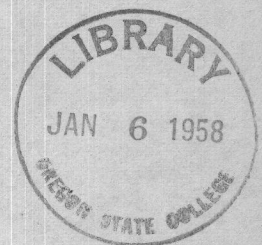


RANGE MANAGEMENT ON
THE NATIONAL FORESTS

SCHOOL OF FORESTRY
OREGON STATE COLLEGE
CORVALLIS, OREGON



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OBJECTIVE

When the early settlers and pioneers crossed the Mississippi and pushed into the vast range areas of the West, they believed that the supply of forage produced on these ranges would carry all the stock with people might desire to graze on them and still maintain their productivity forever.

But shortly after the middle of the nineteenth century depletion began to be noticed and in a short time became severe. Nevertheless few people realized the seriousness of the condition of the range and in many places depletion has continued down to the present time.

Even yet it is only a small percentage of the people who realize the seriousness of the range condition. Consequently, it has been difficult to get necessary appropriations and support in developing proper management of livestock and range land. Some of the more progressive livestock producers have learned the value of systematic management and have maintained the productivity of their land. The Forest Service has been building up the range land on the National Forests, but in so doing they have had many difficulties to overcome. Perhaps the fact that, although the range area consists of about one third of the total land area of the United States, it contains only about two and one-half per cent of the voting population of the United States, has had con-

siderable effect on the lack of funds and cooperation by the people in a problem of such importance.

In this paper I have attempted to show a little of the history of range land, and the work of the Forest Service in rebuilding the range land on the National Forests.

A BRIEF HISTORY OF THE LIVESTOCK INDUSTRY IN THE UNITED STATES

Although there had been some areas where the raising of livestock was of importance since before 1800, it was not until between 1880 and 1885 that there was any great boom in the livestock industry. During that period the development of the cattle industry was phenomenal. Huge companies and corporations were organized, owning thousands of cattle and grazing enormous tracts of land. And although these range lands were publically owned, each cattleman claimed certain areas and his rights were respected by the other owners. They all united against trespass by new owners. These organizations gained control of all the land around streams, lakes, and springs so that any individual trying to start up in the stock business would find himself blocked out.

By 1886 the range was overstocked and prices collapsed resulting in the ruination of many of the cattle owners. To add to the disaster, very severe weather was encountered from Kansas south into Texas during the winter of 1885-86 causing enormous losses of stock because the owners had no supplementary feed for their stock and the range was so overgrazed that they could not find food nor withstand the cold.

Furthermore, the summer of 1886 was very hot and dry in the northern part of the range area and the following winter besides being extremely cold, was marked by severe blizzards

which caused great losses of stock in this area. Coupled with these disasters were droughts in various parts of the range areas between 1886 and 1904, all of which caused a reduction in the number of cattle on the range.

But this was not the only cause of trouble. Between 1880 and 1910 sheep made great inroads onto the already overgrazed cattle range. They grazed the range clear as they went along. The result was range wars between the sheep and cattle owners with each side ruining the range by grazing areas until they were bare, thereby preventing the other side from gaining any value from them. At the same time the stockmen were fighting against settlers who were moving in and taking up considerable of the range area. The result of all this was the complete destruction of most of the range land.

After this period during which the range was almost ruined and many of the livestock owners lost all they owned, the stockmen learned the value of raising supplementary feed. As a result the percentage of forage obtained from irrigated pasture and crop lands increased from five percent in 1890 to twenty-nine percent in 1935 for the Great Plains States. During the same period the percent of supplemental forage used for stock in the Western States was increased from twelve to forty-three percent.

After the collapse of the stock prices in 1886 prices gradually recovered until by 1898 another period of peak prices was reached. From then on the price trend was

downward until by 1905 prices were about half of those of 1898. Then again in 1918-1919 prices took another jump upward because of the demand brought about by the participation of the United States in the World War.

Because of the demand brought about by the war, 1,063,000 head of stock above the number usually permitted on the National Forests for summer grazing were admitted. They were allowed to enter the reserves earlier in the season and stay later than usual as well. This resulted in a severe set-back in the Forest Service's work of rebuilding the range.

In 1921, the price of livestock and wool took another drop and the stockmen found themselves in such a financial predicament that by 1930 mortgage debts in this industry was about thirty-five percent of the value of the outfits. Since 1930 this percentage has increased.

Between 1930 and 1935, the entire range area suffered a drought. To make the effect of this drought worse, the previous fifteen years had been comparatively dry.

Although a bill was passed in 1897 which gave the Federal Government power to promulgate rules and regulations for proper control of livestock, it was not until 1905 when forestry was transferred from the Department of Interior to the Department of Agriculture that controlled grazing began. Also, in that year, President Harrison set aside 13,416,710 acres as national forests and the name was changed from the

Bureau of Forestry to the Forest Service. Since then the interest in controlled grazing has gradually increased as the people began to recognize the importance of protection of the range. Likewise, the acreage of the national forests has been greatly increased since then, the greatest increase coming under the regime of Theodore Roosevelt when he increased the National Forest Area to 148,346,925 acres. Just before signing an appropriation bill carrying an amendment which prohibited the establishment of additional national forests or extending of those already created in California, Oregon, Washington, Idaho, Montana, and Wyoming, he created national forests covering 16,000,000 acres of public land in these states.

A BRIEF HISTORY OF THE UNITED STATES

At the time the early settlers started moving westward, agriculture land required only a very small percentage of the vast area of the United States. At that time almost two-thirds of the area of what now comprises the United States was virgin range land. If deductions were made for barren deserts, dense forests, bare mountain tops and the like, the area suitable for grazing was about 850 million acres.

This area varies greatly in temperature, elevation, soil, climatic conditions, and types of vegetation, and the pioneer moving westward passed through many forage types, each of which covered an area so great that these men could scarcely believe that all the forage would ever be utilized.

After crossing the Mississippi, the first type of range land encountered by the early settlers in their westward trek was the tall grass prairies which extended from Illinois northwesterly into Canada, southwesterly into Texas, and westward through what is now the Dakotas, Nebraska, and Kansas and Oklahoma.

Upon leaving the tall grass prairies, they next passed into the short grass plains. These plains extended from beyond the Canadian border southward to the Panhandle in Texas, westward to the foothills of the Rockies, while their eastern boundary was about the center of what are now the states of North and South Dakota, Nebraska, Kansas, and Oklahoma. Most

of this area is fairly level and forms a belt from three to six hundred miles wide comprising an area of about 280 million acres.

Those who followed the Oregon Trail reached the bunchgrass plains of what is now Oregon and Washington, while those going to central California encountered a similar type of vegetation. These bunchgrass plains comprised a vast area bounded by western Montana, southeastern Idaho, eastern Washington and Oregon, and central California.

If, instead of following the Oregon Trail into Oregon or Washington, the pioneers travelled to the Southwest near the Mexican Border, they reached an area having a semi-desert type of vegetation. This type occupied a discontinuous belt of arid grassland paralleling the Mexican Border in Texas, New Mexico, and southern and eastern parts of Arizona.

There were many other types of range land which the pioneer might encounter in the west depending on where he chose to settle. The driest of all range types was the southern desert shrub, of which the greater principle was found in the southwestern part of California. Smaller areas were present in southern and western Texas and southern New Mexico.

There was also the sagebrush type through which the Oregon Trail passed from Eastern Wyoming to the Cascade Mountains of Central Oregon. This type extended southward from Nevada to the foothills of the Sierra Nevadas.

There was also the salt-desert shrub type covering about

42 million acres in southwestern Wyoming, southern Idaho, Utah and Nevada; and the pinon-juniper type which was the first type encountered by the pioneers after crossing the great Plains. The latter type was a low-growing open forest of Pinon pine and juniper covering about 74 million acres from the eastern foothills of the Rocky Mountain in Colorado, westward to Central Oregon, and south through the foothill country of Utah, Nevada, eastern California, Arizona, and New Mexico.

The woodland-chaparral type extended around the sides of the central valley of California, on the low hills along the Pacific Coast from San Francisco south to Mexico, and into southern Arizona.

In the 13 million acres of open forest that grew on the slopes of almost every mountain range from the eastern foothills of the Rockies to the slopes of the Cascades and Sierras occurred another supply of valuable forage. These forests produced an abundance of grass under their widely spaced canopy. But there were also forests so dense that, because sufficient light did not reach the forest floor, they were devoid of grass and herbage. The Western white pine-Western Larch forests of what is now Northern Idaho, the Lodgepole pine thickets throughout the Rocky Mountains, the Sitka Spruce-Western Hemlock, and the Douglas fir forests of Western Oregon and Washington and parts of Engelmann Spruce-Alpine Fir forests of the high Cascade ranges and Rocky

Mountains were included in the types too dense to produce appreciable amounts of forage.

By 1933, there were 214 million acres of land classed as forest land. Of this, 144 million acres were used for grazing but only sixty-four million acres were classified as range land. Approximately fifty-one percent of the range land is privately owned, twelve percent is in National Forests, six and one-half percent is Indian land, eighteen and one-half percent is Public Domain and grazing districts, while two and one-half percent is under other federal ownership and nine and one-half percent is owned by states and counties.

DEPLETION

At the present time there are about 728 million acres of range land in the continental United States. This constitutes nearly forty percent of the land area included. Of this, one-half is privately owned; one-third is federal range divided among national forests, grazing districts, public domain and other withdrawells and reservations.

The depletion for this entire area averages more than one half. Furthermore, three-fourths of the area has declined in productivity during the last thirty years while only a little over one-sixth has improved. Of this range deterioration, depletion on the public domain and grazing districts has averaged about 67 percent, on private, Indian, state and county lands about fifty percent, and on national forests only about thirty percent. As a result of this decline only about ninety-five million acres is in reasonably satisfactory condition. Nearly half of the national forest land is included in this category, while only about one-eighth of the private grazing land is in satisfactory condition.

This depletion has been brought about by excessive stocking, use of grazing land for other purposes, and lack of rainfall. Precipitation on the range country averages less than one-third of the Middle West and East and practically every range area is characterized by one to four drought years in every ten.

This depletion has caused the livestock industry to change so that now about thirty-five percent of the feed of western livestock is raised on crop land or irrigated pastures where previously almost all food was derived from grazing on the range. Even with this change it will probably require more than fifty years of management to restore the range to close to its original productivity.

As early as 1800, the Spanish had established themselves on the west coast from San Diego north and their herds of sheep covered the ranges in great numbers. These early grazers did not attempt to grow supplementary feed for the winter feeding of their livestock, but let them scatter over as wide an area as was necessary to obtain the required forage.

Later grazing of livestock developed in Texas and rapidly increased until the range was overstocked due to the lack of transportation facilities to enable shipping of beef. By 1867, the livestock owners of Texas began trailing north through the Staked Plains, across the Indian Territory, and into Kansas where they met the railroad and were able to ship their cattle to the eastern market.

In making these long drives with the huge herds of cattle, they seldom travelled more than eight to ten miles a day, and the cattle gained weight while on the trail.

But as the railroad was extended westward, emigrants also pushed westward. They converted the range land into agricultural uses, established towns, and steadily pushed the stockmen westward. While the range area was being decreased due to the westward movement of settlers, people were beginning to realize the great opportunities for profits in raising sheep and cattle on the vast free and open ranges of the west. Great cattle companies were formed in the East and even in Europe. Their promoters rushed into Texas where they purchased thousands of head of cattle and moved them on to the great open ranges to the north.

At first huge profits resulted from these enterprises but as more stock was put on the ranges which were now already overstocked, depletion began to set in, the native grasses started to die, and the rate of profit began to rapidly decrease.

None of these early stockowners had yet started to raise feed for winter feeding and when, in 1886, a very severe winter occurred, thousands of cattle starved to death causing the ruination of many of the large livestock companies. In 1893, a similar disaster occurred in the southwest.

About this time sheep began to gain power in the northwestern states and, to a lesser extent, in other range areas. They began gradually to force the cattlemen

to move back with their stock. From the experience of the cattlemen, the sheep-men had learned the value of raising supplemental food for their stock. But even with this knowledge, the ever-increasing population of the range and the bitter range wars between the cattlemen and sheep-men resulted in the rapid deterioration of the range.

In more recent years, dry-land farming has utilized some of the range land which was already over-crowded with livestock and has utilized large areas needed for spring range forage production. Between 1910 and 1929, mostly after 1915, some fifty million acres of range largely on the Great Plains was ploughed up for dry farming. This has forced stockmen to hold their herds on pastures and hayfields so late in the spring that these have also been damaged.

However, since the Forest Service has taken over the control of a large part of the grazing land and because many owners have learned the fallaciousness of the theory of putting all the stock possible on an area, over-grazing in the west is much less wide-spread than it was twenty-five to forty years ago.

The grazing land managed by the Forest Service has made far more advancement toward regaining its past productivity than that under any other unit.

Prior to the inclusion of land in the National Forest, stock usually had access to the range before the snow was entirely off of it, and therefore when the earliest growth was appearing. As the season advanced the stock drifted or were driven to higher regions reaching each portion of the range soon after growth commenced. This resulted in serious damage to the plant growth.

At the present time $82\frac{1}{2}$ million acres or sixty-two percent of the total area of the western national forests is available for grazing. Upon this area the grazing capacity has been increased nineteen percent since 1910 and the national forest ranges on the whole are seventy percent as good as the virgin range, as contrasted with the thirty-three percent on public domain, and forty-eight percent on privately owned range land of the West.

The difference in the percent of depletion may be easily seen from the following tables taken from the Senate Document 199, Separate Number 2, the first of which shows the depletion of virgin range forage by ownership and depletion classes and the second of which shows average forage depletion by types:

DEPLETION OF VIRGIN RANGE FORAGE BY OWNERSHIP AND
DEPLETION CLASSES

Ownership or control	Moderate depletion (0-25%)		Material depletion (26-50%)		Severe depletion (51-75%)		Extreme depletion (75-100%)		All depletion classed		
	<u>1,000A</u>	<u>%</u>	<u>1,000A</u>	<u>%</u>	<u>1,000A</u>	<u>%</u>	<u>1,000A</u>	<u>%</u>	<u>1,000A</u>	<u>%</u>	
FEDERAL											
National F.	40,897	6.5	35,172	40	10,553	12.0	1,332	01.5	87,954	100	
Indian L.	3,171	6.6	17,328	35.8	26,128	54.0	1,764	3.6	48,391	100	
Public Dom. graz. dist.	1,868	1.5	18,320	14.3	61,168	47.9	46,434	36.3	127,792	100	
Other Fed.	463	2.0	4,871	21.2	11,527	50.1	6,136	26.7	22,997	100	
All Fed.	46,399	16.1	75,691	26.4	109,376	38.1	55,668	19.4	287,134	100	
State + County	4,676	7.1	30,909	47.2	24,209	37.0	5,722	8.7	65,516	100	
PRIVATE	43,750	11.7	138,397	36.9	136,885	36.4	56,514	15.0	375,546	100	
ALL OWNERSHIP	94,825	13.0	244,997	33.7	270,470	37.1	117,904	16.2	728,196	100	

AVERAGE FORAGE DEPLETION

TYPE	National Forest	Indian Lands	Public D. graz. dist.	Other Fed.	All Fed.	State County	+ Private	All Ownership
Tall Grass	12	20	12	12	14	12	22	21
Short Grass	30	38	47	55	43	43	51	49
Pac. bunchgrass	37	70	68	59	55	54	50	51
Semi desert shrub	53	62	58	65	60	51	54	55
Sagebrush-grass	40	45	71	56	66	57	71	67
Southern desert shrub	60	63	63	66	63	58	63	62
Salt-desert shrub	26	52	71	81	70	80	74	71
Pinon-Juniper	41	61	72	76	61	64	56	60
Woodland-Chap.	44	39	51	50	49	50	51	50
Open forest	26	38	56	47	29	40	38	33
	<u>30</u>	<u>51</u>	<u>67</u>	<u>63</u>	<u>53</u>	<u>49</u>	<u>51</u>	<u>52</u>

For the whole of the 376 million acres of privately owned range land in the West, the original grazing capacity has been reduced by more than half. There is, however, forty-four million acres (12%) of the privately owned range land which is in good condition. Where the productivity has been maintained, it is due to a number of factors such as: better than average growing conditions, highly resistant and recuperative forage plants, good soils, good grazing capacity conditions which favor good stock distribution, low purchase, carrying, and production costs, balanced economic units, favorable location, and good management.

There are forty eight million acres of Indian land which are used for grazing purposes. Of this, the area in Oregon, Washington, a portion of the Great Plains, and part of Idaho is in good condition, while that in the southwest is seriously depleted.

Over most of the grazing districts formed by the act of the 1934 depletion is severe. There are about eighty million acres in these grazing districts of which sixty-one million acres are in range land. There are also sixty-seven million acres in various reservations and withdrawals that still lack any provision for grazing management. The average deterioration on this public domain is seventy percent.

It is the most seriously overgrazed and depleted range in the United States. More than 95% of it is eroding, one-half

materially, and one-half severely. The effects of land in such a condition has been clearly shown by the floods of the Ohio Valley, those in Utah, and elsewhere.

HOW THE FOREST SERVICE INCREASES THE CARRYING
CAPACITY OF RANGE FOUND TO BE BADLY DEPLETED

Among the practices used in restoring the vigor of range forage are closing the range to grazing, artificial reseeding and practicing deferred and rotational grazing.

When an area is very badly rundown, it may be necessary for the area to be closed to grazing until the plants have had a chance to regain vigor and show an increased rate of growth. However, this method should seldom be used for deferred and rotational grazing will usually bring about as favorable results without the disadvantages of year long protection. Where small area of potentially productive land are devoid of forage, it may be found feasible to artificially reseed them. This practice is very costly and can not be used extensively, nor is it usually used on poor grazing land.

It is frequently advisable to practice deferred and rotational grazing to build up a range and to retain its productivity once it is returned to a high yield capacity. When this method is used, an overgrazed area of range land which is large enough to supply forage for the required number of stock from the time for seed maturity until the end of the growing season is protected from grazing until seed maturity. After the maturity of the seed, the area is grazed closely, but not destructively. The following years and succeeding years until the range area is built up, grazing is deferred

until after seed maturity and then is grazed lightly. When an area has been thoroughly reseeded, another area of sufficient size to carry the stock from the time of seed maturity until the end of the growing season is set aside and receives the same treatment as the previously protected has received. This system is continued until the entire range being managed under a deferred and rotational system has had a chance to reseed and build up. The policy of deferring grazing on a certain portion of the area until the seed has matured is usually continued even after the entire area has had a chance to reseed, thereby maintaining a high carrying capacity.

Though the chief advantage of this system is that the forage is being fully utilized while the land is being reseeded, it also has the advantage of lessening the fire danger that would be encountered under a system whereby the range remained idle for several seasons. Likewise, the seed is very apt to get trampled into the ground where it can produce new plants, and the particular area which is deferred will have a good crop of forage when otherwise all the area would have been grazed before the end of the season.

SOME REASONS FOR THE SUCCESS OF THE
FOREST SERVICE IN RANGE MANAGEMENT

In any well planned method of grazing designed to handle the land as permanent grazing areas, two objects must be kept in mind. One is cropping of the herbage at a time in season when growth and reproduction will be interfered with as little as possible. The other is the utilization of the forage when it is most needed and when the herbage is palatable and nutritious. The success of the management plans on the National Forests is indicated by the fact that besides successfully fulfilling these two objectives, the majority of the ranges are properly stocked and have reasonable satisfactory distribution and nearly ninety percent have proper seasonable use.

Besides restoring the range to close to its former capacity, the Forest Service by their range administration have offered greater opportunity to small operators, and have furnished supplemental range to stockmen and farmers. Through protection they have increased the wildlife population of the forests, have protected and improved watersheds, and by a multiple use policy have made highest use of the resources, besides developing a practice of management and protection which is applicable to other forms of range land.

Among the reasons for the success of the Forest Service in range management is their policy of:

1. Decentralized resident control
2. Anticipating problems and preparing for them
3. Equal considerations for all resources
4. A long time viewpoint
5. Accepting full responsibility for decisions, and
6. Setting up definite aims and objectives and adhering to them.

Their objectives have been to build up the forage resources and its productivity through the development and introduction and of the best possible methods of management, and to promote a stable and prosperous use of these resources by permanent settlers/^{on} or adjacent to the National Forest who are dependant upon the supplemental range.

The Forest Service has always operated under the policy of equal opportunity, thereby protecting the settler and small owners. They have cooperated with local agencies, and recognize the stockmen's associations and give them a voice in the management of the range land which they use. The Forest Service also cooperates with agriculture and is governed by a multiple use policy for resources.

The Forest Service has made numerous investigations on the relation of range use to timber growing and watershed

protection. From their studies and experiments, they have evolved some important grazing principles. Among the things they have found is that it is necessary to be conservative in stocking ranges to prevent overgrazing of the range in poor years or dry cycles. They have found that palatable plants must be allowed to make vigorous growth before being grazed, that bunchgrass should have periodic opportunities to reseed.

It is by their careful investigations of conditions and necessities, their careful management of range land, and their foresight in formulating policies which has caused the range managed by the Forest Service to improve so much more rapidly than that controlled by other agencies. With the grazing regulations in force on the National Forests, excessive grazing before the forage is mature and overgrazing is eliminated. The lands are managed with the idea of perpetrating all the uses of the land, and by sustained forage production help to stabilize the livestock industry.

In managing grazing on the National Forests, the following functions are performed:

1. The class of stock suitable for the allotment is determined.
2. Driveways are located.
3. The date stock can go on the allotment and the period for which they can stay is determined.

5. The determination of who is to get the allotment
is made.
6. Grazing permits are issued and fees collected.
7. Trespassing is controlled and damages assessed.
8. All possible assistance is given the permittee.

SOME GRAZING PROBLEMS

There are a great number of problems which the Forest Service has been required to meet in the past and which are continually coming up. The decision must be made as to what type of stock should be allotted on various grazing areas. This is probably the first important decision that must be made in the supervision of range land. The character of forage; distribution of watering places; protection of watersheds, game, and timber; climate and topography; and accessibility are all items affecting the final decision. Sheep prefer weeds, tender green foliage, and the grain of many small grasses but do not care for coarse grasses and grain. Cattle and horses prefer coarse grasses and grain and ordinarily do not care for weeds. Both sheep and cattle eat browse, but sheep find it more palatable than do cattle. Horses do not ordinarily eat browse.

Cattle need water at least every two days and should not have to travel far for it. On very rough ground they should not have to go over a mile for water, while on more level ground they can travel up to two and one-half miles for water without adverse results. Sheep, however, can go several days without water, and on succulent feed and where there are frosts at night, they can go for many days without water. Horses can travel long distances to water but cut deep trails.

Cattle prefer level or gently rolling country and where the country is rough, they will hang in the valleys and around waterholes and will not graze the rougher areas. This causes deterioration of the more accessible range and at the same time the stock does poorly. Although sheep prefer gently rolling land, with proper care they can be satisfactorily run on very rugged range.

Another decision that must be made is the determination of the person to whom each allotment is to be assigned. Most of the ranges were already fully occupied when the Forest Service took over the range. They have given preference to small settlers or homebuilders to allow them an opportunity to build up their enterprises. Preference is given to owners of farm land or winter range who require summer range for the number of stock which they can support the remainder of the year when the stock is not on the National Forest. Those living adjacent to the allotments usually have first opportunity to use the area. No rights have been allowed to accrue, therefore a stockman can not sell his grazing privilege to any other individual. In 1909 there were 27,327 permittees, while in 1934 there were 25,224.

Of the 133,875,000 acres of federally owned land in the National Forest of the western range states, 82,538,000 or sixty-two percent of the total is used for grazing domestic livestock. In eleven western states, about 1,400,000 cattle,

30,000 horses, and 6,152,000 sheep are grazed on the National Forests during the summer months. This is twelve percent of all the cattle and twenty-three percent of all the sheep in these states.

Another problem is the determination of the number of stock to be allowed on an area. The Forest Service endeavors to regulate grazing of livestock so that the number of stock need not be decreased but if possible the carrying capacity of the range will be increased. Under proper grazing management, reproduction does not suffer any great amount of damage and fire danger may be decreased.

It is only by careful investigation of each range area by experienced men who are well trained in range management that the carrying capacity of allotments can be determined. The appearance of certain indicator plants will show the experienced range inspector when an area is being overgrazed. Stocking is determined on the basis of an average year, making allowance for some forage to be left to assure the maintenance of plant vigor as well as carrying the stock through during adverse years.

When the carrying capacity is determined by experienced men, they determine the density of the plant cover and the average palatability of this cover. The product of these two figures is then multiplied by the surface area within the type. The figure thus determined is the number of

of forage acres of the types. The number of forage acres for an area can also be determined by multiplying the total land area by the surface supporting vegetation and then multiplying this product by the figure obtained when the density of the cover is multiplied by the percentage of palatable forage. A forage acre is an acre of ground entirely covered with plants which are wholly palatable to livestock. The number of forage acres divided by the number of forage acres required per head to run stock a given length of time gives the carrying capacity for the period of time figured for a particular type of stock. There are several methods by which the field data may be obtained for the determination of carrying capacity.

After the number of stock which the area will carry is determined, a range management plan is prepared. This plan is both written and graphic. It prescribes:

1. The class of stock to which the range is best adapted.
2. Number of stock to be allowed.
3. Season of grazing best suited to growth requirements.
4. Needed improvements.
5. The manner by which the stock will be handled to secure uniform distribution and utilization.

These plans have been made or are being made of each stock allotment on the National Forests.

After the plans are put in force, careful records are kept on the number of stock grazed, the period in which they are grazed, and the condition of the range following grazing. When permits are issued to grazees they tell the number of stock to be grazed, the period when stock may enter, how long they may remain on the area, how the area is to be grazed, and other regulations that must be followed.

Since National Forests were established primarily for the protection and development of the forest and the protection and care of the watershed, great pains must be taken to harmonize grazing with these primary purposes. Therefore, grazing on the National Forests is regulated so that the grazing resources will be utilized to the fullest extent consistent with the protection, development, and use of other resources.

Some other problems which must be faced in the management of range land on the National Forests are erosion, rodent control, eradication of poisonous plants, financial handicaps, unsound land policies of the past, necessity for additional improvements, and the need for further research. In certain sections, uncontrolled burning, damage caused by the rooting of hogs, grazing of sprouts, and the need for coordination of grazing on forest ranges with the use of improved pastures

and supplemental feeding form range problems.

There are about 100,000 acres of valuable range land which are badly infested with poisonous plants. On the National Forest ranges, approximately eight thousand cattle and twenty thousand sheep valued at about five million dollars die annually from eating poisonous plants. This loss is sometimes greater than the loss from the combined effect of contagious and infectious diseases and predatory animals. By proper salting methods and care in driving and herding stock this loss can be decreased. The eradication of poisonous plants is frequently very difficult and expensive.

Successful management of range land is dependent upon a thorough knowledge of grazing, its effect on the range, needs of stock, and the forage value and productivity of the various ranges. This knowledge can only be secured by research and training.

The United States was one of the first countries to undertake research of range-land problems. Investigations by federal and state agencies began about 1900 and by 1910 eight state agriculture experiment stations had each attempted one or two range projects. In 1907 the Forest Service commenced range investigations in conjunction with the Office of Grazing Studies. The Forest Service is the only agency which has developed a comprehensive range-wide investigation.

It is estimated that one million dollars are spent annually on research in the United States. On the nineteen million dollars spent by the Federal Government in 1933, research on range problems drew less than one percent. An additional seventy-five thousand was invested by state agriculture experiment stations. By 1900 range livestock was valued at approximately two hundred and eight million dollars. By 1930 the range livestock value had increased to seven hundred million dollars, and only about one hundred thirty thousand dollars was spent in Federal range land research.

The Forest Service is not only hampered by lack of money in range research, but also needs more money for administration and improvements. The average amount spent per acre for administration of domestic livestock on the National Forests during the fiscal years from 1932-1935 was only 00.0089 dollars. When exhaustive studies were made in 1930 it was found that the National Forest should be allocated to grazing administration no such allocation could be made. In order to secure proper administration an additional 00.006 dollars per acre would be required. This would bring the total cost for adequate range administration to 00.0149 dollars per acre. The table on the next page gives costs for desired improvements.

The following table gives costs for desired improvements on the National Forests:

Cost Items	Area to be covered Million Acres	Cost per acre Dollars	Period to complete Years	Total cost Dollars	Annual cost for first 5-year period Dollars
Range surveys and development	56.80	0.0090	5	512,000	102,000
Range fences	82.50	.0530	10	4,376,000	438,000
Water Development	82.50	.0407	10	3,362,000	336,000
Artificial vegetation	.78	3.5000	20	2,730,000	136,000
Rodent control	8.00	.8000	5	640,000	128,000
TOTAL CAPITAL INVESTMENT-----				11,620,000	1,140,000
Administration (gen.)	82.50	.0060			500,000
Wildlife management	120.00	.0042			500,000
Maintenance and repl. of improvements	82.50	.0090			742,000
TOTAL ANNUAL COST-----					2,882,000

THE IMPORTANCE OF RANGE LAND

The use of the range land is absolutely essential to the livestock industry of the United States. It supplies feed to sheep, cattle, horses, and goats at a collective cost only about one-fifth to one-tenth the cost of supplemental feed. Without the use of this range the amount of livestock which could be run on summer range would have to drastically be reduced. Some of the people running livestock would attempt to run stock on pastures and winter range the year around. This would ultimately cause complete destruction of the range. Furthermore, use of range land enables farmers living near the National Forests to run a few stock which they can carry on their own land during the winter and thus gain supplementary incomes which enable them to continue to operate. The use of the grazing land on the National Forest also tends to stabilize the livestock industry as well as assisting in keeping the price of beef, mutton, wool, leather, etc. at a price which makes them available to the American people.

The importance of the livestock industry is indicated by the fact that in 1930, western crops produced one and one-half billions of dollars and wool and mohair produced eighty-two million dollars. Furthermore, excluding irrigation improvements, the 1930 census valued and appraised farm lands and buildings, privately owned range land and farm and range livestock at nearly twelve and nine-tenths million dollars.

Range land is also very important in the control of the flow of streams. Eighty-five percent of the flow of important western streams comes from about 232 million acres of which approximately seventy-nine percent is range land. As a result the management of range land determines the extent of erosion over thousands of acres and directly affects many irrigation projects.

Grazing frequently reduces the fire danger and the cost of protection. The livestock eat foliage which would otherwise become very inflammable, and they trample into the ground dead material which would otherwise constitute a fire hazard.

2

THE EFFECTS OF GRAZING ON FOREST REPRODUCTION

Investigations have shown that a reasonable degree of grazing is not detrimental to plant growth. Studies made in the mountains of Central Utah indicate that grazing closely twice or even three times a season, provided the first grazing is late enough and the intervals are sufficient for vegetation to recover from early cropping, ordinarily does not seriously affect the yield and vigor of plant cover. Experiments made in the Douglas fir region of Oregon and Washington likewise show that moderate grazing is not harmful, although grazing can only be practiced for a few years following logging in much of the Douglas fir type because of the dense canopy which seriously hinders the growth of weeds and grass. Experiments made in Ponderosa pine, Lodgepole pine, Aspen, and other types have all indicated that properly managed grazing causes but slight damage to tree reproduction.

It has been found that in most cases where there was a reasonable amount of palatable forage and the handling of stock has been efficient, the damage to seedlings has been greater due to trampling than to cropping.

The chief damage to seedlings is caused by stock brought about by improper handling and overgrazing. However, grazing should be deferred on types such as Douglas fir cut over land for a season so that germination may take place.

Although the damage to reproduction under proper care of livestock on the range is slight, the injury caused by sheep is greater than that caused by cattle. The reason for more damage by sheep is that they are more apt to eat woody stems. Both eat terminal shoots to about the same extent. After the terminal shoots and the top lateral branches are out of reach, the injury to reproduction of most coniferous growth is practically eliminated. However, injury to western yellow pine is very slight after a height of six inches is reached, and it is almost eliminated after a height of one and one-half feet is reached.

To interfere seriously with the food manufacturing process or with the form development of the young tree, at least one-fourth of the total number of the branches must be destroyed. A study made in Aspen showed that over a period of five years reasonable grazing by sheep caused death of 17.1 percent of the sprouts and injured 27.3 percent. However, during this same period, other agencies, chiefly bark eating rodents, caused the death of 11.7 percent of the sprouts and injury to an additional 6.3 percent other than that caused by grazing.

In studies made in western yellow pine, it was found that seventy-three percent of the injury to reproduction occurred before the seedling was one year old. The reason for this is that during the first year, the seedlings are exceedingly small, are shallowly rooted and lack a woody stem.

It was likewise found that most of the injury and death to reproduction occurred in the early part of the growing season when the stems are brittle, the trees have less woody material and when injured they do not accrue and recuperate before the dry season sets in. If they are not injured early in the season they have a better chance for survival because by autumn, the seasons growth is nearly finished, the roots are deeper, and the stems are stronger.

From the above mentioned studies, the following conclusions were derived.

1. That damage is inversely proportional to the amount of palatable forage.
2. That with sufficient feed, injury sustained by stock is greater due to trampling than because of browsing.
3. Areas should be grazed just enough to remove the greater part of the palatable forage.
4. Areas on which the reproduction is less than three years old should not be grazed.
5. Grazing should be light on steep slopes and re-producing burns.
6. Areas with high fire danger should be grazed early.
7. Areas should be grazed before the forage becomes dry and unpalatable.

In the same experiments, the following causes of deterioration of range and injury to reproduction were set forth.

1. Too many animals on the range.
2. Faulty distribution of stock.
3. Congestion of stock in the valleys.
4. Excessive use of sheep bed ground and close herding.
5. Trailing stock.
6. Inadequate or poorly located watering places.
7. Poor salting practices.
8. Improper seasonal use.
9. Poor balance between classes of animals and type of range.

CONCLUSIONS

The Past history of the range land in the United States shows the result of unregulated grazing and the need for systematized management of range land. Studies made in recent years show that in many cases on private land and on much of the unregulated public domain, improper grazing is still being practiced and the land is going down in producing power.

Likewise, land history shows the result of people attempting to practice dry farming on land suited only for grazing purposes. Even yet people are continuing to try to farm land upon which they can not produce sufficient income for a reasonable livelihood.

The results of poorly managed grazing and farming on land not suited for such use, when compared with the result obtained by the Forest Service in their management of grazing and timber land, shows the advantage of scientific management, and a clearly defined policy which looks far into the future.

Therefore, I believe that all the public land which is not under control of the Forest Service or in grazing districts should be classified and appraised and then put under scientific management. The management principles developed by the Forest Service, and their policy of building up all values and protecting all the natural resources plus their

practice of planning for future needs shows the suitability of this organization for further control of grazing lands.

BIBLIOGRAPHY

- AGRICULTURE, Secretary of, A National Plan For American Forestry, Senate Documents #12, 2 vol., pps. 144, 148 322-325, 527-554, 586-589, 642-643, 673-676, 1235, 1559. and 1621.
- AGRICULTURE, Secretary of, The Western Range, Senate Document #199, Washington, 1936.
- BARNES, Will C., Western Grazing Grounds and Forest Ranges, Sanders Publishing Co. for Breeders Gazette, Chicago, 1913.
- BEATTIE, R. Kent, Plants Used For Food by Sheep on the Mica Mountain Summer Range, State College of Washington Agriculture Experiment Station Bulletin #113, Dec. 1913
- BENTLEY, H. L., Experiments in Range Improvements in Central Texas, USDA Bureau of Plant Industry Bulletin #13, 1902
- COTTON, J. S., Range Management in the State of Washington, USDA Bureau of Plant Industry Bulletin #75, 1905.
- DARLINGTON, H. T., A study of Grazing Conditions in the Wenaha National Forest, State College of Washington Agriculture Experiment Station Bulletin #122, 1922.
- GRIFFITHS, David A., A Protected Stock Range in Arizona USDA Bureau of Plant Industry Bulletin #177, 1910.

HILL, Robert R., Effects of Grazing Upon Western Yellow Pine Reproduction in the National Forests of Arizona, and New Mexico, USDA Bulletin #580, Dec. 1917.

HUNTER, Byron and THOMPSON, Harry, The Utilization of Logged Off Land for Pasture in Western Oregon and Western Washington, USDA Farmer's Bulletin #463, 1911.

INGRAM, Douglas C., Vegetative Changes and Grazing Use on the Douglas Fir Cut-Over Land, Journal of Agriculture Research, Vol. 43, No. 5, Washington D. C., Sept. 1, 1931, pp. 387-417.

JARDINE, James T. and ANDERSON, Mark, Range Management on the National Forests. USDA Bulletin #790, Aug. 1919.

MARSH, C. K., Stock Poisoning Plants of the Range, USDA Bulletin #1345, Oct. 1929.

SAMPSON, Arthur W., Plant Succession in Relation to Range Management, USDA Bulletin #791, Aug. 1919.

SAMPSON, Arthur W., Range and Pasture Management, John Wiley and Sons, Inc., New York, 1913.

SAMPSON, Arthur W., and COVILLE, Frederick V., The Revegetation of Over grazed Range Area, USDA Forest Circular #158, 1908.

SARVIS, J. T., Effects of Different Systems and Intensities of Grazing Upon the Native Vegetation at Northern Great Plains Field Station, USDA Bulletin #1170, July, 1923.

STEPHENS, WILSON, BAIRD, SARVIS, THYSELL, KILLAND, AND BRINSMADE, Report of the Northern Great Plains Field Station for the 10-year Period, 1913-1922, Inclusive, USDA Bulletin #1301, 1925.

WOOTEN, E. O., Carrying Capacity of Grazing Ranges in Southern Arizona, USDA Bulletin #367, June 1916.

WOOTEN, E. O., Factors Affecting Range Management in New Mexico, USDA Bulletin #211, May 1915.