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Demise of Spiny Hopsage Shrubs Following Summer Wildfire: An Authentic Record

Abstract

Spiny hopsage, *Grayia spinosa*, shrubs growing in a plant community dominated by greasewood, *Sarcobatus vermiculatus*, shrubs were destroyed by a summer wildfire. In the first season after the burn, greasewood shrubs sprouted, and by April of the second spring season, greasewood had restored about one-half of its preburn canopy cover. Spiny hopsage shrubs did not sprout and their demise is attributed to stressed growing conditions imposed by an alkaline-sodic rooting substrate. The demise of spiny hopsage would likely have gone unnoticed were it not for the existence of a permanently marked study plot.

Introduction

Wildfires are recurring events in shrubsteppe plant communities growing on the United States Department of Energy's Hanford Site in southeastern Washington. The most abundant shrubs are big sagebrush, *Artemisia tridentata*, and antelope bitterbrush, *Purshia tridentata.* These plants do not sprout after being severely burned. Other taxa; rabbitbrush, *Chrysothamnus nauseosus*, greasewood, *Sarcobatus vermiculatus*, and spiny hopsage, *Grayia spinosa*, are less abundant than sagebrush and bitterbrush but these sprout after burning (Daubenmire 1970). Humphrey (1974) in his extensive review of burning makes no mention of the fire response of spiny hopsage. This article describes the response of spiny hopsage and greasewood, following a summer wildfire, and provides an authentic record of the demise of spiny hopsage by summer burning.

Materials and Methods

The study area is a greasewood-spiny hopsage plant community located on the Arid Lands Ecology (ALE) site on the U.S. Department of Energy's Hanford Site, Benton Co., Washington (Harr and Price 1982). The community lies at an elevation of approximately 250 m above mean sea level. Annual precipitation averages 16 cm. The community has a history of study. Plant-soil-water relationships have been studied by Harr and Price (1972) and Rickard (1967). Sodium and potassium accumulation by greasewood and spiny hopsage leaves has been studied by Rickard (1964, 1965), Rickard and Keough (1968), and Rickard (1982).

The fire history of the community before 1943 is unknown. The community has a known history of heavy livestock grazing between the years 1943 and 1963. In 1963 the community and about 800 acres of surrounding land was fenced to exclude livestock. The community has not since been grazed by livestock, and the riparian woody vegetation along the nearby spring stream has greatly benefited (Rickard and Cushing 1982).

In 1965 a 30x30 m study plot was staked using 24 steel fence posts spaced at 5 m intervals around the plot perimeter. The only man-induced disturbances since its establishment have been one-day visits to the plot by field ecology classes in April every other year. During these visits seven 30 m lines stretched between opposite fence posts were used to intercept shrub canopies, and the number of living shrubs rooted inside the plot perimeter were counted.

In July 1981, a wildfire burned through the study plot and adjacent areas destroying the aboveground parts of shrubs and the understory herbs. The plot was revisited in April 1983, and canopy-cover and shrub density were determined in the same way as had been done in previous years.

Results

Shrub canopy cover and density determinations made in April 1981 and in April 1983 are summarized in Table 1. The July 1981 wildfire killed 43 spiny hopsage shrubs on

TABLE 1. Canopy cover (percentage) and density of greasewood and spiny hopsage shrubs on a 30x30 m study plot on the Arid Lands Ecology (ALE) Reserve in April 1981 and April 1983.

Shrub Taxa	Number of Shrubs	1) % C	2) % C	Average of 1 and 2
		Preburn Measurements 1981		
Greasewood	185	10.7	12.2	11.4
Spiny hopsage	43	6.4	5.6	6.0
Total	228	17.1	17.8	17.4
		Postburn Measurements 1983		
Greasewood	210	4.8	5.9	5.4
Spiny hopsage	0	0	0	0
Total	210	4.8	5.9	5.4

1) Average of seven east-west lines.

2) Average of seven north-south lines.

the study plot. Greasewood shrubs sprouted vigorously and canopy cover of greasewood was restored to about 47 percent of its preburn values, but only 31 percent of total shrub canopy was restored. There were 185 greasewood shrubs counted on the plot in 1981 and 210 were counted in 1983, an increase of 25 shrubs. Burning apparently stimulated sprounting of greasewood. The dominant herbaceous species in 1981, Sandberg bluegrass, *Poa sandbergii*, and cheatgrass, *Bromus tectorum*, were also the understory dominants in 1983.

Discussion

The community in the past 20 years has supported three shrub species; greasewood, spiny hopsage, and sagebrush. Only a few living sagebrush plants were present in the community 20 years ago, although they were not on the study plot. The dead, standing stems of sagebrush were more numerous than living plants. The absence of charcoal and burn scars on the dead sagebrush stems prior to the 1981 burn indicates that their demise was probably not due to burning. It has been suggested that their demise may have been initiated by accelerated wind erosion (Rickard 1964). Years of overgrazing and trampling by livestock may have damaged the soil binding understory plants resulting in the loss, by wind action, of several decimeters of surface soil. Loss of top soil could have reduced the soil water holding capacity of a thin soil layer with normal chemistry above a deep alkaline-sodic soil layer, creating a new soil profile unsuited for sagebrush but still acceptable to the more salt-tolerant spiny hopsage and greasewood shrubs.

Our study community differs floristically from other greasewood dominated communities in eastern Washington because salt grass, *Distichlis stricta*, is not a part of the herb understory (Daubenmire 1970). Instead the understory consists of herbs characteristically found in sagebrush dominated communities. The surface soil in the study community was also chemically different from that of greasewood communities elsewhere in Washington. The pH of the surface soil between greasewood shrubs was near neutral, but values of 9 and higher were measured in the surface soil beneath shrub canopies indicating changes in soil chemistry induced by leaf fall and leaf decomposition (Rickard *et al.* 1973). The surface soils between greasewood shrubs in greasewood-saltgrass communities elsewhere in Washington had pH values of 10 (Daubenmire 1970) instead of near neutral as was the case in our community.

Extensive wildfires occurred on the ALE site in the years 1957, 1973, and 1981. However, the study community burned for the first time in 1981, after a 17 year respite from livestock grazing. Cattle grazing tends to suppress the spread of wildfires by keeping the herbaceous biomass (fuel) at reduced levels. The years of protection from grazing has probably contributed to the early demise of spiny hopsage on the study plot by allowing accumulation of herbaceous fuels.

Spiny hopsage is also reported to be very susceptible to the chemical herbicides used to kill weeds in agricultural fields (Daubenmire 1970). Nevertheless, the demise of spiny hopsage in our study community was very likely not caused by fugitive herbicides because the community is remote from agricultural fields and roadside spraying is not practiced.

Spiny hopsage begins its annual growth cycle by putting out new leaves in February. Flowering takes place in March and April and seeds ripen in May and June. Leaves drop from the twigs in summer. This same seasonal pattern of leaf retention and leaf fall has been noted for spiny hopsage growing in southern Nevada (Ackerman *et al.* 1980). Wildfires usually occur on the Hanford Site in July and August when hopsage is aestivating and shrubs are probably least susceptible to fire damage at this stage. Sprouting in the spring is the usual response to summer burning (Daubenmire 1970).

Greasewood shrubs have access to subterranean water via deeply penetrating root systems and the foliage of greasewood shrubs remains green and succulent throughout the hot, dry summer months (Harr and Price 1972). The wetness of the shoots also probably helps to reduce the severity of burn damage and helps to promote a strong sprouting response.

Over the past 17 years sagebrush and spiny hopsage have been lost from the community, indicating that changes in plant species composition can occur for different reasons. It is likely that the demise of spiny hopsage in this community would have gone undetected were it not for the estabishment of the study plot and its data record. The value of permanently marked study plots in detecting changes in plant species composition of natural communities, following unscheduled environmental disturbances, is demonstrated. The failure of spiny hopsage to sprout after burning suggests that the plants were growing under less than optimal conditions and were therefore sensitive to burn damage in this habitat.

One of the important findings of field research would be to provide some capability to identify plant populations that are "stressed" from those that are "non-stressed." At the present time field indicators of stress are dwarfed plants, chlorotic and necrotic leaves, failure to produce seeds, and other gross morphological features. Research needs to be directed to finding ways to indicate the presence of physiological stress in plant populations that appear to be normal morphologically but react abnormally to man-induced perturbations such as burning, spraying with chemical herbicides, herbivory, or chronic air pollution from industrial facilities.

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