Annual Fluctuation in Production of Some Eastern Oregon and Washington Shrubs

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SHRUBS are an extremely important source of forage for livestock and big game in the forested ranges of Oregon and Washington east of the crest of the Cascade Mountains. On about 19 percent of the forested summer range the understory is made up mainly of shrubs; on the remainder, appreciable amounts of shrubs are associated with the more abundant grasses and forbs (herbaceous plants other than grasses or grasslike plants). The browse (or forage) furnished by many of these shrubs is important because it retains a fairly high nutritive content during the late summer, fall, and winter. At this time grass and forb herbage, even if not under a snow crust, is low in nutritive value, and the shrubs are heavily used by livestock and big game.

Management of ranges where there is considerable dependence upon shrubs has generally been based on the concept that browse production is fairly constant from year to year. This concept may stem from the year-around presence of woody plant parts, the long life, or the evergreen habit of some species. In other words, fluctuations in browse yields are commonly thought to be minor in comparison to differences among years in grass yields.

Yet biotic and climatic factors have been reported to cause severe reductions in shrub production. Girdling by rodents, defoliation by Great Basin tent caterpillars (*Malacosoma fragilis*), winter-kill, gall, rust, and excessive browsing can seriously injure or destroy antelope bitterbrush (*Purshia tridentata*) (Hormay, 1943). Damage to snowbrush ceanothus (*Ceanothus velutinus*) by both winter-kill and a defoliating caterpillar (*Nymphalis californica*) has been reported (Dahms, 1950). In Idaho 15 to 75 percent of new growth on redstem ceanothus (*Ceanothus sanguineus*) was killed in 1942 by a late spring frost, the severest damage occurring on southerly exposures (Young and Payne, 1948).

The effect of moisture conditions on average twig length of true mountain mahogany (*Cercocarpus montanus*) has been observed (Forsling and Storm, 1929). Computations made from southwestern Utah observations show the 1925 twig increment was 3.4 times the 1924 twig growth, moisture conditions in 1924 being less favorable for plant growth.

Grass, forb, and shrub cover measurements made in the Snake River plains of Idaho show the effect of the 1934 drought (Pechanec, Pickford, and Stewart, 1937). Computations made from a four year summary of 140 density-estimate plots show the density (coverage) for all grasses in 1933 was 3 times their density in 1934 and density for all forbs in 1935 was 5.1 times their density in 1934. The density-estimate method showed smaller changes, however, for shrubs. As a class, their greatest density occurred in 1933 and was 2.3 times their density for the dry year of 1934. Density of one shrub, downy rabbitbrush (*Chrysothamus puberulus*), in 1935 was 3.8 times its 1934 density.

The density of only one grass species fluctuated more widely, but variations in density of all principal forbs were decidedly greater.

Green-weight yields of grasses, forbs, and shrubs from 150 plots in eastern Oregon pine forest were measured by the weight-estimate method on both a wet and dry year (Harris, 1951). It was found the change in yield of pinegrass (*Calamagrostis rubescens*), elk sedge (*Carex geyeri*), or any other grass of importance between 1948 and 1949 was not significant, even though 1948 was a very wet year and 1949 was one of the driest on record. Of the important forbs only heartleaf arnica (*Arnica cordifolia*) showed a significant change; its 1948 production was 26 times its 1949 production. Among the shrubs no significant change in yield was found for two species, creeping mahonia (*Mahonia repens*) and *Rosa* spp., but shinyleaf spirea (*Spiraea lucida*) yielded 2.2 times more, and common snowberry (*Symphoricarpos albus*) yielded 1.8 times more herbage in 1948 than in 1949.

Twig length observations made in shrub studies by Julander (1937) and Young and Payne (1948) could also be used to demonstrate variation among years in shrub production.

In the foregoing review, evidence is presented which shows annual yield of some shrubs can fluctuate as much or more than grass yields. However, it appears shrub production does not vary as much from year to year as forb production. Further evidence of shrub fluctuation is presented here, from a study of proper use conducted by two U. S. Forest Service offices, the Pacific Northwest Forest and Range Experiment Station and the Pacific Northwest Regional office.

Field Layout and Procedures

The field layout of the proper use study consisted of a series of ¼-acre game-proof exclosures situated on National Forests in eastern Oregon and Washington. Within each exclosure or plot 15 plants of one of the following species were selected for study: antelope bitterbrush, snowbrush ceanothus, rubber rabbitbrush (*Chrysothamnus nauseosus*), creambush rockspirea (*Holodiscus discolor*), and big whortleberry (*Vaccinium membranaceum*). Three plants were assigned to each of five treatments and a prescribed amount of current growth was clipped from the treated plants each year. Clipping was done in the fall, mid- or late-winter; no clipping was done during periods of active growth. Time of harvest assigned each exclosure was used throughout the study. (Data on the effects of different intensities of clipping are to be presented in a later article).

Annual production (air-dry weight) records from this study have furnished the basis for most of the information to be presented here. During the four years of study it was found that for any one shrub species, fluctuations in production were similar regardless of clipping intensity. Therefore, for simplicity and to show variation in yield at a common utilization intensity, only data from the three plants that received the 50 percent clip in each plot will be presented for each of the five species studied. Records of production were multiplied by two to give total yield. Comparison between current production and precipitation were made for two plots where adequate precipitation records were available in the vicinity.

Antelope Bitterbrush

Variations in production of bitterbrush exemplified the effects of rodent attacks and annual variations in precipitation. In one instance (Plot No. 4), the yield for the year of greatest production, 1946, was about 3.2 times the yield in the poorest year, 1945 (Table 1). During these same years the winter-summer precipitation, October through September, totaled 34.1 and 23.4 inches respectively as recorded by the nearest weather station having an altitude about the same as the study area (Fig. 1).

TABLE 1

Browse (or forage) production record of five shrub species

SPECIES	PLOT NO.	TOTAL TWIG YIELDS, THREE PLANTS PER PLOT*					ANNUAL YIELD ÷ LOWEST YIELD				
		1945	1946	1947	1948	1949	1945	1946	1947	1948	1949
		Grams									
Antelope bitterbrush	1	168	140	148	136	—	1.24	1.03	1.09	1.00	
	2	212	242	190	190	—	1.12	1.27	1.00	1.00	
	3	158	144	78	64	—	2.47	2.25	1.22	1.00	
	4	40	126	48	56	—	1.00	3.15	1.20	1.40	
Snowbrush ceanothus	5	—	1400	1180	2856	1420		1.19	1.00	2.42	1.20
	6	—	1420	1120	2056	1149		1.27	1.00	1.84	1.03
	7	—	950	660	1384	1204		1.44	1.00	2.10	1.82
Rubber rabbitbrush	8	154	126	232	216	—	1.22	1.00	1.84	1.71	
	9	538	752	648	334	—	1.61	2.25	1.94	1.00	
	10	878	642	1230	652	—	1.37	1.00	1.92	1.02	
Creambush rockspirea	11	196	780	420	330	—	1.00	3.98	2.14	1.68	
	12	386	556	600	480	—	1.00	1.44	1.55	1.24	
	13	38	40	20	20	—	1.90	2.00	1.00	1.00	
Big whortleberry	14	—	40	12	8	30		5.00	1.50	1.00	3.75
	15	—	28	10	12	12		2.80	1.00	1.20	1.20

* Yields shown for plot 4 are from only two plants; those for plot 13 from one plant.

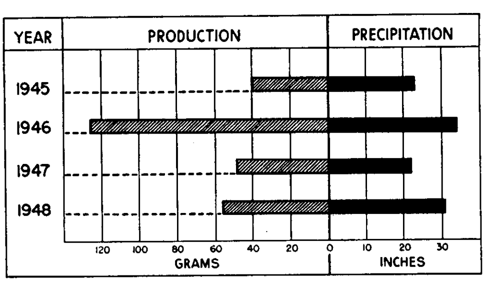

FIGURE 1. Comparison of antelope bitterbrush yields (Plot No. 4) and the annual precipitation recorded at Chemult, Oregon, for the winter-summer periods (October through September).

Fluctuation in yield of one of the other bitterbrush plots (No. 3) appeared to be mainly related to rodent damage. Its production in 1945 was 2.7 times its yield in 1948, a year considered to have above normal precipitation for the region in which this plot was located. Loss in productivity for that season probably can be attributed to extensive girdling of basal stems and some branches by rodents. Portions of the crowns died on girdled plants. Fluctuations in yield of the other two plots (No. 1 and No. 2) were rather small.

Snowbrush Ceanothus

Fluctuation in production of this species at all study locations appeared to reflect the annual variations for the October through September precipitation. Lowest yields for all snowbrush ceanothus plots occurred in 1947, a relatively dry year, and the greatest yield in 1948, when precipitation was much greater. However, only one plot (No. 5) was near enough to a weather station to permit comparison of production and precipitation records (Fig. 2). This plot showed the greatest fluctuation in yield for this species; third annual harvest was 2.4 times the second harvest (Table 1). Maximum fluctuations for the other plots were not much less.

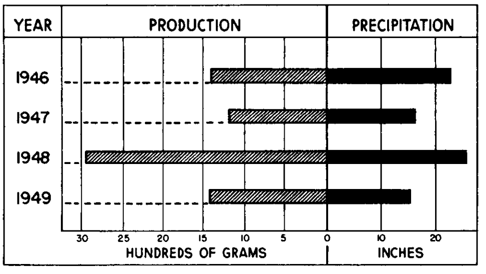

FIGURE 2. Comparison of snowbrush ceanothus yields (Plot No. 5) and the annual precipitation recorded at Austin, Oregon, for the winter-summer periods (October through September).

Insects demonstrated on this shrub that they are also a factor which can influence the amount of production. One of the three snowbrush ceanothus plots was attacked by cottonwood scale (*Chionaspis ortholobis*) about the time the study ended. The following year part of each clipped shrub died. Production of unclipped plants appeared unimpaired.

RUBBER RABBITBRUSH

Maximum fluctuation in yield of rubber rabbitbrush was less than that recorded for the other species studied. The yield for the year of greatest production in this case (Plot No. 9) was only 2.2 times as large as the low yield (Table 1). Variations in production were about the same magnitude for the other rubber rabbitbrush plots. Girdling by rodents in two plots was responsible for the low yields. In another instance (Plot No. 10) an infestation of various gall-forming insects of the families Itonidadae and Tephritidae restricted production by killing portions of the plants. These instances of low production occurred during years that were considered to have the most favorable moisture conditions for plant growth of the study period.

CREAMBUSH ROCKSPIREA

The largest fluctuation in production of creambush rockspirea was only exceeded by big whortleberry. At one location (Plot No. 11) the second annual yield of creambush rockspirea was practically 4 times the first harvest (Table 1). Maximum fluctuations at the other locations were only half as large or less. Weather records of the nearest Weather Bureau cooperators were too incomplete to permit a comparison of annual shrub production and precipitation records.

BIG WHORTLEBERRY

Big whortleberry production showed the largest yield variations of any shrub studied. Production of the most variable plot (No. 14), for the first year of the study, was 5 times the third harvest (Table 1). The greatest yield at the other location was 2.8 times the smallest harvest. Records of the nearest precipitation station were of no value in trying to explain these variations in yield. No rodent or insect damage to the shrubs was noted.

CONCLUSION

Biotic and climatic factors can cause wide variations in the annual production of shrubs. In a 4-year study in eastern Oregon and Washington on antelope bitterbrush, snowbrush ceanothus, rubber rabbitbrush, creambush rockspirea, and big whortleberry, variations in precipitation or damage by rodents and insects reduced the browse in some years to as little as one-third or one-fifth of the production in other years. These fluctuations should be considered in grazing management for eastern Oregon and Washington shrub ranges.

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