

Plant Counts and Seed Production on California Annual-Type Ranges

H. H. BISWELL AND CHARLES A. GRAHAM

*Professor of Forestry, University of California, Berkeley;
Range Conservationist, California Forest & Range Experiment Station¹*

California has about 22,000,000 acres on which annual plants predominate in the herbaceous cover. This is known as the California annual-type vegetation (Talbot, Biswell and Hormay, 1939). The flora is made up of many different species, as many as 200 or 300 per square mile. As many as 35 and commonly 15 to 20 species have been recorded for a square foot of ground. Seed production is generally high, even under adverse weather conditions and fairly close grazing. Burcham (1955) reported yields of 400 to 1,600 pounds per acre in open grassland ranges. The vegetational cover varies greatly from place to place and from season to season depending upon such factors as variable weather, kind

of soil, degree and season of grazing, and occurrence of fire (Talbot and Biswell, 1942; Hervey, 1949; Kadish, 1955; Biswell, 1955).

To learn more about the ecology of the annual-type vegetation, counts were made of individual plants on 152 sample plots over a period of three years at the San Joaquin Experimental Range,² in the Central Sierra Nevada foothills of California. This area is fairly representative of a vast portion of the 22,000,000 acres of the annual-type vegetation. Another reason for making the counts was to test the practicability of this method of sampling yearly and seasonal changes in the resident annual-type vegetation.

Plant Numbers and Survival In Dense Stands

Soon after the first rains in the fall, ground that has been virtually

²A branch of the California Forest and Range Experiment Station.

too dry during late summer for plants to grow becomes literally covered with thousands of annual plants. Approximately 50 percent of those in dense stands die before reaching maturity, and one-half to three-fourths of those remaining are stunted plants. This sequence of development was followed for three years by counting the individual plants on the 152 sample plots.

During the first year the young seedlings were counted on 0.2 x 0.2-foot square sods taken from the very densest stands obtainable of certain abundant range plants. Converted to a square-foot basis, four samples of soft chess (*Bromus mollis*) averaged 17,433 plants per square foot; four of foxtail fescue (*Festuca megalura*) 20,875; and nine of broadleaf filaree (*Erodium botrys*) 1,048. Scattered in with the broadleaf filaree were about an equal number of other plants, mainly grasses. These averaged 1,600 per square foot for the nine plots.

On the densest plots the seedlings were about as thick as they could possibly grow. Foxtail fescue seedlings, being the smallest, occurred in the greatest numbers. Broadleaf filaree seedlings are relatively large and not nearly as many can grow on a given unit of area.

¹The California Forest and Range Experiment Station is maintained at Berkeley, California by the Forest Service, U. S. Department of Agriculture in cooperation with the University of California.

During the second season, 33 2 x 2-foot plots were staked out in dense stands, including soft chess, foxtail fescue, broadleaf filaree and whitetip clover (*Trifolium variegatum*). Density of vegetation was estimated for each of these plots, after which two 0.2-foot-square units of equal density were chosen in each plot for the plant counts. One unit was carefully removed, the sod torn apart and the seedlings counted; the second was staked for counting at the height of plant development, during the latter part of April. When the April counts were made, density was again estimated for the two sets of plots. The results from these counts and estimates are summarized in Table 1.

The estimates of forage density on the 2 x 2-foot plots were considerably higher than over the experimental range as a whole: 56 percent as against 37 percent. The estimates of vegetation density on the 0.2 x 0.2-foot units were still higher, averaging almost 77 percent.

The greatest reduction in plants from the seedling stage to maturity occurred in the clover stands and the least reduction in the broadleaf filaree plots. The percentage reductions for each of the species were as follows: foxtail fescue, 50 percent; soft chess, 38 percent; broadleaf filaree, 11 percent; whitetip clover, 93 percent. The whitetip clover has a spreading habit of growth which may partly account for the greater mortality in stands of this species as it develops to maturity. The grasses in dense stands seldom develop tillers but in thinned stands



FIGURE 1. Annual plants comprise nearly all of the resident herbaceous vegetation in the lower portions of the Central Sierra Nevada foothills of California.

the tillers may be many. In a contiguous area where scraping the soil surface had greatly thinned the stand, foxtail fescue plants had developed as many as twenty tillers. These added materially to the density of the vegetation in the mature stage.

In the spring of the third year, ten sods of one square-foot each of the four species were selected at random in mature stands of 90 percent density or better and counts made of all the plants. These sods showed the following numbers of plants per square foot: foxtail fescue—7,435, with 395 additional plants of other species; soft chess—5,075, with 525 additional plants of other species; broadleaf filaree

—1,002 with 1,002 additional plants of other species; and whitetip clover—705, with 1,085 additional plants of other species. Another set of 10 sods per species selected at random in stands of about average density showed the following numbers at maturity: foxtail fescue—2,020, with 432 of other species; soft chess—1,435, with 370 of other species; whitetip clover—347, with 150 of other species.

The sample sods each year showed wide range in number of plants per unit area.

Time required for the counts averaged 1¼ hours for each of the seedling plots and one hour for the mature plant sods. Because of the

Table 1. Density and number of plants per square foot on dense sample plots in the annual-type vegetation.

Dominant species	No. of plots	Plant density				No. of plants per square foot					
		Seedlings		Mature plants		Dominant species		Other plants		Total	
		2x2-ft. plots	.2x.2-ft. plots	2x2-ft. plots	.2x.2-ft. plots	Seedlings	Mature plants	Seedlings	Mature plants	Seedlings	Mature plants
Foxtail fescue	10	40	60	60	74	15,625	7,435	332	395	15,957	7,830
Soft chess	9	46	58	58	77	8,638	5,075	438	525	9,076	5,600
Broadleaf filaree	10	45	76	53	77	1,210	1,002	1,032	1,002	2,242	2,004
Whitetip clover	4	37	55	55	79	6,650	381	2,462	231	9,112	612

variability in numbers of plants per sod and the time required to make the counts it was concluded that the count method of sampling resident annual vegetation as used here would likely be impractical where many plots are needed for a reliable sample. However, for certain studies in which exactness is desired the count method may prove highly satisfactory. It has been used occasionally in reseeding studies.

Seed Production

Annual plants usually produce an abundance of seed. Judging from the number of plants per unit area, no scarcity of seed existed on the ground in the areas where counts were made. Seed production insufficient for another year's crop under normal conditions is usually not a particular problem on annual-type ranges.

As an indication of the number of seed produced per unit area, counts were made of the seed production of broadleaf filaree. The seeds were counted on 26 plots of 4-foot radius distributed along a one-mile fence line separating a heavily grazed pasture from one moderately to lightly grazed over a 7-month period. An average of

537 broadleaf filaree seeds were produced per square foot in the heavily used pasture, and 683 in that moderately-to-lightly used. Four plots protected from grazing gave an average of 1,087 seeds, the number varying from 335 to 2,283. The forage density on all plots, grazed and ungrazed, averaged 33 percent with broadleaf filaree comprising 41 percent of the plant cover. On the four protected plots the plant density averaged 41 percent, and broadleaf filaree made up 51 percent of the cover.

Summary

Counts were made of individual plants of several species in the seedling stage and at maturity on sample plots in the California annual-type vegetation to learn more of the ecology of this plant cover and to test the practicability of this method of sampling changes in the vegetation. Measurements were also made of the number of seed produced by plants of broadleaf filaree.

Seedling numbers varied widely, being highest in foxtail fescue, a plant with small seedlings, with 20,875 per square foot in the densest stands. Approximately 50 percent of the seedlings in dense

stands die before reaching maturity and up to three-fourths of those remaining are stunted plants.

Because of the great variability in number of plants per unit area and the time required for making counts, this method of sampling annual and seasonal changes in the vegetation has limited application.

Seed production in the annual vegetation type is high under normal conditions of weather and grazing.

LITERATURE CITED

- BISWELL, H. H. 1955. Ecology of California grasslands. *Jour. of Range Mangt.* 9(1): 19-24.
- BURCHAM, L. T. 1955. Recent trends in range improvement on California foothill ranges. *Jour. Range Mangt.* 8: 121-125.
- HERVEY, D. F. 1949. Reaction of a California annual-plant community to fire. *Jour. of Range Mangt.* 2: 116-121.
- KADISH, AMRAM. 1955. Vegetation as related to soil type. Unpublished data.
- TALBOT, M. W., H. H. BISWELL AND A. L. HORMAY. 1939. Fluctuations in the annual vegetation of California. *Ecology* 20: 394-402.
- TALBOT, M. W. AND H. H. BISWELL. 1942. The forage crop and its management. In *The San Joaquin Expt. Range, Calif. Agr. Expt. Sta. Bull.* 663: 13-49.