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Voles Damage Big Sagebrush in Southwestern Montana

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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 because it can affect production of browse and forage for several 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 irrupted 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 of 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 (S. 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

FIG. 1. Big sagebrush stem and branches barked presumably by voles; the section shown here is approximately 20 inches high.

FIG. 2. More than 80% of the big sagebrush plants in this dense 300-acre stand (Area 1) were killed—presumably by voles.

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)*, skunkbush 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. B. 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-

Table 1. Percentages of big sagebrush, by age classes, apparently killed by vole damage in southwestern Montana, observed in 1964.

Area no.	Approx. area (acres)	Canopy kill				Total plant kill
		Young	Mature	Decadent	All classes	
1	300	89	98	96	97	84
7	800	38	86	85	78	66
3	50	24	87	91	76	66
6	350	38	68	78	70	51
8	150	24	72	66	56	35
2	50	26	64	65	55	30
5	1,200	8	46	64	50	23
4	20	8	22	35	23	10

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 streamsides, benches, slopes as steep as 20%, and the various aspects. The soils were fairly deep, and had small to moderate amounts of rock. All sites were in areas where snow pack had been continuous during the winter.

The damaged areas ranged from approximately 20 to 1,200 acres. Damage was generally restricted to stands in isolated drainages, and was by no means continuous. Most big sagebrush stands in southwestern Montana grow intermittently with timber and herbaceous types.

On the areas sampled, from 10 to 84% of the big sagebrush had been killed (Table 1). On the most heavily damaged areas, mortality exceeded 90% on some spots smaller than an acre. Usually the amount killed within a single stand varied with location and site productivity. Damage appeared to be greatest in the more lush, productive spots.

The greatest canopy kill, approximately 97%, was measured on Area 1 (Fig. 2 and Table 1) in a large, dense stand of big sagebrush. Plant mortality in this stand averaged 84%. Interestingly, canopy kill on the mature and decadent shrubs was far greater than that on the young shrubs. 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.

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