Appendix C. Considerations Concerning Stocking Rates

LAKESIDE RANGER DISTRICT
APACHE-SITGREAVES NATIONAL FORESTS
SOUTHWESTERN REGION
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CONSIDERATIONS CONCERNING STOCKING RATES

- 1 -

INTRODUCTION

Stocking is the placement of livestock on rangeland. A ***stocking rate*** is the number of specific kinds and classes of animals grazing a unit of land for a specified time. The total number of animals which can be sustained on a given area based on the proper use of the total forage resources available is referred to as ***grazing capacity***. This report presents various methodological factors and considerations used to determine grazing capacities for allotments scheduled for new or revised allotment management plans [AMPs] in 1999.

Capacity is based on a determination of total herbage production and of that portion which could be utilized by livestock and wildlife while achieving the Desired Future Condition (DFC) established for the allotment. Other factors affecting the capacity of an allotment include, availability of water, management techniques, allowable use levels, and class of livestock. An estimated grazing capacity for livestock will be determined for each pasture within an allotment to determine the length of time livestock may graze in that pasture. This will help the Forest evaluate whether permitted use is in balance with capacity, as directed by the Forest Plan standards and guidelines (p. 77-1). In development of an individual AMP, information presented will be used to evaluate the current management situation and differing management alternatives, including no livestock grazing.

It is important to recognize that stocking rates are but an estimate based on certain assumptions, such as an even distribution of animals or average climatic conditions. Estimation methods are designed to yield stocking levels close to what the land can appropriately carry. These levels may need to be modified after an AMP is implemented. Monitoring forage use in key areas must be done to ensure compliance with allowable use standards. Monitoring will help determine needed adjustments in stocking rates. Drought, which is fairly common in Arizona, will often necessitate temporary livestock reductions.

GRAZING CAPABILITY

Vegetation is produced on most acres of an allotment. Forage produced on every acre, however, may not be available for grazing use. In order to estimate forage available for grazing, a determination of which acreage can be grazed and of the amount of available forage will be made considering a combination of four factors: forage production, soil stability, distance from water, and steepness of slope.

A. Forage Production. Methods for estimating forage production are detailed in the following section. It should be noted here that range which produces 50 air-dried pounds or less of herbaceous forage (grass and forbs) per acre is not considered suitable for grazing. Such areas generally lack sufficient ground cover to protect the soil, or have a dense overstory canopy. This acreage is not included in the livestock capacity estimate (FSH 2209.21, Sec. 21).

B. Soil Stability. There are three classes of soil stability based on the status of current soil loss. Soil loss is expressed in tons/hectare/year (TES 1989 -- a hectare is about 2.5 acres) which can be equated to grazing capability classifications found in FSH 2209.21, Sec. 23.

Stable soils: Where the current soil loss is less than tolerance soil loss, the rangeland is considered stable and classed as full capacity [FC] range. Such areas are included in estimations of grazing capacity. These areas will be used by most animals in most situations. With proper allowable forage use, stable soils can be used without long term damage to the soil resource or plant community (FSH 2209.21, Secs. 21 and 23.1).

Impaired soils: Where current soil loss exceeds the tolerance soil loss, the rangeland has impaired soil stability and is classified as potential capacity [PC] range. Such areas usually are not included in the grazing capacity estimate. However, they may be included when the allotment is under intensive management with proper stocking and conservative allowable forage use (FSH 2209.21, Secs. 21, 23, and 53.3). For proposed actions on PC areas, the allowable forage utilization will be set at 10%, a level which will help reduce the possibility of overutilizing forage on FC sites.

Unstable soils: Where natural soil loss exceeds the tolerance soil loss, the rangeland has unstable soil conditions and is classified as no capacity [NC] range. It cannot be used by livestock without long term damage to the soil resource or plant community. These areas are not included in an estimated grazing capacity even though livestock use may occur (FSH 2209.21, Secs. 21 and 23.3).

C. Distance from Water. Holechek (1988:Table 4) cites the failure to adjust stocking rates for travel distance to water as being the cause of considerable range degradation in hot, arid rangelands such as the southwestern United States. Other authors have also identified the need to adjust stocking based on availability of water (Glendening 1944, Phillips 1965, Clary 1975, Pinchak et al. 1991, Hart et al 1991). Based on this information, adjustments to capacity were made by reducing the allowable forage use on stable, forage producing sites as shown in Table 1.

Table 1. Reduction in Cattle Grazing Capacity Based on Distance from Water

Distance (miles)	Grazing Capacity Reduction
< 1	None
1 - 2	50%
> 2	100% (considered ungrazable)

Unlike cattle, sheep do not require water every day and, because of herding, will use areas up to two miles from waters. Adjustments for distance from water are normally not considered for sheep (Holechek 1988:11), however site-specific information may indicate the need to do so.

D. Steepness of Slope. Holechek (1988:Table 3) provides guidelines for grazing capacity adjustments for terrain. Other authors have also identified the need to adjust stocking based on slopes(Cook 1966, Mueggler 1965, Goodwin 1962, Glendening 1944, Phillips 1965, Clary 1975, Pinchak et al. 1991, Ganskopp and Vavra 1987). Based on this

information, adjustments were made for cattle by reducing the allowable forage use on stable, forage producing sites as shown in Table 2.

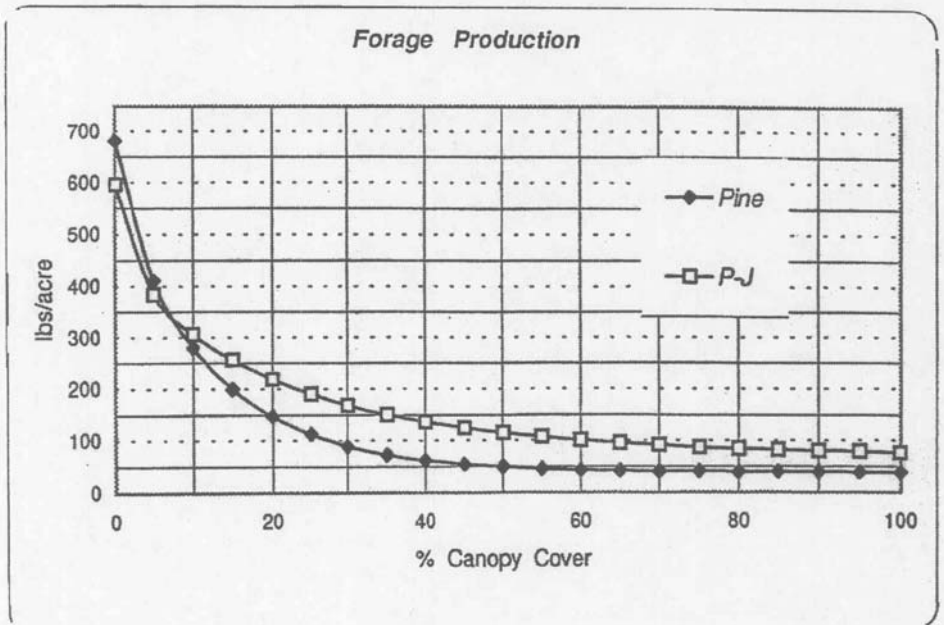
Table 2. Reduction in Cattle Grazing Capacity Based on Slope

Percent Slope	Grazing Capacity Reduction
< 11	None
11 - 30	30%
31 - 60	60%
> 60	100% (considered ungrazable)

Citing a study by McDaniel and Tiedeman (1981), Holechek *et al.* (1995:198) find that ``slopes greater than 45% should be considered unusable by sheep, but little or no adjustment appears necessary for slopes under 45%."

FORAGE PRODUCTION

Herbaceous forage production records for some allotments are more than 10 years old; such data are not considered usable for the present analyses. The scientific literature was reviewed to determine if methods exist to estimate forage production using vegetation data such as basal area or canopy cover. A number of studies were evaluated but not used because trial results in Forest study areas proved inconsistent with observed production (Ffolliott 1983; Bojorquez 1987; Uresk and Severson 1989; Peiper 1990, 1994; Tapia *et al.* 1990; Covington and Fox 1991; Mitchell and Bartling 1991). The studies by Jameson (1967) and Thill *et al.* (1983) did prove useful, however, Jameson's (1967) studies were conducted in northern and central Arizona, and included grass and forbs. His regression curves are used for the ponderosa pine forest and pinyon-juniper woodland. The formulas yield production data which are consistent with Forest observations; exceptions are found on volcanic soils at higher elevations (>8,000 feet) where production is generally somewhat higher.



Thill *et al.*'s (1983) studies were conducted in east-central Arizona, on the Alpine and Springerville Ranger Districts, and included browse, grass, and forbs. Their regression curves are used for the mixed conifer type. Most mixed conifer stands produce less than 50 pounds per acre.

The above formulas are used to calculate the initial production for the analysis area. This preliminary information is then incorporated into GIS and used to generate map of forage production for the allotment using the classes shown in Table 3 below. This table summarizes the regression estimations, and shows the forage production classes which are used in an initial categorization. (It should be noted that, since all the above-referenced equations are curvilinear functions, adjustments needed to be made at the upper and lower extremes; these adjustments were made based on available data.)

Table 3. Forage Production Classes (air-dried pounds per acre)

	700	600	500	400	300	200	100	< 50
Canopy Cover - %								
Ponderosa	0	-	-	1 - 9	10 - 14	15 - 19	20 - 40	> 40
PJ / Oak	-	0	-	1 - 9	10 - 14	15 - 25	26 - 65	> 65
MC / Aspen	< 1	-	-	-	1 - 16	17 - 21	22 - 43	> 43
Basal Area - ft^2/acre								
Ponderosa	-	-	1 - 14	-	15 - 24	25 - 35	36 - 85	> 85
MC / Aspen	<15	-	-	-	15 - 25	26 - 30	31 - 60	> 60

The initial forage production map will be verified and/or modified through field observations. Corrections to the production information will be made where needed, based on field estimates of production to be conducted by Clay Baxter, Rangeland Management Specialist, and Chris Nelson, Soil Scientist. Both these individuals have extensive experience and considered factors such as weather when estimating production.

PROPER FORAGE UTILIZATION

Proper forage use refers to the degree of grazing use plus trampling damage that individual species can sustain while maintaining vigor, forage production, and reproductive capacity. ***Allowable use*** is determined from proper use, and is the level of grazing use that can be permitted on an area when all influencing factors are considered. Allowable use values are a tool to improve range health and plant vigor. Current range conditions are based on a professional determination of the range condition for each allotment as verified during field reviews.

Deferment means that livestock grazing is not allowed in a pasture until grass seed set occurs. Typically, this is mid to late August on ranges where warm season species dominate, or late May where cool season species dominate. ***Rest*** means that livestock grazing does not occur in a pasture during a calendar year.

The level of allowable use is based on existing conditions, management strategy and the desired conditions. Allowable utilization levels will be 0 to 10% would improve conditions the fastest, utilization levels of 10 to 30% would also improve conditions, 30

to 35% would tend to stablize conditions, 35 to 45% would also tend to stablize conditions, but with a higher risk of causing a downward trend and 45%+ would not improve or maintain conditions and could cause a decline in conditions.

Allowable use will consider existing and desired conditions resource conditions, such as soils, watershed, range, wildlife, etc. If range conditions are expected to reach fair or better condition in a timely manner, a conservative allowable use should be employed.

Consideration is not provided for use levels that exceed 50%. Holechek's (1988) literature review indicates that 50% use levels appear applicable only to humid and to annual grasslands, situations not found on the Forest.

The allowable use figures are for FC range. If grazing capacity is assigned to PC range sites for analysis of alternatives, the allowable use factor will be 10% in order to assure FC range is not overused (FSH 2209.21, Sec 53.3). Some alternatives may be developed that would provide for a different allowable use because of issues brought up during scoping. In these cases, the allowable use on PC range should remain at the lesser, more conservative figure in an attempt to change the impaired sites to stable sites.

WILDLIFE FORAGE CONSUMPTION

Wildlife, particularly large ungulates, are notable consumers of herbaceous forage. Such utilization needs to be taken into account. Estimated wildlife density data were provided by the Arizona Game and Fish Department [AGFD] in the form of seasonal density maps for deer, elk, antelope, and bighorn sheep. These maps were digitized, entered into the Forest's GIS system, and then overlain by allotment boundaries so wildlife populations for each allotment could be estimated.

Holechek (1988) notes that a wide range of studies are consistent in showing that various wildlife ruminants consume about 2% of body weight per day in dry matter when forage availability is not restricted. The average body weight for wildlife species was furnished by AGFD. The average elk weighs some 535 pounds, mule deer about 125 pounds, white tail deer about 85 pounds, and antelope about 100 pounds (figures will vary by hunt unit).

Wild ungulates' diets are not solely herbaceous forage, both shrubs and trees comprising a varying proportion. The percentage of browse use varies by season for different species. In the AMP analyses, a reduction of total herbaceous forage needed by wild ungulates will be made to reflect the browse consumption. Herbaceous forage for elk was estimated at 80% of their total intake need for summer and 60% for winter; for deer, the estimates are 50% for summer and 30% for winter (see Brown 1990; Leege 1984; Miller *et al.* n.d.; Rowland *et al.* 1983; Severson and Medina 1983; Wallace 1984). Forage requirements for antelope were not adjusted because they utilize little browse in their diets. Table 5 shows average annual forage consumption for the ``typical" animal of a species; no consideration is made for gender or seasonal variations due to reproductive status or other factors. Further adjustments could be made for a specific allotment to account for local conditions.

Table 5: Average Annual Forage Consumption for Wild Ungulates.
(Dry Matter Equivalent, in Pounds)

Summer	Winter	Annual

Species	(182 Days)	(183 Days)	
Elk	1558	1175	2733
Mule deer	228	137	365
White tail deer	155	93	248
Antelope	364	366	730

LIVESTOCK FORAGE CONSUMPTION

Cattle: Information provided by Rice (1995) was used to determine forage requirements for cattle. His data were derived from the National Research Council Publication for estimating feed intake of food producing animals and adjusted "*for typical beef cows in Arizona*". This information may be used for livestock of various weights and for varying forage quality. For example, with medium forage quality and with a calf weighing 200 pounds, consumption of dry forage by a dry cow and cow-calf pairs of varying weight is shown in Table 6.

These figures equate to a forage requirement of 1.7% of body weight during the period calves are not with their mothers (normally the dormant plant period). This also equates to 2.9% of body weight when calves are present (normally during the plant growth period). Sprinkle (1998) indicated that an adequate estimate of forage needs for a 1,000 pound cow and calf would be 30 pounds of forage per month, or 3% of body weight, for North Central Arizona. Holechek (1988) provides comparable figures, stating that the daily forage demand is 1.5% of body weight during dormancy, while during the active growth period it is 2.5%. Utilizing this information, forage requirements for livestock will be calculated using 2.9% and 1.7% of live body weight for summer and winter respectively for all allotments analyzed.

Table 6. Seasonal Forage Intake Needs of a Dry Cow and a Cow-Calf Pair (Dry Matter Equivalent, in Pounds)

Dry Cow	April - October (214 Days)	September - May (151 Days)	Annual
Light (800 lbs)	2910	2054	4964
Medium (1000 lbs)	3638	2567	6205
Heavy (1200 lbs)	4366	3080	7446
Cow-Calf Pair			
Light cow/200 lb calf	5778	2054	7832
Medium cow/200 lb calf	6206	2567	8773
Heavy cow/200 lb calf	6848	3080	9928

Cattle may forage on browse species during the summer months. In most cases this use would be incidental except, perhaps, in the case of aspen. Thill *et al.*'s (1983) study includes aspen in the production data, so further consideration for browse use is not considered necessary.

Sheep: Forage requirements for sheep were derived from Ensminger (1978: Table 4-53). Daily forage demand for a ewe varies by size and reproductive status, ranging from as little as 1.6% of body wieght (heavy ewe, maintenance) to as much as 4.2% (light ewe,

first eight weeks of lactation). Table 7 summarizes data for ewes of different weights by reproductive period.

Table 7. Forage Intake Needs of a Ewe (Dry Matter Equivalent, in Pounds)

Ewe	Gestation I (First 15 weeks)	Gestation II (Last 6 weeks)	Lactation I (First 8 weeks)	Lactation II (Last 8 weeks)	Maintenance (15 weeks)	Ann
Light (110 lbs)	252	155	258	207	231	1,1(
Medium (143 lbs)	315	185	297	246	263	1,3(
Heavy (176 lbs)	347	202	319	269	305	1,4

Equivalents: An animal use month [AUM] is defined as one month's grazing by a dry cow. A permittee may prefer to graze cow-calf pairs, yearling cattle, or sheep, so there is a need to convert different kinds of livestock to equivalent AUMs. Table 8 provides the conversion factors (FSM 2200, R-3 Supp. 2200-91-1).

Table 8. Conversion Factors for Yearling Cattle and Sheep

Class	Factor	No. of Animals/AUM
Cow-calf Pair	0.76	1.32
Yearling Cattle		
Light (300 - 450 lbs)	0.55	1.82
Medium (450 - 650 lbs)	0.70	1.43
Heavy (650 - 800 lbs)	0.75	1.33
Sheep	0.20	5.00

LIVESTOCK CAPACITY

Livestock capacity for each alternative will be determined as follows:

1. Estimated forage production, as field verified, will be multiplied by acres and by the allowable use factor to determine the pounds of forage available for use. This will be done on FC and PC range by pasture. Further adjustments for soil stability, distance from water and/or slope may be made as described in Section II.
2. Livestock and wildlife forage requirements will be determined.
3. The available forage may be distributed for both wildlife and livestock. Alternatives may be developed to evaluate effects of forage distribution at varying ratios.
4. A capacity will be established for each pasture based on the amount of forage available for use and the forage requirements of both livestock and wildlife. The pastures' capacity (excluding holding traps) will be summed to establish a capacity for the allotment.

9 -

ACQUIRED LANDS

Since the Forest Plan was implemented (1987), a number of formerly private parcels have been acquired. Wildlife surveys indicate that some of these lands may be within big game critical winter range in some years, depending on snow level. In accordance with Forest Plan standards and guidelines (pg. 75-1), special consideration will be given to critical big game winter ranges in areas where winter range has been determined to be a limiting factor in achieving game management objectives. New land acquisitions in critical winter range areas will not be used for domestic livestock grazing unless their inclusion in a grazing system better meets big game objectives. The AMP analyses will evaluate the situation, as appropriate, and develop appropriate alternatives.

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