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Variations in the Moisture Content of Several Fuel Size Components of Live and Dead Chamise

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ABSTRACT: Samples taken May 25, Sept. 2, and Dec. 8, 1964, indicated that leaves were the only fuel components of live chamise with appreciable seasonal moisture fluctuation. A close relationship in fuel moistures existed between like components from the different shrubs sampled. Dead chamise showed little or no variation due to fuel size or season of the year.

Chamise (Adenostoma fasciculatum H. and A.) is a fast-burning fuel and covers much of southern California brushland. It may make up as much as 70 percent of the chaparral in southern California (Leonard and Carlson 1957), and unlike other chaparral species, it often grows in extensive, nearly pure stands. Knowledge of its fuel characteristics is of vital importance to land managers and owners.

Fire behavior is influenced by a host of fuel characteristics—including moisture content. The moisture content of chamise reaches a peak in spring, but drops during the dormant period in summer (Firestop 1955; Olsen 1960). As moisture drops, the chamise becomes more susceptible to fire (Buck 1951). Olsen (1959, 1960) found that the moisture content of a green (living) fuel, such as chamise, is closely related to soil moisture. Olsen also concluded that short-term weather fluctuations had an appreciable effect on green-fuel moisture. This note reports a study of moisture content in different size classes of living and dead chamise fuel.

Sampling Moisture Content

The fuel was sampled on the North Mountain Experimental Forest, about 30 miles east of Riverside, California. The site lies on the lower extremities of a south-facing slope at an elevation of 3,400 feet. It is occupied with what Horton (1960) has described as pure chamise-chaparral type vegetation of light to medium density. Typical of hazardous fire areas in southern California, the site has been subject to repeated wildfires in the past.

A 200-foot-long sampling course was laid out along a contour so that all sampling plots would be at the same elevation. Center points for five plots were staked at 50-foot intervals along this course. Three large vigorous living chamise shrubs (one for each

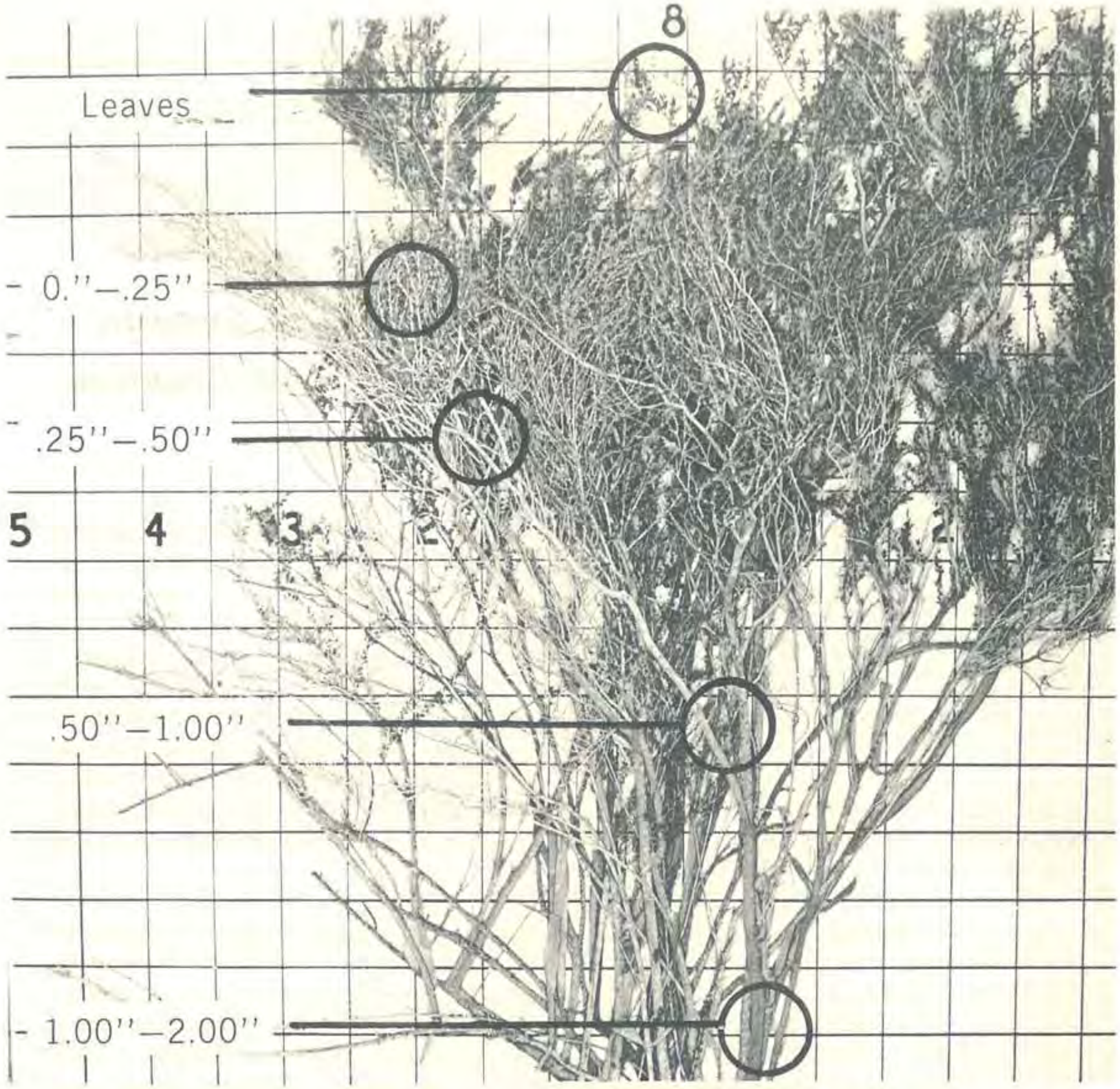

Figure 1.--Live chamise fuel components were sampled according to size.

study period) were selected as near as possible to each plot center. Three dead chamise shrubs were selected in the same manner. Each plant was tagged and coded for the study period in which it would be sampled.

Old and new-growth leaves were sampled three times during the 1964 season: May 25, September 2, and December 8. All sampling was done between 11 a.m. and 2 p.m. Other fuels were classified as follows (fig. 1):

- Twigs and branches: up to .25 inch in diameter
- Twigs and branches: .25 to .50 inch in diameter
- Twigs, branches, and stems: .50 to 1 inch in diamter
- Twigs, branches, and stems: 1 to 2 inches in diameter.

Each sample of fuel was collected simultaneously. We followed this procedure so as to minimize variations in moisture content due to diurnal fluctuations (Philpot 1964). Three 16-ounce plastic containers were filled with fuel samples from each component class. This provided 15 samples from each live and dead shrub, or a total of 150 samples for each of the three sampling periods. We made one exception to this procedure on May 25 when we included 15 additional samples of new-growth leaves. Fuel moisture content, on a dry weight basis, was determined by the solvent distillation method using xylene (Buck and Hughes 1939).

Environmental conditions were recorded during each sampling period (table 1).

Results

Leaves were the only component of living chamise fuel in this study that fluctuated appreciably in seasonal moisture content (fig. 2). Old-growth leaves sampled in spring (May 25, 1964) were high in moisture content, as expected for this time of the year. But by September 2, the foliage moisture content had dropped from 108 to 58.0 percent. The December 8 sample showed that moisture content in leaves had increased to 90 percent. New growth had a moisture content of 127

Table 1.--*Environmental conditions at study site, North Mountain Experimental Forest, May 25, September 2, and December 8, 1964*

Condition	Spring, May 25, 1964	Summer, Sept. 2, 1964	Fall, Dec. 8, 1964
Dry bulb temperature (°F.)	85	83	60
Wet bulb temperature (°F.)	[1]62	54	40
Relative humidity (percent)	27	11	9
Windspeed and direction[2]	SW 3	E 11	E 10
Fuel moisture sticks (percent)[3]	6.0	4.0	5.0
Sky condition	(4/)	(5/)	(5/)
Average soil moisture (percent dry weight basis)[6]	3.9	1.6	3.6
Brush burning index[7]	5	33	23
Fire ignition index[7]	63	89	78
Fire load index[7]	7	32	27

[1]Determined by use of sling psychrometer.

[2]Determined by use of Dwyer Wind Meter at 4-1/2 feet above ground.

[3]One-half-inch ponderosa pine dowels. Weights determined by Chisholm portable fuel moisture scales.

[4]Scattered clouds.

[5]Clear.

[6]Determined gravimetrically.

[7]California Wildland Fire Danger Rating System.

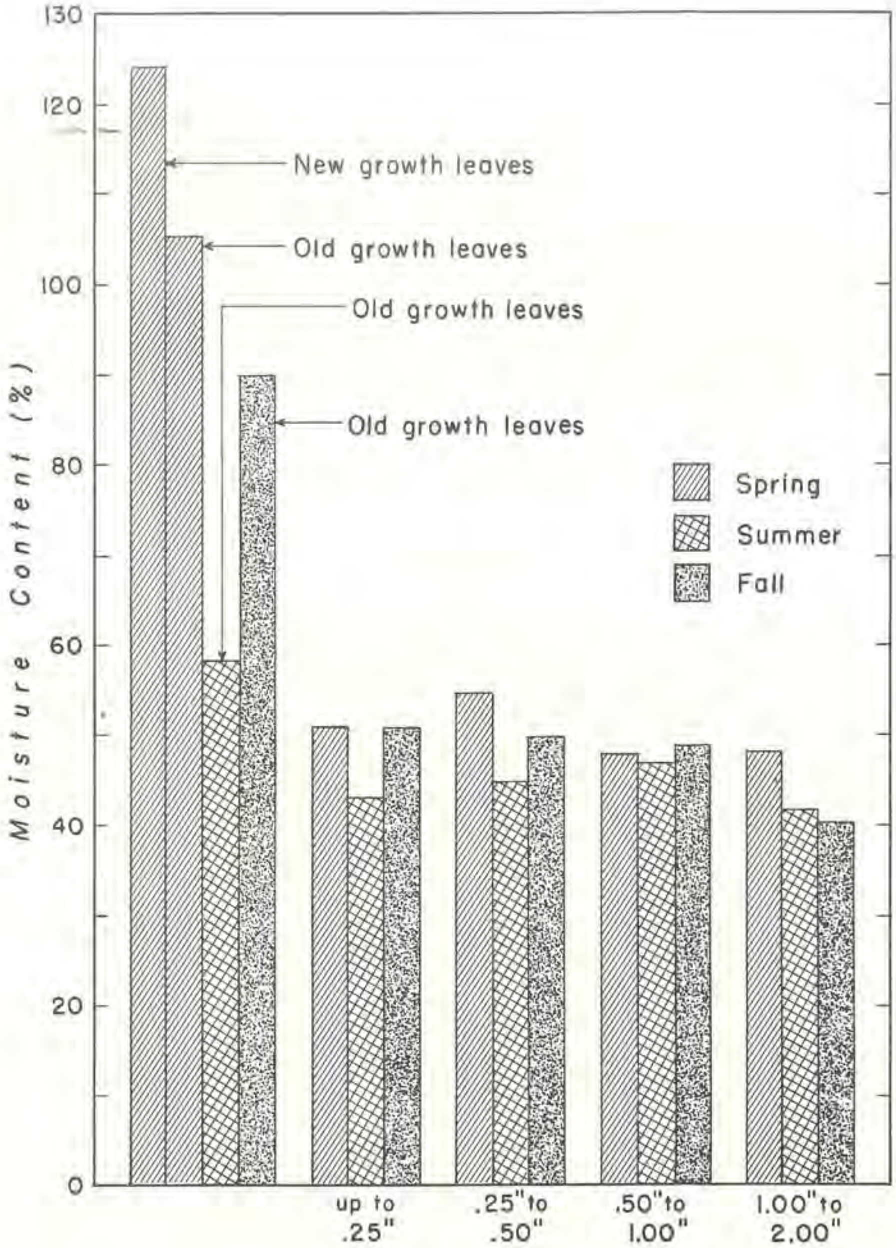

Figure 2.--The average moisture content of fuel size classes (live chamise), May 25, September 2, and December 8, 1964.

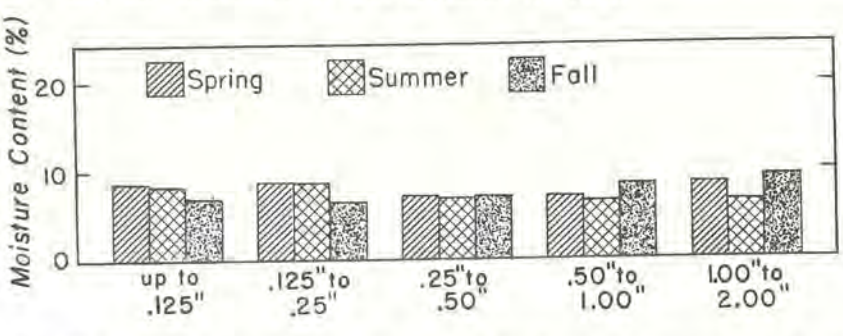

Figure 3.--The average moisture content of fuel size classes (dead chamise), May 25, September 2, and December 8, 1964.

percent in the spring and had made the transition to old growth by September 2.

Twigs, branches, and stems showed only minor seasonal changes in moisture content (fig. 2). The stem components sampled on May 25 had average moisture contents ranging from 44.3 to 56.1 percent, depending upon size class. Their moisture contents on September 2 showed only a slight drop, averaging from 42.9 to 47.1 percent (table 2). Values in this same general range were measured on December 8, 1964. There was only slight difference in moisture content between the various size classes, excluding foliage. And moisture content of different plants in the same general location was quite similar. Whether this similarity holds over a wider range of conditions needs to be determined.

The dead-fuel components show moisture content reflecting the weather conditions during the time of sampling. When the relative humidity was 27 percent in June, the moisture content of dead fuels ranged between 7.0 and 8.3 percent. In September, when relative humidity was 11 percent, dead fuels had a moisture content of 5.7 to 7.8 percent. And in December, when relative humidity was 9 percent, dead fuels had 6.3 to 8.9 percent moisture content.

Dead fuel moisture did not vary between size components under the weather conditions in this study (fig. 3). When these samples were taken, the temperatures and relative humidity had become somewhat stable and any differences in lag times shown by the components had been nullified. Such differences, however, would have shown up if the microclimatic conditions had been changing more rapidly as in the morning or evening.

Average soil moisture in the surface 2 feet dropped from 3.9 percent by weight in June to 1.6 percent in September. During this typically dry period there was little precipitation. By December 8,

Table 2.--*Average fuel moistures of live chamise shrubs sampled September 2, 1964*

Shrub no.	Old leaves	Up to .25 inch diam.	.25 inch-.50 inch diam.	.50 inch-1 inch diam.	1-2 inch diam.
	Percent				
1	59.2	44.4	48.9	45.8	47.9
2	59.2	19.7	39.9	41.8	37.6
3	62.1	51.6	45.5	45.8	45.6
4	58.3	47.6	44.7	51.5	46.8
5	51.2	51.1	45.5	50.6	38.0
Av.	58.0	42.9	44.9	47.1	43.2

the soil moisture had risen to 3.6 percent. It is estimated that more than 2.50 inches of precipitation fell between the September and December sampling periods.

Philpot (1963) reported that the moisture content of whiteleaf manzanita at 3,000 to 5,000 feet elevation in the central Sierra Nevada remained at its lowest moisture content during the winter months. The present study shows that chamise at a similar elevation gained moisture after rainfall in November. This difference probably means that chamise remains physiologically active at this elevation in winter in southern California.

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