Measuring Fireweed Utilization

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Highlight: Measurement of grazing use on forbs has not received as much attention as grasses. On the Willamette National Forest, forbs are major forage producers for the first 10 years after clearcutting and slash disposal. Studies on fireweed showed that a percent-height to percent-weight curve could be developed which was accurate and efficient to use. Utilization measurements, to be meaningful, however, must be correlated with resource use or protection.

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Forbs are the major forage-producing species on Willamette National Forest clearcut units. Fireweed in particular (*Epilobium angustifolium*) is utilized by sheep, deer and elk. (Ingram 1931; Young et al. 1942) To determine the forage use of this plant by these animals, a study was initiated on the Willamette National Forest to find an efficient and accurate method of measuring fireweed utilization which would provide the means of determining proper use of clearcut units.

Fireweed appears to have a life form very similar to that of a coniferous tree. As the volume and weight can be determined for trees, it seems logical that a method can be developed to measure utilization of fireweed. Also, the Forest Service has done considerable work in the past with utilization curves for sedge and grass.

TABLE 1
CLIPPING FIREWEED
FOR
HEIGHT-WEIGHT UTILIZATION CURVE

HEIGHT INCHES	STEM WEIGHT	LEAF WEIGHT
35"	7 Gr.	10 Gr.
28"		9 Gr.
24"	6 Gr.	8 Gr.
20"	5 Gr.	7 Gr.
16"	4 Gr.	5 Gr.
12"	3 Gr.	3 Gr.
8"	2 Gr.	1 Gr.
4"	1 Gr.	0

STEM % WEIGHT	% HEIGHT	LEAF WEIGHT
	100%	100%
	80%	90%
86%	69%	80%
71%	57%	70%
57%	46%	50%
43%	34%	30%
29%	23%	10%
14%	11%	0%

Preliminary samples were taken in 1975 to determine height, weight, and width relationships (NAS-NRC 89, 1962). Three life forms were found: one similar to a conifer tree; another also similar to a conifer tree but with four or five tops; and the third a contorted dwarf-like form caused by a worm or insect. Fortunately, the latter two forms are in the minority and will have very little effect on judging utilization.

Other items examined were the relationships between leaf-width and weight; leaf-width and plant height; and total height in relation to total weight. Of all these, the best correlation and highest "*R*-square" value was percent-height relative to percent-weight.

Methods

Ten plants of various heights provide an adequate sample for construction of a percent-height/weight curve. The procedure is easily done and consists of the following steps:

(1) The fireweed plant is clipped at a 1-inch stubble height;
(2) The plant is then cut at 4-inch intervals. (Table 1)
(3) With a one-gram scale, each 4-inch sample of stems and leaves is weighed separately. The plants are best weighed on-site in a wind-protected area to prevent moisture-weight loss (especially in the leaves) and to provide accurate readings on the scale.

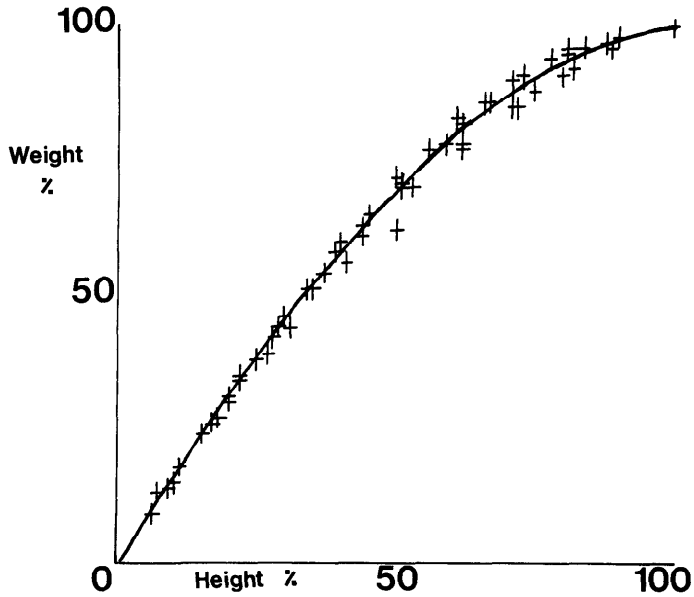

Fig. 1. *Relationship between percent-weight and percent-height removed.*

(4) Air-dry weight is determined from the separated samples of leaves and stems from at least five plants. This method of keeping the leaves and stems in separate containers proves more accurate than use of the total plant because of the loss of brittle leaves.

The 1976 data indicate air-dry weight to be 32%; or 68% of the plant is water.

To plot the data, a computer is used with the ability to plot regression curves, with the percent-height on the X-axis and corresponding percent-weight on the Y-axis (FIG. 1). The data are plotted separately for the stems and leaves.

As the curves are to be used with the percent-height on the Y-axis and percent-weight on the X-axis, the graph must be revised. This is done by placing percent-weight on the bottom (X-axis) and changing 100% to 0 and 0 to 100%. The percent-height is shifted to the vertical (Y-axis) without changing the figures.

Field Application

Once the curves are constructed, field application is compara-

Table 2. Record of utilization of 100 fireweed plants, 5 from each of 20 plots. Measurements for ungrazed plants are circled.

Plot number	1		2		3		4		5	
	Ht	% LVS	Ht	% LVS	Ht	% LVS	Ht	% LVS	Ht	% LVS
1	16	0	21	40	14	0	14	0	9	10
2	16	50	5	10	15	60	12	10	15	0
3	8	0	10	90	10	40	17	30	11	30
4	17	10	11	20	8	20	11	10	8	20
5	28	30	31	20	20	0	31	15	33	50
6	22	70	17	5	16	10	13	10	15	95
7	8	0	24	15	16	10	14	0	7	10
8	8	10	9	50	8	70	10	90	13	10
9	10	0	10	0	8	0	6	0	8	10
10	15	10	8	0	19	5	16	5	26	5
11	15	60	9	60	20	40	19	40	8	70
12	14	70	14	90	20	10	24	40	9	20
13	15	20	(18)	0	12	20	20	60	6	0
14	16	60	14	95	13	30	20	10	25	25
15	43	70	19	80	(16)	0	(28)	10	17	0
16	13	5	17	5	14	0	23	0	19	0
17	13	90	12	90	12	20	13	30	24	90
18	22	5	24	10	18	0	33	5	23	0
19	21	90	16	50	11	20	12	10	10	10
20	(24)	0	(12)	0	(20)	0	13	10	25	0
Total		LVS = 26% Avg. Stubble Height = 15.95								

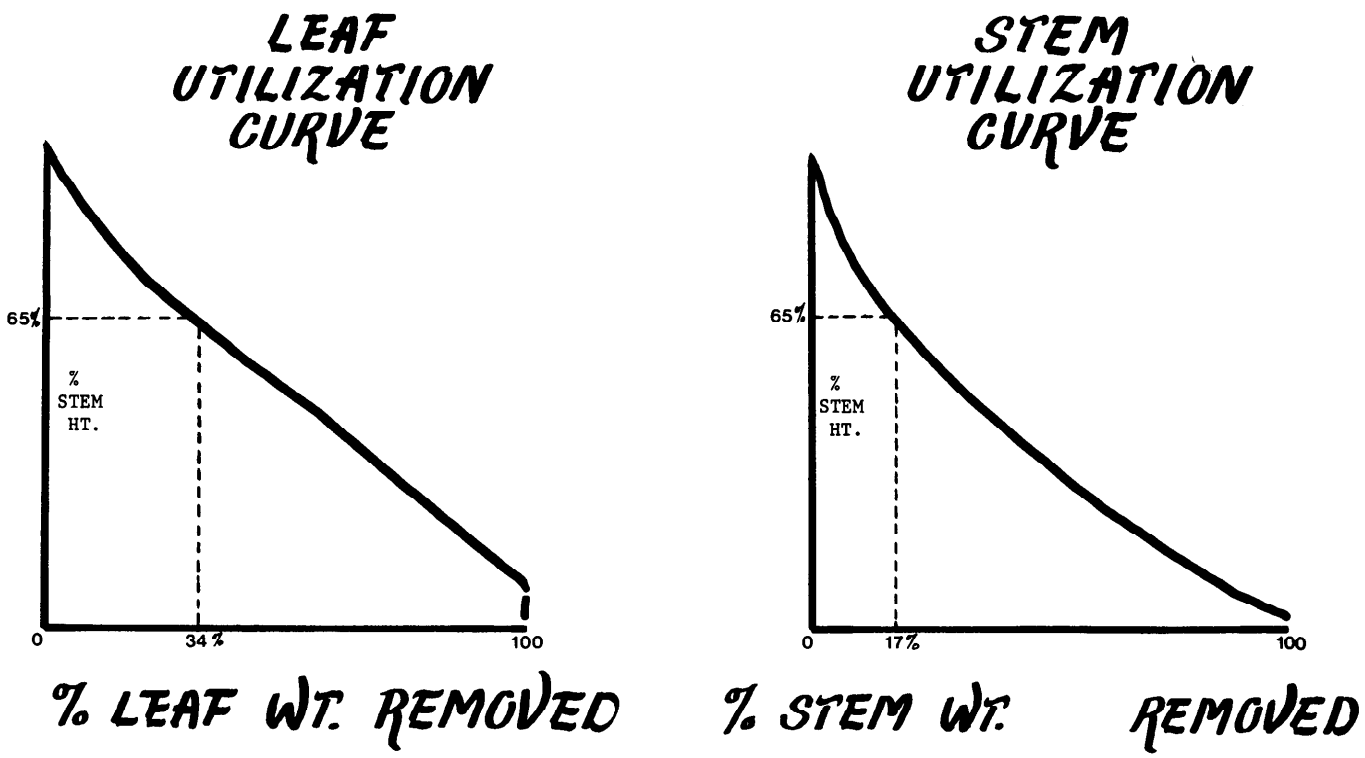

Fig. 2. *Determining weight removed from remaining height = Leaf = 34% - Stem = 17%.*

tively simple. On the Willamette National Forest, measurements will be made to determine wildlife use before domestic livestock (in this case, sheep) enter a unit and again after the sheep leave the clearcuts. The resulting data will be used to correlate wildlife and domestic utilization with proper resource use. Of course, this method will only be used to measure utilization on those clearcut units where fireweed occurs in adequate numbers. If there are fewer than five fireweed plants per 1/250th-acre sample plot, it is not representative, nor are samples taken from large areas where fireweed does not grow, such as grasslands.

The total height is measured and entered for five plants closest to the center point on each of 20 plots per clearcut unit. Circling the height of the plants indicates the plant has been ungrazed (TABLE 2). If the plant has been grazed, the percentage of leaves removed must be shown, even if the stem has not been grazed. This is used to determine the total percentage of leaves removed.

Once 100 plants have been measured, the average ungrazed height is determined. At times, where grazing is heavy, a cage will be required to preserve a sufficient number of plants ungrazed. (NOTE: If very little use of an area has been made, the grazed height possibly may still be higher than the ungrazed height because of the animals' preference for eating the tops of the tallest plants.)

The average height for the 100 plants, both grazed and ungrazed, is calculated next (TABLE 2). This average is divided by the average ungrazed height for the percent-height remaining. In cases where only leaves have been grazed, the average height of the 100 plants will be the same as the average height of the ungrazed plants.

Measurement of a grazed unit is as follows:

Average height of 100 plants (grazed + ungrazed) = 15.95 inches

Average ungrazed plant heights = 24.55 inches

The average height of the 100 plants sampled equals 65% of the ungrazed height:

15.95 ÷ 24.55 = 65%

A total leaf weight removed is determined by reading the leaf weight curve (Fig. 2), which equals 34% of the grazed leaf weight, and adding a weighted figure based on the estimated 26% of leaf weight removed. The 26% figure was determined by adding the percentage of leaves utilized and dividing by 100.

(Table 2) 2600 ÷ 100 = LVS 26%

The weighted leaf weight removed is calculated by subtracting 34% from 100%, which equals 66%. This figure (66%) is then multiplied by the amount of leaf removed (26%) to give the weighted leaf weight removed (17%).

26% × 66% = 17%

By adding 34% to 17%, a figure of 51% of leaf weight utilized is arrived at:

34% + 17% = 51%

Stem weight utilized is determined by going from the 65% remaining height to the curve and reading 17% of weight removed (Fig. 2).

During the period of utilization of fireweed, the leaves average 52% of the total plant weight and stems average 48%; thus, to complete the computation, these must be multiplied by their respective "utilized" percentages.

Leaves: 51% × 52% = 26%

Stems: 17% × 48% = 8%

The true utilization is approximately 26 plus 8, or 34%. Higher utilization of leaves than stems follows that found by Young et al. (1942), where 62% of the leaves and 23% of the stem were utilized by sheep.

Discussion

As stated before, the transitory range is "clearcuts" and the land allocation is "commercial forest land." The quality management objectives for grazing must meet the land use objective, which is to maintain a commercial forest community with its attendant flora and fauna composition and numbers.

A major consideration to be stressed is that determining percentage utilization of fireweed is not an end in itself. First, fireweed must meet the definition of "key forage species." In other words, it must be a "perennial forage plant with above-average palatability to the grazing animal, fairly abundant, having at least moderate ability to withstand grazing and injury, and a plant which must be retained to insure maximum forage production on a

sustained-yield bases." (Hall 1965) Second, at what percentage utilization of this plant do animals cause significant damage to non-target plants such as Douglas-fir trees? Third, at what point do domestic livestock compete with lifelife for the available forage?

Utilization measurements on fireweed must be taken before browsing of fireweed stops. Preliminary data indicate this occurs some time in the first 2 weeks in September, correlating with reduction in leaf moisture. In mid-August, leaf weight was 57% of the total weight. In the first week of September it was 48%; and by the first week of October, 37%. This moisture regime was also indicated by sheep use on other forests, where these animals did not browse significantly on fireweed after the middle of September. Measurements of deer utilization indicate they also turned away from the older, more mature fireweed about this time; but on very recent clearcut units, they still grazed on young green plants. Seed dissemination was the visual key to cessation of grazing.

Additional investigations into fireweed were initiated at the same time. Some studies will continue; others may prove to be a "blind alley." One such test estimated the pounds of fireweed per-acre, based on average-height-to-average-weight, multiplied by the average number of plants per-acre. When it came to an application of this method to obtain the measurements necessary, it would have required 140 plots (at the 5% level) of the three sizes tested (9.6 sq. ft.; 1/500th and 1/250th of an acre). This number of plots would be an inefficient use of both available dollars and man-power.

Preliminary data indicate a reliable estimation of plant weight from leaf width. As inches are not precise enough, leaf-width must be measured in centimeters, and the study must include at what height on the plant this leaf-width measurement gives the most reliable data.

Another part of the program in investigation of fireweed utilization is to correlate fireweed growth with the percentage of soil moisture. The Willamette Forest has soils with a high clay content. If these areas are used by domestic livestock at a time of high moisture content, compaction can result. This lowers site productivity, both for forage and for growing trees.

Studies indicate that when fireweed is used for more than 50%, its vigor declines (Ingram 1931). We have initiated clipping studies to see if it is 50% of weight or 50% of height.

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