Voles Damage Big Sagebrush in Southwestern Montana

W. F. MUEGGLER

Plant Ecologist, Forest Service, U.S.D.A., Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Bozeman, Montana, maintained in cooperation with Montana State University.

Highlight

Extensive destruction of big sagebrush in southwestern Montana in the winter of 1963-64 is attributed to a sudden irruption of the population of voles. Such extensive sudden destruction of browse species over wide areas concerns both ranchers and game managers. On the other hand, damage to sagebrush could benefit grass production for livestock in many areas by reducing competition, but could also be undesirable where sagebrush provides important browse for either livestock or big game. A single year's severe damage can affect forage production on an area for many succeeding years.

Outbreaks of voles, Microtus spp., are not uncommon historically. Such plagues averaged about three per century in Europe and caused much destruction of crops (Elton, 1942). At least two severe outbreaks have been recorded for the Western United States since 1900. In 1907-08, mountain vole (M. montanus) generally infested parts of Nevada, Utah, and northeastern California, but was most damaging in the Humboldt Valley, Nevada (Piper, 1909). Populations of mountain voles ruptured again in Nevada, northern California, southern Oregon, and western Idaho in 1956-58 (Jellison, et al., 1958). Concentrations as high as 3,000/acre in November 1957 suffered at least 90% mortality by the following April (Spencer, 1958). Normal populations of mountain vole on Sierra Nevada meadows do not usually exceed 10/acre (Jenkins, 1948). Aumann (1965) thoroughly reviewed the literature on population densities of voles and other microtine rodents.

Most reports of vole damage pertain to girdling of fruit trees and destruction of cultivated crops. However, Murray (1965) noted that voles barked some sagebrush, and Hubbard and McKeever (1961) mention girdling of bitterbrush during the 1957-58 outbreak in northern California.

Rodent damage to valuable browse species such as bitterbrush concerns both ranchers and game managers. On the other hand, damage to sagebrush could benefit grass production for livestock in many areas by reducing competition, but could also be undesirable where sagebrush provides important browse for either livestock or big game. A single year's severe damage can affect forage production on an area for many succeeding years.

An outbreak of voles in southwestern Montana in 1962-64 demonstrated the possible effect these infestations could have on stands of native shrubs. I first noted this infestation immediately following snowmelt in the spring of 1963, evidenced by moderate bark stripping on big sagebrush (Artemisia tridentata) in a natural grass-sagebrush community. By the spring of 1964, damage to big sagebrush was so severe that I surveyed surrounding areas to document the extent and severity of the infestation.

Methods

I contacted federal land managers throughout southern Montana to obtain preliminary information on the extent of increased rodent activity on shrubs. I then visited areas where damage had been reported. Although several different shrub species showed stem barking, damage was most pronounced on big sagebrush, which grows in relatively dense stands and over comparatively large areas. Quantitative data on the effect of barking was collected from eight or the more heavily damaged stands of big sagebrush. These stands are located as follows:

Area 1, Wapiti Creek (Sec. 19, T.9S., R.4E.)
Area 2, lower Taylor Fork (Sec. 8, T.9S., R.4E.)
Area 3, upper Taylor Fork (Sec. 10, T.9S., R.4E.)
Area 4, Call Road (Sec. 15, T.8S., R.2W.)
Area 5, Antelope Flat (Sec. 19, T.13S., R.2E.)
Area 6, Tepee Creek (Sec. 17, T.13S., R.1W.)
Area 7, Divide Creek (Sec. 7, T.12S., R.3W.)
Area 8, Antone Station (Sec. 20, T.12S., R.5W.)

The effect of barking was assessed by estimating the percent of crown mortality on individual big sagebrush plants. If 100% of the crown was dead, the plant was recorded as killed (big sagebrush does not sprout from the base). Plants were classified on the basis of size and vigor prior to bark stripping as follows: young—crown 4 to 12 inches in average diameter; mature — crown larger than 12 inches in diameter and vigorous; decadent — crowns larger than 12 inches in diameter and obviously lacking vigor prior to barking. The sample excluded plants having less than 4 inches crown diameter.

Shrub mortality and canopy kill were measured on a 2-acre...
plot selected as typical of conditions within each stand sampled. Thirty-two sample points were located by restricted randomization; the closest shrub in each quadrant surrounding each point was then selected for measurement. A total sample of 128 shrubs was thus obtained for each stand. Size of each affected stand was estimated and general site conditions were noted.

Results and Discussion

Extensive bark stripping was either reported to me or seen by me at scattered locations throughout southwestern Montana on the following shrubs: big sagebrush, silver sagebrush (A. cana), skunkbrush sumac (Rhus trilobata), antelope bitterbrush (Purshia tridentata), curlleaf mountainmahogany (Cercocarpus ledifolius), Saskatoon serviceberry (Amelanchier alnifolia), and common chokecherry (Prunus virginiana). The latter four species are especially desirable browse for either big game or livestock, or both. The most severe damage was concentrated in Gallatin, Madison, and Beaverhead counties. All stem barking was similar in appearance, but differed in degree. Damage to big sagebrush was by far the most impressive because of the intensity of stripping and the amount of sagebrush affected.

Evidence that voles were responsible for stripping the bark from the shrubs is largely circumstantial. The type of damage noted (Fig. 1) was typical of that described by Bailey (1900) for voles: "... in the spring, when the snow disappears, trees and shrubs are found stripped of their bark for a wide space near the ground. The marks of tiny teeth remain in the hard wood, and little piles of dry outer bark, mixed with characteristic pellets of excreta, show what animal has been at work. ... Shrubs and small trees are often stripped of their bark and killed." The damage apparently took place during the winter when snow covered much of the vegetation.

R. D. Finley, Research Biologist for the Fish and Wildlife Service, Denver, Colorado, determined by trapping that meadow voles (M. pennsylvanicus) occurred on Area 1. He attributed sagebrush damage to voles primarily because of the appearance of runways, burrows, and grass nests above ground under the bushes. Both meadow voles and mountain voles are common to southwestern Montana. Meadow voles prefer a wet meadow habitat, but mountain voles prefer drier grasslands (Findley, 1954). Either or both of these species could have stripped the bark from the sagebrush. Trapping was not attempted on the other areas, but the shrub damage was identical.

The eight big sagebrush stands sampled were at elevations between 6,800 and 7,600 ft. They were typical of the sagebrush-bunchgrass communities in mountainous areas of southwestern Montana. The sagebrush canopy, from 1 to 3 ft tall, covered 50 to 70% of the ground. The most prominent species in the understory were: Idaho fescue (Festuca idahoensis), wheatgrasses (Agropyron spp.), lupines (Lupinus spp.), prairie-
smoke (Geum triflorum), cinquefoil (Potentilla spp.), and sticky geranium (Geranium viscosissimum). Grasses and forbs covered from 60 to 80% and litter covered from 10 to 30% of the ground surface. Approximately 10% remained in bare soil. Affected stands occupied streamside benches, slopes as steep as 20%, and the various aspects. The soils were fairly deep, and had small surface. Approximately 10% re-

The herbaceous understory did not appear to have been damaged by the outbreak of voles. Some foliage may have been eaten, but root systems remained intact. Production of grasses and forbs on these areas should benefit by reduction of competition from big sagebrush.

Rodents continually influence the establishment and growth of native vegetation, but this influence is not generally apparent. This influence usually appears as isolated damage to individual plants, or as collection and destruction of seed. As this outbreak has shown, however, small rodents, which are usually unobtrusive, occasionally cause spectacular changes in native shrub stands.

Table 1. Percentages of big sagebrush, by age classes, apparently killed by vole damage in southwestern Montana, observed in 1984.

<table>
<thead>
<tr>
<th>Area no.</th>
<th>Approx. area (acres)</th>
<th>Canopy kill</th>
<th>Total plant kill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300</td>
<td>89</td>
<td>98</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>26</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>350</td>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td>4</td>
<td>1,200</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>145</td>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>24</td>
<td>64</td>
</tr>
</tbody>
</table>

Voles often stripped the bark from both the main stem and larger branches of the mature shrubs, but seldom completely girdled the stems of young shrubs on the same area.

On Areas 1, 2, 3, and 7, numerous stems were barked prior to the winter of 1963-64. Comparative weathering of the girdled scars and lack of deterioration of dead twigs suggest that much of this damage had occurred in the previous winter, 1962-63. Some shrubs may have been damaged even earlier. Thirty-two percent of the canopy kill on Area 1 was attributed to bark stripping before 1963-64, as was 22% on Area 2, 20% on Area 3, and 14% on Area 7.

Vole populations can increase tremendously within just a few months (Frank, 1957). Population peaks are usually followed by extremely rapid declines (Elton, 1942; Spencer, 1958). On these four areas, however, the buildup apparently lasted over at least a 2-year period, somewhat similar to the Pacific Northwest outbreak in 1956-58 (Spencer, 1958). Vole numbers very likely reached their peak in the winter of 1963-64 on Areas 1, 3, and 7—if amount of bark stripping is a reliable indication. This may or may not be true for the areas where disturbance was less severe, especially since damage prior to 1963-64 was not generally apparent on these areas. If population peaks were not reached on certain areas, damage to native shrubs could be even more severe than these data show.

The herbaceous understory did not appear to have been damaged by the outbreak of voles. Some foliage may have been eaten, but root systems remained intact. Production of grasses and forbs on these areas should benefit by reduction of competition from big sagebrush.

Rodents continually influence the establishment and growth of native vegetation, but this influence is not generally apparent. This influence usually appears as isolated damage to individual plants, or as collection and destruction of seed. As this outbreak has shown, however, small rodents, which are usually unobtrusive, occasionally cause spectacular changes in native shrub stands.

**LITERATURE CITED**


Frank, F. 1957. The causality of microtine cycles in Germany. J. Wildlife Manage. 21 (2): 113-121.


A Step Toward Automatic Weighing of Range Cattle

S. CLARK MARTIN, KENNETH K. BARNES, AND LEONARD BASHFORD

Principal Range Scientist, Rocky Mountain Forest and Range Experiment Station; Tucson, Arizona; Head, Department of Agricultural Engineering; and former Graduate Research Assistant, Department of Agricultural Engineering, University of Arizona, Tucson, respectively.

Highlight

A battery-operated electronic scale recorded range cattle weights accurately, without disturbing the animals. With refinement, the system could operate automatically.

The purpose of this study was to develop a cattle-weighing system that would operate under field conditions without affecting the animal's rate of gain. The weighing system was designed for research on such questions, as: When do cattle gain or lose weight? How are gains or losses related to vegetation, rainfall, temperature, or other factors? And, how do gains and losses correlate with the quantity, chemical composition, and digestibility of forage eaten by the animals?

The system was also designed to answer such practical questions as: When do calves or yearlings reach their peak weights? and, how are these peak weights related to the end of the spring or summer growing seasons, the drying of the perennial grasses, maximum and minimum temperatures, etc? Answers to these questions will help ranchers determine when animal weights and market prices combine to give maximum returns.

The usual way to weigh range cattle is to round them up, sort them, and weigh them over conventional level-fulcrum scales. This procedure is adequate for determining the value of cattle bought and sold, but it has serious shortcomings for research either in range animal husbandry or range management. One obvious disadvantage is cost. Few research projects are well enough financed to afford several sets of corrals and scales and a full-time weighing crew of two or three men equipped with saddle horses and the means for transporting them. A second disadvantage of conventional weighing is that range cattle lose weight in the process, and may not recover fully for several days. Thus, frequent weighing by conventional methods may be expected to underestimate rates of gain and exaggerate rates of loss.

With these thoughts in mind, we set out to devise a system that would meet the following minimum requirements:
1. The basic system should consist of:
   a. An inexpensive platform which the animals would cross naturally to get to water or feed (identical platforms could be built at several locations).
   b. Weight-sensing devices and a remote recorder that could be quickly connected to any platform where animal weights might be taken.
2. The scale should weigh animals individually as they cross the scale platform.
3. Operation of the system must not disturb the normal routine of the animals.
4. The system must be operable at remote locations not served by central station electric power.

Design and Construction of the Scale

The design criteria allowed for one animal entirely on the scale at one time, and restricted the animal from turning around on the scale. The width dimension was taken from a large Hereford bull. The length was determined by measuring the tracks of a 900-lb cow walking through sand. With these measurements as a guide, a platform 42 x 90 inches and a supporting structure were built (Fig. 1). The supporting structure was constructed from 6-inch channel iron and a 3-inch I-beam. The platform rests on the base or below-ground portion of the supporting structure, except when cattle are being weighed. Four links attached to the platform and supporting structure allow sufficient vertical movement of the platform but prevent horizontal movement.

Since one criterion of design was that the system weigh animals as they moved across the scale without stopping, an electrical method was considered most feasible.

Four electrical resistance strain-gage load rings were made up in the Department shop. Each load ring was a 2-inch section of standard 5-inch-diameter black pipe with wall thickness of 0.250 in. Eyebolts were attached to opposite sides of the ring along one diameter for loading. Strain

1 Submitted as Journal Article #1130, Department of Agricultural Engineering, University of Arizona, Agricultural Experiment Station.
2 Central headquarters located at Fort Collins, Colorado, in cooperation with Colorado State University. Author stationed in Tucson, Arizona, in cooperation with the University of Arizona.