, disposable units are considerably more portable than the reusable system used in this study; however, their cost is much higher (11–35 times more when considering only the cost of the foam and 2.3–7 times more when the initial cost of the system we used is included). The ratio approaches the higher figure as more foam is used.

We did not use any light, disposable foam units but believe the larger sizes would be adequate for mapping burrows. However, the relatively high cost of the foam must be considered when deciding whether portability is a higher priority than cost. Although this technique was tested only on pocket gopher burrow systems, we believe that it could be adapted to map tunnel systems of other burrowing animals.

Acknowledgments.—We thank T. E. Hakonson for suggesting this project and for manuscript review. We also thank group H-1 (Health Physics) of Los Alamos National Laboratory for loaning the foaming equipment to us.

LITERATURE CITED

GUNDERSON, H. L. 1976. Mammalogy. McGraw-Hill Book Co., New York, N.Y. 483pp.

HANSEN, R. M., AND M. J. MORRIS. 1968. Movement of rocks by northern pocket gophers. J. Mammal. 49:391–399.

REID, V. H., R. M. HANSEN, AND A. L. WARD. 1966. Counting mounds and earth plugs to census mountain pocket gophers. J. Wildl. Manage. 30: 327–334.

RICHENS, V. B. 1966. Notes on the digging activity of a northern pocket gopher. J. Mammal. 47: 531–533.

VLECK, D. 1981. Burrow structure and foraging costs in the fossorial rodent, *Thomomys bottae*. Oecologia 49:391–396.

Received 27 October 1981.
Accepted 20 July 1982.