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DIVISION OF BOTANY

A Study of Grazing Conditions in the Wenaha National Forest

by

H. T. DARLINGTON

BULLETIN NO. 122
May, 1915

All Bulletins of this Station sent free to citizens of the State on application to Director.

A Study of Grazing Conditions in the Wenaha National Forest

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H. T. DARLINGTON

Formerly Assistant Professor of Botany, State College of Washington

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GENERAL SUMMARY

The principal forage plants of the higher portions of the Wenaha National Forest are perennial in character, consisting principally of shrubs.

With the exception, possibly, of the tops of some ridges there seems to be no deterioration in the grazing areas. The tops of the ridges, forming a small part of the total grazing area, and being necessary highways for the sheep, may be considered negligible. This does not apply to the glades.

On account of snow, the range is limited to about five months grazing. This fact is a valuable element of strength, which will be permanent.

Lists of the relative distribution and abundance of the principal forage plants should be made from time to time, to indicate whether there is any undesirable plant succession going on.

The full carrying capacity of the range is not being utilized. A more complete utilization will require the construction of new trails.

So far as the regulation of the sheep industry and the enforcement of law and order are concerned, Government leasing to single individuals has been a marked success in the Wenaha National Forest.

GENERAL INTRODUCTION

The free range policy of the past has produced serious conditions in several of the Western states. It has led not only to bitter feuds at times between sheep men and cattle men, but in some cases to the depletion and serious damage to the range.

Belief, on the part of the early settlers, in the inexhaustibility of free ranges and the lack of any tendency to conserve them finally made government intervention and regulation a

necessity. It soon became apparent that especial efforts were necessary and desirable to conserve the range, or improve it, at the same time to preserve its utility to the fullest extent.

Working out of some method of improvement becomes advisable for many of the depleted areas. The majority of range investigations heretofore have been in the arid or semi-arid regions. These areas have lent themselves to the operations of the large stockmen better than the mountianous districts. Such large, seemingly waste tracts, particularly those of the Southwest, have been among the first to suffer. It is here that a vegetative covering holds its own by only a small margin against the adverse conditions of environment. (Where only a slight rainfall obtains the quick maturing grasses and drouth-resistant plants are the prevailing types). Where this balanced condition has been destroyed by man, a barren waste soon results. Later investigations, however, are taking account of those areas where vegetation has, naturally, less opportunity of holding its own.

The conservation and proper utilization of any particular range is affected by the location, climate, and altitude of the range as well as the breed and number of head grazed and the methods of herding. The influence of the leasing system and the effect of governmental control must be considered in the future in making comparative studies of grazing.

CONDITIONS IN THE WENAHA NATIONAL FOREST

This report is a description of the work accomplished by an expedition from the Department of Botany of the State College of Washington to the Blue Mountains for a period of six weeks, during the summer of 1913, for the purpose of determining the character and carrying capacity of the grazing areas centained in the Wenaha National Forest, situated in the southeastern part of Washington and the northeastern part of Oregon. An effort has been made to interpret the conditions found there in the light of modern investigations, and thus throw some light on what may be expected as to the future development and maintenance of the grazing areas contained therein.

The area examined is used as a summer range for a large number of sheep, which winter in the more or less open country between the mountains and the Snake River. Some of the more specific objects of the study were: (1) To determine the character of the areas grazed over; (2) to ascertain so far as possible in the given time, whether there has been either deterioration or improvement in the range; (3) to make lists of the plants eaten, and also those avoided by the

sheep; (4) to determine whether the full carrying capacity of the range is being utilized, and (5) to obtain information which might be of value to those who should have the future care of the range.

The party drove into the mountains by way of Pomeroy. Through the courtesy of Mr. R. A. Jackson, a large sheep owner of Washington, the party was afforded an opportunity to study certain bands of sheep in the upper reaches of the Tucanon River, one of the larger streams on the north side of the divide; and other bands between Butte Creek and Crooked Fork, streams on the south side, flowing into the Wenaha, or Little Salmon River. The party is indebted to Walter Jackson, who unofficially acted as guide over most of the trails leading to the more inaccessible portions of the mountains, and to his assistance in packing supplies and equipment. Mr. Andy Graden, Range Inspector of the Reserve, kindly loaned the party maps and furnished information in regard to trails. Mr. G. R. Kerns, a student of the State College, acted as assistant on the expedition.

The investigations commenced in the upper Tucanon Valley June 20th. On account of the wet weather this season, the bands were late in getting into the mountains. They are usually driven in between the middle of May and the middle of June, and are kept in the mountains about four months. During the fall their food is principally the wheat bunch grass (*Agropyron spicatum* Pursh) which is common in eastern Washington, being typical of the lower portion of the Arid Transition zone. In the early spring "silver top" (*Plantago purshii* R. & S) forms an important part of their food as well as several species of grasses. During the worst of the winter they are fed on alfalfa hay, thirty pounds to the head usually being sufficient to carry them through the winter. In apportioning range land for winter feed, about one and one-half acres is taken as a basis for calculations; i. e., a band of 2,500 should be allowed about six sections.

Mr. Jackson's sheep are in charge of French herders. One man, with the aid of two dogs, handles one band. The herders live in log houses on the open range during the winter, their headquarters during that time being rather permanent in character. In the mountains on the summer range, they live in tents, moving camp every week or ten days. The bands observed contained approximately 2,500 sheep each, about 1,000 of them being lambs and the rest ewes. The lambing period for mutton sheep begins about February 1; for fine wools, about March 1. Mr. Jackson makes a specialty of American Rambouillets.

GRAZING AREAS

In studying the grazing problem, it is necessary to know something of the physical features of the area grazed over. The Wenaha National Forest contains 1,237.5 square miles, 500 square miles being situated in the State of Washington, in Garfield, Asotin, and Columbia counties. This part of the Blue Mountain range extends in a general northeasterly and southwesterly direction, the outer portion consisting of rather low-lying foothills. The topography of the inner portion is quite rugged, consisting of high ridges with deep valleys between, accessible during only a few months of the year. This is where the sheep are summer-ranged. The narrow valleys between the low foothills, which were formerly used as ranges, are, in most cases, fairly well settled up with small ranches. A good deal of hay is grown on the lower, more level and open land, furnishing a large supply of winter feed. The higher valleys are wooded and so narrow as to make ranching, even on a small scale, impracticable.

Fairly good mountain roads are found in the lower valleys, but the interior portions of the mountains are reached only by pack horses, often over steep, rugged trails. Many of these trails have been built by pioneer sheep men at considerable labor and expense. They are maintained and kept open at present by the Government forest rangers, and almost invariably follow the tops of the ridges, forming the only practicable means of access to the region. There is no difficulty in driving sheep over the roughest of them, tho there may be trouble in getting pack horses over. The deep interior valleys are covered with a dense stand of timber near the bottoms, which usually thins out toward the tops of the ridges. Many of the latter are rocky and barren in places, affording only a slight growth of grasses. This alternation of deep valleys and high ridges, with variations of from 2000 to 3000 feet, naturally produces marked variations in the physical factors which influence the vegetative covering. The valleys, with their mountain streams and dense brush and timber, are always cool, even in summer. These small streams are usually bordered with a dense growth of underbrush; the banks of the streams are often steep and rocky, so that trail building along the bottoms of the valleys is unusual. The trails would be expensive to maintain as well as to build, on account of the fallen timber and luxuriant growth of shrubbery which would have to be removed from time to time. The valleys, however, are more equable in

their climate than the ridges. The latter become dry in summer and cold and wind-swept in the winter, giving the greatest extremes of temperature.

The highest points in the section of country visited are the East and West Oregon Buttes, the former reaching a height of 6500 feet above sea-level. In the vicinity of these buttes, snow lies well into the middle of summer, and several swift mountain streams rise in this vicinity, from watersheds sloping in nearly every direction, all eventually pouring their waters into the Snake River. From observations made by R. A. Jackson, extending over a period of twenty years, it is thot the rainfall in this section of the mountains will average 25 inches. By the middle of October, the range usually becomes snowbound, and the sheep must be taken out a week or more before this time, and put on the winter range until May. Light rains are of frequent occurrence during the summer months, so that the range is not subjected to those long periods of drouth which are characteristic of the open ranges of the Southwest. So far as the writer knows, no experiments have been made as to the depths to which the soil is wet by either the summer rains or the winter snows. Generally speaking, the soil on top of the ridges is of an open, more or less friable nature, adapted in every way to a rapid run-off. In places it is only a few inches deep, and supports only a few hardy plants, especially those forming rosettes. Several ridges, however, are timbered entirely to the top, where the soil accumulates more humus, and retains more moisture, so that a greater variation is found in the types of vegetation. The soil in the bottoms of the valleys is naturally more loamy, containing those elements which enable it, together with the greater moisture and more uniform temperature, to support a greater variety of plant life.

From what has been said, it is evident that the physical factors favor perennial forms of vegetation. The predominating species are, in fact, perennials. This is especially true of the lower, cooler slopes. The exposed places higher up, having greater extremes of temperature are better suited to annual types. It is fortunate that the range is inaccessible until late in the spring, since the young seedlings are then well rooted, and the ground has had some chance to stiffen up after the melting snows.

In general, three zones of vegetation may be recognized in the region examined, the lowest in altitude being what is usually termed the yellow pine zone. Above this come the Canadian and Hudsonian zones, these constituting most of the grazing areas for the sheep. There are no sharp limits to

these zones, which necessarily overlap each other. However, each is usually marked by more or less predominant species of plants. The conditions of the yellow pine or Transition zone are confined almost entirely to the lower valleys. The lower portions of such streams as Tucanon Creek, Touchet Creek, and of several streams flowing south into the Grande Ronde River fall into this zone. Yellow pine (*Pinus ponderosa* Dougl)., is the dominant type of tree. It is usually associated with Douglas fir (*Pseudotsuga mucronata* Raf.) and white fir (*Abies grandis* Lindl.), with scattering trees of Western Larch (*Larix occidentalis* Nutt.). There is conerable variation in the density of the stand of yellow pine, and in the amount of shrubbery present. As before stated, the lower, wider portions of the valleys have been settled for many years.

In the Canadian zone, which runs up to 5000 feet, the yellow pine almost disappears. Lodgepole pine, a form of *Pinus contorta* Dougl., was found to be common in certain sections of the zone, Douglas fir and white fir seem to be almost equally distributed. However, these trees are usually confined to the draws running down from the ridges and to north slopes. Englemann's spruce (*Picea engelmanni* Parry) is found occasionally in the deep, cool valleys. The south slopes are almost devoid of timber, but have small areas of bunch grass (*Agropyron spicatum* Pursh) and brome grass (*Bromus marginatus* Nees.) here and there. Several important shrubs are found here, which, together with the grasses, afford good grazing for the sheep. On account of the very rugged character of the country, with its extremes of altitude, exposure and temperature, the conditions of the two zones mentioned are strangely mixed. For instance, on hillsides with south exposures in the Canadian zone, especially where the soil is of a gravelly nature, it is not unusual to find a patch of yellow pine.

Still further in the interior of the ranges, the character of the country is somewhat different. Some of the principal higher ridges broaden out on top to form plateaus, designated locally as "glades." The predominant tree of this zone, the Hudsonian, becomes the Alpine fir (*Abies lasiocarpa* Hook.), tho Douglas fir is quite common. Mountain mahogany (*Cercocarpus ledifolius* Nutt.) and Rocky Mountain juniper (*Juniperus scopulorum* Sarg.) are found here on barren, rocky ridges, not appearing in the other zones. Tho there is some grass in this zone, by far the greater portion of the food of the sheep is "browse" from the shrubs which cover

a large portion of the steep hillsides. Trails are quite easily constructed thru the glades, as a usual thing; tho occasionally one encounters a dense stand of lodgepole pine, or a "burn." The glades contain a considerable amount of pasture land, but they necessarily form part of the highways for the sheep, and furnish pasturage for the pack horses, so that they are kept closely cropped. Being comparatively level, they afford good camping places, and corral grounds for counting and segregating the sheep. It is not unusual to find good springs of water in the glades; in fact, small patches of marshy ground, abounding with various sedges, are not uncommon in places.

The grazing area described above is controlled by the federal government and is leased to individual sheep owners under well known rules and restrictions.

THE CAMP AT TALLOW FLAT

It was decided to study first a band of sheep which was stationed at Tallow Flat, a point on the main ridge between Tucanon Creek and Little Tucanon, in section 36, Twp. 9 N., R. 40 E. This ridge is typical of all the lower ridges; therefore a description of conditions found there will be illustrative of most of the Canadian zone.

In all cases observed, the sheep were bedded on the tops of the ridges, the herding system being adopted. The Government, in cooperation with certain sheep owners in the Reserve, is making experiments in which the bedding out system is compared with the above-mentioned system. The herders show an unwillingness to adopt the bedding-out system, claiming that it is too hard work for both the man and the dogs. In the herding system the sheep leave the bedding ground in the morning and return again the evening, the time of leaving and returning depending somewhat on the state of the weather. In the vicinity of Tallow Flat, the top of the ridge broadens out from 200 to 300 yards in places. In other portions of the ridge close by, it narrows on top to only a few yards in width, with rocky, rather precipitous slopes in places. At this point, the faces or slopes of the ridge are about a mile in width, marked and furrowed with secondary ridges and valleys, forming watersheds to the streams above mentioned. The top of the ridge in places is timbered, and forms a good camping ground. Springs are found nearby in the timber, and such springs originating near the tops of the ridges are not uncommon. The flat portion of the ridge, which is almost destitute of any vegitation, is used as a bedding ground for the sheep. On the edge

of the timber close by, the herder has his camp. He thus has his sheep close enough at night to make them comparatively safe from the molestations of any wild animals. Cougars and bob-cats have occasionally given some trouble, but the dogs usually give the alarm. Such a bedding ground is used year after year. There is an advantage in this, since the sites chosen have natural advantages such as shelter for the tent, wood supply and water, besides trails, salt-troughs for salting the sheep, and other more or less permanent structures which the ingenuity of the herder may suggest. From this camp as a temporary headquarters, the herder grazes the sheep on both sides of the ridge, supposedly within the territory covered by the lease. The areas covered by the lease are usually bounded by creeks and ridges. Upon the camp mover, who packs in supplies and moves the camps from time to time, devolves the responsibility of keeping the band within leased territory.

PLANTS EATEN BY THE SHEEP

Two bands were studied for some time, one in the Canadian, and one in the Hudsonian zone. Notes on others were taken as occasion offered. A careful record was made of the plants eaten at each place. So far as most of the shrubby plants are concerned, the conditions were very similar in both cases. The exceptions will be noted later

The common shrubs growing on the hillsides which furnish the chief food of the sheep are: service-berry (*Amelanchier florida* Lindl.); Ninebark (*Opulaster pauciflorus* (T. & G.) Heller); ocean spray (*Holodiscus discolor* (Pursh) Maxin); mountain maple (*Acer douglasii* (Hook.) (Piper); Scouler willow (*Salix scouleriana Barratt*); wild cherry (*Prunus emarginata* (Dougl.) Walk.): and *Spiraea corymbosa* Raf. The sheep browse on the leaves and tender shoots of these shrubs. The relative abundance and distribution of these plants vary considerably. In general, they are more abundant in the small draws having a north or west exposure. This is especially true of the willows, maples, wild cherry and service-berry. Sheep are very fond of the leaves of service-berry, often standing on their hind legs to pull down the branches. Ninebark is abundant and much eaten. Spiraea and ocean spray are found on the drier situations. The leaves of these are drier and not liked as much as some of the other shrubs. However, the wild rose bush, which often grows in dry situations, produces tender leaves and shoots which are relished by the lambs, as well as the older sheep. The wax-berry bush (*Symphoricarpos racemosus* Michx.) is not usually

eaten during the summer, the leaves being tough and leathery. Neither the chokecherry (*Prunus demissa* (Nutt.) Dietr.) buckbrush (*Ceanothus sanguineus* Pursh); nor sticky laurel (*Ceanothus velutinus* Dougl.) were common at Tallow Flat camp. Where present, however, they were eaten with relish. The sheep are very fond of the younger, more succulent shoots of species of elder (*Sambucus glauca* Nutt.) and (*S. melanocarpa* Gray). The latter, the red-berried elder, is found commonly in the higher portions of the mountains. Whether this shrub will be able to persist when the young shoots are destroyed year after year is a point worth watching. A certain amount of wheat bunchgrass is usually found on the drier hillsides, but grass is scarce amongst the brush. Tufts of brome grass (*Bromus marginatus* Nees) and sheep fescue (*Festuca ovina* Hack.) are not common. Where bunchgrass and brome grass appear, they are stripped of their leaves by lambs, the flowering heads often being left untouched. Some of the common herbs are eaten more or less, but they form a comparatively unimportant part of the forage. Among those eaten are "wild parsnip" (*Pteryxia foeniculacea* Nutt); yarrow (*Achillea millefolium* var. *lanulosum* (Nutt.) Piper); painted cup (*Castilleja Sp.*); alum root (*Heuchera glabella T. & G.*); purple avens (*Sieversia ciliata* (Pursh) G. Don.); hawkweed (*Hieracium scouleri* Hook.) and (*Gilia aggregata* (Pursh) Spreng.). The "wild parsnip" is eaten wherever found, and seems to do no injury. The sheep eat the leaves of certain lupines, but avoid the yellow lupine (*Lupinus sulphureus* Dougl.). The plants mentioned above supplied practically all of the food in the vicinity of Tallow Flat, which may be taken as fairly representative of the lower portion of the range.

CAMP AT POVERTY FLAT

Three weeks later the party was located in the higher, interior portion of the range, about two miles south of the East Oregon Butte, between Butte Creek and Crooked Fork, the vegetative zone being the Hudsonian. Here another band was studied. As before stated, the tops of the ridges here often broaden out into plateaus of considerable extent, which are frequently timbered. These often border rather abruptly and sometimes precipitously on very deep valleys, which include a wide range of vegetation from top to bottom. In this zone sticky laurel becomes abundant and forms an important part of the forage. Besides most of the shrubs mentioned for the Canadian zone, the following were noted as forming a part of the food of the sheep; red osier dogwood

(*Cornus stolonifera* Michx.); mountain ash (*Pyrus setchensis* (Roem.) Piper); fly-honeysuckle (*Lonicera involucrata* Banks.), and various species of wild currant (*Ribes*). Some of the important herbs eaten here were: cinquefoil (*Drymocallis glandulosa* (Lindl.) Rydb.); wild rye grass (*Elymus triticoides* Buckl.); various species of sweet cicely (*Osmorhiza*), and brome grass. The latter is frequently abundant on old bedding grounds, though often smutted. Some of the older bedding grounds are covered with *Monolepis nuttalliana* (Roem & Schult.) Green, lamb's quarters (*Chenopodium album* L.), and other weeds of the same character.

"What the sheep eat depends largely on what they have to eat." Their favorite "browse" among the above mentioned shrubs are service-berry, ninebark and sticky laurel. Various species of Pentstemon, including *P. deustus* Dougl., *P. diffusus*, *P. fruticosus* (Pursh.) Green, and *P. attenuatus* Dougl. are exceedingly common in the Blue Mountains and form a larger part of the herbaceous vegetation in the higher parts, but so far as the writer observed, the sheep will not touch them. In addition, the following plants were generally avoided: The bracken fern (*Pteridium aquilinum* Underw.) the meadow rue (*Thalictrum occidentale* Gray), *Phacelia heterophylla* Pursh. and *Lupinus sulphureus* Dougl.

When feeding the older sheep scout ahead, and browse on the larger shrubs, while the lambs seem to eat nearly everything they can get: i. e., their forage seems to be more diversified. Grasses, however, form a larger proportion of their food than that of the older sheep.

There were no cases of poisoning so far as the writer knows in either of the bands during the time they were under observation. Special care was taken to observe whether the sheep ate larkspur (*Delphinium menziesii D C.*). The plant was frequently met with where the tops were nipped off. but no injury seemed to follow. Another band in the vicinity of the Oregon Buttes (not belonging to R. H. Jackson), reported several lambs lost by poisoning. The herders report that the lambs suffer the most frequently from poisoning, and that it occurs most along streams in the timber. The sheep are rarely watered.

From all observations, it is evident that the leaves of shrubs, or "browse," constitute the chief food of the sheep in the higher portions of the mountains.

ANNUAL AND PERENNIAL RANGES

In any discussions of those causes which may operate to maintain or improve the range under consideration, it is well

not only to consider rather carefully the character of the range, but to point out some of the essential differences between annual and perennial ranges. An annual range is one in which the predominating forage plants are annuals, or plants lasting but one year. Annuals usually produce an abundance of viable seed. Such ranges are characteristic of arid or semi-arid regions. Where perennial forage plants are the most abundant, the areas are known as perennial ranges. They are characteristic of those sections where rains are more or less frequent. Mountainous or timbered grazing areas as well as many of the northern grassy plains are of this character. In general they are more plastic and enduring than the annual type of range. Since the latter depends on the production of seed for its preservation, close cropping before the seeds mature means a destruction of a large part of the next generation, as well as the present. This may not always show on a virgin range, as there is a certain amount of ungerminated seed lying dormant. An annual range should therefore never be cropped too closely. A certain percentage of the plants should always be left, varying with the strength of the range. Injury due to close cropping is not so apparent in a perennial range as the principal forage plants persist by means of underground parts which live over winter and are the principal means of renewing the growth of the plants in the spring. On the other hand, annuals can take advantage of the seasons; their occupation of an area is often only temporary. In some cases, they may germinate, mature and seed in the short space of five or six weeks; such are the so-called summer annuals. Where they germinate in the fall, rest during the winter by forming rosettes, and mature the following spring, they are known as winter annuals.

To use a range intelligently, evidently something should be known of the life history of the principal forage plants. In the Wenaha National Forest, annuals form an unimportant part of the forage. The problems to be considered are those of a perennial range.

RANGE DETERIORATION

To work out a satisfactory scheme of range maintenance for any locality, it is necessary to understand some of the causes which have led to deterioration in some grazing sections. The primary cause has been overgrazing, but this may take several phases: 1. There may be too many animals to a given area. 2. The bands or herds may be kept too long in one place. 3. The grazing may be started too

early in the spring before the seedlings are sufficiently developed. 4. In the case of some annual ranges, proper allowance is not made for a poor, dry season, when the proportion of forage is below the normal. The free range has been particularly subject to overcrowding, because of the absence of any restrictions. The effects of overstocking are not at first apparent; they are cumulative. Again, the community grows; more settlers move in; part of the range is often farmed, leaving less to be grazed, and the roads and trails become continually more accessible. All of these have their effects. Where the bands or herds are kept too long in one place, they do damage not only by too close cropping, but often by injuring the physical character of the soil. Continual tramping on a clayey soil packs it so closely as to prevent plant growth. The effects of this are found around watering places. Gravelly soils, on the other hand, are sometimes loosened and furrowed by sheep bunching too closely.

Even when it is apparent that the carrying capacity of a range has been reduced by adverse climatic conditions, such as prolonged drouth in certain sections, it is sometimes found impossible to reduce the herds. Again, in certain range regions, it has been found that the more abundant raising of hay has been an indirect cause of the depletion of the free ranges, by increasing the number of stock that can be winterded over and fed on the summer range.

When close cropping is practiced, a selective process goes on, which eventually hastens deterioration. The best forage plant is that which is eaten most closely; this is the first to suffer. Weakened until it ceases to be the dominant forage species, a less valuable plant then takes its place and becomes the dominant type. The succession is often gradual and unnoticeable, but eventually a new plant society is established, and the dominant species are found to be worthless weeds. Some of our perennial ranges, of whose value and permanence we feel most assured, are deceptive in this respect. The principal forage plants of such ranges should be watched and lists of the more valuable plants checked up from time to time in regard to their relative quantities and distribution.

The grazing lands included within the Wenaha National Forest are fortunately free from the injuries common to many ranges. The character of the range and the comparatively late season at which it can be entered are in its favor. Overcrowding and overcropping in the ordinary sense are prevented by Government control. It is believed, however,

that a careful watch should be made of any tendency toward an undesirable plant succession.

CARRYING CAPACITY

The question as to how closely a range may be safely grazed is an important one. It will depend on the character of the range as well as the time of year. If an annual range is grazed before the important forage plants mature their seed, evidently it will not be safe to graze to the maximum capacity. If the same sort of range is grazed after the seeds have matured and dropped, fairly close grazing will not injure it, altho the nutritive value of annuals at this period is low, and even in the case of the perennials the plants are less palatable than before the seeds mature. This applies particularly to some of the important forage grasses. Where the forage of a perennial range consists almost entirely of "browse" from shrubs, it is less likely to be injured than a perennial grass range. The highest utilization of the range within limits, having a proper regard for the future, is often designated its optimum caqacity. This is evidently less than the maximum capacity for any given year. The difference between the maximum and the optimum forms the reserve strength of the range, which must be guarded. The commonest mistake of sheep and cattle men is to put the optimum too high. Deterioration is rapid after the optimum is reached. This makes it highly desirable that careful experiments be made to determine the optimum in a given range. The optimum in an annual range is lower than that of a perennial. The forage value of the annual is also less.

The grazing plants of the Wenaha National Forest, being mostly shrubby, suffer only from partial defoliation. This takes place during the summer and early fall, when the plants are in flower or fruit. Whether this partial defoliation year after year will sensibly weaken these plants, is a question. It seems impossible to determine this in a short time; so far as can be judged on the spot, there seems to be no evidence of it. If the sheep were allowed to browse on these shrubs during the early spring months, probably injury would result.

The only parts of the range which are denuded are the tops of the ridges. These have for years formed highways for the sheep in passing from one place to another. The total surface thus used forms a comparatively small portion of the total area. But taking the area observed as typical of the Blue Mountain section, it would seem that the range is not being utilized to its full carrying capacity. In the

bands studied the sheep pastured from one-third to one-half the distance down the side of the ridge. The remaining two-thirds or one-half the hillside is left ungrazed. This is due to the fact that the bedding grounds are on the tops of the ridges. The distance the sheep go down and return in a day represents the days feeding. The next day they are fed from another point of the ridge. Below the area of a day's feeding it would be hard to go from a bedding ground on top of the ridge, as the sheep are driven with difficulty over a previously grazed area. They resist the driving efforts of the dogs, bunch together and plant their feet in the ground in such a way as to plow furrows and even destroy shrubby vegetation. The only solution would seem to be to construct more trails lower down on the hillsides. This would mean some expense, but would probably be justified by the greater utilization of the range.

RANGE IMPROVEMENT

The principal cause leading to range investigation has been deterioration of the ranges. Various efforts have been made to restore depleted ranges to their original condition. These efforts have been directed along several lines, such as (1) fencing and resting the land during parts of one season or for parts of several seasons, (2) rotation of pastures, (3) reduction in the number of stock over a given area, and (4) reseeding with or without cultivation. In the range possessing little reserve strength. such as some of those of the arid regions, recovery is a serious question. In places, destruction has gone on so far that erosion has set in, due to the lack of any sustaining plant roots, or to the furrowing produced by the feet of grazing animals. Artificial reseeding on such large areas is probably not practicable at the present time. Careful experiments, however, have shown that it is possible, especially where the ground is cultivated. This of course should be done if the returns will justify the expense. The cheapest and most practicable way of restoring such ranges is to give them some form of rest. This always involves a number of economic problems, which should be made secondary to the main problem—the restoration of the range. The solution of the economic problems is often a matter of legislation. Where land is held in private ownership, it can be fenced; on public land some sort of range inspection seems necessary. In the stronger and more valuable perennial ranges, there is more chance of improvement. Reseeding is often advisable; new forage plants may be introduced with success The question naturally arises as to what extent a primitive range may be improved.

In the Wenaha National Forest. there is a large amount of open, untimbered land. As stated elsewhere, this is usually on the south and east slopes. In many places even the shrubby vegetation is sparse. Bunchgrass occupies some of these open spaces. In other places there is little vegetation of any kind. In some of these seemingly sterile places brome grass seems to grow readily. This is a fairly good forage grass: the sheep are fond of it. Whether this grass can be made to grow abundantly on these open areas is a question for the future to determine. In the moist valleys of the Canadian zone, and the open meadows of the Hudsonian. there seems to be no reason why timothy and redtop could not be introduced. Seed could be sown in the higher valleys and draws in autumn before the snow falls. Cultivation would probably not be practicable at present. except perhaps in some of the glades. on account of the inaccessibility and very rough nature of the country.

In closing. it may be said that the future of the Wenaha range is promising. Tho not so intensive, acre for acre, as a grass range, its shrubby nature gives it an element of stability which a purely grass range lacks. However. in the treatment of a grazing area. it is well to keep in mind the old adage. "An ounce of prevention is worth a pound of cure." In those parts of our country where the climate and rainfall are adapted to tilling the soil. only the roughest portions will eventually be left as grazing areas. This condition applies to the Wenaha National Forest.

BIPLJOGRAPHY

1. Beattie, R. Kent. Plants Used for Food by Sheep on the Mica Mountain Summer Range. Washington Agricultural Experiment Station. General Bulletin No. 113. 1913.

2.Bentley. H. L. Experiments in Range Improvements in Central Texas. Bur. Plant Indus. Bul. 13. 1902.

3. Blankenship, J. W. Range Improvement. Montana Experiment Sta. Rp., pp. 71-75. 1902.

4. Cotton, J. S. Range Management in the State of Washington; U. S. D. A.. Bur. Plant Indus. Bul. 75. 1905.

5. Cotton, J. S. The Improvement of Mountain Meadows; Bur. Plant Indus. Bul. 127. 1908.

6. Cotton, J. S. Range Management; U. S. D. A. Yearbook, pp. 225-238. 1906.

7. Davy, J. B. Stock Ranges of Northwestern California. Bur. Plant Indus. Bul. 12, 1902.

8. Forbes, R. H. Range Improvement and Administration. U. S. D. A. Exp. Sta. Bul. 115, pp. 85-86, 1901.

9. Griffiths, David. Forage Conditions and Problems in Eastern Washington, Eastern Oregon, Northeastern California and Northwestern Nevada; B. P. I. Bul. 38, 1903.

10. Griffiths, David. The Reseeding of Depleted Range and Native Pastures; U. S. D. A., B. P. I. Bul.117, 1907.

11. Kennedy, P. B. A Preliminary Report on the Summer Ranges of Western Nevada; Nev. Exp. Sta. Bul. 51, 1901.

12. Piper, C. V. Flora of Washington. Contributions from the National Herbarium. Vol. XI., 1906.

13. Sampson, A. W. Grazing Lands. Forest Service, Cir. 169, 1909.

14. Sampson, A. W. The Revegetation of Overgrazed Range Areas, Preliminary Report. Forest Service, Cir. 158, 1908.

15. Thornber, J. J. The Grazing Ranges of Arizona; Ariz. Ex. Sta. Bul. 65, 1910.

16. U. S. D. A., Forest Service. Revised Regulations and Instructions in Reference to Grazing.

17. Wooton, E. O. The Range Problem in New Mexico; N. Mex. Exp. Sta., Bul. 66, 1908.