

Vegetational Changes During Biological Control of Klamath Weed

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Current procedure in the control of Klamath weed (*Hypericum perforatum*) on California ranges provides an interesting application of biological principles. The use of the leaf-feeding beetles (*Chrysolina*) as a biological control is similar to the use of insects on such other weedy plants as prickly pear in Australia and gorse in New Zealand. The biological control method may be possible on other alien weedy range plants.

The establishment and spread of Klamath weed in the western states has been typical of the invasion of many introduced range weeds. In the early 1940's, well over 1½ million acres of rangeland in California had varying infestations of the weed. Where infestations were heavy, forage production on the range was considerably reduced. Early workers in the field (Parker and Sampson, 1930, and Raynor, 1937) reported

the extent of the problem. Holloway and Huffaker (1948, 1951) reported on the use of beetles for weed control. The University of California and the Bureau of Entomology and Plant Quarantine developed a joint project for importing, testing and colonization of the insects. The first importations were made in 1944 and by fall of 1945 four initial colonies were established in different sections of California.

Changes in the forage composition while the biological control was in progress have been reported by Huffaker and Holloway (1949) and Huffaker (1951). Their reports indicated that most of the space vacated by the weed had been occupied by fair to good forage species found resident in the range area studied.

The purpose of this paper is to note the vegetational changes and the plants most likely to replace

Klamath weed while biological control is in progress.

Methods

The area selected for study, located near the town of Blocksburg in southeastern Humboldt County, California, has been heavily infested with Klamath weed since the 1920's. Two pastures varying in size from 5 to 50 acres were involved in the study. Elevation is approximately 2,000 feet. A cooperative arrangement was drawn up between the University of California and two ranchers so control of forage use would be possible. Occasionally, during the process of study, the sheep use had to be suited to the range operator's plan of use; thus animals were not always available when needed. Livestock control was possible from the spring of 1948 to the summer of 1951.

Southeastern Humboldt County has approximately 60 inches of rainfall annually and is capable of supporting a stand predominated by perennial grasses. However, past stocking practices have reduced the grass composition mostly to annuals. During the study perennial

grasses were encouraged by withholding grazing during the period of seedhead development until seed shattered, and by rotating the grazing to develop thrifty grass plants. After four years of controlled animal use, a greater change in perennial grasses was not possible because of the low initial population density.

Invasion of other weedy range plants accompanied the reduction in Klamath weed. Medusa-head (*Elymus caput-medusae*) was one of the more prominent weedy plants present on the experimental pastures. Other undesirable weedy grasses of less aggressiveness include nitgrass (*Gastridium ventricosum*), dogtail (*Cynosurus echinatus*) and foxtail fescues (*Festuca dertonensis* and *F. megalura*).

The area generally has a very dense cover typical of the California annual vegetation. This pattern restricts the practical use of individual plant counts if a large number of samples is taken. For this study, forage was separated into annual grasses, perennial grasses and Klamath weed, and the percentage of total vegetation for each group determined. Estimates of composition were made by using a square-foot frame placed on the ground at 20-foot intervals along an established line. Estimates were made to the nearest five percent.

The percentage of perennial grasses on all the study areas was relatively low, yet they are important as forage producers. Where these plants occurred, they were listed by species in percentage density for closer observation.

Grazing Use

Sheep were used in all the study pastures. Grazing was conducted at two separate periods: during April and May, and in late June and July. The aim of this type of grazing was twofold: first, to utilize the annual growth by early grazing,

thus reducing its competition with perennial grasses, and to utilize the new tender spring shoots of the Klamath weed; second, to allow the desirable perennial grasses, notably California oatgrass (*Danthonia californica*), to set seed crops. Oatgrass was able to set seed between the first and second grazing period. Animals grazed some of the flowering Klamath weed and reduced its seed crop, tramped mature oatgrass

seed into the ground and utilized some of the summer forage growth.

The grazing use of Klamath weed to assist in its control may seem rather unusual, but no deaths in sheep could be attributed directly to Klamath weed in the Humboldt County area during the period of observation.

The two primary effects of Klamath weed on a range are: (1) good forage plants are crowded out;



FIGURE 1. Biological control of Klamath weed in the experimental area. *Upper*. Before beetle control, July 10, 1950. Notice abundance and vigor of Klamath weed in foreground. *Lower*. After control, July 12, 1951. Annual grasses and forbs have replaced the Klamath weed.

(2) animals are more subject to malnutrition and disease because of the inferior feed.

Results

The two areas selected for this study differed principally in elevation, conditions of the vegetative cover and distance from beetle liberation points.

Tooby and Prior Ranch Experimental Pastures

Pasture elevation is 1,000 feet with a ten-degree slope to the southwest, draining toward the Eel River. Past grazing was characterized by fairly constant use from early winter until late spring or during the major growing period of the range plants. This use resulted in a dominant stand of annual plants and few perennial grasses.

Beetles were first released in 1946 about a mile south of the T & P experimental pasture. They were first noted in the study site during the 1949 observations. A year later beetle numbers and evidence of feeding had been so great during the year that Klamath weed comprised less than five percent of the vegetation, compared to 40 percent before the beetles were released. (See Table 1).

Annual grasses and forbs each made up about 30 percent of the vegetation. After Klamath weed was controlled by beetle feeding, the weed-free area was covered about equally with annual grasses and forbs. The trace of Klamath weed noted in 1953 was from a seedling crop that had developed that year. Beetle numbers in 1953 had declined temporarily from 1950-51 high.

This area had a few spots infested with Medusa-head, an undesirable range grass. One line transect went through such a spot so that a progressive study could be made. In 1948 only a trace was recorded, but the next year this weedy

Table 1. Vegetational composition on sheep-grazed range during biological control of Klamath weed from 1948 to 1953. Tooby and Prior Ranch Experimental Pastures

	1948	1949	1950	1951	1953
	Percent				
<i>North Field</i>					
Klamath weed.....	50	40	T	O	T
Annual grasses.....	25	40	55	45	50
Perennial grasses.....	O	T	T	T	T
Forbs.....	25	20	45	55	50
<i>South Field</i>					
Klamath weed.....	30	35	O	O	T
Annual grasses.....	30	40	45	40	50
Perennial grasses.....	T	T	T	T	T
Forbs.....	40	25	55	60	50

grass made up 16 percent of the annual grasses. In 1953, this had increased to 24 per cent.

Other undesirable weedy grasses of less noxious character than Medusa-head included nitgrass and dogtail.

The perennial grass found most frequently in the plots was California oatgrass, which had managed to withstand the Klamath weed competition. When the weed was controlled, oatgrass had an excellent opportunity to spread. For this section of the state, California oatgrass is probably the best native forage grass available.

Purple stipa (*Stipa pulchra*) was the second most frequent perennial grass, followed by squirreltail (*Sitanion hystrix*) and blue wildrye (*Elymus glaucus*).

Blocksburg Experimental Pasture

These study pastures are at an elevation of 2,000 feet, on a five percent slope to the north, and drain into Larabee Creek, a tributary of the Eel River. Past grazing use has been principally in spring and summer, tending to give a

slightly better perennial grass stand initially than in the previously mentioned study area.

These pastures were approximately 10 miles from the initial beetle release area. The first indication of beetle feeding was in 1950. Since many colonies had been distributed by ranchers on various sections of the range, it is quite possible that the beetles may have come from areas other than the initial release point. Observations during 1953 were not possible.

Klamath weed made up 70 percent of the vegetation in the 1948 pre-beetle observation (Table 2). This dropped to 15 percent the year after beetles were first observed. The annual grass and forb population was about equal the first year of observation. After Klamath weed was greatly reduced by beetle feeding, the annual grasses occupied a greater part of the vacated area.

Medusa-head did not appear in the count area until the 1950 readings, and then only in one line transect. On this line, it made up 60 per cent of the annual grass cover,

Table 2. Vegetational composition on sheep-grazed range during biological control of Klamath weed from 1948 to 1951. Blocksburg Experimental Pasture

	1948	1949	1950	1951
	Percent			
Klamath weed.....	70	50	50	15
Annual grasses.....	20	30	25	55
Perennial grasses.....	T	T	10	10
Forbs.....	10	20	15	20

or 20 percent of the total forage cover. During 1951, the annual grass cover increased, but at this time the weedy grasses made up only 30 percent of the annual grass cover, but only 20 percent of the total forage cover.

California oatgrass was the most abundant perennial both before and after Klamath weed control. After weed control some Hall's bentgrass (*Agrostis hallii*) and blue wild-rye were found in the measured areas. Purple stipa was entirely lacking.

Discussion

To insure improved forage conditions on the range after the removal of Klamath weed by biological control, better forage plants should be encouraged. On nearly all ranges with a Klamath weed problem, both desirable and undesirable forage plants are present. On areas with a well-adapted forage grass, such as California oatgrass, available, grazing use should be aimed to encourage this plant.

On most Klamath weed ranges of California, Medusa-head will thrive and provide serious competition to the more desirable forage plants. Range improvement can only be achieved where better annuals and perennials replace the undesirable forage plants.

Summary

Changes in vegetational composition were studied on two Humboldt County range areas from 1948 to 1953 during biological control of Klamath weed. Set grazing periods in spring and summer were run in conjunction with the study until 1951. In all cases where beetles were noted to be feeding during the late spring and summer Klamath weed was reduced to a minor part of the forage or completely eliminated the subsequent year. Both the annual grasses and forbs were aggressive competitors for the vacated space. In one case annual grasses were most aggressive but in two other

cases forb and annual grasses were equally aggressive. Out of three trial areas, the perennial grasses increased in percentage density in only one area. Weedy grasses, such as Medusa-head, showed some increase.

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