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EFFECTS OF GRASS COMPETITION ON BITTERBRUSH:
SECOND-YEAR REPORT^{1/}

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ABSTRACT: The second year's data of a study designed to test the effects of perennial grass competition on the vigor of bitterbrush (Purshia tridentata) in an area of heavy bitterbrush mortality are reported. The data demonstrated that competition from other plants, mainly perennial grass, significantly reduced bitterbrush growth.

Antelope bitterbrush (Purshia tridentata) mortality on winter deer ranges in northeastern California is a matter of considerable concern to land managers because bitterbrush is one of the most important winter deer foods. Generally, mortality is limited to individuals or small groups of plants within a stand and additional plants soon replace them. But in eastern Siskiyou County, large blocks--one over 200 acres--of bitterbrush are dead for no apparent reason and no replacement plants are in sight.

Although grazing of bitterbrush by deer and cattle has probably caused some mortality, it is not the major factor. A number of other factors probably contribute to this mortality. One such factor may be an increase in perennial grass accompanied by increased plant competition.

This paper reports second-year results of a study designed to test the magnitude of perennial grass competition with bitterbrush. The

^{1/} The work reported in this note is from studies conducted by the Pacific Southwest Station in cooperation with the California Department of Fish and Game. Part of the work was done under the Federal Aid in Wildlife Restoration Act, Pittman-Robertson Research Project W51R entitled "Game Range Restoration."

first year's data have been reported previously,^{2/} but are included in this note for comparison.

THE STUDY AREA

The study area is located about 15 miles east of Mt. Hebron, California, on the Klamath National Forest. Annual precipitation averages about 20 inches. Ponderosa pine (Pinus ponderosa), dense stands of bitterbrush, and perennial and annual grasses grow on the site. The ponderosa pine was clear-cut about 20 years ago; now only islands of pole-sized trees and a few scattered mature trees remain. The dominant brush species, bitterbrush, is in various stages of vigor. But on several large blocks it is entirely dead, except under islands of ponderosa pine. The perennial grass includes: bottlebrush squirreltail (Sitanion hystrix), Idaho fescue (Festuca idahoensis), western needlegrass (Stipa occidentalis), and sedge (Carex sp.). Cheatgrass (Bromus tectorum), mule's ear (Wyethia mollis), and miscellaneous forbs also are present in the understory.

METHODS

In 1958 two study sites were located in the general area of a heavy bitterbrush die-off. One adjoins a large block of dead bitterbrush. Plants on the site are in very poor condition. The other site, where bitterbrush is in good condition, is about 300 yards away from the poor condition site. At each location livestock have been excluded from a 75- by 75-foot plot. Since 1959 half of each plot has been kept weeded of all vegetation except bitterbrush.

Average leader length and average number of leaders per branch have been used to reflect growth and vigor responses of the bitterbrush to the weeding treatment. To obtain estimates of leader length and the number of leaders per branch, we selected 15 bitterbrush plants at random. A branch was defined as that portion of plant material above the first fork of old wood. On each branch the leaders were measured and counted. We defined a leader as any new growth over one-half inch long. To compute an average leader length for a plant, at least 50 leaders were measured. When 50 leaders were not found on the first 4 branches, we randomly selected additional branches. However, the average number of leaders per branch was computed from counts on the first four branches only.

^{2/} Hubbard, R. L., and Sanderson, H. R. Grass reduces bitterbrush production. Calif. Fish and Game 47(4): 391-398. 1961.

RESULTS AND DISCUSSION

EFFECT OF WEEDING ON LEADER LENGTH

Bitterbrush leader length increased as a result of weeding on both good and poor condition plots in 1960 and 1961, but the increase was greater on the poor plot in 1960 and greater on the good-condition plot in 1961 (fig. 1). In 1960 the increase due to weeding was 50 percent (0.7 inch) on the good-condition plot and 87 percent (0.8 inch) on the poor-condition plot. In 1961 the increase due to weeding was 52 percent (1.1 inches) on the good-condition plot--similar to 1960 increases. But on the poor-condition plot the increase was only 9 percent (0.2 inch). Average leader length was greater on all plots in 1961 than in 1960.

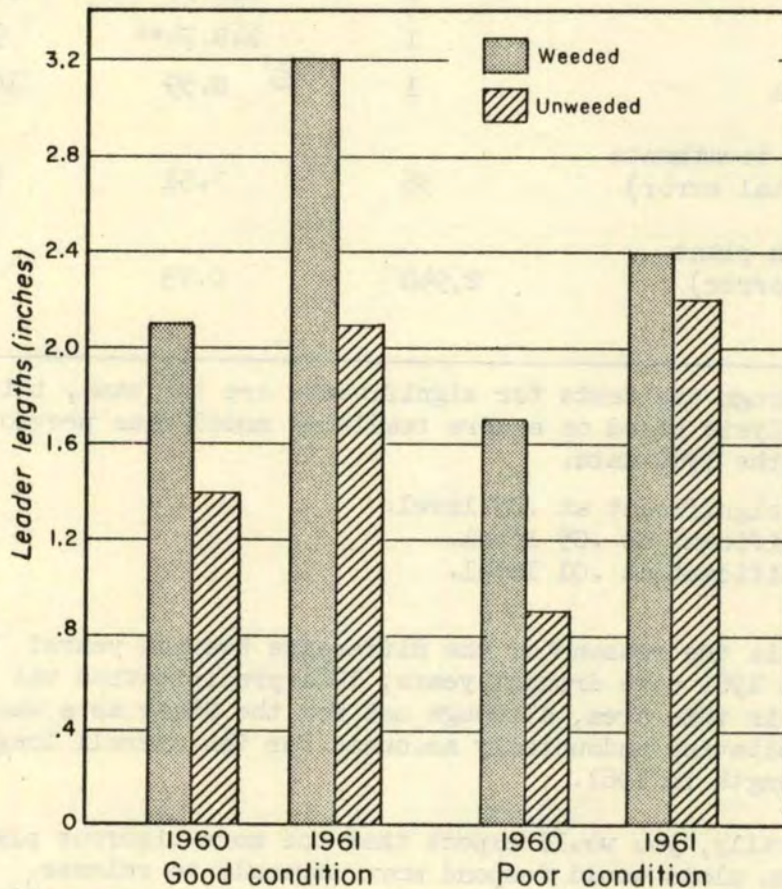


Figure 1.--Average leader length of bitterbrush in good and poor condition plots, 1960 and 1961.

An analysis of variance showed a significant difference for the weeding treatment and for condition effects for both years (table 1). The interaction between plant condition and treatment was significant in 1961 but not in 1960, meaning that the response to weeding was related to plant condition in 1961 but not related in 1960.

Table 1.--Analysis of variance of leader lengths found on weeded and unweeded fenced plots in the Mt. Hebron bitterbrush die-off area, 1960 and 1961

Item	: Degrees : of : freedom	: Mean squares	
		: $\frac{1}{1960}$: 1961
Source of variation:			
Treatments	1	426.57**	374.25**
Condition	1	149.74**	92.03*
Interaction	1	$\frac{2}{0.59}$	141.39**
Plants within treatments (experimental error)	56	7.51	16.50
Leaders within plant (sampling error)	2,940	0.73	2.41

$\frac{1}{}$ Although the tests for significance are the same, this is a different analysis based on a more realistic model than previously reported for the 1960 data.

$\frac{2}{}$ Not significant at .05 level.

* Significant at .05 level.

** Significant at .01 level.

What is the reason for the difference between years? First, both 1959 and 1960 were drought years; 1961 precipitation was slightly above normal in this area, although not for the State as a whole. The higher precipitation undoubtedly accounts for the overall longer average leader length in 1961.

Generally, you would expect that the more vigorous plants on the good-condition plots would respond more strongly to release. This did not appear to be true in 1960--a drought year--but did in 1961--a normal precipitation year. By imposing a 1/2-inch limit for separating leaders from flower spurs, we may have skipped many of the shorter, less productive leaders in 1960 and measured only the more productive leaders. We also suspect that in 1961 these shorter leaders grew past the 1/2-inch

limit and were measured. The 1960 data suggested that competition from the understory was more severe on the poor-condition plot, but this conclusion was not supported in 1961.

EFFECT OF WEEDING ON NUMBER OF LEADERS PER BRANCH

Average leader length is fairly well accepted as a reflection of a browse plant's growth and vigor. In 1960 average leader length and average number of leaders per branch were closely correlated. So close, in fact, that we had suggested the possibility of using leader counts as a single measure of plant vigor. Analysis of data collected in 1961 from the same plants did not support this hypothesis (fig. 2). In 1960 the plants in good condition showed a 56 percent increase in the number of leaders per branch owing to weeding--about the same percentage response as found for leader length. Number of leaders per branch on the poor-condition plants increased 223 percent as a result of weeding. This tremendous increase on the poor-condition plants probably resulted from the weeding treatment that permitted many short leaders to grow into the measurable class.

In 1961 the average number of leaders per branch on both the good- and poor-condition plots as a result of weeding showed slight but not significant decreases (table 2). The average number of leaders per branch in 1961 was higher on both the weeded and the unweeded plants on the poor-condition plots than on the good-condition plots. This difference may reflect an "agony branching" tendency--the final effort of these poor-condition plants to produce a large number of leaders in order to survive.

Table 2.--Analysis of variance of number of leaders per branch found on weeded and unweeded plots in the Mt. Hebron bitterbrush die-off area, 1960 and 1961

Item	Degrees of freedom	Mean squares	
		1/1960	2/1961
Source of variation:			
Treatments	1	1659.00*	2/46.00
Condition	1	2/478.84*	2/833.00*
Interaction	1	116.21	2/2.00
Plants within treatments (experimental error)	56	45.60	50.9
Branches within plants (sampling error)	180	19.30	30.8

1/ Although the tests for significance are the same, this is a different analysis based on a more realistic model than previously reported for the 1960 data.

2/ Not significant at .05 level.

* Significant at .01 level.

EFFICIENCY OF WEEDING ON NUMBER OF LEADERS PER BRANCH

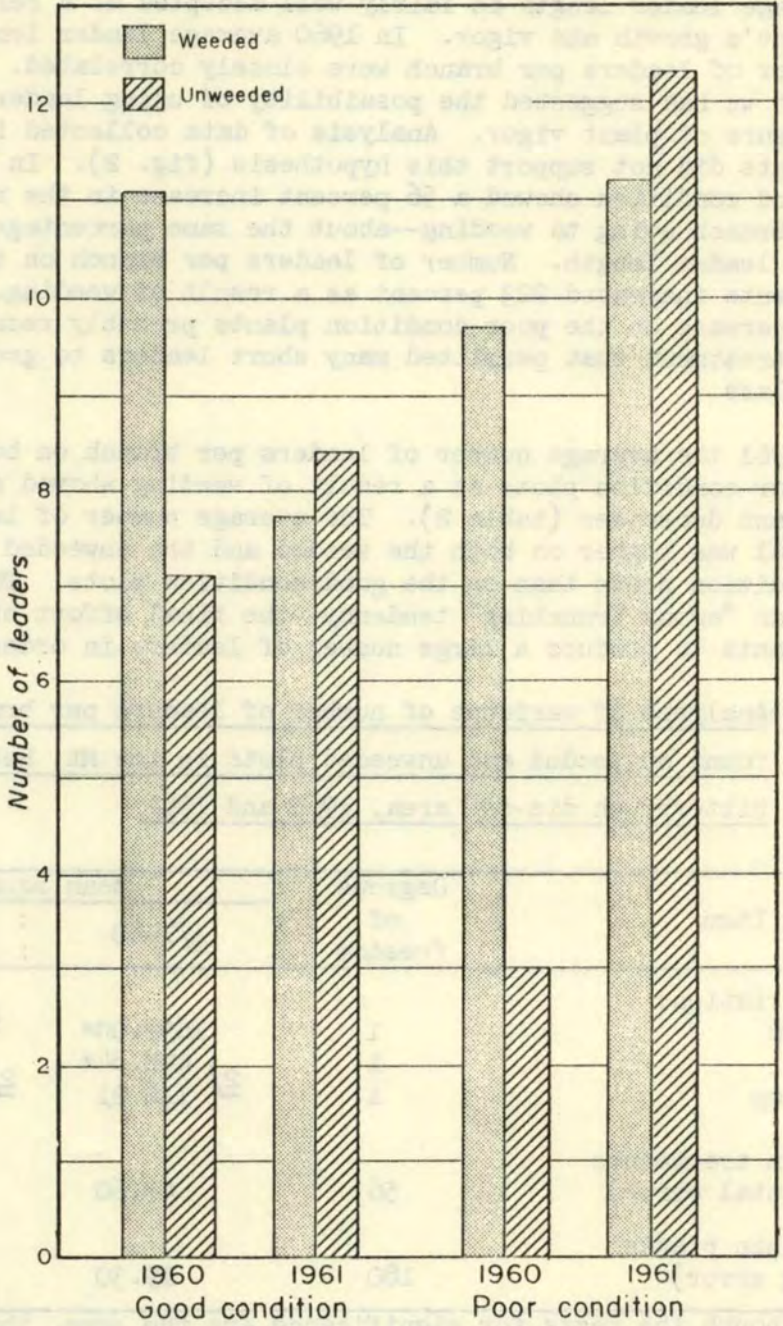


Figure 2.--Average number of leaders per branch in good and poor condition plots, 1960 and 1961.

CONCLUSIONS

Data collected in 1961 again demonstrated that competition from other plants, mainly perennial grasses, significantly reduced bitterbrush growth. This does not mean that the understory vegetation was necessarily killing the bitterbrush--only that it was reducing growth and probably vigor, and perhaps making the plants more susceptible to damage from other sources. If the lower vigor is linked to bitterbrush mortality, as we suspect it is, livestock and deer management practices that favor browse over grass will have to be developed.

The 1961 data failed to support our previous contention based on the 1960 data that count of leaders per branch might prove to be an adequate, single measure of plant vigor.

Defining a leader as any new growth over 1/2-inch long did not seem to be adequate for distinguishing between leaders and flower spurs, particularly in poor growth years.

