

with a few small patches of white fir (*Abies concolor*). The volume per acre was approximately 15,000 board feet. The stand was characteristically open, occupied sites III and IV, and was mature to overmature in age.

The principal plant species found in the understory are given in the following table:

Table 1.—Principal forage species on the Burgess Spring Experimental Range

Perennials		% use ¹
Grasses		
1.	<i>Festuca idahoensis</i>	45
2.	<i>Sitanion hystrix</i>	45
3.	<i>Carex rosea</i> (a sedge)	55
4.	<i>Stipa occidentalis</i>	20
5.	<i>Stipa elmeri</i>	20
6.	<i>Poa sandbergii</i>	50
Forbs		
1.	<i>Wyethia mollis</i>	5
2.	<i>Senecio lugens</i>	5
3.	<i>Viola purpurea</i>	5
4.	<i>Balsamorhiza sagittata</i>	25
5.	<i>Crepis acuminata</i>	35
Shrubs		
1.	<i>Artemisia tridentata</i>	0
2.	<i>Purshia tridentata</i>	90
3.	<i>Ceanothus prostratus</i>	5
4.	<i>Chrysothamnus bloomeri</i>	5
5.	<i>Cercocarpus ledifolius</i>	5
Annuals		
		% use
1.	<i>Collinsia torreyi</i>	0
2.	<i>Phlox gracilis</i>	0
3.	<i>Gayophytum humile</i>	10
4.	<i>Polygonum imbricatum</i>	5
5.	<i>Cryptantha affinis</i>	0

A. L. HORMAY: The effect of logging on forage:—The question has been raised as to whether or not disturbance of vegetation and soil following logging is affecting the forage cover on the ponderosa and Jeffrey pine lands of northeastern California (Modoc, Lassen and Plumas Counties) sufficiently to require adjustments in livestock numbers.

Cutting of the virgin timber in this section of the State is progressing rapidly. Approximately 1,011,000 out of an estimated 3,700,000 acres have been logged to date. On the basis of cutting in 1936 the remaining virgin stand will be cut over in 40 years. What changes in forage are to be expected from this cutting are only roughly approximated at present.

From general field observations it appears that grazing capacity is reduced for a year or two following logging and then rapidly builds up and surpasses the capacity of the virgin timber forage. As tree reproduction reoccupies the ground the grazing capacity reaches a maximum and then slowly takes a downward trend. The shape of this curve and the time of occurrence of inflections in it are of interest to silviculturists and are needed by grazing men for the proper maintenance of the range.

Two years' work at the Burgess Spring Experimental Range near Halls Flat in Lassen County has aided in a better analysis of this problem and in determining the vulnerable points in it. A brief description of conditions at Burgess Spring should help in understanding some of the results obtained.

At the time of cutting in 1936 the timber stand consisted largely of Jeffrey and ponderosa pine (*Pinus jeffreyi*, *P. ponderosa*)

This area was logged with tractors and arches. The trees were dragged out in tree lengths to landings along the logging railroad where they were bucked into logs and transported to the mill. The slash and debris were left in place on the ground and were protected from fire by a system of fire lanes and by observation from lookouts.

An indication of the amount and character of ground and forage disturbances created by logging on certain plots is given in table 2. Counts and areal measurements of the vegetation the year before and the year following logging were made on 50-1.65 × 6.66-foot quadrats which were arranged in a systematic grid over each 2½ × 5-chain plot.

Table 2.—Forage and ground disturbance created by logging

Plot :	Skidded	Debris covered	Total disturbance	Reduction in forage ²
1 :	20	26	46	17
2 :	16	25	41	21
3 :	12	31	43	33
4 :	17	41	58	24
5 :	12	14	26	11
6 :	3	3	16	Trace
Av. :	14	24	38	19

Table 2 shows that more than one-third of the area on the plots was disturbed by logging. Fourteen percent was skidded relatively free of vegetation, litter, and logging debris while 24 percent was covered by slash.

¹ Utilization by cattle, a relative indicator of forage value.

² Immediately following logging. An indication of grazable forage was obtained by taking the sum of the products of the weight and palatability of each species.

This amount of disturbance reduced the grazable forage on the ground by about 19 percent at the time of logging. In other words, this 19 percent represents the forage actually skidded out or covered up by logging and does not account for the possible increase in growth or volume of the remaining forage — even the first year following cutting — from decreased competition with the trees removed and from a general change in environmental conditions.

A certain amount of this response in increased growth no doubt was present at the time of the second examination of the quadrats. However, the magnitude of its effect was not measured in this preliminary effort.

Careful measurements each year of the weight of forage produced and of the influence of climate will have to be made before actual changes in grazing capacity can be approximated. This is made difficult by the fact that the forage on the quadrats cannot be disturbed by clipping and weighing. Weights of each species have to be obtained off the plots and applied to the quadrats.

Changes in forage value depend not only on the amount of logging disturbance but also on the species composition of the forage. A cover consisting of a high percentage of palatable plants may suffer a greater reduction of forage values than one containing a smaller amount of such species. The lack of a stronger correlation between total disturbance and reduction in forage in table 2 may be partly due to this factor.

There is also some indication that certain plant species are more susceptible to destruction and removal by logging than others. Figures show that only 13 percent of the perennial grasses survived on 47 quadrats which were completely skidded over. A greater amount of perennial herbs such as *Senecio* and *Crepis* survived, namely 14 percent of the *Senecio* and 37 percent of the *Crepis*. Deep-rooted perennials such as *Wyethia* and *Balsamorhiza* were even more resistant to injury. On 20 quadrats completely skidded, 66 percent of these plants resprouted. Thus the more palatable forbs and grasses on this area seemed to be removed most readily by logging.

This study is looking forward to the possibility of predicting probable changes in forage values in advance of logging if the kind of logging, the degree of cutting, and the composition of the forage be known.

The most formidable problems of technique are concerned with:

1. Measuring changes in the vegetation by (1) mapping to keep track of individual plants, and by (2) weighings to permit making comparisons of amounts.
2. Refinement in plant measurements that will allow differentiation between logging and climatic effects.

File 2

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