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Rangeland Resource Inventory of the Six-County Area of Utah

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RANGELAND RESOURCE INVENTORY OF THE SIX-COUNTY AREA OF UTAH

by

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Verl Bagley

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ABSTRACT

Rangeland Resource Inventory of the

Six-County Area of Central Utah

by

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Utah State University, 1980

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The intent of this study is to estimate rangeland acreages, forage production, and potential forage production in Utah's Six-County Area (Juab, Millard, Piute, Sanpete, Sevier, and Wayne Counties). Acreages were classified by range site, climatic zone and by stage of plant community succession. Range site production data collected since 1953 by the U.S. Soil Conservation Service on Utah's rangelands provided a basis for estimating both present and potential forage production.

(82 pages)

INTRODUCTION

Utah's rural economy has typically been based on livestock production. Probably no other facet of this industry has contributed more to the success of the ranching community than the state's vast grazing lands. Grazing is the largest agricultural use of land in Utah. Of the state's 52 million acres, nearly 48 million acres or 92 percent are considered rangeland. Also, high quality water and air, wildlife habitat, scenic beauty, energy resources, and recreational uses make rangelands one of the states most valuable resources.

Proper management and development of this resource to optimize forage production is the goal of today's rancher and range manager. However, this attitude of development, conservation, and proper use has not always existed in the livestock producing community. Prior to 1900, local herds of cattle and sheep began to increase rapidly and stockmen were soon competing for grazing on the open range. Rangelands began to deteriorate due to overgrazing. Transient, nonresident sheep herds, also began traversing the state competing with local livestock for the available forage.

As rangelands continued to deteriorate the general trend in Utah was for the desirable forage plants to be replaced by less palatable shrubs, trees, and annual weeds. Today, many grazing lands show little resemblence to the original climax vegetation of a century ago and produce only a small percentage of the forage the land is capable of producing.

Parker (1976) charges that public land management agencies have not conducted adequate inventories of basic rangeland resources, including condition and trend of plant communities.

The earliest attempt at large scale (extensive) range inventory was conducted by the United States Forest Service (USFS) (USDA 1934). Results of the survey suggested that western rangelands were only producing about one-half of their potential forage production. After publication of the inventory, a 50 percent or one half value began cropping up in the literature (Forsling 1949, Sampson 1949, 1952, USDA 1962, Vallentine 1975) and may well remain a much used, generalized out of date and unsupported bit of data unless adequate, and scientifically sound range inventories are conducted which verify or dispute such claims.

As a first step in securing a general quantitative inventory of rangelands and rangeland production within the state of Utah, Utah State University Extension and Utah State University Range Science Department jointly supported a range resource survey in south central Utah. The study was conducted in the Six-County multi-county government unit comprising Juab, Millard, Piute, Sanpete, Sevier, and Wayne Counties. The study area includes 10,861,440 acres.

Objectives

Objectives of the study were threefold:

1. To determine range site acreages by range condition class within the six counties.

2. To estimate the present grazing capacity of rangeland in the study area by animal unit months (AUM).
3. To calculate the potential carrying capacity (AUM's) of all rangelands within the study area.

The six-county area was chosen inasmuch as it represents nearly all climatic zones found within the state. The zones range from the Colorado desert in eastern Wayne County to the high mountain zone represented in all six counties. Geographically the area includes portions of the Basin and Range Province of the Great Basin, the Colorado Plateau, and the Wasatch Plateau. The area represents two distinct precipitation patterns--summer precipitation and winter precipitation. Wayne and Piute Counties and small portions of Sevier County are in the summer precipitation zone where more than 50 percent of the annual precipitation falls within the plant growing season. Sanpete, Millard, and Juab Counties and most of Sevier County are in the winter precipitation zone where one-half or more of the annual precipitation falls during the plant dormant period.

REVIEW OF LITERATURE

As a first step in conducting an extensive range resource inventory the investigator must first arrive at an understanding of what comprises or includes rangelands.

Forsling (1949) suggests that rangeland is land which is suitable for grazing but not suitable for cultivation because of the climate and/or topography. Addressing the United Nations Scientific Conference on Conservation and Utilization of Resources, Sampson (1949) referred to rangeland as "natural grazing ground." Dyksterhuis (1958) interpreted rangeland as " . . . land upon which the climax vegetation is a natural pasture." A similar definition but one which puts an economic limitation on rangeland was provided by Renner (1962). Dyksterhuis (1964) suggests that rangeland is any land with a grazable forage crop. Ellison (1960) interpreted rangeland as land covered with native vegetation that cannot be grazed heavily without causing damage to plants and soil.

More recently, the Society for Range Management (1974), in an effort to provide a more precise definition for rangeland, offered the following:

> RANGELAND. Land on which the native vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs or shrubs suitable for grazing or browse use. Includes lands revegetated naturally or artificially to provide a forage cover that is managed like native vegetation.

Rangelands have been further subdivided into more precise rangeland groups called "range sites" (Carpenter 1938, Humphrey 1947,

Dyksterhuis 1949, 1958, 1964, Renner 1962). Range site is a combination of soil and climate supporting a specific kind and amount of potential vegetation. Later Dyksterhuis (1964) identified sites as soil-groups which differ from other soil groups in potential plant production.

Humphrey (1947) reported that different range sites are sub-units of an ecological type which can be identified by differences in potential plant production in the type. Ellison (1949), writing of soil and climate differences on rangelands, used the term "complex" when referring to what other researchers have identified as "range sites". Dyksterhuis (1958) used the terms "complex" and "range site" synonomously when referring to different kinds of rangeland. The Soil Conservation Service (SCS) has more recently referred to two or more sites mapped or managed as a single unit as a complex (USDA 1971).

Distinctive differences in rangeland result from the combination of soil and climate of the site. A site is a kind of land with a unique potential for producing native or climax plants (Renner 1962).

Mason (1971) reported that a range site is a distinctive area of land which differs from all other sites in it's ability to produce a climax species composition unique to that site. The Society of Range Management (1974, pp. 22-23) authored the following definition of range site:

> RANGE SITE. A distinctive kind of rangeland, which in the absence of abnormal disturbance and physical site deterioration has the potential to support a native plant community typified by an association of species different from that of other sites. This differentiation is based upon significant differences in kind or proportion of species or total productivity.

Early explorers and settlers to Utah have written or made glowing reports of the abundance of grazing that existed under pristine conditions. Some of these accounts also provide insight into the early grazing use these lands received (Harris 1909, Gottfreson 1919, Work Project Administration undated).

Accounts differ as to when livestock numbers peaked in Utah and to the numbers of animals on the range. However, sometime between 1915 and 1940, range animals in Utah reached a record number which greatly exceeded the carrying capacity of the range. This husbandry practice resulted in a marked deterioration of range forage and a reduced capacity of the range to support livestock production. The United States Department of Interior (1954) suggests that the peak year of range deterioration was 1934 when severe overgrazing coincided with the peak of a drought cycle.

To date, man and his livestock have shouldered the responsibility for nearly all overgrazing. However, wildlife have also had an adverse affect on the states rangeland. According to Rasmussen and Gaufen (1949), elk were fully stocked on elk ranges by 1925 and over browsing occurred shortly thereafter. By 1930, the deer population had also increased dramatically and problem areas were appearing. Julander (1962) reports that by 1942, deer numbers had outgrown the capacity of the range and preferred deer forage plants were decreasing on range sites.

As mentioned previously, many of these same rangelands have regressed or deteriorated to the extent that they no longer resemble the pristine range discussed by early Utah explorers. These vegetative changes have been documented by Hall and Cottam (1955) and

Christensen and Johnson (1965). Mason (1971) reports that unusually high populations of insects, rodents, and other animals as well as natural disasters have caused and do cause fluctuations and changes in the condition class of range sites.

When the vegetation of a site is destroyed or altered due to biological or physical disturbance on the land, an orderly process of plant community replacement occurs on that site. The reestablishment of a climax vegetation due to a series of orderly invasions of plant species which replaces preclimax species is termed "succession". After a plant community disturbance has been removed or reduced, the tendency of the site, by succession, is to eventually approach the pristine. Successional changes discussed above are progressive or positive, indicating that the range is usually advancing in quality of forage species. Another view of succession is the negative or retrogressive form, where the range forage species are decreasing in quality and quantity. Retrogressive succession also follows an orderly pattern of species invasion and replacement. Retrogression, however, follows a pattern of palatable species removal and invasion of early maturing, and less desirable species (Sampson 1917).

The principles of succession and retrogression prepared the way for the development of range condition classification and is the basis for making decisions concerning class of livestock, game harvest, stocking rates, grazing dates, and for determining the need for management changes and cultural practices on rangelands.

Though the idea of range condition was first espoused by Clements (Stoddart, Smith, and Box 1973), the term "range condition" first appeared in the literature when Spence (1938) credited L. A.

Stoddart (exact reference not given) for developing a five class condition scheme in 1935 while working with the United States Forest. Humphrey and Lister (1941) were the first to develop a general analysis of range condition. Six condition classes were outlined with descriptions of dominant vegetation of each class. Quantitative analysis was not provided and the descriptions were applicable only in the Palouse ranges of the Pacific northwest. The classes were not given individual descriptive titles, i.e. excellent, good, poor.

A USDA bulletin published to stimulate wartime livestock production recognized four condition classes: (1) excellent, (2) good, (3) fair, and (4) poor (Renner and Johnson 1942). A quantitative analysis of each condition class was not included.

Humphrey (1949) reported a quantitative analysis of vegetation for condition classification based on possible forage production. The following classes were reviewed by Humphrey: (1) excellent, production 80-100 percent of possible forage; (2) good, producing 60-80 percent of possible forage; (3) fair, producing 40-60 percent possible forage; (4) poor, producing 20-40 percent of possible forage; (5) very poor, producing less than 20 percent of possible forage.

Classification of range condition using the preceding method was abandoned, possibly because some range sites actually produce more forage if deteriorated one or two classes. Seasonal climatic fluctuations also cause great differences in forage production on one site from year to year (Dyksterhuis 1949).

Dyksterhuis (1949, 1958) helped refine the five condition class system into a four class scheme which was based on percent of climax

vegetation on the site rather than potential production. Under such a system a site producing 76-100 percent climax species for the site is rated as excellent condition. Good condition range produces 51-75 percent climax plants while fair condition range sites produce 26-50 percent climax vegetation. Sites containing 25 percent or fewer climax plants are rated as poor condition range.

In identifying climax conditions, Dyksterhuis (1958) grouped plant species into three categories: 1) decreasers, 2) increasers, and 3) invaders. Decreasers are highly palatable species which are removed very quickly from the plant community under moderate to heavy grazing. Increaser species are native to the climax community and replace the decreaser plants. Increasers are usually valuable forage species which may eventually decrease from the site when excessive grazing or other physical or biological disturbance continues. Invaders are not usually native to the site but become established when decreasers and/or increaser plants are reduced or removed from the site due to disturbances. Invader plants are sometimes opportunists, spreading from adjacent range sites where they are part of the climax vegetation. Some invader species occur naturally on the site, existing on disturbed soils such as mounds of burrowing animals. Still other species have been introduced by man's cultural practices.

Since 1953, Mason (1971) has been correlating range sites with soil taxonomic units. As soils are identified and mapped by standard soil survey methods, range site names are assigned to the respective soil units. A range site is given a name descriptive of both climate and soil of that site, e.g. Desert Loam. Yield data

for sites by range condition class have also been recorded since 1953. These data include species weight by percent of the total plant community and average pounds of total herbage production for both favorable and unfavorable years. These data also include forage values (percent forage) for each condition class within a site. For additional information on range site classification see Mason (1971).

A new classification scheme unique to the United States Bureau of Land Management has been tested by that agency. This unnamed system is not based on the ecological principles of plant community succession but rather on the present quantity and quality of grazable plants on the site. What might be rated as excellent condition range for cattle may also be classed as poor condition range for sheep and goats (USDI 1976). Under such a system a climax vegetation could be classed as poor condition range if the dominant plant species were not preferred by the class of livestock utilizing that site. Also, a site which has suffered severe successional retrogression could be classed as excellent condition if the present plant community provides enough desirable forage for the livestock utilizing that rangeland. This invalidates the concept of range condition and therefore range condition trend.

METHODS AND PROCEDURES

In November 1975, the author met with Lamar Mason, State Range Conservationist, USDA Soil Conservation Service (SCS), and requested that a general survey of rangelands, by condition class, be conducted in the Six-County area by the Soil Conservation Service. Mason agreed to the request and Horace Andrews, Range Conservationist in the study area was given that responsibility.

Range Site Acreages

Acreages by range sites, on private and state lands, were compiled from soil survey maps, site information, and inventories acquired since 1953 by the Soil Conservation Service. On federal rangeland, USFS and BLM range conservation personnel consulted with Mr. Andrews and assisted in estimating site acreages under their respective management. Interpretation of range sites and estimates of range condition were necessary on federally managed ranges since soil surveys correlated to range sites are not available for federally managed lands in the study area. On private and state lands where soil surveys had not been completed, soil scientists, and range conservationists from the SCS who were familiar with these lands estimated the range site acreages which were rounded off to the nearest 500 acres. Condition class acreages were also estimated where field measurements had not been taken. Estimates were made after conducting field spot checks and consulting with range conservationists familiar with each area.

Range sites under 500 acres were not identified in this survey but are included in the total acreage of the most dominant site adjoining the lesser site. Range site acreages were divided into condition classes after Dyksterhuis (1948, 1949, 1964).

Carrying Capacity

Present carrying capacity of rangeland is expressed in animal unit months (AUM) and was calculated using the following formula:

$$AUM = \frac{TA \times AHP \times PF \times .5}{800}$$

where:

TA = total site acreages by condition class;

AHP = average annual herbage production;

PF = percent forage (percentage of plants growing on an area normally considered to be forage species);

.5 = proper use factor (percent forage use under proper management);

800 = pounds of air dry forage required for one animal unit month (one cow unit for one month).

To calculate present carrying capacity it was necessary to determine a mean herbage production value (AHP) for each of the four condition classes of each site. To arrive at these values, the average high annual herbage production (pounds) for favorable years and the low production figure for unfavorable years were totaled and divided by two. Each site required four replications, one for each condition class. Production data were taken from SCS Range Site Descriptions for Utah (USDA 1971, 1975).

The percent forage (PF) for most range site condition classes was taken from the publication, Yield and Composition of Utahs Range Sites (USDA 1971). For those sites where forage factors were not provided, a committee consisting of Frank E. Busby, USU Range Science Department, Karl Parker, Extension Range Specialist, Utah State University, and the author reviewed SCS production data for each range site in the study area and estimated the percent forage species required for each site and condition class. As a final check Lamar Mason, State Range Conservationist, U.S. Soil Conservation Service and curator of SCS range site data for Utah, reviewed the committee's work for possible errors.

A proper use factor of .5 follows Stoddart, Smith, and Box (1975). An 800 pound air dry forage requirement per AUM was used in these calculations. This value follows Forest Service guidelines (USDA 1964).

Potential Carrying Capacity

The preceding formula was also used to estimate potential carrying capacity or potential AUM's in the study area. Average production for each site in the highest condition represented potential producation. Only one compilation was required per site since it was only necessary to calculate the highest range condition or potential.

Condition Classification

In this paper rangelands production 0-25 percent of climax (potential) forage production are classed in the "early succesSon" condition class. Rangelands producing 26-50 percent of climax forage

production is "late succession". Rangeland producing 76-100 percent of climax vegetation are classed "potential".

RESULTS AND DISCUSSION

Data presented here, from the six county rangeland inventory, does not distinguish individual range site acreages, but represents a consolidation of the range sites within each climatic zone, e.g., upland. For individual range site data see Appendix A.

Total Rangelands

Inventoried rangelands in the study area comprise 7,581,197 acres out of a total of 10,861,440 acres. Acres not inventoried represent cultivated land, waterways and lakes, rocklands, playas, coniferous forests, residential areas, and rock outcrops.

Counties ranked according to total rangeland areas are: (1) Millard, 2,690,670 acres; (2) Juab, 1,870,000 acres; (3) Wayne, 1,170,525 acres; (4) Sevier, 941,500 acres; (5) Sanpete, 519,102 acres; (6) Piute, 389,400 acres.

Figure 1 graphically reflects differences in total county acreages. The three largest counties, Millard, Juab, and Wayne are largely composed of desert and semidesert sites or those sites averaging less than 12 inches of precipitation per year. The three smaller counties are dominated by sites receiving over 12 inches of annual precipitation. County rangeland acreage by precipitation zones are listed in Table 1.

Sites receiving 0 to 8 inches of annual precipitation are in the desert zone while sites averaging 8 to 12 inches of annual

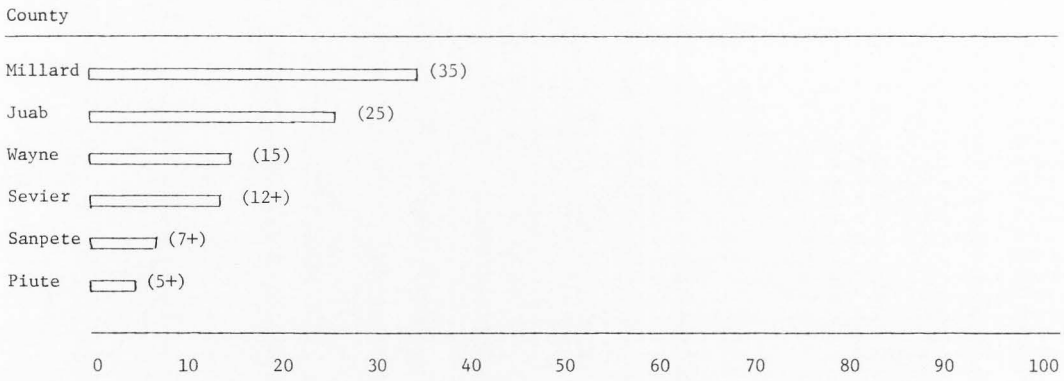

Figure 1. Counties in Utah's six county area ranked by percent of total study area rangeland acreage.

Table 1. Six County Area rangeland acreages by precipitation zone

County	Desert	Semi-desert	Upland	Mountain	High Mtn.	Wetland
Millard	1,511,450	638,220	162,500	297,500	20,500	60,500
Juab	810,000	530,500	327,000	127,500	29,500	45,500
Wayne	548,500	194,500	101,600	128,800	175,625	21,500
Sevier	25,000	66,000	209,000	373,000	241,000	27,500
Sanpete		139,635	181,757	115,684	17,996	64,030
Piute		32,500	108,900	88,500	141,000	18,500
Totals	2,894,950	1,601,355	1,090,757	1,130,984	625,621	237,530

precipitation are in the semidesert zone. The upland zone receives 12-16 inches of average annual precipitation and in the mountain zone average precipitation ranges from 16-22 inches annually. The high mountain zone receives over 22 inches of annual precipitation. Wetlands are not directly dependent on annual precipitation but are supplied moisture from underground water sources and from surface flows. Wetlands occur within all of the zones discussed above.

Current Range Condition Classification

Of the 7,581,197 acres of rangeland accounted for in the study, only 3 percent of 205,341 acres are now in excellent condition. Eleven percent or 840,489 acres, are rated as good condition range. Fair condition sites account for 2,188,109 acres or 29 percent of the total rangeland in the six-county study. Poor condition ranges amount to 4,347,262 acres or 57 percent of the total rangeland resource for the six counties.

Millard County not only represents the greatest number of acres but also the highest number of acres in poor condition and the fewest acres of all the counties in excellent condition. Millard County rangelands in poor condition equal 2,253,780 acres or 84 percent of the rangeland in that county. Only 23,015 acres are rated excellent which represents less than 1 percent of the total grazable acres in Millard County.

The reader must be apprised that there exists a difference of opinion among the SCS range scientists concerning the number of acres in Millard County which are in poor condition. Lamar Mason, state range conservationist for the Soil Conservation Service in

Utah suggests that the poor condition range site acreage for Millard County has been estimated too high.

Sanpete County ranks second in total acres in excellent condition. However, Sanpete has the highest percentage, 7 percent, in excellent condition. Sanpete County also has the lowest percentage, 26 percent, of grazalbe acres in poor condition. Individual county acreages by condition calss are listed in Table 2.

As a group, the plant communities of the desert zone have regressed farther than other zones inventoried in the study area. Seventy-five percent of the desert acres are rated in early succession. Ninety-three percent of the desert lands have regressed at least 50 percent from the climax state. Only 1 percent of the desert acres rate the potential condition status.

As opposed to wetlands which rely on underground water supplies, those zones directly dependent on annual precipitation follow a pattern that the higher the average annual precipitation, the higher the average condition class. High mountain ranges show high proportions of acres in potential condition as opposed to early succession condition in the same zone. Desert ranges show high proportions of early succession range as opposed to potential condition range. With each successive change in the climatic zones, i.e, mountain-upland-semi-desert-desert, there is an accompanying change in the proportion of potential and late succession acres to early succession and mid-succession acres. Plant communities in high precipitation zones, excluding wetlands, appear to be more stable than those sites receiving low levels of average annual precipitation.

Table 2. Rangeland acres by range condition class for the Six-County Area.

County	Total	Early Succession	Mid Succession	Late Succession	Potential
			Acres		
Millard	2,690,670	2,253,780	371,625	42,250	23,015
Juab	1,870,000	685,975	851,300	307,650	25,075
Wayne	1,170,525	717,825	233,475	154,315	64,910
Sevier	941,102	389,600	340,600	180,100	31,200
Sanpete	519,102	132,937	243,954	104,620	37,591
Piute	389,400	167,145	147,155	51,550	23,550

Wetlands in the six-county area have regressed considerably from the pristine condition discovered by early explorers and pioneers. Eighty-seven percent of the wetlands are now in mid-succession or early succession, 64 percent are classed as early succession while 23 percent are rated in mid succession. Only 1 percent of the wetland areas are now in potential condition.

The earliest settlements in the six-county area were established adjacent to the wetland ranges because of the abundant forage which could be grazed and also cut for hay. The author suggests that these sites probably have received earlier and much more intensive grazing than ranges farhter removed from settlements. Many of these ranges have also experienced year round grazing. Such husbandry practices have undoubtedly had a major impact on plant community regression in the wetland zone. The successional stability of wetlands should be investigated according to individual site differences and past management. Tables 3-8 show climatic zone acreages by condition class for the six counties.

AUM Production

Average annual AUM (animal unit month) production per county may be a more accurate measure of the importance of grazing to the six-county area as opposed to total acres. Counties ranked according to AUM production are: (1) Juab, 391,301 AUMs; (2) Millard, 370,538 AUM's; (3) Sevier, 368,230 AUM's; (4) Wayne, 281,034 AUM's; (5) Sanpete, 238,517 AUM's; and (6) Piute, 157,327 AUM's.

Table 3. Millard county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Desert	1,511,450	1,438,760	72,690		
Semidesert	638,220	472,605	128,575	26,800	10,240
Upland	162,500	116,600	26,350	7,800	11,750
Mountain	297,500	177,250			
High Mountain	20,500	615	12,710	6,150	1,025
Wetlands	60,500	47,950	11,050	1,500	

Table 4. Juab county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Desert	810,000	317,550	346,500	145,950	
Semidesert	530,500	162,900	269,650	88,450	9,500
Upland	327,000	108,350	156,475	47,775	14,400
Mountain	127,500	38,175	65,975	22,175	1,175
High Mountain	29,500	20,600	6,400	2,500	
Wetlands	45,500	38,400	6,300	800	

Table 5. Wayne county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Desert	548,500	402,450	91,500	38,850	15,700
Semidesert	194,500	174,250	18,050	2,200	
Upland	101,600	70,450	19,250	7,140	4,760
Mountain	128,800	45,350	38,600	41,150	3,700
High Mountain	175,625	14,125	58,875	61,875	40,750
Wetlands	21,500	11,200	7,200	3,100	

Table 6. Piute county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Semidesert	32,500	22,750	8,125	1,625	
Upland	108,900	69,395	35,055	4,450	
Mountain	88,500	36,700	43,600	8,200	
High Mountain	141,000	25,150	56,500	35,800	23,550
Wetlands	18,500	13,150	3,875	1,475	

Table 7. Sevier county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Desert	25,000	21,500	3,500		
Semidesert	66,000	39,700	18,300	7,000	1,000
Upland	209,000	127,500	62,500	15,000	4,000
Mountain	373,000	136,000	141,000	86,000	10,000
High Mountain	241,000	43,500	109,300	72,000	16,200
Wetlands	27,500	21,400	6,000	100	

Table 8. Sanpete county climatic zone acreages by condition class

Zone	Total Acres	Acres in Early Succession Condition	Acres in Mid Succession Condition	Acres in Late Succession Condition	Acres in Potential Condition
Semidesert	139,635	56,000	62,874	15,900	4,761
Upland	181,757	25,437	98,700	38,000	19,620
Mountain	115,684	32,100	56,800	21,670	5,114
High Mountain	17,996		6,165	6,500	5,331
Wetlands	64,030	19,400	19,400	22,550	2,765

Animal Unit Month production for most sites follows the trend or pattern of the higher the condition class the greater the average annual forage production.

Forage production on all early succession ranges in the study area equal 497,224 AUM's or 28 percent of the total forage produced in the six counties. Acreages from mid succession sites produce 682,660 AUM's or 38 percent of all AUM's produced. Late succession ranges produce 452,366 AUM's or 25 percent of the total area AUM production. Potential condition sites produce 174,697 AUM's or 9 percent of the total AUM production in the six-county area.

Animal Unit Month Production by condition class is presented for each of the six counties in Table 9.

Potential Forage Production

For each forage species in a plant community there is probably a genetic yield capacity which limits production to a maximum level. Variations in temperature and available moisture, soil fertility, disease, insects, rodents, and other variables most likely prevent the plant species from ever reaching this genetic potential. In range sites or plant communities a similar principal may apply. A range site perhaps has the genetic and/or ecological potential of producing an ultimate forage yield. However, past and present utilization plus other environmental factors mentioned above would probably prevent the site from ever attaining the inherent potential.

In this paper a potential forage production yield is reported for each range site included in the inventory. This modified or practical potential reflects average yields for range sites if the

Table 9. AUM production by condition class for the counties in the Six-County Area.

County	SUCCESSIONAL STAGES								
	Early Succession AUM's	%	Mid Succession AUM's	%	Late Succession AUM's	%	Potential Condition AUM's	%	Total AUM's
Juab	80,638	20%	192,328	49%	104,201	27%	14,134	4%	391,301
Sevier	79,017	21%	144,022	39%	115,092	31%	30,099	8%	368,230
Sanpete	21,139	9%	101,214	43%	88,260	37%	27,904	11%	238,517
Wayne	52,518	17%	77,947	28%	89,148	32%	61,421	22%	281,034
Piute	37,844	24%	56,244	36%	35,274	22%	27,965	18%	157,327
Millard	226,068	61%	110,905	30%	21,391	6%	13,174	3%	371,538
Total	497,224		682,660		453,366		174,697		1,807,947

average excellent range condition status is attained. Potential as discussed here does not imply that maximum forage production is produced annually on that site. Potential, as used here, does reflect an average production value which considers forage production for favorable and unfavorable years for sites in average excellent condition.

Climatic zones in the study area ranked by average annual AUM producation are: (1) High Mountains, ranked fifth in total acres, 486,115 AUM; (2) Mountain, ranked third in total acres, 329,780 AUM; (3) Upland, ranked fourth in acreage, 286,575 AUM; (4) Desert, ranked first in total acres, 272,659 AUM; (5) Wetlands, ranked sixth in total acreage, 234,913 AUM; (6) Semidesert, ranked second in total acres, 196,604 AUM.

Tables 10 through 15 show average annual AUM production by climatic zone and condition class for each of the six counties involved.

In the six-county study area, desert zone plant communities in early succession are presently producing more total forage than any other zone. Within this zone 53 percent of the current desert forage production is from early succession communities. Potential condition plant communities are of minor importance inasmuch as only 1 percent of the desert AUM production is from plant communities rated in potential condition. Plant communities rated mid succession and late succession provide 30 percent and 16 percent, respectively, of the total annual desert AUM production in the six-county area.

Semidesert zone plant communities in the mid succession stage produce 43 percent of the total forage production for that zone.

Table 10. Average annual desert zone AUM production in the Six-County Area by condition class.

County	Early Succession Condition AUM's	Mid Succession Condition AUM's	Late Succession Condition AUM's	Potential Condition AUM's	Total AUM's
Millard	103,608	12,685	43,978		116,293
Juab	17,852	57,733	36,733		112,234
Wayne	21,658	11,737	7,245	2,681	43,321
Sevier	526	585			1,111
Total	143,644(53%)	82,656(30%)	43,978(16%)	2,681(1%)	272,959

Table 11. Average annual semidesert zone AUM production in the Six-County Area by condition class.

County	Early Condition Condition AUM's	Mid Condition Condition AUM's	Late Succession Condition AUM's	Potential Condition AUM's	Total AUM's
Millard	39,426	25,496	8,209	3,105	76,136
Juab	9,611	40,680	21,812	2,880	74,983
Sanpete	3,238	12,352	4,245	1,487	21,322
Sevier	4,268	3,978	2,158	303	10,707
Wayne	8,039	1,259	284		9,582
Piute	2,278	1,191	405		3,874
Total	66,860(34%)	84,856(43%)	37,113(19%)	7,775(4%)	196,604

Table 12. Average annual upland zone AUM production in the Six-County Area by condition class

County	Early Succession Condition AUM's	Mid Succession Condition AUM's	Late Succession Condition AUM's	Potential Condition AUM's	Total AUM's
Juab	16,286	60,824	29,827	10,600	117,537
Sanpete	2,869	31,041	15,100	9,999	59,009
Sevier	16,828	14,082	6,519	2,231	39,660
Millard	15,551	9,184	5,285	8,704	38,724
Piute	6,452	7,890	1,837		16,179
Wayne	6,255	4,753	2,133	2,325	15,466
Total	64,241(22%)	127,774(45%)	60,701(21%)	33,859(12%)	286,575

Table 13. Average annual mountain zone AUM production in the Six-County Area by condition class.

County	Early Succession Condition AUM's	Mid Succession Condition AUM's	Late Succession Condition AUM's	Potential Condition AUM's	Total AUM's
Sevier	18,549	49,144	41,023	7,405	116,121
Millard	34,524	37,806			72,330
Sanpete	6,933	19,650	11,961	3,874	42,418
Wayne	6,886	12,764	16,812	1,990	38,252
Juab	6,915	16,632	11,406	654	35,607
Piute	8,834	12,766	3,452		25,052
Total	82,441(25%)	148,762(45%)	84,654(26%)	13,923(4%)	329,780

Table 14. Average annual high mountain zone AUM production in the Six-County Area by condition class.

County	Early Succession Condition AUM's	Mid Succession Condition AUM's	Late Succession Condition AUM's	Potential Condition AUM's	Total AUM's
Sevier	24,394	65,726	65,260	20,160	175,540
Wayne	6,752	40,407	59,598	54,425	161,182
Piute	13,342	30,376	27,702	27,965	99,385
Juab	11,438	4,509	2,048		17,995
Millard	338	9,652	6,004	1,365	17,359
Sanpete		3,533	5,459	5,662	14,654
Total	56,264(12%)	154,203(32%)	166,071(34%)	109,577(23%)	486,115

Table 15. Average annual wetland zone AUM production in the Six-County Area by condition class.

County	Early Succession Condition Class AUM's	Mid Succession Condition Class AUM's	Late Succession Condition Class AUM's	Potential Condition Class AUM's	Total AUM's
Sevier	14,452	10,507	132		25,091
Wayne	3,128	7,026	3,076		13,230
Piute	6,938	4,021	1,878		12,837
Juab	18,536	12,034	2,375		32,945
Millard	32,621	16,182	893		49,696
Sanpete	8,099	34,638	51,495	6,882	101,114
Total	83,774	84,408	59,849	6,882	234,913

Early succession provides 34 percent of the annual AUM production in the same zone. Late succession plant communities produce 19 percent, while potential condition stage communities in the semidesert zone produce only 4 percent of the total annual AUM production.

Over 80 percent of the upland acres have regressed 50 percent or more from the pristine condition. These same acres, however, are of major importance to the local range livestock industry since two-thirds of the total annual upland forage production is from plant communities in the early succession stage. Forty-five percent of the annual AUM production is from mid succession communities, 22 percent from communities in early succession, 21 percent from late succession, and 12 percent from communities rated in potential condition.

In the mountain zone, annual AUM production rated by condition classes are: early succession plant communities, 25 percent of the total production; mid succession, 45 percent of total production; late succession, 26 percent of total production; and potential condition, 4 percent of total production.

Of all the zones in the study area, the high mountain zone has the highest proportion of acres in potential condition and late succession. Thirty percent of the high mountain acres are in late succession and 14 percent in potential condition. Twenty-three percent of the high mountain AUM production is from potential condition plant communities. Communities in the late succession stage produce 34 percent of the total annual AUM production. Mid succession communities produce 32 percent while early succession plant communities produce 32 percent while early succession plant communities are

responsible for only 12 percent of the high mountain annual AUM production.

In the wetland zone, annual AUM production rated by condition classes are: potential condition sites, 3 percent of the total production; late succession, 25 percent of total production; mid succession, 36 percent of the total production; and early succession, 36 percent of total production.

Acreage to AUM Ratio

Rangeland productivity and usability can also be expressed as acres or portions of an acre of rangeland required to produce one AUM. In the six-county area the ratio of acres to AUM for the climatic zones follows two patterns: (1) as range condition increases the number of acres required per AUM decreases, and (2) as average annual precipitation decreases with zonal changes, the greater the acreage required to support one AUM. These two patterns are for the zones in general but not for all sites. There are sites in the study area which produce more forage after regressione one, two, or three condition classes. Also, there are some sites which produce more forage than other sites in a higher precipitation zone. These sites and difference are reported later in this paper. These differences agree with Dyksterhuis (1949).

The average desert zone ratio of acres per AUM for the six-county area is 10.6 acres per AUM. Individual county ratios for the desert zones range from 23 acres per AUM in Sevier County to 7 acres per AUM in Juab County. The semidesert ratio of acres to AUM for the study area is 8 acres per AUM. Individual county ratios

range from 6 acres per AUM in Sevier County to 20 acres per AUM in Wayne County. The upland zone ratio is 3.8 acres per AUM. The range of county ratios varies from 3 acres per AUM in Sanpete and Juab counties to 7 acres per AUM in Wayne County. The Mountain zone average ratio is 3.4 acres per AUM. Variation is less on higher zones. The range of ratios is 3 acres per AUM in Sanpete to 4 acres per AUM in Millard County.

As reported earlier in this paper, the High Mountain zone has the greatest number of acres in good and excellent condition. The average High Mountain ratio is 1.3 acres per AUM. Individual county ratios for this zone range from one acre per AUM in Wayne County to 1.6 acres per AUM in Juab County.

Of the six zones inventoried, Wetlands show the most favorable ratio of acres per AUM. The average ratio is 1 acre per AUM. The individual county ratios range from 0.6 acres per AUM in Sanpete County to 1.6 acres per animal unit month in Wayne County. The relative abundance of moisture and the low proportion non forage plants in the depleted sites of this zone contribute to high forage production and the low acre to AUM ratio.

Table 16 shows ratios of acres required to produce one AUM for rangeland in the Six-County Area.

Table 16. Ratios of acres or portions of acres required to produce one AUM for rangeland in the Six-County Area, by climatic zones.

County	Ratio For Desert Zone (Acres: AUM)	Ratio For Semidesert Zone (Acres: AUM)	Ratio For Upland Zone (Acres: AUM)	Ratio For Mountain Zone (Acres: AUM)	Ratio For High Mtn. Zone (Acres: AUM)	Ratio For Wetland Zone (Acres: AUM)
Millard	13:1	8.0:1	4.0:1	4.0:1	1.2:1	1.2:1
Juab	7:1	7.0:1	3.0:1	3.6:1	1.6:1	1.4:1
Wayne	13:1	20.0:1	7.0:1	3.4:1	1.0:1	1.6:1
Sevier	23:1	6.0:1	5.0:1	3.0:1	1.4:1	1.0:1
Sanpete	--	6.5:1	3.0:1	3.0:1	1.2:1	0.6:1
Piute	--	8.5:1	6.5:1	1.4:1	1.4:1	1.4:1

The existing average annual AUM production in the Six-County area is 1,806,946 AUM's. This current production is only 47% of the 3,875,684 ecological AUM production potential for the study area.

Millard County, as discussed previously, has the greatest number of total acres and the highest percent of total acres in early succession. This imbalance is further reflected when actual AUM production is compared with potential AUM's. Current AUM production in Millard County is only 33 percent of the potential production. Potential AUM's from Millard County range sites are 1,129,849 as compared with present production of 370,538 AUM's.

Sanpete County which has the least number of acres in early succession and the highest number of total acres in potential condition also has the highest percent of potential AUM production. Range sites in Sanpete are producing 64 percent of the ecological forage potential. Existing production is 238,517 AUM compared to the potential of 374,441 AUM's.

Potential AUM production estimates for each county and current production totals are compared in Tables 17 thru 23.

Table 17. Estimates of potential AUM production, percent of potential AUM production and current AUM production for counties in the Six-County Area of Utah.

County	Potential AUM's	Current AUM's	Percent of Potential AUM's Now Produced
Sanpete	374,441	238,517	64
Piute	279,997	157,327	56
Wayne	538,427	281,033	52
Sevier	753,231	368,230	49
Millard	1,129,849	370,538	33

Table 18. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from desert sites in the Six-County Area.

County	Current AUM Production	Current Acres to AUM Ratio	Potential AUM Production	Potential Acres to AUM Ratio	Percent of Potential AUM's Now Produced
Millard	166,293	13:1	439,952	3.5:1	26
Juab	112,234	7:1	226,614	3.5:1	50
Wayne	43,321	13:1	113,551	5 :1	38
Sevier	1,111	23:1	5,101	5 :1	22
Six-County Area	272,959	10.6:1	785,218	3.7:1	35

Table 19. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from semidesert sites in the Six-County Area.

County	Current AUM Production	Current Acres to AUM Ratio	Potential AUM Production	Potential Acres to AUM Ratio	Percent of Potential AUM's Now Produced
Millard	76,136	8.0:1	228,865	3.0:1	33
Juab	74,983	7.0:1	172,382	3.0:1	43
Sanpete	21,322	6.5:1	46,115	3.0:1	46
Sevier	10,707	6.0:1	21,111	3.0:1	51
Wayne	9,582	20.0:1	51,441	4.0:1	19
Piute	3,874	8.5:1	8,894	3.5:1	44
Six-County Area	196,604	8.0:1	528,808	3.0:1	37

Table 20. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from upland sites in the Six-County Area.

County	Current AUM Production	Current Acre to AUM Ratio	Potential AUM Production	Potential Acres to AUM Ratio	Percent of Potential AUM's Now Produced
Juab	117,537	3.0:1	199,663	1.5:1	59
Sanpete	59,009	3.0:1	96,441	2.0:1	61
Sevier	39,660	5.0:1	102,862	2.0:1	36
Millard	38,724	4.0:1	94,300	2.0:1	40
Wayne	15,466	7 :1	43,412	2 :1	36
Piute	16,179	6.5:1	57,044	2 :1	28
Six-County Area	286,575	3.8:1	593,722	1.8:1	48

Table 21. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from mountain sites in the Six-County Area.

County	Current AUM Production	Current Acre to AUM Ratio	Potential AUM Production	Potential Acres to AUM Ratio	Percent of Potential AUM's Now Produced
Sevier	116,121	3 :1	270,895	1.4:1	43
Millard	72,330	4 :1	229,723	1.3:1	31
Sanpete	42,418	3 :1	80,872	1.5:1	52
Wayne	38,252	3.4:1	80,826	1.6:1	47
Juab	35,607	3.6:1	90,886	1.4:1	39
Piute	25,052	3.5:1	44,121	2 :1	57
Six-County Area	329,780	3.4:1	797,323	1.4:1	41

Table 22. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from high mtn. sites in the Six-County Area.

County	Current AUM Production	Current Acre to AUM Ratio	Potential AUM Production	Potential Acres to AUM Ratio	Percent of Potential AUM's Now Produced
Sevier	175,540	1.4:1	297,692	.8:1	43
Wayne	161,182	1 :1	232,573	.8:1	69
Piute	99,385	1.4:1	142,738	1 :1	70
Juab	17,995	1.6:1	38,788	.8:1	46
Millard	17,359	1.2:1	27,290	.8:1	64
Sanpete	14,654	1.2:1	20,216	.9:1	72
Six-County Area	486,115	1.3:1	759,297	.8:1	64

Table 23. Potential and current AUM production, acres to AUM ratios, and percent of potential AUM's now produced from wetland sites in the Six-County Area.

County	Current AUM Production	Current Acre to AUM Ratio	Potential AUM Production	Potential Acres To AUM Ratio	Percent of Potential AUM's Now Produced
Sanpete	101,114	.6:1	130,797	.5:1	77
Millard	49,696	1.2:1	108,439	.6:1	46
Juab	32,945	1.6:1	71,406	.8:1	46
Sevier	25,091	1 :1	55,570	.5:1	45
Wayne	13,230	1.6:1	16,624	1.3:1	80
Piute	12,837	1.4:1	27,200	.7:1	47
Six-County Area	234,913	1 :1	410,036	.6:1	57

Increased Forage from Depleted Sites

While the range condition concept was still in its infancy, Dyksterhuis (1949) suggested that some rangelands which have retrogressed successionally will actually produce more forage than the same rangeland in excellent condition. Range site data for several range sites in the Six-County area tends to support this concept.

Data from fifteen inventoried range sites, indicates that one or more of the following situations applies to each of these sites: (1) a site in early succession produces more forage than that same site in mid succession; (2) a site in mid succession produces more forage than that same site in late succession; (3) a site in late succession produces more forage than that same site in potential condition (Table 24).

From these sites there are 573,427 acres in various condition classes which are producing more forage in the current condition class than would be produced from the same acreages in the next higher condition class, e.g., Desert loam in good condition produces more forage than does Desert loam in excellent condition. In the event that all of the above mentioned acres were to improve one condition class, 36,900 AUM's would be lost due to the reduction in total forage production.

Table 24 illustrates the difference in forage production for those sites discussed above.

Table 24. Average annual forage production differences by condition class where a lower or more depleted site produces more forage than that site in a higher condition.

Site	Pounds of Forage Early Succession From Sites	Pounds of Forage Mid Succession From Sites	Pounds of Forage Late Succession From Sites	Pounds of Forage Potential Condition From Sites
Salt Meadow		1523	952	
Semiwet Meadow		3510	2115	2232
High Mountain Stony Loam (Aspen)			950	900
Mountain Gravelly Loam	364	264		
Mountain Loam (Summer precipitation)	1064	907	790	851
Upland Gravelly Loam			1122	858
Upland Stony Loam			1095	897
Semidesert Alkali Flat			806	813
Semidesert Loam	435	416	536	485
Semidesert Loam (Summer precipitation)		420		413
Desert Alkali Flats		264	245	
Desert Flats			684	603
Desert Loam	320	308	619	546
Desert Shallow Loam			254	240
Desert Silt Flats			581	490

Succession Towards Potential

Under livestock grazing systems plant communities follow successional patterns which are influenced by the class of livestock utilizing the forage. Plant composition will be influenced greatly by the type of grazing pressure on the range site, e.g., sheep utilization favors the increase, in relative plant composition, of grass and grass-like species while cattle grazing favors browse and forb populations at the expense of grasses and grass-like plants. Grazing of certain sites by sheep and cattle, under proper stocking rates and by proper season use, has been shown to be a desirable system which allows for plant communities to remain constant or progress toward the near climax vegetation (Frischknecht and Harris 1973; Workman, Malechek and Smith 1972).

During the 1950's and 1960's the U.S. Forest Service and BLM divided many Federal rangelands into separate cattle and sheep allotments. Since initiating this practice the sheep ranges on High Mountain, Mountain and Upland sites have generally followed successional patterns so that these ranges now produce heavy yields of relatively unused grass and sedges. On similar sites used by cattle the same system of succession has produced plant communities dominated by browse and forbs which receive only minor grazing use from cattle.

Also, the nature of cattle is to avoid grazing steep slopes and heavily wooded sites, while sheep will readily graze woodlands and steeper slopes. Each year many acres of steep slopes and woodlands on high elevation cattle ranges are not profitably used because of these natural habits of the cattle. Likewise, many acres of wetland sites receive only minimal use by sheep.

It is very unlikely that the current or potential annual forage production from the Six Counties will ever be totally utilized by livestock grazing in single class (species of animal) systems. Because different classes of animals prefer and utilize forage species at different levels of use, many plants are under utilized when grazing is limited to one species. Also, many plant species are under utilized when single season grazing is the practice.

Range managers must also realize that cattle and sheep have morphological differences which make each more suitable than the other for the harvest of different plant species and areas of rangeland. The narrow pointed nose and prehensile lips of sheep and goats provide these animals with definite advantages in harvesting browse plants, especially those with dense branches, spines and small delicate leaves, e.g., black brush (Coleogyne ramossima). As opposed to sheep and goats, cattle with their wide mouth opening and large incisor teeth are better adapted for the harvest of tall, coarse grass or grasslike plants.

With the current world demand for red meat and with calls for increased forage production (USDA 1978), the author suggests that a policy of common grazing of cattle, sheep, and/or goats be readopted, where feasable, by the Federal land management agencies. Where possible, private land should be utilized in the same manner. However, caution should be practiced so as not to disrupt economically sound ranching operations which are contributing to the socioeconomic welfare of rural southern Utah.

Common grazing of cattle and sheep not only provides additional AUM production but should provide the range manager with a wider variety of options for rangeland manipulation and improvement.

If policy must direct that the single species (animal) grazing systems be maintained, then where possible, cattle and sheep producers might periodically switch grazing units. Such practices would help prevent communities from successionally moving in directions which favor the establishment of one vegetation type, i.e., shrubs.

Considerations

If all rangelands of central Utah would ever again reach the potential condition status, it is doubtful that the same level of grazing could exist that occured during the early 1900's.

Several situations and/or husbandry practices which existed during the grazing boom years are not evident today. Livestock producers during the grazing "hayday" utilized higher percentages of the plant material than is utilized under current grazing systems (Work Project Administration). The proper use concept was not adhered to during that period, and livestock probably utilized older plant material, for forage, which had accumulated over many years. Precipitation during the years 1900 and 1930 were considerably higher than for any extended period between 1700 and 1970 (Stockton, Meko and Mitchell, 1978). This period of unusually high precipitation probably resulted in higher than normal forage production on central Utah rangelands.

Rangeland use by livestock probably precludes most, if not all, range sites from proceding to the potential condition or near pristine condition. Some transitory plant species may not be able to tolerate even light grazing by livestock. The nature and instinct of livestock to congregate around water holes and other key areas and to utilize these preferred areas beyond the proper use level will prevent such

areas from advancing to the potential condition. Under practical livestock grazing systems there will be areas which must be sacrificed.

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the Animal Unit Month (AUM) production from rangelands in the Six-County Area of central Utah. Also, to determine the rangeland acreage and estimate potential rangeland forage production in the Six-County Area.

Specific objectives of this study were to determine:

Range site acreages by condition class within the six counties.

Present grazing capacity (Animal Unit Months) of rangeland in this study area.

Potential carrying capacity (Animal Unit Months) of range lands within this study area.

The study area consisted of Millard, Juab, Wayne, Sevier, Sanpete, and Piute counties in central Utah. Total inventoried acreage was 10,861,440 acres.

Rangeland acreages by range site and range condition class were compiled from survey maps, site information and inventories conducted by the Soil Conservation Service. United States Forest Service and Bureau of Land Management range conservationists assisted in estimating range site acreages by condition class on the federally administered rangelands. The inventory portion of the investigation was coordinated by the U.S. Soil Conservation Service field staff in the study area.

Present and potential carrying capacity (AUM production) was determined by the following formula:

$$AUM = \frac{TA \times AHP \times PF \times 0.5}{800}$$

where,

TA = total site acreage by condition class

AHP = average annual herbage production

FF = forage factor (mean percent forage)

0.5 = proper use factor (percent forage use under proper management

800 = pounds of air dry forage required for one cow unit for one month

Site data from the study was consolidated and reported according to climatic zone.

Comparisons of forage production were made between climatic zones and between range condition classes within each zone. Average acres of rangeland required to produce one AUM were also determined for each climatic zone and for each condition class in those zones.

The important findings of this study are:

1. Total inventoried range land in its study area is 7,581,197 acres.

2. Climatic zones ranked by total acres are: (1) Desert, 2,894,950 acres; (2) semidesert, 1,601,355 acres (3) mountain, 1,130,984 acres; (4) upland, 1,090,757 acres; (5) high mountain, 325,621 acres; (6) wetland 237,530 acres.

3. Fifty-seven percent of range land acres in the study area are rated as early succession range, twenty-nine percent are rated mid

succession, eleven percent are rated late succession and three percent are classed as potential condition range.

4. Actual AUM production in the study area is 1,806,946 or 47 percent of the potential. Estimated potential AUM production is 3,875,684.

5. Rangelands in the desert zone have retrogressed successionally farther than lands in other zones. The desert zone now produces only 35 percent of its potential forage production. Lands in the high mountain zone have regressed less than all other zones. High mountain forage production is 64 percent of potential. Other zones and percent of potential forage production are: upland, 48 percent; wetlands, 47 percent; mountain, 41 percent and semidesert, 37 percent.

6. Rangeland in Sanpete County has regressed successionally less than rangeland in the five other counties. Millard County ranges have regressed farther from the pristine than the rangeland in the rest of the study area. Counties ranked by percent of potential vegetation now being produced are: (1) Sanpete 64% (2) Piute 56% (3) Wayne 52% (4) Sevier 49% (5) Juab 49% and (6) Millard 33%.

7. Fifteen range sites in the Six-County Area actually produce more forage if deteriorated one, two or three range condition classes.

8. Rangeland climatic zones ranked according to total annual forage production per acre are: (1) Wetland (2) High Mountain (3) Mountain (4) Upland (5) Semidesert and (6) Desert.

Conclusions

As a result of the analysis of data obtained in this study, the following conclusions were made:

1. Desert range sites in the Six-County Area have successionally retrogressed farther than the plant communities in other climatic zones included in the study.

2. High mountain range sites are presently more stable, successionally, then the sites in other climatic zones.

3. Most range sites follow a pattern that the higher the condition class the higher the average annual forage production while some range sites produce more forage if deteriorated one, two, or three condition classes.

4. Except in the case of wetland sites, the higher the average annual precipitation the higher the average range condition for those sites.

5. The wetland zone produces more total forage production per acre than does any other zone in the study.

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APPENDIXES

Appendix A.

Range Site Summaries

Table 25. Range site summary for Millard County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Desert Alkali Bench	83500	79325	1552	4175	130					9785	1682
Desert Alkali Flats	197000	197000	4771							46172	4771
Desert Alkali Sand	50500	47975	2804	2525	383					13098	3187
Desert Flats	322000	315560	11834	6440	1689					121354	13523
Desert Gravelly Loam	328000	311600	8033	16400	2440					98400	10473
Desert Loam	389000	350100	70020	38900	7506					132746	77526
Desert Sandy Flats	50500	50500								3788	0
Desert Sant	5950	5950	178							1859	178
Desert Shallow Loam	85000	80750	4416	4250	537					12750	4953
Sub Total	1511450	1438760	103608	72690	12685					439952	116293
Semidesert Alkali Flat	172500	163875	13315	8625	2818					76816	16133
Semidesert Limy Loam	141000	77550	1636	56400	10046	7050	1627			49967	13309
Semidesert Loam	126720	65280	11782	32000	8330	19200	6435	10240	3105	38420	35652
Semidesert Sand	11000	9900	520	550	46	550	147			3945	713
Semidesert Shallow Loam (10" - 12")	59000	47200	811	11800	900					19783	1711
Semidesert Silt Loam	69000	58650	4234	10350	1320					23126	5554
Semidesert Stony Loam	59000	50150	1128	8850	1936					17700	3064
Sub Total	638220	472605	39426	128575	25396	26800	8209	10240	3105	228865	76136
Upland Gravelly Loam	25000	16250	1904	6250	1504	2000	1403	500	268	13406	5079
Upland Loam	40000	20000	4384	7200	3067	2800	2030	10000	8020	32081	17501
Upland Shallow Hardpan (JP)	10000	9500	393	500	53					3023	446
Upland Shallow Loam	9500	6050	715	1900	761	950	449	600	416	6591	2341
Upland Shallow Loam (JP)	25000	21250	1029	3750	674					13457	1703
Upland Stony Loam	20500	13325	1685	5125	2599	2050	1403			11493	5687
Upland Stony Loam (NP)	32500	30225	5441	1625	526			650		14249	5967
Sub Total	162500	116600	15551	26350	9184	7800	5285	11750	8704	94300	38724

Table 25. Continued.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Mt. Gravelly Loam	90000	54000	12285	36000	5940					73786	18225
Mountain Loam	66500	33250	11232	33250	18724					71508	29956
Mt. Loam (Oak)	35000	8750	1028	26250	5578					15881	6606
Mt. Shallow Loam	70500	56400	6345	14100	3745					39260	10090
Mt. Stony Loam	35500	24850	3634	10650	3819					29288	7453
Sub Total	297500	177250	34524	120250	37806					229723	72330
High Mt. Loam (Aspen)	20500	615	338	12710	9652	6150	6004	1025	1365	27290	17359
Sub Total	20500	615	338	12710	9652	6150	6004	1025	1365	27290	17359
Alkali Bottoms	10500	9450	1595	1050	310					10336	1905
Salt Meadow	15000	10500	3946	3000	2855	1500	893			26719	7694
Semiwet Meadows	19500	15600	15746	3900	4826					27209	20572
Wet Meadows	15500	12400	11334	3100	8191					44175	19525
Sub Total	60500	47950	32621	11050	16182	1500	893			108439	49696
Total	2690670	2253780	226068	371625	110905	42250	20391	23015	13174	1129849	370538

Table 26. Range site summary for Juab County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Desert Alkali Bench	44000	13200	258	26400	825	4400	265			5156	1348
Desert Alkali Flats	152500	61000	1477	61000	10046	30500	4670			35742	16193
Desert Alkali Sand	39500	11850	692	23700	3599	3950	633			10245	4924
Desert Flats	170500	68200	2558	68200	17887	34100	13544			64257	35989
Desert Gravelly Loam	174500	69800	1800	69800	10383	34900	6714			52350	18897
Desert Loam	127000	50800	10160	50800	9803	25400	9824			43339	29787
Desert Salt Flats	49000	19600	0	19600	1145	9800	622			3675	1767
Desert Sand	24000	14400	431	9600	1761					7500	2192
Desert Shallow	29000	8700	476	17400	2200	2900	461			4350	3137
Sub Total	810000	317550	17852	346500	57649	145950	36733			226614	112234
Semidesert Alkali Flat	23500	18800	1528	4700	1536					10465	3064
Semidesert Gravelly Loam	20500	14350	224	6150	778					7745	1002
Semidesert Limy Loam	76500	22950	377	45900	6455	7600	1463			22089	8295
Semidesert Loam	95000	19000	5175	47500	12365	19000	6368	9500	2880	29676	26788
Semidesert Loam (10"-12")	202000	40400	694	111100	8471	50500	11007			67733	20172
Semidesert Silt Loam	22000	11000	794	8800	1122	2200	506			7374	2422
Semidesert Stony Loam	91000	36400	819	45500	9953	9100	2468			27300	13240
Sub Total	530500	162900	9611	269650	40680	88450	21812	9500	2880	172382	74983
Upland Gravelly Loam	35000	21000	2461	14000	3369					18769	5830
Upland Loam	108000	21600	4735	54000	23001	21600	15660	10800	8662	86619	52058
Upland Shallow Loam	5500	1100	130	3025	1212	1375	650			3816	1992
Upland Shallow Loam (JP)	36500	14650	710	14650	2632	3600	1491	3600	1938	19647	6771
Upland Stony Loam	70000	14000	1770	42000	21295	14000	9581			39244	32646
Upland Stony Loam (JP)	72000	36000	6480	28800	9315	7200	2445			31568	18240
Sub Total	327000	108350	16286	156475	60824	47775	29827	14400	10600	199663	117537

Table 26. Continued.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Mt. Gravelly Loam	51000	20400	4641	25500	4208	5100	2174			41812	11023
Mt. Loam	3500	175	59	2800	1577	525	480			3764	2116
Mt. Loam (Oak)	20000	7000	823	10000	2125	3000	1350			6075	4298
Mt. Shallow Loam	23500	4700	529	12925	3433	4700	2009	1175	654	11897	6625
Mt. Stony Loam	29500	5900	863	14750	5289	8850	5393			24338	11545
Sub Total	127500	38175	6915	65975	16632	22175	11406	1175	654	90886	35607
High Mt. Loam	5000	1000	658	1500	788	2500	2048			6172	3494
High Mt. Loam (Aspen)	24500	19600	10780	4900	3721					32616	14501
Sub Total	29500	20600	11438	6400	4509	2500	2048			38788	17995
Alkali Bottoms	17500	17500	2953							17227	2953
Salt Meadows	9000	8100	3044	900	856					16031	3900
Semiwet Meadows	11000	8800	8883	2200	2723					15348	11606
Wet Meadows	8000	4000	3656	3200	8455	800	2375			22800	14486
Sub Total	45500	38400	18536	6300	12034	800	2375			71406	32945
Total	1870000	685975	80638	851300	192328	307650	104201	25075	14134	799739	391301

Table 27. Range site summary for Wayne County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Desert Alkali Flat	86000	68800	1666	17200	2833					20156	4499
Desert Flat	25500	25500	956							9610	956
Desert Gravelly Loam	26500	19875	512	5300	788	1325	255			7950	1555
Desert Loam	79000	63200	12640	7900	1524	7900	3056			26959	17220
Desert Loamy Shale	49000	49000	427							5053	427
Desert Salt Flats	28500	25650	0	2850	167					2138	167
Desert Sand	61500	24600	736	18450	3383	12300	2326	6150	1922	19219	8367
Desert Shallow Loam	92500	69375	3794	18500	2339	4625	735			13875	6868
Desert Shallow Shale	81000	48600	743	16200	316	8100	233	8100	456	4556	1748
Southern Desert Loam	4500	1800	29	1125	120	1575	262			996	411
Southern Desert Sand	12000	4800	143	3600	253	2400	335	1200	273	2734	1004
Southern Desert Stony Loam	2500	1250	12	375	14	625	43	250	30	305	99
Sub Total	584500	402450	21658	91500	11737	38850	7245	15700	2681	113551	43321
Semidesert Loam (Summer Precipitation)	16000	16000	1538							4313	1538
Semidesert Sand (Summer Precipitation)	59000	59000	5033							28209	5033
Semidesert Shallow Loam (P.J.)	58500	52650	0	5850	155					3885	155
Southern Semidesert Loam	22000	15400	809	4400	470	2200	284			5528	1563
Southern Semidesert Shallow Loam	39000	31200	659	7800	634					9506	1293
Sub Total	194500	174250	8039	18050	1259	2200	284			51441	9582

Table 27. Continued.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Upland Loam (JP) (WS)	26600	21000	952	2100	315	2100	494	1400	569	1375	2330
Upland Loam (SP)	38000	19000	3895	4560	1532	3040	1577	3040	1577	19718	10659
Upland Shallow Loam (SP)	4000	2400	73	800	63	480	107	320	179	2243	422
Upland Stony Loam (J) (SP)	14000	11900	893	2100	566					6038	1459
Southern Upland Stony Loam (PJ)	19000	16150	442	2850	154					4038	496
Sub Total	101600	70450	6255	19250	4753	7140	2133	4760	2325	43412	15466
Mtn. Gravelly Loam (SP)	10000	300	656	4000	1295	3000	1539			6738	3490
Mt. Loam (SP)	31500	9450	1528	12600	5113	6300	3386	3150	1877	18767	11904
Mt. Shallow Loam (PP, Shrub)	5000	2000	141	1500	123	950	141	550	133	1031	518
Mt. Shallow Loam (SP)	36800	17250	1375	2300	341	17250	4744			23934	6460
Mt. Stony Loam (SP)	45500	13650	2986	18200	5892	13650	7002			30656	15880
Sub Total	128800	45350	6686	38600	12764	41150	16812	3700	1990	80826	38252
High Mt. Loam (Aspen)	102000	10200	5610	45900	34855	25500	24894	20400	27158	135788	92517
High Mt. Stony Loam (Aspen)	8000	800	175	3600	1468	2000	1188	1600	900	4500	3731
High Mt. Loam (SP)	65625	3125	967	9375	4084	34375	33516	18750	26367	92285	64934
Sub Total	175625	14125	6752	58875	40407	61875	59598	40750	54425	232572	161182
Alkali Bottoms	11500	9200	1553	1150	340	1150	498			11320	2391
Salt Meadow	3500	700	263	2800	2664					6234	2927
Semiwet Meadows	6500	1300	1312	3250	4022	1950	2578			9070	7912
Sub Total	21500	11200	3128	7200	7026	3100	3076			16624	13230
Total	1170525	717825	52518	233475	77946	154315	89148	64910	61421	538427	281033

Table 28. Range site summary for Sevier County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Desert Alkali Flats	6000	4500	109	1500	247					1406	356
Desert Flats	5000	4000	150	1000	262					2138	412
Desert Loamy Shale	6000	5500	48	500	13					619	61
Desert Salt Flats	3500	3500								263	
Desert Shallow Loam	4500	4000	219	500	63					675	282
Sub Total	25000	21500	526	3500	585					5101	1111
Semidesert Alkali Flat	5500	4700	477	800	261					2449	738
Semidesert Limy Loam	8000	5000	22	2500	352	500	96			2310	470
Semidesert Loam	23500	10000	2723	7500	1952	5000	1676	1000	303	7125	6654
Semidesert Silt Loam	15000	12000	866	2500	319	500	115			5027	1300
Semidesert Stony Loam	14000	8000	180	5000	1094	1000	271			4200	1545
Sub Total	66000	39700	4268	18300	3978	7000	2158	1000	303	21111	10707
Upland Gravelly Loam	47000	15000	230	25000	997	6000	747	1000	308	14476	2282
Upland Loam	26500	10500	2302	10000	4259	5000	3625	1000	802	21234	10988
Upland Loam (JP)	5000	3500	123	1000	310	500	282			3328	713
Upland Shallow Hardpan (JP)	13000	12000	497	1000	105					3930	602
Upland Shallow Loam	23000	12500	1477	8000	3206	2500	1181			15956	5864
Upland Shallow Loam (JP)	14500	7500	363	7000	1258					7805	1621
Upland Stony Loam	8500	2500	316	3000	1521	1000	684	2000	1121	4765	3642
Upland Stony Loam (JP)	71500	64000	11520	7500	2426					31348	13946
Sub Total	209000	127500	16828	62500	14082	15000	6519	4000	2231	102862	49660

Table 28. Continued.

Range Site	Total Acres	Early Succession Sites	AUM's From Early Succession Acres	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Mt. Gravelly Loam	70500	3000	683	18500	3053	48000	20460	1000	820	57799	25016
Mt. Loam	54500	10000	3378	37500	21117	5000	4569	2000	2151	58605	31215
Mt. Loam (Oak)	26000	8000	940	15000	3118	3000	1350			12870	5478
Mt. Loam (Pon. Pine)	2500	2000	59	500	25					484	84
Mt. Shallow Loam	149000	90000	10125	34000	9031	20000	8550	5000	2784	82974	30490
Mt. Stony Loam	70500	23000	3364	35500	12730	10000	6094	2000	1650	58163	23838
Sub Total	373000	136000	18549	141000	49144	86000	41023	10000	7405	270895	116121
High Mt. Loam	100000	15000	9878	65000	34125	15000	12291	5000	6172	123438	62466
High Mt. Loam (Aspen)	123500	25000	13750	38500	29236	50000	48813	10000	13313	164410	105112
High Mt. Stony Loam (Aspen)	17500	3500	766	5800	2365	7000	4256	1200	675	9844	7962
Sub Total	241000	43500	24394	109300	65726	72000	65260	16200	20160	297692	175540
Alkali Bottoms	2000	2000	338							1969	338
Salt Meadow	9000	7500	2818	1500	1427					16031	4245
Semiwet Meadows	6500	4400	4441	2000	2475	100	132			9070	7048
Wet Meadows	10000	7500	6855	2500	6605					28500	13460
Sub Total	27500	21400	14452	6000	10507	100	132			55570	25091
Total	941500	389600	79017	340600	144022	180100	115092	31200	20099	753231	368230

Table 29. Range site summary for Sanpete County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Semidesert Alkali Flat	15974	14000	1138	1974	645					7113	1783
Semidesert Limy Loam	10061	7000	148	2000	356	900	208	161	57	3505	766
Semidesert Loam	22407	5000	1362	14000	3644	3000	1005	407	123	6794	6134
Semidesert Shallow Loam 10"-12"	36396	16000	275	15000	1144	4000	862	1396	468	12204	2749
Semidesert Stony Loam	54797	14000	315	30000	6563	8000	2170	2797	839		9857
Sub Total	139635	56000	3238	62974	12352	15900	4245	4761	1487	46115	21322
Upland Clay	2291	700	49	700	150	700	303	191	96	1147	598
Upland Loam	18899	2500	548	10000	4259	3300	2393	3099	2485	15150	9865
Upland Shallow Hardpan (JP)	28443	5443	225	12000	1260	9000	1702	2000	605	8600	3792
Upland Shallow Loam (JP)	22444	3044	147	15000	2695	3000	1242	1400	754	15311	4838
Upland Shallow Shale	22242	8000	945	12000	4809	2000	945	242	168	15430	6867
Upland Stony Loam	20188	1500	190	11000	5577	5000	3422	2688	1507	11318	10696
Upland Stony Loam (JP)	67250	4250	765	38000	12291	15000	5093	10000	4384	29485	22533
Sub Total	181757	25437	2869	98700	31041	38000	15100	19620	9999	96441	59009
Mountain Clay	6875	1800	705	3500	2157	1100	804	475	461	6669	4127
Mtn. Gravelly Loam (Oak)	3033	900	89	1400	383	600	349	133	111	2521	932
Mtn. Loam	6970	2400	811	3400	1915	770	704	400	430	7495	3860
Mtn. Loam (Oak)	40102	8000	940	25000	5313	6000	2700	1102	500	18196	9453
Mtn. Shallow Loam	9098	4000	450	3500	957	1200	513	398	222	5066	2142
Mtn. Stony Loam	49606	15000	3938	20000	8925	12000	6891	2606	2150	40925	21904
Sub Total	115684	32100	6933	56800	19650	21670	11961	5114	3874	80872	42418
High Mtn. Loam	6531			4000	2100	2000	1639	531	655	8062	4394
High Mtn. Loam (Aspen)	7421			1421	1079	3000	2929	3000	3994	9879	8002
High Mtn. Stony Loam (Aspen)	4044			744	354	1500	891	1800	1013	2275	2258
Sub Total	17996			6165	3533	6500	5459	5331	5662	20216	14654

Table 29. Continued.

Range Site	Total Acres	Early Succession Sites	AUM's From Early Succession Acres	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potantial AUM's	Actual AUM's
Alkali Bottoms	16850	12000	2025	3500	1034	1350	585			16587	3644
Salt Meadow	6747	1600	601	2347	2233	2500	1488	300	534	12018	4856
Semiwet Meadows	8965	1800	1817	3000	3713	3700	4891	465	648	12509	11069
Wet Meadows	31468	4000	3656	10468	27658	15000	44531	2000	5700	89683	81545
Sub Total	64031	19400	8099	19315	34638	22550	51495	2765	6882	130797	101114
Total	519102	132937	21139	243954	101214	104620	88260	37591	27904	374441	238517

Table 30. Range site summary for Piute County.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
Semidesert Loam (Summer Precip.)	8500	5950	572	2125	558	425	110			2291	1240
Semidesert Stony Loam (Summer Precip.)	24000	16800	1706	6000	633	1200	295			6603	2634
Sub Total	32500	22750	2278	8125	1191	1625	405			8894	3874
Upland Loam (Summer Precip.)	10500	6300	221	3675	1139	525	296			6989	1656
Upland Loam (JP) (SP)	11500	8625	391	2875	431					4672	822
Upland Loam (SP)	18000	10800	2214	6300	2020	900	302			9340	4536
Upland Shallow Loam (JP)	6500	4875	236	1625	292					3499	528
Upland Shallow Loam (SP)	21500	12900	393	7525	588	1075				12053	1221
Upland Shallow Shale	1900	1520	47	380	39					546	86
Upland Stony Loam (JP)	19500	14625	2633	4875	1577					8550	4210
Upland Stony Loam (SP)	19500	9750	317	7800	1804	1950	999			11395	3120
Sub Total	108900	69395	6452	35055	7890	4450	1831			57044	16179
Mt. Gravelly Loam (SP)	10500	4200	919	5250	1700	1050	539			7074	3158
Mt. Loam (Oak)	10000	4000	470	5000	1063	1000	450			4538	1983
Mt. Loam (SP)	19000	7600	5077	9500	5382	1900	938			10103	11397
Mt. Shallow Loam (PP)	6500	3900	177	2600	152					853	329
Mt. Shallow Loam (SP)	27500	11000	878	13750	2041	2750	756			11447	3675
Mt. Stony Loam (SP)	15000	6000	1313	7500	2428	1500	769			10106	4510
Sub Total	88500	36700	8834	43600	12766	8200	3452			44121	25052

Table 30. Continued.

Range Site	Total Acres	Early Succession Acres	AUM's From Early Succession Sites	Mid Succession Acres	AUM's From Mid Succession Acres	Late Succession Acres	AUM's From Late Succession Acres	Potential Condition Acres	AUM's From Potential Condition Sites	Potential AUM's	Actual AUM's
High Mt. Loam (Aspen) (SP)	80000	16000	10625	36000	21150	20000	13359	8000	6500	65000	51634
High Mt. Stony Loam (Aspen)	11000	1650	397	5500	2692	3300	2155	550	371	7425	5615
High Mt. Loam (SP)	50000	7500	2320	15000	6534	12500	12188	15000	21094	70313	42136
Sub Total	141000	25150	13342	56500	30376	35800	27702	23550	27965	142738	99385
Alkali Bottoms	4500	3600	608	900	266					4430	874
Salt Meadows	6500	5200	1954	975	928	325	193			11578	3075
Semiwet Meadows	7000	4200	4239	1750	2166	1050	1388			9767	7793
Wet Meadows	500	150	137	250	661	100	297			1425	1095
Sub Total	18500	13150	6938	3875	4021	1475	1878			27200	12837
Total	389400	167145	37844	147155	56244	51550	35274	23550	27965	279997	157327

Appendix B.

Forage Values

Table 31. Percent of average annual herbage production for range sites by condition class in the Six County Area of Utah which can be utilized as forage.

Site	Early Succession	Mid Succession	Late Succession	Potential Condition
Wet Meadows	.45	.89	.95	.96
Salt Meadows	.37	.58	.68	.95
Semiwet Meadows	.76	.90	.90	.95
Alkali Bottoms	.18	.45	.59	.90
High Mt. Loam	.43	.60	.76	.79
High Mt. Loam (Aspen)	.22	.36	.44	.60
High Mt. Stony Loam (Aspen)	.20	.30	.40	.50
High Mt. Loam (S.P.)	.15	.25	.55	.74
High Mt. Loam (Aspen) (S.P.)	.25	.40	.45	.65
Mt. Loam (S.P.)	.95	.74	.79	.84
Mt. Gravelly Loam (S.P.)	.20	.37	.67	.77
Mt. Shallow Loam (S.P.)	.15	.25	.55	.74
Mt. Stony Loam (S.P.)	.20	.37	.67	.77
Mt. Shallow Loam (Ponderosa Pine, Shrub)	.10	.15	.25	.30
Mt. Shallow Loam (Ponderosa Pine)	.10	.15	.25	.30
Mt. Loam (Oak)	.08	.20	.36	.44
Mt. Loam	.23	.63	.86	.93
Mt. Gravelly Loam	.26	.33	.62	.99
Mt. Stony Loam	.24	.51	.75	.88
Mt. Shallow Loam	.16	.50	.72	.81
Mt. Gravelly Loam (Oak)	.15	.35	.60	.70
Mt. Clay	.38	.68	.78	.97
Upland Loam	.23	.58	.60	.70
Upland Clay	.18	.55	.71	.89
Upland Stony Loam	.33	.59	.73	.92
Upland Stony Loam (J.P.)	.24	.30	.53	.61
Upland Shallow Loam (J.P.)	.05	.25	.50	.65
Upland Shallow Hardman (J.P.)	.05	.12	.22	.45
Upland Shallow Shale	.27	.57	.63	.74
Upland Gravelly Loam	.25	.44	.68	.88
Upland Stony Loam (J) (S.P.)	.10	.25	.42	.60
Upland Loam (J.P.) (W.S.)	.05	.20	.35	.50
Upland Shallow Shale (J.P.)	.05	.13	.26	.40
Southern Upland Stony Sand (J.P.)	.05	.15	.25	.40
Semidesert Loam	.15	.84	.59	.75
Semidesert Shallow Loam (P.J.)	.00	.45	.67	.69
Semidesert Sand (S.P.)	.21	.30	.66	.85
Southern Semidesert Shallow Loam	.05	.20	.40	.60
Southern Semidesert Loam	.15	.35	.50	.67
Semidesert Stony Loam	.09	.70	.70	.80
Semidesert Loam	.41	.49	.65	.66
Semidesert Shallow Loam 10"-12"	.10	.25	.45	.74
Semidesert Limy Loam	.05	.60	.72	.84
Semidesert Alkali Flats	.20	.51	.75	.75
Semidesert Gravelly Loam	.05	.30	.50	.78
Semidesert Silt Loam	.21	.51	.64	.65
Semidesert Shallow Loam 8"-10"	.43	.50	.60	.64
Semidesert Sand	.21	.51	.64	.65
Desert Gravelly Loam	.15	.56	.60	.80
Desert Silt Flats	.16	.63	.93	.98
Desert Alkali Flats	.05	.31	.25	.50
Desert Flats	.12	.78	.82	.67
Desert Loamy Shale	.15	.25	.40	.60
Desert Salt Flats	.00	.11	.14	.16
Desert Sand	.13	.34	.62	.80
Desert Shallow Shale	.15	.25	.40	.60
Desert Shallow Loam	.50	.85	.70	.64
Desert Loam	.80	.65	.97	.84
Desert Alkali Bench	.10	.2-	.35	.50
Desert Alkali Sand	.22	.27	.54	.83
Southern Desert Stony Loam	.05	.20	.40	.60
Southern Desert Loam	.05	.20	.38	.59
Southern Desert Sand	.10	.25	.54	.81

VITA

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