TECHNICAL BULLETIN 103 FEBRUARY 1968

Effects of Forest and Grazing Practices on Mixed Coniferous Forests of Northeastern Oregon

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Effects of Forest and Grazing Practices on Mixed Coniferous Forests of Northeastern Oregon

D. W. HEDRICK, J. A. YOUNG, J. A. B. MCARTHUR, and R. F. KENISTON

SUMMARY AND APPLICATION OF FINDINGS

Mixed coniferous forests make up about 10% of the total forest area in northeastern Oregon. Approximately 146,000 acres of this forest type are in private ownership in the foothill areas of the Wallowas and Blue Mountains. Studies at the Hall Ranch, part of the Eastern Oregon Experiment Station at Union, are applicable to a much larger acreage of foothill range in the 20-inch precipitation zone on ash soils, supporting a forest canopy of predominantly grand fir, Douglas-fir, western larch, and ponderosa pine.

Basic objectives of this study were threefold:

1. Clarify the relationship between the amounts of forest overstory and forage.

2. Compare forage production from logged and unlogged areas.

3. Determine ways of improving forage utilization in a mixed coniferous forest.

Research into the basic ecological relationships in this area revealed a high correlation between the amount of forage available for grazing animals and the density of the forest canopy. As the overstory cover increased, there was a marked reduction in the production of both herbaceous and browse forage. In addition, the quality of the forage decreased under more shade.

Logging on a haphazard and selective basis since 1870 has, in the absence of fire, hastened the succession of forest trees toward a grand fir dominance. A sanitation logging in 1960 was designed to remove diseased trees and encourage the establishment and growth of Douglas-fir and ponderosa pine. This cutting was both beneficial and detrimental to herbage production. There was a marked increase in forage where old openings were enlarged or new ones created, but some areas were taken out of production by heavy soil disturbance and slash accumulations. Forage improvement could have been aug-

mented after logging by seeding heavily disturbed areas to grasses and legumes. Native plants increased rapidly under moderate disturbance, but bare areas remained so for several years after logging.

Livestock management practices to improve patterns of forage use in these areas of relatively steep topography and dense timber fall into four main categories: (1) facilitating actions, (2) class of livestock, (3) methods to improve livestock distribution, and (4) proper season of use.

Facilitating actions included fencing, water development, and, most important, the integration of logging and grazing plans. Without the latter, much good forage resulting from timber removal would be lost or unavailable to livestock. Timber sale contracts must be written so that trails are left clear, cull logs are positioned properly, and slash or logging debris is removed. Suggestions for writing these requirements into a timber sale contract are included in the appendix.

Young animals were found to use these rough timbered areas most efficiently. A ranking to show different classes of cattle in declining order of suitability for these areas is as follows: Steers, replacement heifers, young cows with grazing experience in area as heifers, old cows without calves, and regular cows and calves.

Occasional riding to disperse concentrations of livestock and salting lightly grazed areas where good forage was available were helpful in reinforcing facilitating actions. Unless riding and salting are used as supplemental rather than primary factors, they have little effect on livestock use patterns in the mixed coniferous forest.

Proper season of use was found to be an important consideration in obtaining improved livestock distribution patterns and performance records. Early grazing can be accomplished without soil damage and is essential to harvest pinegrass and associated leguminous species before maturity and consequent loss in nutritive value. If adequate forage remains for late grazing, this can best be used by mature cows without their calves. In fact, early calf weaning with better grazing supplied from meadows and hay aftermath was found to be an essential livestock management practice on these kinds of timbered foothill ranges.

Preliminary results of a grazing experiment with yearling steers in the mixed coniferous forest indicated that with early grazing from mid-May to late August, gains averaged about 100 pounds per head and amounted to about 8 pounds per acre for the season. In addition, another 60 to 70 AUM's, or about two thirds the amount of steer grazing, was obtained by cows without calves which grazed in this same area in September and October. Over a five-year period an average of one AUM per 3 acres was procured at the same time that areas of non-use and very heavy use were reduced to acceptable levels in the grazing patterns.

INTRODUCTION

Private landowners interested in maximum production from forested ranges in northeastern Oregon recognize that only limited forage is available on densely timbered areas. Few, however, may realize that good forestry and range practices, if properly coordinated, are both compatible and complementary. Results of five years of work on this general subject are reported in this publication. The basic objectives were threefold: (1) Clarify the ecological relationships between forest overstory and forage, (2) compare forage production from logged and unlogged areas, and (3) determine ways of improving forage utilization in a mixed coniferous forest.[1]

These investigations were carried out on the Hall Ranch, part of the Eastern Oregon Experiment Station. The ranch is located in the foothills of the Wallowa Mountains on Catherine Creek, about 11 miles southeast of Union, Oregon. The elevation varies between 3,400 and 4,200 feet.

The ranch area of about 2,000 acres rests entirely on basalt and basaltic andesite, which are similar in origin to the Columbia River basalts. The soils of the mixed coniferous forest of the Hall Ranch area consist of well-drained, medium-textured Regosol soils developed from wind-deposited volcanic ash. The ash has been deposited in geologically recent times, probably as a result of volcanic activity in the high Cascade Mountains.

The bulk of precipitation on the Hall Ranch falls as rain and snow during the cold winter months. July and August are dry and warm, although infrequent showers occur. Lengthy weather records are not available for the Hall Ranch, but the annual precipitation of the ranch area is estimated at 16 to 20 inches on the basis of limited records and information from adjacent weather stations.

The mixed coniferous forest stands studied are highly disturbed, but they are thought to represent a rather narrow range of ecologic potential. Although the sites in question are located at low elevation in a predominantly Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco)[2]/ ponderosa pine (*Pinus ponderosa* Laws.) type, they are potentially a topoedaphic climax vegetation dominated by grand fir (*Abies grandis* (Dougl.) Lindl.) as a result of their physiographic position on north-facing slopes and their location on deep volcanic ash soils of high moisture retention and availability (Young, 1965).

The present vegetation of the mixed coniferous forest stands on the Hall Ranch consists of an overstory of predominantly grand fir, Douglas-fir, western larch (*Larix occidentalis* Nutt.), and a few

[1] A mixed coniferous forest is a grand fir/Douglas-fir/western larch forest in terms of the Society of American Foresters cover types.

[2] *Pseudotsuga taxifolia* (Poir) Britt.

ponderosa pines (Figure 1). The shrub layer is composed of two tall shrubs—ninebark (*Physocarpos malvaceus* (Greene) Kuntze) and oceanspray (*Holodiscus discolor* (Pursh.) Maxim.)—and three low shrubs—snowberry (*Symphoricarpos albus* (L.) Blake.), wood rose (*Rosa gymnocarpa* Nutt.), and huckleberry (*Vaccinium membranaceum*) Dougl.). The understory is dominated by pinegrass (*Calamagrostis rubescens* Buckl.), elk sedge (*Carex geyeri* Boott.), blue wild rye (*Elymus glaucus* Buckl.), Cusick's vetch (*Lathyrus nevadensis* ssp. *cusickii* (Wats.) C. L. Hitchc.), green lupine (*Lupinus polyphyllus* Lindl.), and meadow rue (*Thalictrum fendleri* Engelm.).

RESEARCH PROCEDURE

Field information was obtained by delineating stands of the mixed coniferous forest on aerial photographs and sampling them with randomly located circular macroplots, 1/100 of an acre in area.

One macroplot was allotted to every 2 to 6 acres of area, depending on the variation found within the stand. Three densities of overstory were sampled by species on the macroplots. Tree cover was ocularly estimated, and the number of stems and their diameter at breast height was recorded.

One 4.8-square-foot circular microplot was located randomly in each quarter of a macroplot. Projected herbage cover and herbage weight in grams were estimated by species for each plot. One randomly selected microplot in each macroplot was clipped as a check on estimates. The clipped material was placed in a forage dryer for 24 hours at a temperature of 170° F, and air-dry weights were obtained.

On microplots which contained rooted shrubs, the following procedure was used: (1) The shrubs were cut at ground level and the total weight was determined, and (2) current annual growth was clipped from the shrubs and both green and dry weights were taken.

Overstory crown cover immediately above the microplots was recorded in three classes: (1) open, 0 to 20% cover; (2) moderate shade, 21 to 40% cover; and (3) heavy shade, 41 to 100% cover.

The macroplots and microplots were established and first sampled in 1963. Additional microplots were located and readings taken in 1964. All microplot sampling was done when pinegrass heads began to emerge from the boot.

Correlation coefficients indicative of relationships among 26 species and other variables encountered in sampling were computed. This simple correlation matrix was used as a guide in determining possible significant relationships to analyze in more detail.

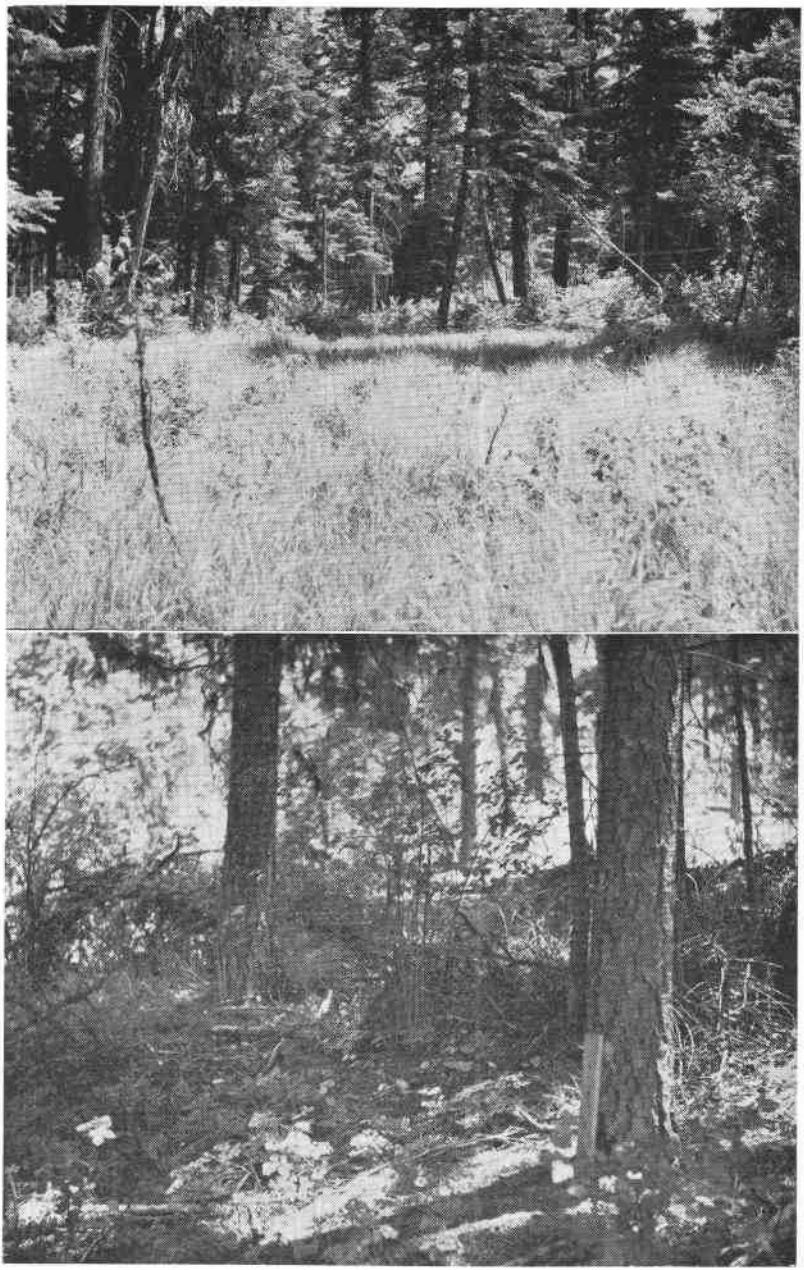

Figure 1. Examples of variation in the overstory and understory of the mixed coniferous forest on the Hall Ranch. The top photo was taken in an opening which has a heavy stand of herbaceous species. The second picture shows the dearth of herbaceous species in the dense shade.

BASIC ECOLOGICAL RELATIONSHIPS

The degree of overstory crown closure in the mixed coniferous forest is closely related to conifer reproduction, shrub cover and production, and the composition and production of herbaceous vegetation (Young *et al.* 1967a).

Relation of tree overstory and conifer reproduction

The relationship of overstory crown closure to conifer reproduction is very striking in the mixed coniferous forest. Ponderosa pine reproduction is restricted to the more open overstory cover areas. Douglas-fir reproduction is most abundant under a moderately dense overstory. Grand fir reproduction tends to be dominant under all degrees of undisturbed crown cover, and is virtually the only coniferous reproduction found under dense stands. If this type of vegetation is allowed to remain unmanaged, grand fir will play an increasingly dominating role in the structure of the overstory as plant succession proceeds.

Relation of overstory cover and the shrub layer

The mixed coniferous forest generally has a well-developed shrub layer. The development of this layer is related definitely to tree cover, but even under the heaviest overstory canopy a few shrubs persist to invade any chance openings. Figure 2 illustrates the relationship between overstory and shrub cover in the mixed coniferous forest.

Wood rose, snowberry, and huckleberry, low shrubs which grow in association with herbaceous vegetation, are found predominantly in low-density crown cover areas. The tall shrubs, ninebark and oceanspray, are concentrated beneath the margins of openings in the tree canopy and dominate the subordinate herbaceous vegetation. Ninebark rootstocks rapidly invade disturbed areas under open canopies in the mixed coniferous forest.

The relation of shrub production to overstory crown cover is illustrated in Figure 3. The concentration of tall shrubs at the margins of openings produces highest total shrub production under the middle overstory cover classes. The peak in current annual growth occurs before the peak in shrub weight in relation to overstory crown cover.

Shrub production (both total and current annual growth) in the mixed coniferous forest in relation to the shade classes is presented in Table 1. Mean shrub weight per acre was estimated at 8,000 $\pm$ 1,750 pounds and mean current annual growth was estimated at 85 $\pm$ 10 pounds, both at the 95% confidence level. Approximately 100 pounds of woody material were present for each pound of current annual twig growth on shrubs in the mixed coniferous forest.

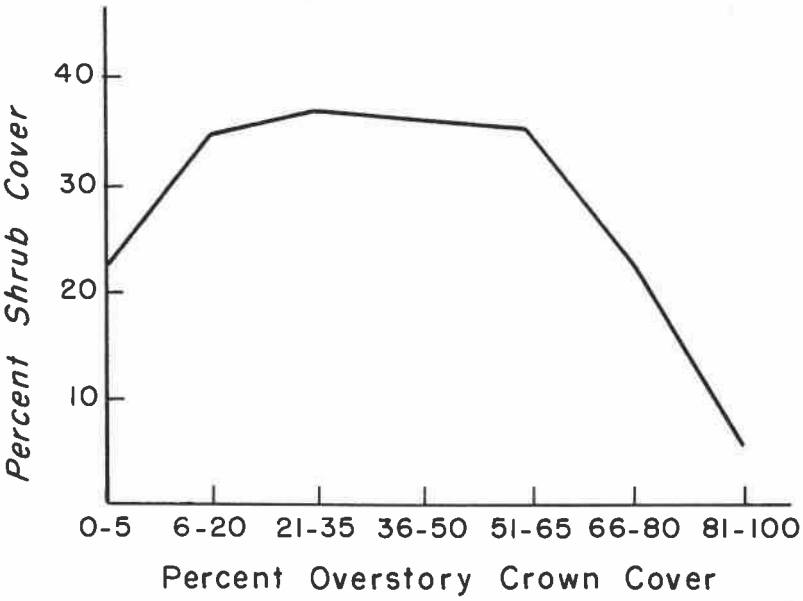

Figure 2. Relationship between tree overstory and shrub crown cover in the mixed coniferous forest.

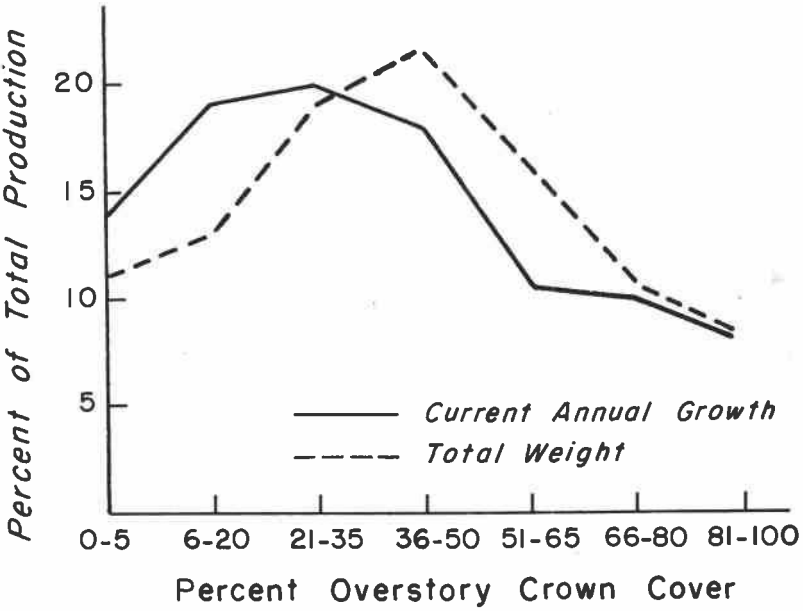

Figure 3. Relationship of current annual growth and total weight of shrubs to overstory crown cover in the mixed coniferous forest.

Table 1. Shrub Production in the Mixed Coniferous Forest in Relation to Shade Classes

Shrub production	Shade classes			
	Open	Moderate shade	Heavy shade	Mean[2]
	Lbs./A[1]	*Lbs./A*	*Lbs./A*	*Lbs./A*
Total shrub weight	16,900 ± 1,600	12,500 ± 3,100	5,700 ± 1,800	8,000 ± 1,750
Current annual growth	75 ± 19	140 ± 41	60 ± 24	85 ± 10

[1] Mean weights followed by the standard error calculated for a 95% confidence level.
[2] Based on average of all macroplots.

Table 2. Simple Correlation Coefficients and Coefficients of Determination of the Forest Overstory Variables With Herbage Cover and Yield

Forest overstory	Herbage cover		Herbage yield	
	r	R	r	R
Crown cover	−.410**[1]	.168	−.503**	.253
Basal area	−.253**	.064	−.319**	.102
Stems per plot	−.293**	.086	−.307**	.094

[1] Double asterisk (**) means significant at the 99% level.

Relation of overstory cover and the herbaceous layer

Simple correlations of mixed coniferous forest overstory variables with herbage cover and yield are presented in Table 2. There is a highly significant negative relationship between tree crown cover and both herbage cover and yield. There also is a highly significant negative relationship between both basal area and stems per plot and herbage cover and yield, but the coefficients of determination of these relationships are lower than for overstory cover and herbage cover and yield. Overstory crown cover accounts for more of the variability in herbage production than either tree basal area or stems per plot.

The yield of herbaceous species of the mixed conifer forest in relation to overstory shade classes is shown in Table 3. Open canopy areas produce significantly more herbage than the other classes, but they compose only 20% of the mixed coniferous forest. Moderate shade areas are intermediate in herbage production and occupy 30% of the total forest area. The heavy shade areas have a much lower herbage production and compose 50% of the total forest area. When production of the three shade classes is weighted in relation to the area covered by each, all contribute about equally to total herbage production.

Table 3. Pounds per Acre of Herbage in Relation to Overstory Cover in the Mixed Coniferous Forest

Species	Overstory cover classes[1]			
	Open	Moderate shade	Heavy shade	Weighted mean[2]
Calamagrostis rubescens	190	140	20	90
Elymus glaucus	30	10	T	10
Carex Geyeri	30	10	T	10
Lathyrus nevadensis	20	20	T	10
Thalictrum Fendleri	10	10	T	T
Lupinus polyphyllus	20	T	T	T
Spiraea lucida	T	T	T	T
Festuca occidentalis	T	T	T	T
Fragaria cuneifolia	T	T	T	T
Vicia americana	T	T	.....	T
Astragalus spp.	T	T	.....	T
Hieracium albiflorum	T	T	.....	T
Bromus marginatus	T	.....	.....	T
Frasera speciosa	T	.....	.....	T
Aster conspicuus	T	.....	.....	T
Castilleja Cusickii	T	.....	.....	T
Pedicularis racemosa	T	.....	.....	T
Achillea lanulosa	T	.....	.....	T
Arnica cordifolia	T	10	10	10
Melica bulbosa	T	T	10	T
Trifolium microcephalum	.....	T	T	T
Pteridium aquilinum	.....	T	T	T
Osmorhiza purpurea	.....	T	T	T
Carex Rossii	.....	T	T	T
Linnaea borealis	.....	.....	T	T
Viola adunca	.....	.....	T	T
Anemone Piperi	.....	.....	T	T
Smilacina stellata	.....	.....	T	T
Adenocaulon bicolor	.....	.....	T	T
Goodyera oblongifolia	.....	.....	T	T
Mean[3]	310 ± 30	210 ± 10	85 ± 30	170 ± 20
Percent of all plots	20	30	50	

[1] T represents less than 10 pounds herbage yield per acre.
[2] Weighted on the basis of the portion of the total forest area contributed by each shade class.
[3] Mean with standard error calculated for the 95% confidence level.

INFLUENCE OF LOGGING ON HERBAGE AND BROWSE PRODUCTION

Land use history

The Hall Ranch area has been subject to haphazard logging and post cutting since the 1870's (Hug, 1961). Past logging has played an important role in shaping the present vegetation of the mixed conifer forest. Daubenmire (1961) pointed out that valuable lumber species are seral (tend to be replaced by more tolerant trees) and when they are cut an understory of slow-growing climax trees is released to develop. This type of logging (leaving the less valuable trees), combined with the exclusion of general fire, has served to hasten the course of succession and encourage grand fir dominance of the mixed coniferous forest.

In the portions of this forest on the Hall Ranch where there has been no recent logging, the species composition of the old-growth overstory differs significantly from the composition of the conifer regeneration. The regeneration is sparse except in openings, but runs more heavily to grand fir and Douglas-fir than the overstory.

Logging plan design and sampling procedure

A 1960 sanitation logging was designed to remove diseased trees and encourage the regeneration of seral species. Trees were marked for cutting to remove: (1) 100% of the grand fir 16 inches diameter at breast height (dbh) or larger, (2) 70% of the larch and Douglas-fir 16 inches dbh or over, and (3) 50% of the old-growth ponderosa pine. In addition, smaller trees which were seriously infected with disease, infested by insects, or badly deformed were marked for cutting.

The sale area covered 215 acres, of which 120 acres were classified as mixed coniferous forest. A series of similar mixed coniferous stands located adjacent to the sale area on the Hall Ranch served as an unlogged comparison.

A system of macro- and microplots similar to that already described was employed to compare the logged and unlogged mixed coniferous stands. This was the same system reported by Young and others (1967) for sampling in the mixed coniferous forest.

Each microplot was rated according to the amount of soil disturbance caused by logging. The rating was based on the appearance of the surface soil and the vegetation present three and four years after logging. The classes were as follows: (1) No soil disturbance evident, absence of herbaceous species representative of early successional (low seral) stages; (2) surface soil disturbance evident, presence of a few low seral herbaceous species; and (3) soil disturbance severe enough to expose undifferentiated volcanic ash, dominance of low seral species.

The percent of each microplot occupied by logs and woody debris that did not provide a rooting medium for herbaceous plants was estimated.

Thirty-one macroplots were established in the logged stands and thirty-three in the unlogged stands. The macroplots were established in 1963, three years after logging, and the microplot sampling was carried out both in 1963 and 1964.

The abundance of disturbed areas in the logged stands made precise sampling difficult. To clarify the comparison of herbage production in logged and unlogged stands, but still reduce the variation encountered in sampling, plots free from understory disturbance were selected. These plots were stratified on the basis of overstory cover following the method developed by Young (1965) for sampling in this variable canopy forest type.

Forty, 9.6-square-foot plots were clipped in each of the following crown cover classes: (1) openings, 0 to 20% crown cover; (2) intermediate shade, 21 to 40% crown cover; and (3) heavy shade, 41 to 100% crown cover. The herbage from four contiguous plots was composited, resulting in ten determinations for each crown cover class for the logged and unlogged stands.

The plots were clipped in late June of 1964. This is before the peak of herbage production, but at the period when pinegrass is most highly preferred by cattle. The samples clipped from the selected plots were analyzed for percent crude protein according to the standard procedures described by the Association of Official Agricultural Chemists (1955).

Comparisons of logged and unlogged areas

The sanitation logging of mixed coniferous forest stands was both beneficial and detrimental to herbage production. Herbage production was greatly increased where old openings in the canopy were enlarged or new ones created, but some areas were taken out of production by heavy soil disturbance and slash accumulations. Average herbage production from all microplots was similar in both logged and unlogged stands. However, the variability was much greater in the logged areas.

Herbage and crude protein yields from selected plots in the logged and unlogged mixed coniferous forest stands are presented in Table 4. On the basis of this sampling there was a striking increase in herbage production in the undisturbed understory areas where the overstory was removed or thinned by logging. Selection of plots eliminated the negative effect of bare skid roads and nonproductive slash accumulations on herbage production. The increased herbage production within shade classes after logging probably is a reflection of increased lateral light transmission and the effects of thinning in releasing the under-

Table 4. Herbage and Crude Protein Yields by Three Shade Classes From Selected Logged and Unlogged Plots in the Mixed Coniferous Forest

Species	Air-dry yield[1]					
	Opening		Inter. shade		Heavy shade	
	Herbage	Crude protein	Herbage	Crude protein	Herbage	Crude protein
Unlogged	*Lbs./A*	*Lbs./A*	*Lbs./A*	*Lbs./A*	*Lbs./A*	*Lbs./A*
Calamagrostis rubescens	260	26	130	14	60	6
Other species	270	36	140	19	30	3
Total	530 ± 40	62 ± 17	270 ± 30	33 ± 6	90 ± 10	9 ± 16
Logged						
Calamagrostis rubescens	380	36	190	20	70	7
Other species	310	39	120	17	50	5
Total	690 ± 60	75 ± 28	310 ± 40	37 ± 11	120 ± 10	12 ± 5
Percent increase	33	20	13	12	25	35

[1] Mean with standard error calculated for the 95% confidence level.

story in logged stands. Open spots tend to be larger after logging than before and thus are subject to less lateral shading. Unlogged stands have a multi-layered canopy, while the old-growth layer has largely been removed in the logged stands. A lower increase in herbaceous production from logged areas in the intermediate shade class probably is a reflection of the competition shrubs give herbaceous vegetation beneath the margins of openings in the forest canopy.

The percentage increase in crude protein production from logging was less than for herbage production since the percent of protein in the forage was slightly lower in some logged stands.

Influence of soil disturbance on herbage yields

Data in Table 5 illustrate the relationship between herbage yield and soil disturbance caused by logging. Sixty-one percent of the logged area showed no evidence of soil disturbance. Twenty-four percent of the area showed evidence of surface soil disturbance. Herbage production of these areas was significantly higher than on the undisturbed areas. The differences in production probably resulted from the following: (1) Soil disturbance is associated with areas where the overstory canopy was removed or thinned by logging and (2) pinegrass appears to respond favorably to moderate amounts of soil disturbance.

Table 5. Herbage Yield in Relation to the Extent of Soil Disturbance Caused by Logging in the Mixed Coniferous Forest

Soil disturbance class	Percent of area	Herbage production[1]
	%	*Lbs./A*
No disturbance	61	240 ± 30
Surface disturbance	24	320 ± 40
Subsoil disturbance	15	80 ± 20

[1] Mean with standard error calculated for the 95% confidence level.

In contrast, 15% of the logged area received heavy soil disturbance and produced only one third as much herbage as the undisturbed areas.

The very slow revegetation of heavily disturbed areas by native vegetation is an important management factor in the mixed coniferous forest. Three years after logging, the vegetation of these areas consisted predominantly of bull thistle (*Cirsium lanceolatum* (L) Scop.) and annual hairgrass (*Deschampsia danthoniodes* (Trin.) Munro). The bull thistle is of slight forage value and apparently attracts rodents, which may then damage tree seedlings. Herbage cover on heavily disturbed areas was estimated at only 20% three years after logging. These open areas are easily invaded by Canadian thistle (*Cirsium arvense* Scop.), which is a serious problem. Some highly successful forage grass seedings have been observed on exposed soil areas in the logged mixed coniferous forest adjacent to the Hall Ranch. Garrison (1960) advocated the practice of seeding forage grasses on areas denuded by logging to provide immediate desirable cover rather than risking an increase in low value species.

On the basis of the random sampling it was estimated that 17% of the area of the logged stands was occupied by logs, slash, and other woody debris. In comparison, only 4% of the unlogged stands was occupied by logs and woody debris. The logger left many cull grand fir logs in the woods. These logs were limbed, but they occupied a considerable area and were a serious obstruction to grazing animals. Slash was piled and burned along roads. The burned spots were successfully seeded to introduced forage species.

Shrub cover and production in logged and unlogged mixed coniferous forest stands is compared in Table 6. Logging definitely released the shrubs of the mixed coniferous forest. Shrub cover and current annual shrub growth was higher in the logged stands, but total shrub weight was considerably lower. The low total weight in relation to current annual growth in the logged stands is a reflection of typical shrub crown sprouting in areas disturbed by logging. The creeping rootstocks of ninebark rapidly invaded disturbed areas and sent up a considerable number of sprouts.

Table 6. Comparison of Shrub Cover and Production in Logged and Unlogged Mixed Coniferous Forest Stands Four Years After Logging[1]

Shrub characteristics	Logged	Unlogged
Mean shrub cover (%)	31 ± 4	20 ± 6
Mean shrub weight (*Lbs./acre*)	4,100 ± 800	6,900 ± 1,800
Mean shrub current annual growth (*Lbs./acre*)	190 ± 40	70 ± 20

[1] Mean with standard error calculated for the 95% confidence level.

The increase in shrub production following logging in the mixed coniferous forest is illustrated by data in Table 7. These figures for current annual growth production of shrubs were obtained from experiments conducted in a cattle exclosure in the logged area of the Hall Ranch for 1960 before logging, and for 1962 through 1965 after logging. The tall shrubs, ninebark and oceanspray, significantly increased in production following logging.

Table 7. Current Annual Growth of Shrubs in a Cattle Exclosure in the Mixed Coniferous Forest for 1960 and 1962-1965

Species	Current annual growth				
	1960[1]	1962	1963	1964	1965
	Lbs./A	*Lbs./A*	*Lbs./A*	*Lbs./A*	*Lbs./A*
Physocarpos malvaceus	....[2]	60	70	90	108
Holodiscus discolor	6	4	10	20	7
Rosa gymnocarpa	....	2	5	5	....
Symphoricarpos albus	4	7	5	5	5
Vaccinium membranaceum	7	5	10	10	24
Total	....	78	100	130	180

[1] Data from R. L. Walton: *The seasonal yield and nutrient content of native forage species in relation to their synecology.* M.S. thesis, Oregon State University, Corvallis, 1962.
[2] No data available.

FORAGE UTILIZATION IN A MIXED CONIFEROUS FOREST

The Hall Ranch serves as summer range for the cattle herd of the Eastern Oregon Experiment Station. Each summer about 150 cows and calves and 35 replacement heifers are grazed there. The cows and calves are run on the ranch from about June 15 to September 15, when the calves are weaned. The dry cows remain on the Hall Ranch until the first snowfall, which usually occurs between November 15 and December 1.

The Hall Ranch has been grazed by cattle, horses, and sheep since the late 1800's. A range inventory on an ecological basis was undertaken in 1956 and has been followed by an active range improvement and management program. The improvement program consisted of such facilitating actions as fencing, water developments, and stock trails, which made it possible to develop a management program. The management program defers the grazing use on one half of the ranch each year until after seed is produced by the dominant forage species.

Utilization of herbaceous vegetation has been recorded in each mixed coniferous forest stand near the end of the grazing season since 1962. Use estimates were made using a five-class system. This system is based on a comparison between the degree of utilization on the abundant and less preferred pinegrass and the relatively scarce but highly preferred elk sedge. The utilization classes are as follows:

No use. No use evident and little or no evidence of cattle having used the area.

Light use. Less than 50% of the preferred elk sedge utilized.

Moderate use. Approximately 50% utilization of preferred species.

Heavy use. More than 50% utilization of preferred species, but uneven use on other species, especially pinegrass.

Very heavy use. Even use on all species greater than 50%.

Use classes were obtained on the same macroplots which had been established in the mixed coniferous forest of the Hall Ranch for estimating the relation of overstory cover to herbage production (Young, 1965). Other estimates were made in each of these stands on the Hall Ranch, and an average overstory cover for each stand was derived from macroplot sampling.

This system of estimating utilization is used to obtain management data on the entire Hall Ranch. Data covering the period 1962 through 1966 are shown in Table 8.

Table 8. Percent of Total Range Area of Hall Ranch in Various Utilization Classes and Percent of Total Use Obtained From Mixed Coniferous Forest

Utilization	1962	1963	1964	1965	1966	Mean
Class						
Nonuse (%)	7	1	1	4	7	4
Light (%)	22	18	14	3	9	13
Moderate (%)	29	36	47	39	37	38
Heavy (%)	39	19	29	54	37	35
Very heavy (%)	3	26	9	0	10	10
Total AUM's on ranch	1,058	760	811	936	704	854
AUM's from mixed coniferous forest	145	142	167	170	144	154
Total from mixed coniferous forest (%)	14	19	21	18	21	19

Influence of overstory cover on utilization

The relationship of forage utilization to mean stand overstory crown cover in the mixed coniferous forest is shown in Figure 4 (Young, *et al.* 1967b). A more precise graphic description of this relationship is illustrated in Figure 5, where forage utilization estimates are related to mean macroplot overstory cover. In both figures, it is apparent that it is more difficult to obtain moderate or heavy utilization under dense overstory canopies than it is under low-density canopies. Conversely, open areas are more subject to overuse than heavily timbered areas. Ellison and Houston (1958) comment that an appreciation of this relationship is the key to understanding timbered rangeland utilization by livestock and has application to the development of sound condition and trend standards for these range lands.

Livestock management practices to improve utilization

The favorable changes in the degree of livestock utilization in the mixed coniferous forest stands of the Hall Ranch shown in Figures 3 and 4 and Table 8 were a result of the following factors: (1) facilitating actions, (2) class of livestock grazed, (3) management methods to improve livestock distribution, and (4) proper season of use.

Facilitating actions. The upland portion of the Hall Ranch was cross-fenced in 1962. After analyzing utilization patterns from the 1962 grazing season, a drift fence was added to help hold cattle in the mixed coniferous forest areas. An ambitious program of water development was undertaken on these forested areas of the Hall Ranch in 1963. The aim of the program was to reduce the distance from stock water to less than one-quarter of a mile on all portions of the ranch.

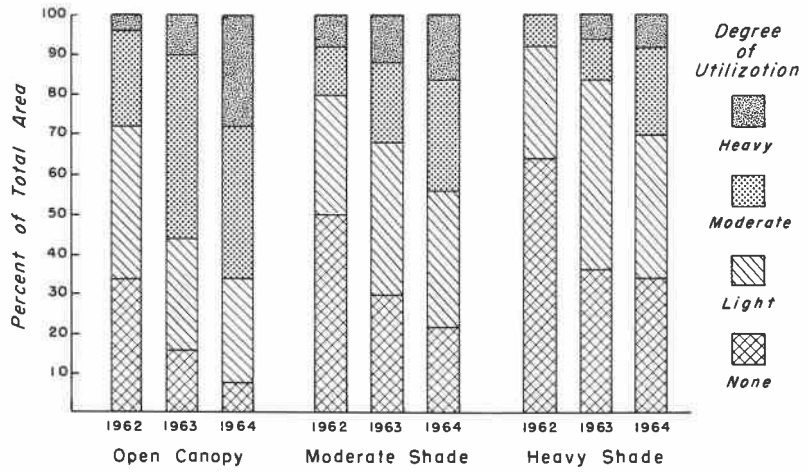

Figure 4. Relation of overstory shade to forage utilization estimates throughout the mixed coniferous forest on the Hall Ranch.

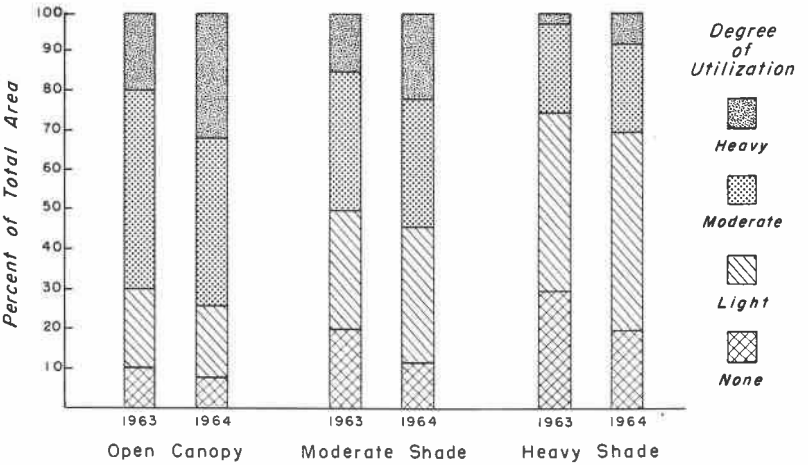

Figure 5. Relation of overstory shade to forage utilization on study plots in the mixed coniferous forest.

To improve the accessibility of water developments, old logging roads were cleared of down logs and slash piles. All these facilitating actions were necessary to obtain reasonable utilization of the forage resource of the mixed coniferous forest.

Class of livestock. It was observed in 1962 that yearling heifers would voluntarily graze in the mixed coniferous forest, while it was impossible to keep cows and calves in these areas. The cow herd was

separated on the basis of age in 1963, and it was observed that first- and second-calf cows would use densely timbered areas where older cows would not graze. This was especially true of first-calf cows who grazed the timbered areas the previous season as bred yearling heifers. By separating the grazing animals on the basis of age, utilization of the forage resource of the mixed coniferous forest areas of the Hall Ranch was greatly improved.

Livestock distribution. The use of good management methods in placing salting stations and riding to prevent concentrations of animals in more open areas has been necessary to obtain better utilization of the forage resource of the mixed coniferous forest. Unless facilitating improvements are undertaken and young cows and calves are used, the salting and riding practices are relatively ineffective in obtaining improved utilization.

Proper season of use. The present management plan for the Hall Ranch defers one half of the upland area each year; this creates problems in obtaining utilization of mature pinegrass and in maintaining calf gains. Cattle do not prefer pinegrass and especially reject it after it is mature. Dry cows have been forced to utilize pinegrass forage on the Hall Ranch late in the fall after their calves were weaned and the cows were on a maintenance ration.

A logical time to graze the mixed coniferous forest areas of the Hall Ranch would be the early summer. High protein forbs are at peak production in mid-June and pinegrass is still immature. The highly preferred elk sedge should not be as susceptible to overutilization in the early summer, when it constitutes only a small fraction of the total green herbaceous vegetation. Research on the best season to use range lands dominated by pinegrass is currently being carried out on the Hall Ranch. The results of this research should provide useful information to improve utilization patterns in the mixed coniferous forest.

Cattle preference in relation to vegetation

Within the mixed coniferous forest there are several different types of vegetation which significantly influence utilization because of wide differences in livestock preference. The blue wild rye/green lupine assemblage found in the openings is preferred by cattle to the more abundant pinegrass/Cusick's vetch forage in the mixed coniferous forest of the Hall Ranch. Management to obtain proper utilization in these forest stands where the openings are dominated by blue wild rye and green lupine is much simpler than in stands where pinegrass dominates.

The presence of preferred leguminous forbs such as green lupine and Cusick's vetch greatly enhances livestock utilization of pinegrass-dominated vegetation in the mixed coniferous forest. These legumes

complete their reproductive cycles in early July and rapidly dry and wither, leaving the relatively unpreferred pinegrass to provide the bulk of the grazing for the remainder of the grazing season.

RECOMMENDATIONS FOR IMPROVING GRAZING VALUES

If land managers expect to maximize timber and forage returns from the mixed coniferous forest, they must coordinate logging plans with grazing management (see appendix). Experience in this study has shown that timber harvests are both detrimental and beneficial to forage production. Unless provisions are included in the cutting plan to minimize detrimental influences, the overall benefits may be largely offset by either covering up herbage or making it inaccessible to grazing animals.

Three steps important to land managers in arranging satisfactory timber sales from these sites are: (1) Provide for initial reduction in grazing the year of cutting and perhaps the first two years after logging, since the immediate effect of logging is to uproot or cover up existing forage; (2) remove down-timber to facilitate livestock accessibility; and (3) seed disturbed areas to forage species compatible with timber establishment and growth.

Where mixed coniferous forest stands occur intermingled with other types, it is unlikely that they can be fenced separately. However, it is important to base grazing management on the areas producing the greatest amount of usable forage. This means that many of these sites produce little grazing before logging, and no reduction in total use will be needed.

Logging can be used to facilitate livestock accessibility if these three rules are followed: (1) Leave all skid trails free of debris, (2) fell all cull trees not removed from the area up and down slope and buck into short lengths, and (3) dispose of all slash. Slash disposal is essential to keep the forage accessible to grazing animals and to maximize grazing value after the overstory canopy has been opened to encourage the growth of understory vegetation.

Seeding disturbed areas has been a regular practice in many forest stands to prevent erosion. Although losses are not high on ash-covered soils, seeding is needed to obtain a forage response under formerly dense overstory canopies or on highly disturbed areas such as skid trails and landings. It is important to seed after logging because unseeded bare areas have been observed to remain virtually devoid of plant cover for a long period. Few data are available to measure the competitive effect of different grasses on trees, but it is apparent that native bunchgrass species and short-lived improved plants are more suitable to use in these stands than many of the aggressive perennials such as orchardgrass and smooth brome. Timothy should be a good

introduced grass and blue wild rye appears to be the most promising native species for use in seeding these sites. Research is now under way to evaluate relative compatibility of several mixtures with tree establishment and growth. The objective of this study is to find species that will reduce competition of undesirable herbs and shrubs, minimize invasions of noxious weeds, and provide a maximum of forage compatible with satisfactory forest regeneration to prevent erosion.

Livestock management

Manipulation of livestock is the key to successful grazing in the mixed coniferous forests. Forage utilization is determined by livestock, so it is important to know the kind and age of livestock, ways of controlling their distribution, and proper season of use.

Since few sheep are used on the range in northeastern Oregon, all of the research on the Hall Ranch has been carried out with cattle. It has been observed that younger animals are more effective than cows and calves in grazing fairly dense forested areas. Replacement heifers or yearling steers are recommended to obtain the most uniform utilization patterns in these more remote and less accessible areas. On lodgepole pine-pinegrass range in British Columbia, McLean (1967) found that yearling steers gained an average of 1.75 pounds per day for 103 days per year over a five-year period. Experience has shown that if it is necessary to use cows and calves, it will pay to use young animals (first- or second-calf females) who used the same range earlier as replacement heifers.

Seasonal use is normally governed by range readiness, which involves both forage development and soil moisture. Since compaction by trampling is not a problem on most ash-type soils in the mixed coniferous forests of northeastern Oregon, grazing can normally be started as soon as the principal forage plant, e.g., pinegrass, is 6 to 8 inches in height. In fact, early grazing is preferred to make better use of the pinegrass which becomes less palatable later in the summer and also to utilize valuable leguminous forbs such as lupine and vetch which are dry and unavailable after mid-July. Rather than keeping cows and calves on this forage after mid-summer, it is better to wean early and graze the calves on aftermath following a second cutting of hay. This management practice is helpful to better calf and cow performance. Calves moved to crop aftermath continue to gain weight and cows freed of a suckling calf use forested ranges more effectively even after pinegrass is mature.

Managers responsible for grazing forested ranges recognize the difficulty in obtaining even use on these areas. Livestock naturally congregate in the openings and on other more accessible portions such as stream bottoms and along trails. Several years of experience in using tools to improve distributional patterns in forested range on the

Hall Ranch has emphasized the value of each when used alone and in combination with others. For example, fencing is an essential aid whenever two unlike areas are involved. However, unless water development is reasonably adequate, no benefit will be obtained by fencing off a lightly used area with the thought of grazing it separately. Similarly, riding and salting can be helpful in securing more uniform utilization of forested areas if these are accompanied by access trail and water development and fencing as primary practices for better use. Before intensive water development, limited fencing, clearing access trails, and a change in kind of livestock and season of use were attempted on a 500-acre mixed coniferous forest range on the Hall Ranch, 45 AUM's were estimated to be potential production from this large area. Since applying the foregoing recommendations in the early 1960's, an average of 150 AUM's has been taken from this same forested area during the past three years. This trebling of the potential grazing while still following good forest and livestock management, may be essential for the private owner to maintain a reasonable yearly income for an economical livestock operation on these lands. In fact, this increased forage crop may provide the private landowner the needed incentive to practice better forest management and thus more fully utilize the total natural resources under his control.

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APPENDIX

Provisions to be included in a timber sale contract to facilitate subsequent grazing on the logged-over area

The PURCHASER agrees:

1. To take only the marked trees and dead and down trees within the sale area. Marking will be by .....

2. To fell all marked cull trees, and all standing dead trees 8 inches or more in diameter and 15 or more feet in height. Felled trees and logs left on the ground will be aligned up-and-downhill and bucked to lengths not over 32 feet.

3. To log in such a manner as to protect the small trees and any trees not specifically designated for cutting.

4. To pile, for later burning, all logging slash, including tops and limbs (or portions of limbs) under 4 inches in diameter. Piles will be located in openings and far enough away from all live trees so that such trees will not be injured or scorched. In addition, piles should not be placed over stumps where the burning period would be unduly prolonged by fire continuing underground. Piles will have a maximum diameter or length of 6 feet. Tops or limbs longer than 6 feet will be cut into shorter lengths.

5. To limb all logs and tops left on the ground. Such logs and tops, as well as large limbs, will be placed so that they do not obstruct any road or trail or needlessly interfere with the movement of grazing animals. Where more than one piece is left in one place, the pieces will be bunched and placed parallel to each other, preferably aligned up-and-downhill.

6. To restore to their previous condition all fences, watering facilities, trails, and roads damaged by the operations of the purchaser.