TECHNICAL NOTES

Effects of Precipitation Variance on Annual Growth of 14 Species of Browse Shrubs in Southeastern Oregon

ROBERT R. KINDSCHY

Abstract

Growth response of 14 species of shrubs to precipitation occurring between September and June was measured during a 15-year period. Vegetative production was found to be significantly correlated ($p = 0.01$) to precipitation. Regression analysis of 3,750 measurements of annual growth enabled the development of linear equations which may be used by habitat managers to forecast shrub browse production expressed as a percentage of normal production.

Precipitation is normally the most influential variable governing the production of vegetation on the semiarid rangelands of the Intermountain western United States (Blaisdell 1958). Increasing precipitation usually provides an overall increase in vegetative growth and overall productivity (Segura-Bustamante 1970). Stevens et al. (1974) determined the response of big sagebrush (*Artemisia tridentata*) to annual precipitation was basically linear rather than sigmoidal due, apparently, to the deep rooting characteristic of this shrub. Garrison (1953) analyzed the annual fluctuation in production of five shrub species during a 4-year period in eastern Oregon and Washington. He concluded that 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 of other years. Sneva (1962) developed a method of forecasting the crop year production potential of a given year as expressed as a percent of the median crop year utilizing data from establishment weather stations. The crop year avoids the two summer months of July and August when typically scant precipitation has little effect on vegetative growth within the Intermountain region.

This paper deals with the growth response to crop year precipitation of 250 tagged plants representing 14 species of shrubs important for ungulate forage production during a 15-year period (1963–1977).

Study Area and Methods

Twenty-two sites were selected within important mule deer (*Odocoileus hemionus*) use areas in Malheur County, Oregon (Fig. 1). Vegetation is typical of the shrub-steppe of central and southeastern Oregon within the Owyhee Upland and southern Blue Mountain physiographic provinces (Franklin and Dyrness 1973).

Measurements of annual leader production were made during late autumn at each of 22 sites. The average production for each plant was recorded in tenths of an inch (2.5 mm). Both terminal and lateral leaders were measured and averaged. Of the 250 plants studied, 144 were antelope bitterbrush (*Purshia tridentata*); 13

Fig. 1. Study area, Malheur County in southeastern Oregon.

additional browse species were similarly studied (Table 1). Selection of species for study was influenced by the frequency of occurrence of species at each site. Not all species occurred at each site with the exception of bitterbrush. During the course of the 15-year study 3,750 measurements were taken, predominantly on the same individual plants.

Precipitation data were abstracted from climatological data published by the National Oceanic and Atmospheric Administration for weather stations within the study area.

Regression analysis was made of the effect upon leader length production of varying amounts of crop year precipitation, viz. the precipitation occurring between 1 September and 30 June. Exponential, linear, and logarithmic regression equations were developed

Author is senior wildlife biologist, U.S. Dep. Int. Bu. of Land Manage., P.O. Box 700, Vale, Oregon 97918.

Table 1. Browse species studied.

Scientific name	Common name
<i>Amelanchier florida</i> Lindl.	Serviceberry
<i>Artemisia rigida</i> (Nutt.) Grey	Stiff sagebrush
<i>A. tridentata tridentata</i> Nutt.	Basin big sagebrush
<i>Atriplex canescens</i> (Pursh.) Nutt.	Fourwinged saltbush
<i>Cercocarpus ledifolius</i> Nutt.	Curlleaf mountain mahogany
<i>Erigonum</i> spp.	Wild buckwheat
<i>Grayia spinosa</i> (Hook.) Moq.	Spiny hopsage
<i>Juniperus occidentalis</i> Hook.	Western juniper
<i>Paraphyllum ramosissimum</i> Nutt.	Squawapple
<i>Philadelphus lewisii</i> Pursh.	Lewis mockorange
<i>Prunus virginiana</i> L.	Chokecherry
<i>Purshia tridentata</i> (Pursh.) DC.	Antelope bitterbrush
<i>Ribes cereum</i> Dougl.	Wax currant
<i>Symphoricarpos oreophilus</i> Gray	Mountain snowberry

for bitterbrush taken separately and, secondly, for all 14 species taken together. Results were subsequently plotted to express the percentage of normal browse leader production to be expected when the percentage of normal crop year precipitation is known.

Fig. 2. Relationship of annual leader production to Crop Year precipitation in southeastern Oregon.

Results

Regression analysis proved the relationship of leader production to precipitation to be linear. This was true of bitterbrush when analyzed separately as well as the analysis of all 14 species taken collectively.

Stiff sagebrush, big sagebrush, fourwinged saltbush, and spiny hopsage appear to produce well during minor drought, in contrast to the more mesic species studied. The long-term average crop year precipitation for the entire study area is 25 cm (9.85 in.), which is thought to be more than adequate for average growth of these xeric habitat species.

Bitterbrush leader production (inches) = $0.593 X - 1.67$ ($r = 0.622$, $t = 2.87$, significant at the 0.01 level). Where X = crop year precipitation at the site. Mean leader production of all 14 browse species = $4.138 + 6.394$ ($r = 0.651$, $t = 2.99$, significant at the 0.01 level). Where X = crop year precipitation at the site.

Application of these equations to crop year precipitation variance from the long-term mean (% X) = (current crop year precipitation $\div$ average crop year precipitation) provides the big game habitat manager with the following equations which may be used to estimate the percentage of normal browse forage production to be expected during the forthcoming growing season (Fig. 2):

$$\text{Percent bitterbrush production} = 1.394 (\% X) - 0.401.$$

$$\text{Percent for 14 species production} = 0.982 (\% X) + 0.155.$$

For example, the average crop year precipitation for a local NOAA station is 9.80 inches. The present crop year produced 8.00 inches. By dividing the present CY precipitation (8.00-in.) by the average CY precipitation, it is determined that this year's precipitation is 0.816 of average.

Application of the equation for bitterbrush determines the anticipated production of browse leader growth:

$$1.394 (0.816) - 0.401 = 0.737 \text{ or roughly } 74\% \text{ of average production.}$$

Similarly, for all studied browse species:

$$0.982 (0.816) + 0.155 = 0.956 \text{ or roughly } 96\% \text{ of average production.}$$

Literature Cited

- Blaisdell, James P. 1958. Seasonal development and yield of native plants on the upper Snake River plains and their relation to certain climatic factors. U.S. Dep. Agr. Tech. Bull. 1190. 68 p.
- Franklin, Jerry F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. U.S. Dep. Agr. Forest Serv. General Tech. Rep. PNW-8, Pac. NW Forest and Range Exp. Sta., Portland, Ore., 417 p.
- Garrison, George A. 1953. Annual fluctuation in production of some eastern Oregon and Washington shrubs. J. Range Manage. 6:117-121.
- Segura-Bustamante, Mariano. 1970. Ecology of bitterbrush *Purshia tridentata* (Pursh) DC. in the Silver Lake deer winter range, Oregon. PhD Thesis. Oregon State Univ., Corvallis, 342 p.
- Sneva, Forrest A., and D.N. Hyder. 1962. Estimating herbage production on semiarid ranges in the Intermountain Region. J. Range Manage. 15:88-93.
- Stevens, Richard, A.P. Plummer, C.E. Jensen, and B.C. Giunta. 1974. Site productivity classification for selected species on winter big game ranges of Utah. U.S. Dep. Agr. Forest Serv., Res. Pap. INT 158, 24 p.