THE BLACK ROCK DEER HERD

Its life history, habitat, management and relation to livestock production

Special wildlife report
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WILDLIFE AND THE BUREAU OF LAND MANAGEMENT

With public domain comprising large areas in the west, the Bureau of Land Management has an important role in the management of wildlife. This responsibility is recognised by the Taylor Grazing Act, where specific provisions are made to safeguard wildlife interests on Federal range. The Bureau of Land Management in keeping within it's high standards of multiple use recognizes the importance of livestock production on public lands and must strive to minimize conflicts with livestock operations.

With great increases in human populations and need for future recreational areas the responsibility to increase wildlife activities is conspicuously heightened. Arizona, with its great population EXPANSION typifies the current and future demand for more hunting areas. Until recent years recreational interest on the Arizona Strip has been small. During the 1961 deer season an estimated 2,000 persons enjoyed hunting on the Arizona Strip District. In the near future recreational use on this area will greatly increase.

Successful use and proper management of our wildlife resource will require a close working relationship with the Arizona Game & Fish Department. Working as an integrated and cooperative team will effect maximum efficiency. Cooperative efforts in game census activities, recommending hunting seasons, construction and maintenance of access roads, assistance in game transplantings, and cooperative financing of projects benefiting wildlife will result in the maximum development of the wildlife resource of the Arizona Strip.

MULTIPLE USE ON THE NATIONAL LAND RESERVE

INTRODUCTION

In recent years the Bureau of Land Management, the Arizona Game and Fish Department, sportsman and local ranchers have become increasingly interested in the wildlife resource of the Arizona Strip. Special interest and concern have been focused on the deer herd that summers on Black Rock Mountain and the adjacent Virgin Mountains. The conflicting interests are typical of the problems involved in the administration and management of federal range. Of major consideration is the fact that this summer range area has the potential to support a relatively large deer population due to an abundance of excellent browse species, available water, isolation and general habitat. Hunters would welcome the increase in deer population. Local stockman whose livlihood is derived from the same area have expressed concern that the deer populations have increased to the point where they are seriously depleting the range and competing strongly with their livestock for forage.

Since it is the responsibility of the Bureau of Land Management to manage and administer ranges under its jurisdiction it is essential to effectively manage deer herds as well as livestock numbers, especially in areas such as this, where the deer are an important consideration and complicating factor.

The overall objectives of this study have been to determine the status of this deer herd and its relation to the livestock industry of the area. Special emphasis has been placed on obtaining information on carrying capacity, vegetation types, and range condition and trend of this range.

The field crew and contributors involved in this study are too many too include here. Field work was contributed by Range conservationist Vincent P. Ogurek, Rex L. Christensen, Raymond D. Mapston and Range Manger Marvin H. Woodbury. Special thanks is given to Harold Pratt and Levi Packard of the Arizona Game and Fish Department who provided valuable information and advice for the compilation of this report. Additional thanks is due local ranchers, old timers and other persons who provided considerable information for this report .

HISTORY

Black Rock Mountain and the higher slopes of the Virgin Mountains since the early 1900's have been an important source of forage for livestock. At the present time numerous livestock operations depend on these mountain areas as summer ranges for livestock.

During the early 1900's a large part of this area was grazed by large bands of sheep and horses. At the present time this range is used strictly for the production of beef, not excluding the wildlife resource and watershed values. The history of heavy grazing pressure by large numbers of domestic animals in combination with other factors have undoubtedly exerted strong effects on the range condition of this once highly productive area.

Oldtimers who lived in the area during the early 1900's say that deer were not seen until about 1910. Some old timers believe that the deer migrated from the Kaibab North while others theorize that deer have always been present in the area. The build up of the Black Rock Deer Herd seems to coincide closely with the growth of the livestock industry of the area. Until the time when ranchers began to develop water for livestock, sources of water were limited. With expanding ranch operations more watering places were constructed and deer dispersed into areas which were formerly unoccupied. This provided space, water and forage for additional numbers and the population build up began. For many years deer populations grew slowly under constant pressure from predators, poachers and natural mortality factors. With more effective law enforcement and increased removal of predators during the past 15 years this deer herd has thrived until at the present time deer are relatively abundant throughout much of the area.

DESCRIPTION OF STUDY AREA

The range area encompassed by this report is located in the extreme north-western part of Arizona on the Arizona Strip District ~~of~~ of the Bureau of Land Management. The range of the Black Rock Deer Herd takes in all that area from Seegmiller Mountain to the Virgin Mountains, but for the purpose of this report our studies have been concentrated on the Black Rock-Virgin Mountains area since most of the deer population is concentrated in this general area.

The rugged Virgin Mountain range is partially fused to Black Rock Mountain by a pinyon-juniper clad area known as Cougar Pass, but ~~are~~ is considered as a seperate set of mountains since the two are largely seperated by the huge canyonous depths of Sullivan Canyon and smaller Cottonwood Wash. The Virgins on its western side raises abruptly and scenically from desert creosote country at 2,000 feet elevation, through black brush, pinyon-juniper, and ponderosa pine to an elevation of 8,350 feet on the boulder covered mount Bangs.

Black Rock Mountain pushes up on its north end from dense blabk-brush at an elevation of 3,600 feet. As the elevation increases towards the black protruding rim rock a rather abrupt transition ~~from~~ to a pinyon-juniper-sagebrush rolling hill topography takes place. Near the western base of Wolfhole Mountain in stands of pinyon -juniper and ~~sh~~ snakeweed, the mountain forms a gentle but broken slope of brush and canyons. From its sandy southern origin, Black Rock juts up from a pinyon-juniper-sand sage mixture to high steep rim rocked cliffs and then at its highest point of 7,386 feet this upheaval of black basalti rock reveals itself to the surrounding country.

~~Figure : Looking west from Maple Springs Canyon on Black Mountain towards Wolfhole Mountain, showing both intermediate and summer range areas.~~

PROCEDURE

Range Surveys

Since deer and livestock are direct product of range plants, a large part of this study has been centered on the vegetation ~~of this area~~. In order to increase reliability and accuracy of this report several approved methods and techniques have been employed to analyze the overall range condition, vegetation types and forage production of this range area. Range surveys incorporated with observations of degree of utilization, range condition, and form and age classes of the key browse species have formed an intricate part of this study .

Carrying Capacity

The Ocular Reconnaissance method was used as an important phase of this study. This method is based upon the amount of forage per acre as indicated by plant density and the palatability of the different plant species. Proper use factors (palatability ratings) were taken from the Interagency plant list, with a few modifications for local conditions. The following factors are measured by the range examiner; (1) The average density of the plant cover (2) The percent ratio that each important species makes up of the average density (3) The area of the type. Making use of this information, a resonably accurate estimate of the carrying capacity can be determined.

Degree of Utilization

Key species are particularly useful in measuring forage utilization because they greatly simplify the process of measuring degree of cropping since amount of use on them is often indicative of the overall extent of browsing. It should be pointed out here, that no matter how palatable a plant is, it must occur in large enough quantity to contribute signifigantly to the carrying capacity.

For determination of degree of utilization two general methods were used. The first is a general reconnaissance method and is based on general observation estimates of the volume of forage removed over an extensive area. The Visual Estimate Method was also used. This involves (1) an examination of the shrubs to reveal the extent of cropping (2) Mentally reconstruct the shrub as it appeared before cropping (3) Estimate the amount of seasonal growth that has been utilized.

Form and Age Class

The more important browse species taking the whole area into consideration were visually broken down into form and age classes to provide additional information. The classes are broken down according to the B. L. M. manual, Volume VX chapter 10.3. Classes are seen below.

Form Class 1-all available, little or no hedging
2-all available, moderately hedged
3-all available, tightly hedged

4-mostly available, little or no hedging
5- mostly available, moderately hedged
6-mostly available, tightly hedged
7-mostly unavailable
8- unavailable

Age Class S-Seedlings; plant of relatively small size, simple branching etc.
Y-Young plants; plants larger, more complex in growth form
M-Mature plants; plants of full size and development attained
D-Decadent plant; plant crown dying back, generally overaged in appearance.

Thus, if a browse plant was judged to be of immature age class , less than five feet tall and only moderately hedged it would be listed as Y-2; if old and dying out with only a few branches available to game use in D-7.

The data on form classes of browse plants indicates their relative importance as forage, degree of past browsing pressure and amount of forage curently available. When corelated with age class this will indicate trend in general range condition.

It should be pointed out that range condition is a reflection of past use while range trend is a reflection of present utilization. however both of these may be diagnosed by exaluating numerous range indicators. Indicators of soil condition, vegetative condition and utilization were all carefully used to provide additional information as to just what is happening on the range area.

To facilitate discussion and description of the study area, the vegetation has been broken down into types and subtypes.

Deer surveys

From June 1960 to October 1961, a multitude of information on this deer herd has been collected and compiled.

Considerable information was gathered by direct observation of the deer themselves. A number of herd composition counts were taken on various parts of the deer range by B.L.M. field personnel to determine sex and age ratios. Deer were classified by groups as seen and only those groups were counted in which every individual could be classified. It is believed that an accurate classification was obtained without emphazing the numbers of those animals which are most readily recognized, such as large bucks.

Estimates of deer populations was based on the use of pellet group counts, degree of forage utilization, road counts, random strip samples, general surveys and other reliable factors.

Interviews

Considerable emphasis was placed on interviews with local persons familiar with loval deer and livestock conditions. Personnel of Federal and state agencies also provided valuable information. Using the interview material provided generalized ideas on conflicts with grazing, history, herd composition, movements, management problems, and relative populations.

VEGETATION TYPES

BROWSE MOUNTAIN SHRUB

The mountain browse type is the most important general vegetation type for deer because of the presence of a variety of good browse plants and favorable cover, two essentials for good deer habitat. This type is variable in plant composition and density depending on slope, elevation, and other factors. For convenience it is divided into several sub types.

Sub type 1:

On some of the steep high exposed southern slopes of the Virgin Mountains manzanita forms large almost impenetrable thickets because of its profuse branching and close growth habit. Cliffrose, gambel oak, silktassal, serviceberry, locust, and mountain mahogony are scattered in small amounts through most of these thickets and make up as much as 15 % of the type. Muttongrass, needle and thread, and squirreltail make up only about 2%, while forbs also are lacking. From 75 to 90% of the vegetation of these thickets consists of manzanita.

Despite the presence of the desirable species, effective utilization of these thickets is almost impossible since it is hard for the animals to work through ~~through~~ the thickets to get to the desirable plants. Livestock were seen feeding in the more open outer fringes, but none were seen in the midst of the thickets. Deer use seems to follow a similar pattern.

Because of the reasons mentioned the amount of forage obtained from such thickets is relatively small and subsequently the carrying capacity for both deer and cattle is low.

Sub Type:2:

Small clearly defined lush green stands consisting primarily (60-80%) of gambel oak grow in profusion on many of the higher swales and small canyons of the Virgin Mountain area, lending a

colorful green aspect to the countryside. These stands also contain varying amounts of serviceberry, snowberry, locust, silktassal and cliffrose which make up 15 to 30 % of the type. grasses including red brome, squirreltail, muttongrass and junegrass are present under protective cover.

In the Black Rock Mountain area, gadderlgrowths of gambel oak form small parks which consist almost exclusively of gambel oak. The gambel oak stands provide excellent deer habitat from the stanpoints of interspersion and juxtposition and are receiving considerable use by deer and cattle. Many bed grounds are located under the protection of these natural deer havens.

Sub Type 3:

The most nutritious and abundant supply of both deer and livestock forage is produced in the large area on Black Rock Mountain south of the "Neck" and extends to the southern most extremity of the mountain. This gently rolling malapai rock country has an average ground density that consists largely of fair to excellent browse species. Representative species and their densities include silktassal (16%), Serviceberry (16%), Cliffrose (8%), bitterbrush (4%), desert ceanothus (4%), snowberry (3%), mountain mahogony (2%), gambel oak (9%), Scrub oak (18%), big sage (10%). Pinyon and juniper are intermingled throughout this type to provide a sub dominant characteristic. Range survey data indicate that the carrying capacity for deer in this area is high. On the north half of Black Rock Mountain the high value browse plants become less prominent and this sub type intergrades into a low carrying capacity pinyon-juniper type where pinyon, juniper, and big sage choke out the desirable browse species.



Photo : The Browse Mountain Shrub Type. Notice the density of high value browse species including silktassal, serviceberry, and gambel oak. The gambel oak in the center of photograph is conspicuously over-utilized.



Photo 9: Excellent deer habitat in the Browse mountain shrub type of Black Rock Mountain.

BIG SAGE TYPE

Big sagebrush is the most conspicuous understory plants in this area. Although being prominent in all vegetation types, big sagebrush is most conspicuously abundant in sagebrush flats, which consist almost exclusively of this silvery shrub. Juniper, gambel oak, serviceberry, and cliffrose ~~may be~~ are scattered throughout ~~t~~his type in small amounts.



Photo 3: Big sagebrush type on the neck of Black Rock Mountain. Notice thick density of sagebrush. This area was sprayed with 2,4-D in 1961.

The ~~biggest~~ largest big sage type is located on the "neck" of Black Rock Mountain. Several other small sagebrush flats are present, but unimportant because of their small acreage. In addition to being

dominant in the big sage type, this low value shrub is sub dominant throughout much of the pinyon-juniper type and is conspicuous in almost all areas.

One of the big problems with sagebrush is its strong competitive petitive and invasive habits. Range personnel on the district became interested in the forage production potential of the area shown in photograph and decided on range rehabilitation mesures. In spring of 1961 this area was sprayed with 2,4-D by airplane. No reseeding was done, but the area was fenced and is being excluded from grazing. Observations at the present time show that the possibility of success is likely. The estimated kill of sagebrush is about 75 to 80%. Tender young grasses, mainly muttongrass and squirreltail have become established, lending a green aspect to the once dull grey countryside. With the majority of the sagebrush competition removed and protection from grazing the carrying capacity of this range will be increased considerably. The available source of grass, which has been lacking on this range should greatly improve beef quality and quantity due to the improved grass factors, which are so important for beef production.

One of the important considerations when undertaking this spray project has been to discover information on the affect of 2,4-D on the desirable browse species in and adjacent to the spray area. Gambel oak at the time of spraying was not sprouting and despite some leaf spotting it has been little affected. Most of the serviceberry, cliffrose, and manzanita that came into normal contact with the 2,4-D have either completely died or their growth process seriously hampered. Juniper showes some affects, while pinon pine seemed almost unaffected. The loss of browse species in this case is insignifigant when compared to the increased forage production of grass stimulated by removing the sage competition.

Surprisingly enough, deer are making considerable use of the succulent grasses in the study area. Ten deer were observed feeding on grass in the sprayed area during the last part of August. Even though deer ordinarily utilize grasses to a large extent in spring, ten deer were seen feeding on the new grass growth of the spray area during late August. Several other groups of deer were reported in the spray area during September and October.

JUNIPER-PINYON TYPE

The pinyon -juniper type is an important part of the vegetation of this area because of its abundance and affects on forage production. This ~~variable~~ type is quite complex since it often intermingles with other vegetative types and varies considerably in plant composition. Because of these reasons it has been broken into two sub types to facilitate discussion.

Sub type 1: Pinyon-Juniper-Sage

This mixed sub type varies from semi open to dense stands of pinyon -juniper and ~~often~~ big sage often forms a dense understory. On the more exposed hillsides and fringes of the mountain browse type cliffrose, serviceberry, bitterbrush, and silktassal become increasingly ~~important~~ abundant. The average carrying capacity is rather low for both deer and cattle because of the severe competition with forage plants caused by the low value sage and pinyon. This sub type is most common on North Black Rock where it spreads over large acreages.



Photo 44: The Pinyon-Juniper-Sage type. Noti ce density of sagebrush.

Sub type 2:

This sub type varies from sub type 1 in that it consists of larger amounts of the more valuable browse species including gambel oak, desert ceanothus, serviceberry, cliffrose. Turbinella oak is also ~~quite common in this~~ more common than in the other sub type. Big sage brush makes up only a small percentage of this type.

Most of this type is located in the drainages and surrounding hillsides of Cottonwood wash and intermediate slope ranges of Black ~~Rok~~ Rock Mountain. The carrying capacity is somewhat higher than the other sub type. because desirable forage species make up a larger part of the plant composition.



Photo 5a: Moderate carrying capacity pinyon-juniper type. This type makes up large part of summer and intermediate deer range.

Ponderosa Pine

Sub Type 1- Is a ponderosa pine big sagebrush area that covers only about 1600 acres on two different stands on the higher elevations of Black Rock. In most of this sub type the pine typically grows in fairly dense stands and the understory consists largely of big sagebrush (40%). Grasses are scarce because of the dense canopy and subsequent collections of pine needles which seem to retard their growth. Muttongrass, squirreltail and sedges are able to grow only under the protection of shrubs in the more open glades and make up only about 4% of the type. Gambel oak, serviceberry, locust, bitterbrush and cliffrose grow in scattered amounts throughout the type and become more abundant on the outer fringes.



Photo 6 : Ponderosa Pine-Big sage type. Note density of sage.

Sub Type 2- A small scattered stand of about 300 acres which is located on a wind swept ridge leading to Mount Bangs.(see photo)

Under the pine overstory gambel oak, serviceberry, silktassal, and a few other species make up 50 to 60 percent of the area to provide a favorable forage production area for both deer and livestock. Muttongrass, squirreltail, junegrass and mountain brome are able to exist in protected havens and make up 6% of the type. Lupines, flox, and weeds average 5%.

This area is receiving considerable deer pressure since it is a natural protective and seclusion area.

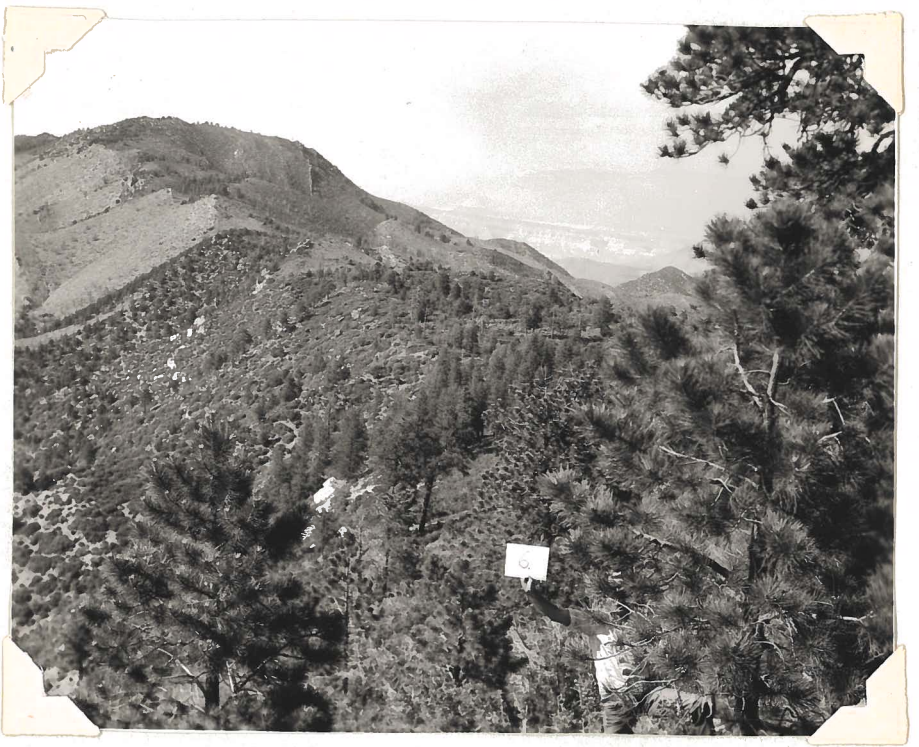


Photo 7 ~~Figure 6~~: The Ponderosa Pine type on the Virgin Mountains. Notice rugged terain. and old burns

BURNS AND BURNING

Persons interested in range management have for many years cussed and discussed the values of fire as a range management tool for improving forage conditions for both deer and livestock. This discussion is not intended to condone or reject the use of fire as a range management tool, but to discuss what affects past burns have had on the vegetation and forage production of the study area.

The vegetation of the study area has been subject to management burns and wilfires for many years and their marks are conspicuous over much of the country side. Both types of fires have exerted pronounced influences on plant composition, age class, plant density, plant vigor, soil and plant succession.

A review of literature on burning research demonstrates that the results after burns are quite variable and dependent on many factors. Taber and Dasman (32), had the following to say about their studies in California;" There is little herbaceous feed in the chaparral (applies to dense brush) because of shading and possibly heavy use of soil moisture by the shrubs. If the shrubs are reduced in size or number, grasses and forbs can be made to grow between the shrubs. If the shrubs are reduced in height the intervening ground is no longer shaded, and a considerable area between shrubs is made available for herbaceous plants. If some of the shrubs are actually removed or killed out, still more space for herbaceous plants is made available."

The same ideas and principles mentioned apply to the dense brush areas located on the Virgin Mountains where manzanita forms almost impenetrable thickets and chokes out desirable forage plants, resulting in an extremely low carrying capacity.

Stoddart and Smith (30) says; "Stockman frequently resort to burning brush in the hope that herbaceous vegetation will replace the shrubby growth. Generally, herbaceous forage is abundant the first year, but in three to four years the brush again dominates!"

California studies on the affects of fire on deer forage (32) found, that a great deal of nutritious forage was supplied to the deer and the deer will respond with a rapid increase. They discovered that burning releases nutrients to the soil, and these nutrients are taken up by the plants growing on the burned area and their nutritive value is increased. Like most other studies however, they found that this fertilization effect is short lived. It is high the first year following burning and lower the next year. By the third year the fertilization effects could not be detected.

Sampson (27), has the following to say about burning," Probably a more potent growth stimulus than the ash is the increase in nitrate nitrogen in the surface soil layer. This stimulus perhaps in combination

with the ash is seen in the production of large individual plants in the first two years after burning but not hereafter.

Longurst, Leopold and Dasman in California found (19) that fires in the chapparal belt of the coast ranges opened up dense brush fields and by promoting sprout growth raised the carrying capacity .... The young tender sprouts were found to furnish abundant and nutritious forage for deer following a fire. They also discovered that areas ~~in~~ that are subject to periodic burning, especially numerous small burns, generally support high densities of deer.

Einarson (11), found that browse plants on the Tillamook burn in Oregon contained more protein than those from unburned areas. He attributed this to the release of soil nutrients by the fire making ~~them~~ available to the plants and likewise to the increased sunlight. He also reported a gradual lowering of protein content in subsequent years following the burn. Deer taken in the area were on the average ~~were~~ much heavier than from the surrounding forest and in addition deer were present in appreciably higher density.

This review of literature on burning clearly demonstrates that under certain circumstances fires have beneficial affects on forage production for both deer and livestock. The effects are limited however and the overall results depend on many variable complicating factors. The burn areas on the study area typlify the variable results.

Most of the burns in the ponderosa pine and pinyon-juniper type regardless of time since burning are dominated ~~principaly~~ mainly by value weeds and forbs, although small amounts of more desirable species are becoming established in some areas. One burn (see ~~Figure~~ photo 7) in the vicinity of Cougar Springs has come back to almost exclusively a low value penstemon cover, despite ~~our~~ efforts to reseed the area with ~~hihj~~ high value grasses. Despite the low forage value of penstemon, livestock many times were seen casually moving from plant to plant plucking off the pink fragrant flowers. Regardless of the use of flowers, very little forage is produced on this burn and the area has been seriously ~~damaging~~damaged by trampling and overgrazing.



Photo 8 : A 10 year old burn near Cougar Springs. Notice low value penstemon cover and excessive trampling.

Other small burns in pinyon-juniper located in the cottonweed Wash have also come back to a weedy vegetation. Wild tobacco (Nicotiana spp.) makes up most of the ground cover, while plant composition, much of the soil surface is exposed to excessive soil erosion by water.

Several burns on the upper slopes of the Virgin Mountains show more favorable results. These burns, whose plant compositions are shown in figure and

On the Black Rock Mountain area burning has produced variable results. One ten year old burn in the ponderosa pine type has caused a serious soil erosion problem. Low value weeds and forbs have largely replaced the once dominant sagebrush and much soil surface has been left exposed. Lupines, spurges and rock cress make up most of the vegetation. Surface runoff has conspicuously eroded the fertile topsoil and it appears that we can expect only a slight increase in ground cover.

Another larger burn in the Black Rock Mountain area showed more favorable results. This ten year old burn swept out of Pocum Cove, over a narrow part of Black Rock Mountain, through Maple Springs Canyon and burned many acres on the western slope. Favorable reproduction, mostly by sprouting species has resulted in good amounts of silktassal, desert ceanothus, and other valuable forage species, while forbs and annual grasses provide an effective ground cover. Because of the reestablishment of desirable forage plants this burn has produced fair forage conditions.

Several burns on the upper slopes of the Virgin Mountains showed similar results. These ten year old burns, whose plant composition is shown in figure now contains fair amounts of young forage plants including silktassal, desert ceanothus, and perennial grasses.

One of the most signifigant facts discovered is that silktassal appears to be a successful fire sprouter. In several burn areas silktassal conspicuously has become the dominant species. In one burn about seven years old silktassal had come back to make up 57% of the total plant composition. This same burn also contained favorable amounts of other desirable species, while manzanita came back to make up 11% of the total vegetation.

The resstablishment of the better species varies according to several factors. Original vegetation, degree of utilization, moisture and sprouting ability are especially important. Time since burning is the big factor and after about ten years manzanita ordinarily replaces the more desirable species as seen in figures 1 & 2.



Photo 59: Silktassal, a desirable sprouter after fires

Table
~~FIGURE~~ 1 : SEVEN YEAR OLD BURN ON THE UPPER SLOPES OF THE VIRGIN MOUNTAINS.

Plant species	%Composition
Muttongrass (Poa fendleriana)	2%
Junegrass (Koeleria cristata)	1 %
Squirreltail (Sitanion hystrix)	2 %
Penstemon (Penstemon spp.)	4 %
Miscellaneous weeds and forbs	6 %
Manzanita (Arctostaphylos spp)	11 %
Silk tassal (Garrya wrightii)	57 %
Turbinella oak (Quercus turbinella)	10 %
Desert ceanothus (Ceanothus greggii)	4 %
Big sage (Artemisia tridentata)	-
Ponderosa pine (Pinus ponderosa)	3 %
	100
	TOTAL

* NOTE ABUNDANCE OF SILKTASSAL

Table
~~FIGURE~~ 2 :20 YEAR OLD BURN * LOCATED IN SITE VERY SIMILAR TO ~~FIGURE~~ TABLE 1

Plant Species	% Composition
Muttongrass (Poa fendleriana)	2 %
Indian Rice-grass (Oryzopsis hymenoides)	-
Junegrass (Koeleria cristata)	-
Mountain brome (Bromus carinatus)	-
Squirreltail (Sitanion hystrix)	1 %
Anemone (Anemone spp)	1 %
Penstemon (Penstemon spp.)	1 %
Lupine (Lupinus spp.)	1 %
Miscellaneous weeds and forbs	2 %
Manzanita (Arctostaphylos spp.)	60 %
Silktassal (Garrya wrightii)	12 %
Gambel oak (Quercus gambellii)	15 %
Serviceberry (Amelanchier utahensis)	3 %
	TOTAL 100

* Note abundance of manzanita.

DEER AND LIVESTOCK FORAGE PLANTS

Big sage (*Artemisia tridentata*)

Big sage is one of the most abundant plants in the area and lends a grey aspect to much of the countryside. This shrub grows as a dominant understory in much of the pinyon-juniper type and in places forms dense almost pure stands as can be seen in photo 2 . Big sage can be found in varying amounts in all the vegetation types. Regardless of its low forage value, big sage warrants discussion because of its abundance and competition with the better forage species.

On many sheep and deer winter ranges sagebrush is much depended on as a staple food. On summer ranges or where a favorable amount of succulent forage is available big sage is seldom used.

Despite its low palatability, chemical analysis studies by McCleary in Wyoming (22) show that the leaves of big sage equal alfalfa meal in protein, have a higher carbohydrate content, and yield twelvefold more fat. He concluded that the high fat content qualifies big sage leaves as valuable winter feed, since fat has a high power to produce heat.

The main problem with sagebrush is its low palatability. The palatability of the bitter, pungent tasting leaves is low, due doubtless to the presence of a bitter material and about 3% of volatile oils (22).

As a source of forage on the study area, sagebrush is insignifigant, although it may become important in certain areas during the winter months. Little use of sagebrush was detected, but one mature doe was observed taking small bites from the annual leader growth. The most important thing about big sage is its invasive and competitive habits. The more desirable species under heavy utilization are yielding space and moisture to the seldom used sagebrush. This is not an unusual occurance, Pickford in his studies on continued heavy grazing in grassy sagebrush ranges found that mismanagement favored the gradual invasion and spread of the relatively unpalatable, less used sagebrush.

Bitterbrush (Purshia tridentata)

This bitter tasting shrub is one of the most important deer browse plants on western ranges. Despite the high quality forage, its importance on the study area is limited considerably because of past and present heavy use and decadent condition of plants. Bitterbrush is fairly common throughout the area and at one time was an important forage producer.

Throughout most of its range the leafy foliage and younger twigs are extremely cropped by deer and all classes of livestock and rates as good to excellent forage. This valuable shrub is one of the first plants to leaf out in spring and hold its leaves until late in the winter so is important on spring, fall and winter ranges (36).

Sampson in speaking of bitterbrush (27), classifies it as a strong feed because it produces solid fat which is not readily lost during inclement weather or when feed is scarce.

Dixon (10), lists it as an excellent winter feed of great importance to mule deer in California.

On the study area bitterbrush is being heavily utilized during all seasons, but especially throughout the summer ~~months~~ grazing period since it is most abundant on the summer ranges of deer and cattle.

Bitterbrush withstands grazing remarkably well. Under close utilization such as occurs on the study area, the upright stems have been killed back to the surface of the ground and the plants are growing in a prostrate form as seen in photograph below.



Photo 10 : Typical prostrate growth of bitterbrush caused by overutilization. Practically all of the bitterbrush plants on the study area are in this condition.

Experimental work in Utah ~~(12)~~, proved that close utilization of bitterbrush would drive it from the range(12) . Almost all of the remaining plants on this area are in a near decadent condition and in place of annual growth only twigs remain. At least, bitterbrush seems to be fairly resistant to grazing in this shape because the sturdy rigid branches serve as protection against furthur grazing.

Bitterbrush is most common on Black Rock in the higher elevation mountain browse and pinyon-juniper types on the summer range. It seems likely that bitterbrush at one time was an important forage producer, but many years of hard grazing by range animals and possibly drought have exerted strong affects on this ~~much~~ preferred plant and at the present time bitterbrush is almost out of the picture as a forage producer. Considering that this plant is common and also severly overbrowsed, the possibility of excessive animal numbers is very likely.

Choke cherry9(Prunus virginiana v.demissa)

This shrub or small tree can be found only on the highest knoll on black rock mountain above trails end reservoir. Although only a relatively few plantw are present, this plant deserves recognition because of its poisonous properties.

The forage value of chokcherry is poor to fair for cattle , while deer probably utilize it more readily.

The poisonous principle is hydocyanic acid(prussic acid), which is produced in the leaves as one of the decomposition products formed by enzymes upon the glucoside,amygdalin. The poisonous properties depend also on the conditions favorable for the action of the enzymes upon the amygadin to produce HCN.

Chokecherry poisoning can be serious up until about September on this range area. Under favorable forage conditions livestock will probably not utilize chokecherry plants to such an extent that they are dangerous. On this area chokecherry isprobably not abundant enough to become a serious threat to livestock. very little use on chokecherry was detected.

Cliffrose (Cowania stansburiana)

This leafy evergreen stiff stemmed shrub or small tree is scattered in small amounts throughout all of the vegetation types, but is most common on rocky hillsides, ridges and rim-rock areas on intermediate and winter ranges.

Despite its bitter taste, cliffrose is a valuable browse plant and produces high quality forage for deer and cattle, although it is little used by cattle or deer during spring and summer if other succulent forage is plentiful. With highly palatable succulent species lacking on this range, both deer and cattle are utilizing cliffrose to a small extent during the summer grazing season.

With good management and conservative browsing the growth of many branches may be induced and subsequently more forage is produced than if cliffrose was only lightly utilized. On the other hand, heavy browsing severely damages cliffrose. Cliffrose under heavy use takes on a definite hedged appearance and many of the plants have largely grown out of reach , rendering them unavailable. Most of the plants are in the mature:largely available:moderately hedged category. Reproduction is limited.

The unavailable and decadent plants have been caused by ~~severe~~ overbrowsing . Although cliffrose produces a good seed crop, years of good plant reproduction are probably dependent on favorable moisture conditions, and lack of moisture has exerted serios affects on cliffose at lower elevations. Future management and proper utilization should be based upon the current years growth. This important browse plant is particularly important and abundant on the winter range areas.

Desert ceanothus (Ceanothus greggii)

This many and rigidly branched shrub is not one of the main forage plants on the study area. Desert ceanothus can be found on several old burns in the Virgin Mountains, but is most common on the intermediate range slopes of Black Rock Mountain. Desert ceanothus can however, be found in scattered amounts on the Black Rock Summer range areas, being present in the mountain browse, pinyon-juniper and ponderosa pine types. See figure for picture of this browse plant.



~~Figure~~ Photo 11 : Desert ceanothus; Notice profuse and rigid branching habit.

The forage value of desert ceanothus flucuates from area to area and the use seems to depend on the amount of succulent and more palatable grasses, forbs, and shrubs. On the study area it may be rated as moderate in value for both deer and cattle because of the lack of succulent forbs and grasses. Its more or less evergreen habit renders this plant

subject to utilization all year long. Deer are able to make better use of desert ceanothus than cattle because they are better able to work into the extensive branching system. Although providing considerable forage during the summer months, desert ceanothus is probably most important on the intermediate spring- late fall deer ranges.

Severe over utilization of this plant is seldom achieved by cattle because of the protective branches, but deer can get to most of the leaves. Many of the desert ceanothus plants have beem moderatly hedged on the summer range ,while more severe use is conspicuous on the intermediate deer ranges.



Photo 12 ~~Figure 11~~ : A heavily browsed desert ceanothus plant. Notice club-like ends of branches.

Gambel Oak (Quercus gambellii) and picture

This well known oak is one of the most conspicuous and abundant plants throughout much of the study area. Gambel oak ranges in size from a shrub to a large tree and is readily recognized by its deeply lobed, deciduous leaves.(15)

Because of its size and leafiness gambel oak produces a vast amount of forage and is rated as fair palatability for all classes of livestock and deer despite its high lignin and resin content. On ranges such as this where there is a scarcity of palatable browse it is considered as fairly good forage. On the other hand, where palatable shrubs are plentiful it is regarded as having little forage value.(12) Gambel oaks sweet, nutritious acorns are readily eaten by both deer and livestock, but the amount of forage produced by the mast crop has been relatively low because of prevailing low moisture conditions. Favorable moisture in 1961 produced good amounts of acorns.

Experiments conducted on a controlled area showed that heavy use of gambel oak resulted in overgrazing of the palatable shrubs; also cattle grazed made poor gains and the calf crop was unsatisfactory.(12) Marsh, Claverson, and March (21) noted that cattle became constipated and may develop fatal sickness when forced to subsist upon an almost exclusive diet of gambel oak.

About ten hours were spent observing cattle feeding at close range with the use of binoculars on several parts of the study area. Actual feeding minutes were recorded for each plant and period of use. Data, observations and examination of the range area clearly demonstrates that gambel oak makes up as much as 80% of the diet of the livestock throughout a large part of the area. Although the amount of forage consumed from grasses is very small, livestock seem to be obtaining enough varity from the other available browse plants to avoid the toxic affects mentioned above. Available information on percent of calf crop, weight of calves sold and beef production is too incomplete to provide reliable information but all of these phases of livestock production are undoubtedly affected to a certain extent.

In talking with ranchers, no unusual sickness of the livestock were reported and the animals appeared to be in a normal state of nutrition and body condition.

Gambel Oak can be found in varying amounts throughout all of the vegetation types. On some of the higher steeper slopes it grows as dense green thickets of shrubs or small trees. On the rolling , sagebrush clad areas of Black Rock this plant often converges to create a small picturesque grove of large trees. These dense growths of gambel oak provide excellent cover and shading areas for both deer and cattle and deer can often be found bedding down or hiding in the midst of the dense protective cover.

Most of the gambel oak are in the largely available, heavily hedged, mature category, but many are in mostly unavailable decadent clan as seen in the photograph due to evergrazing or tree form. Reproduction seems to be ~~substantial~~ sufficient as seedlings, shoots and young plants are abundant throughout most of the area.

The moderately heavy utilization of this abundant key plant indicates that the combined stocking rates of deer and cattle may have surpassed the carrying capacity of this area.



Photo 13 ~~Figure (12)~~ : Severly over utilized Gambel oak. Notice that much of the over browsing is above the reach of deer.

Gooseberry (Ribes spp.)

Gooseberry plants are growing in association with chokecherry and are limited to the higher brush clad knolls of Black Rock Mountain. This spiney shrub despite its bulky leaf production produces poor forage for deer and cattle. The succulent berries are probably utilized to a larger extent by deer. Because of its lack of abundance and low palatability, goosgberry provides very little forage . Even though these plants are located in a deer concentration area ,overall utilization seems to be light.

Juniper (*Juniperus utahensis*)

Juniper is one of the most conspicuous plants on the area, but contributes a relatively small amount of forage. The forage value of juniper is low, although the winter crude fat content exceeds that of the common grasses by as much as ten to one.

Juniper is seldom used by deer or cattle except when better forage is scarce. In addition, the coarse leaves may be slightly injurious to cattle. One mature doe was seen feeding on a large juniper tree for several minutes. The palatability seems to vary from one plant to another because this doe was feeding by reaching high on a plant which already had a browse line. Besides this, she walked through a group of servicerry plants while walking to the juniper. This is an unusual occurance and was probably being used as a tonic .

Manzanita (Arctostaphylos spp.)

Manzanita warrants discussion not as a forage plant but because of its competitive and thicket forming habits. This many branched shrub often forms dense thickets which prevent the growth and utilization of the better companion species.

Manzanita is most abundant on the steep southern slopes of the Virgin Mountains where it forms many acres of impenetrable, subsequently worthless vegetation. It can be found in scattered amounts on the western slopes of Black Rock Mountain.

Manzanita is a strong competitor and these thickets probably result from the gradual spread of manzanita when the less hardy and more used plants are destroyed, the soil depleted or as a result of old burns.

This undesirable plant has little or no forage value as deer or livestock forage, but does provide valuable watershed protection.

Mountain Mahogony (Cercocarpus betuloides)

This highly palatable evergreen shrub or small tree is one of the best deer and livestock browse plants in Arizona (31)(13).

Mountain mahogony rates as good or sometimes even excellent for all classes of livestock and is one of the most valuable winter feeds for deer since the twigs are palatable yearlong and grazed with relish.

Observation and studies indicate that the palatability of mountain mahogony is high. Feeding experiments on deer gave the plant a palatability rating of 70% (21). the rating for cattle is about the same.

This valuable browse plant withstands close grazing very well, but continued overgrazing affects forage production and may even kill the plants (36). Experimental data (29) indicates that removing 80% of the annual growth on test plants did not materially reduce the forage production.

According to range survey data and personal observations, mountain mahogony at the present time is not one of the the major sources of forage throughout most of the study area. This excellent browse species is most common in association with the mountain browse type on rocky hillsides, ridges, and canyons, of the summer range, but is present in scattered amounts in the pinyon-juniper intermediate deer ranges.

The majority of mountain mahogony plants are in the ~~largely~~ unavailable, heavily hedged, decadent class. Heavy use is conspicuous by the presence of many dead twigs and the tall slender partly out of reach growth form. Very few young plants are present and decadent plants are not uncommon.



Photo ~~Figure~~ 13: Severely over-utilized mountain mahogony on intermediate deer range.



~~Figure~~ Photo 15: Severely over browsed mountain mahogony plant on ~~the~~ summer deer range. Notice club-like growth of branches and lack of leaves.

Theoretically on a properly stocked and managed range even excellent browse species should not be over utilized. The excessive use of mountain mahogony may not necessarily ~~indicate~~ be indicative of overall range utilization, but it does show that on at least part of this range the stocking rate has surpassed the carrying capacity. It appears doubtful that mountain mahogony has ever been one of the key forage species, but heavy animal use has exerted definite influences on this valuable forage plant and at the present time only a relatively small amount of forage is derived from this once important species.

Despite its ability to withstand heavy use

Serviceberry (Amelanchier spp.)

This shrub or small tree is one of the three major forage species for both deer and cattle. Serviceberry is scattered through all of the vegetation types on the summer range, but is most abundant in the browse type where it often forms small thickets.

The forage value of serviceberry for deer and cattle seems to be fair to good when the leafage is lush, but is less used as the leafage matures. On several occasions while on feeding observations both deer and cattle were seen passing by serviceberry plants in preference for gambel oak. Deer are utilizing serviceberry to a larger extent than cattle. Serviceberry is especially important because it is the most abundant browse in most areas.

Most serviceberry plants are in the moderately hedged: largely available: mature class. Some plants have grown out of reach of deer and cattle and browsing lines are conspicuous. in some areas. Serviceberry is growing in close association with gambel oak and commonly shows somewhat lighter use than.

Silktassal (Garrya wrightii)

This shrubby thick leaved plant is one of The main deer browse species on this range. Silktassal is scattered throughout all the vegetation types, but is most abundant in the steep canyons and hillsides in the mountain browse type. In parts of the mountain browse type silktassal is often a sub dominant species.



Photo 16 : Silktassal, an important deer browse. Note The large thick leaves.

The importance of silktassal as livestock forage seems to be a debatable. Dr. Wendall Swank (31), says " Deer use on the plant is intermediate, but livestock seem to prefer it over many other species". Dayton (9) disagrees,"Ordinarily this shrub(silktassal) is regarded as practically worthless as

New Mexico Locust (Robinia neomexicana)

This handsome, pink flowered, thronéy shrub or small tree is one of the most colorful plants in the area. Its lovely pink flowers lend a floral decoration to the dominant green aspect. New Mexico locust grows most commonly in scattered patches in the swales and drainages of the pinyon Juniper-sagebrush and mountain brush mixtures but can be found on side hills and ridges. Most of the locust are trees up to 25' high and young plants are scarce.

New mexico locust is usually considered as poor to fair forage for livestock and deer. The flowers especially seem to be relished by ~~the~~ deer and cattle ~~both~~. Apparently SAID even the young growth is ~~only~~ grazed in the early summer before the thorns develop. (36) Reports on the Kaibab National Forest SAY THAT this plant has been heavily grazed and seriously damaged by deer. Such severe use probably indicates severe over stocking since under conservative use by deer the plant is used rather lightly. Palatability rating 45% deer, 10% for livestock.

livestock forage, although in southern Arizona it is sometimes grazed during the winter".

Feeding observations on the study area indicate that silktassal is moderately used by cattle and somewhat heavy extent by deer. The forage value for cattle is apparently affected by a bitter tasting alkaloid substance in the leaves. Deer seem to often prefer bitter tasting plants as testified by their preference for bitterbrush and cliffrose, which contain a similar bitter substance. Because of the prolific leaf production and abundance, silktassal is one of the key forage species for deer and cattle.

Most of the silktassal plants are in the largely available moderately hedged mature class, but decadent, unavailable plants tightly hedged plants are conspicuous in some areas. Overuse is fairly easy to detect since the twigs become club like and browse lines may appear.

~~Under favorable site conditions silktassal can grow out~~

An important feature of this desirable browse plant is its ability to sprout after fires, which allows silktassal to become well established in some burn areas.



Photo 17 :A severely over-utilized silktassal plant. This plant is successfully resprouting from its base.

Snowberry (Symphoricarpos spp.)

Two different species of snowberry can be found on this range. A low many branched species grows in the high elevation pine and mountain browse areas, while a taller growing less palatable species is commonly found on the intermediate mountain slopes.

The low growing species provides an always available source of fair quality forage for deer and cattle. This browse plant may be considered as a secondary species because it does not occur in large amounts. Degree of utilization is moderate, but not excessive.



Photo 18: Mountain snowberry. Notice low growth habit and profuse branching.

Turbinella oak (Quercus turbinella)

This evergreen drought resistant shrub is most abundant on the lower elevation intermediate spring-fall ranges, especially on the eastern slopes of Black Rock Mountain where it intermingles with silktassal, serviceberry, and gambel oak. On the summer range turbinella oak is found only in scattered amounts.

The use of turbinella oak varies directly in proportion to the abundance of more desirable forage species. Turbinella oak is relatively low in palatability and nutritive content, but when young and succulent growth appears livestock and deer will readily feed on it. The leaves of mature plants are taken to some extent by both deer and cattle, but only in the absence of better forage species. Turbinella oak is a good sprouter and after fires provides especially good forage for a short period of time. The Acorns are produced in abundant amounts during good years and provide nutritious forage.

Turbinella oak is being used only lightly on the summer range, but is probably utilized to a greater extent on the intermediate spring and winter deer range because of its evergreen habit.

Junegrass (*Koeleria cristata*)

This valuable perennial bunchgrass grows only in scattered amounts on this range. Junegrass is most prominent in the better soil types. Like the other grasses on this area, junegrass is able to survive only in protected sites.

Junegrass is rated as good forage for cattle. It greens up earlier in the spring than most other grasses and is over grazed early in the season by the combined pressure of deer and cattle. Junegrass grows most actively and produces most of its feed after the summer rains begin.

For best management, care must be taken not to over graze this important grass when it first greens up. In addition, at least one third of the seed stalks should be left for seed production. Serious over use has reduced this plant to a large extent.

Muttongrass (Poa fendleriana)

This valuable perennial bunchgrass is scattered in small amounts throughout all of the vegetation types, being most common on slopes and ridges. Because of heavy grazing pressure in the past muttongrass is relatively scarce and can be found only under the protective cover of trees and shrubs.

Muttongrass starts growth during the warm days of late winter and is ready for grazing in advance of most other grasses, a feature which makes this a highly desirable forage species. Muttongrass rates as excellent forage for cattle and good for deer, although its palatability decreases somewhat at maturity, when the forage becomes rough and dry. During the fall cattle eat the air dried foliage, if more tender and succulent forage is scarce. (36).

Suggested management procedure (13) is to leave at least $\frac{1}{4}$ of the years production of seed heads for next growing season. Rundown ranges such as the study area should not be grazed during July and August in alternate years in order to give the plants a chance to set seed and increase vigor.

Squirreltail (Sitanion hystrix)

This bristly perennial grass can be found throughout the area in scattered amounts. Squirreltail seems to thrive best on hillsides and ridges. This plant is one of the most conspicuous grasses on the study area, probably because it is less grazed than the other species due to its lower palability and troublesome awns.

The palatability of squirreltail appears to vary somewhat according to locality and season of the year. In general, it is fair, or occasionally good for cattle in spring and early summer before the heads develop. it is reported that the bristly spikes are objectionable to livestock and when present, the plant is little used. It tends to green up measurably with the advent of the fall rains, which will greatly increse the desirability of this grass (36). Because of the lack of grasses on the study area, squirreltail is probably being utilized more than in areas where grasses are common.

OTHER GRASSES

Three awn, blue grama, western wheat, sand dropseed, mountain brome, ~~and~~ Indian ricegrass are present in sparse amounts ~~and~~ but have almost been killed out by the heavy livestock use.

Red brome and cheatgrass come in during years of favorable moisture and some areas on the intermediate ranges contain dense growths of these two annuals.

FORBS

Range managers seem to often underrate the importance of forbs as deer and livestock forage. Forbs during the growing season are succulent and relatively high in nutritive value. Forbs are particularly important on ranges lacking in grasses because they are ~~extremely~~ important factors in readying deer and cattle physiologically for the coming breeding season. Research data shows that animal condition and breeding success is better where forbs are more abundant. Survival of fawns is also affected.

Generally speaking, forbs are lacking on the Black Rock Deer range. This in combination with a low grass level must necessarily exert some influences on the nutritional state of both deer and cattle.

Some of the forbs that can be found on this range are discussed below.

(1) Lupine (Lupinus spp.), grows in a few concentrated areas, but is limited in distribution. Despite its poisonous seeds, this plant is used considerably by deer, while the amount of livestock use is less.

(2) Penstemon (Penstemon spp.), is concenfrated in most of the burned and chained areas. This low palatable forb is one of the first plants to come in after fires. The amount of usuable forage is limited by the low palatability, but considerable use is made of the flowering heads.

(3) Annual buckwheat (Eriogonum spp.),is one the most widely distributed forbs, but it grows in sparse amounts. Ordinarily, this is an inferior forage plant for cattle except in the spring when it is succulent. On this range with other sources of succulent feed scarce, both deer and cattle are feeding heavily on this forb.

(4) Deer vetch (Lotus spp.) growse in fair amounts in several small areas, but is not abundant. This forb is highly relished by deer and cattle.

(5) Wild tobacco (Nicotiana spp.), is a common invader in burn areas of all vegetation types, but apparently little used by deer or cattle.

Other forbs include wild onion,sego lillie,spurges,rock cress,oregon grape, wild daisy and others.

DEER-LIVESTOCK COMPETITION

~~DEER-LIVESTOCK COMPETITION~~ Exhibit

The major emphasis on this study has been to analize what affects this deer Herd has on the cattle operations of the study area. For many years livestock production has been the major use of this range. With changing range conditions, increasing deer populations, different concepts of multiple use and concern over range management, a thorough examination of possible competition problems is obviously necessary.

The livestock industry ~~of~~ over a long period of time has exerted both detrimental and favorable effects on the mule deer herds of the West. Leopold (15), one of the most prominent wildlife workers, believes that over grazing by livestock has been an important factor in the irruption of deer herds throughout the West. Other range and wildlife specialist agree. Stoddart (30) says, "Where overgrazing alters the climax vegetation, often secondary species highly acceptable to game animals replace the preferred livestock forages. Wendall Swank (31) concurs; " Undoubtedly the big deer populations in Arizona is due to the overuse of grass ranges by livestock".

Water development is another reason why ranching has greatly helped the growth of Arizona's deer population. At the present time, especially during hot summer months, the Black Rock Deer Herd depends almost completely on livestock water, since other sources of water is practically non-existent on this range. The following two pictures show typical deer use of reservoirs in the study area.



~~Figure~~ Photo 19 Doe and fawn at dusk. Photo taken at Low Mountain Reservoir, North Black Rock Mountain , September 12, 1961.



Photo ~~Figure~~ 20: Three point buck watering at Trails End Reservoir, Black Rock Mountain, September 13, 1961.

Nichol in his Arizona Studies (24) estimates the average water consumption by deer under Arizona conditions to be about 1 to 1½ quarts per day per 100 pounds in winter and twice that in summer. Water consumption is variable however since large or active animals, especially pregnant does require larger amounts of water than an average animal. Several times during the course of this study pregnant does were seen watering at mid-day. Most bucks probably water less frequently than does because of their secretive habits. Mule deer are believed to be able to subsist for several days at a time without water if succulent materials are sufficiently abundant.

The amount of water consumed by cattle is surprisingly greater than the amount consumed by deer. Studies on water consumption by The Agricultural Research Service (4) indicated the following conclusions. As a rule of thumb, the average cow requires 10 gallons of water per day. A herd of ~~approximately 500 cows with~~ 300 cows with

calves will require approximately 4,000 gallons a day. The amount will vary, according to weather, kind of forage, and size of animal. One livestock association, through local experience on ponderosa pine summer ranges, has set the following requirements: 15 gallons per day for a cow and a calf; 10-12 gallons for mature cattle and two year olds; and 7-8 gallons for yearlings. This research showed that more water is required as air temperature increases. Data shows the following requirements for 1,000 pound steers on southwestern ranges: 7 gallons daily at 40 degrees F.; 10 gallons at 70 degrees F.; and 17 gallons at 90 degrees F.

Except during periods of prolonged drought the amount of water consumed by deer is probably not a serious competition factor. It appears that some water development is advisable, since deer and cattle have concentrated in the vicinity of water holes during the course of this study. More watering places will allow more complete dispersal of both deer and cattle and more complete and efficient use of this range will result. Successful management of this range over a long period of time should be greatly enhanced by increased water distribution.

Since salt is vital for the life processes of deer, considerable salt consumption can be expected. Nichol (24), found the monthly consumption of salt by deer to be about 1/10 of a pound per deer per month in the summer and half that amount in winter. Hill (34), in his studies arrived at similar figures. He says, "Deer will use salt when it is available, consumption falling from 0.1 to 0.2 pounds per per month in summer to .05 to .15 pounds per month in winter."

With the absence of natural salt licks on this area deer are obtaining their salt requirements almost completely from livestock salt blocks. Deer probably will use salt almost as frequently as cattle and as many as 32 deer were seen in one evening at one salting spot.

Since deer and cattle are occupying the same range together, and have similar foraging habits, there is a good chance for transference of parasites and diseases from one animal to the other. Since deer are subject to the same diseases and parasites which affect domestic animals this transference is likely and almost inevitable. Deer especially are subject to a great number of parasites which may inhabit almost all parts of their bodies. Cattle are generally less affected since they are subject to treatment by man. Eight freshly killed deer were examined during the 1961 hunting season. Although

The animals are fat and in a good general body condition

many tick and lice were found on all the examined deer, no obvious physical or physiological abnormalities were detected. Deer in this area are apparently not seriously affected by disease or parasites. Deer are usually healthy animals and unless parasites occur in more overwhelming numbers than are now present here deer will tolerate them well.

Although no reliable information is available on beef production, cattle in the area are apparently in normal condition and the calf crop appears to be sufficient. Lice are common and abundant parasites of cattle and some loss in production as well as some deaths can be attributed to them.

Keeping in mind that both deer and cattle can survive only by obtaining substinence from range plants, considerable emphasis has been placed on evaluating the forage relationships of deer and cattle. A review of literature on deer- livestock competition studies on similar areas provided valuable information on feeding habits and possible forage competition problems.

Ralph R. Hill (34), from his discussion on feeding habits of deer states;" Only during the spring months, in most areas, do grasses make up a high percentage of the diet. Then, after a winter season on a diet of limited variety and relatively low nutritive value, mule deer seek the new growth of succulent grasses".

Experimental feeding of captive animals (29) reveals no grass is eaten in the presence of a choice of other forage.

Stomach analysis of deer on the Kaibab National Forest (16), suggests that deer secured less than 3 % of their diet from grass, although they point out that this may also refelect shortage of grasses.

Another author (34) says, " feeding in summer months is a combination of browsing and grazing, the latter commencing in the Spring with the first appearance of lush new grasses and herbs and continues as long as their palatability is retained." He continues," Availibility of plants then (summer) is at a maximum , grass use drops to 3 % in most cases. Forbs reach a peak in summer, but new growth of shrubs may account for as much as $\frac{1}{2}$ the diet. .... Autumn frosts bring changes in food habits as great as those in the spring. .. . This period in general marks the transition to shrubby vegetation ."

Swank (31), in his Arizona deer studies reports;" Most investigators find competition high in fall and when cattle take a good quantity of browse in their diet, and low in summer when grass is

abundant. Deer compete with cattle for a short period early in the growing season when grass first comes through the ground". Literature on other deer - cattle competition studies shows that competition problems often do exist and that livestock numbers have and can often limit deer populations depending on the prevailing conditions. Competition and limitation is inevitable where the two animals are depending on the same plants for their existence.

Most of the previous discussions have largely covered ranges where grasses are sufficiently abundant to be an important part of the carrying capacity. Range survey data of the study area shows that grasses are at such a low level, that they provide only a small amount of forage as compared to the amount of forage derived from shrubby species. The scarcity of grasses is the key to the competition problem. Forbs also are lacking in abundance and subsequently produce little forage.

Perhaps it will be useful to compare the Black Rock - Virgin Mountains area with the famous and well studied Kaibab deer range. Studies on the Kaibab (16), indicates that on a yearlong basis the percentage of diet on browse for cattle is 16.9%, while deer use on grass is only 2.9 %. The grass composition on the Kaibab range is much greater than on this study area, while browse species are somewhat more abundant on the Black Rock area. The Kaibab studies and others clearly demonstrate that on areas of low grass production cattle do resort to utilizing browse species to a much greater extent. This is what has happened on the study area. With depletion of the grasses, cattle have essentially become browsers.

Many hours have been spent taking actual feeding minutes on deer and cattle in various parts of the study area. Direct observations at close distances with the use of binoculars were made while the animals were feeding. The species being utilized were recorded and the actual time spent feeding on each individual plant was clocked. It should be pointed out here that feeding minutes are <u>not a precise</u> method of determining exacting figures on forage habits because different plants yield different forage volumes and the exact recognition of plants being consumed is sometimes difficult. For the purpose of this study, Feeding Minutes have been used to indicate generalized forage habits and not to obtain precise data.

Figures 3 and 4 show the comparative feeding habits of deer and cattle on the study area as determined by use of Feeding Minutes and other feeding observations. Figure 3 is the Mountain Browse type while Figure 4 is in ~~the~~ a burn . The species composition for ~~each~~ type is also shown .a The unknown factor shown in the tables are feeding minutes where the observer was unable to determine the exact species being utilized. Much of this feeding time probably goes to forbs or grasses since they are small and less easy to identify.

Notice the similar feeding habits of deer and cattle. Deer use on grasses in both tables was negligible. Cattle fed only 4.85 % on grasses in the Mountain Browse table and 6.98 % in the burn area. In the Mountain browse type 74.3 % of cow's time was spent utilizing browse species, while the browse intake by deer was 79.62%. In the Mountain browse type where gambel oak makes up an estimated 32 % of the type, 43.12 % of deer use and 46.73 % of cow use was on this important forage plant. In the burned area silktassal made up 57 % of the type and 52.58 % of the deer forage time, while 48.26 % of the cows time was spent feeding on silktassal. These two tables clearly demonstrate the overlapping feeding habits of deer and cattle in two types of the Black Rock Deer Range.

Deer on the study area have been observed utilizing grasses to an undetermined extent in the summer months. Ten deer in August of 1961 were observed feeding on ~~the~~ young succulent grasses which sprouted up as a result of recent rains on the area which was treated with 2,4-D. Deer on the study area are feeding on grass to a somewhat larger extent early in the growing season. Use after this period is probably negligible, although longer utilization of grass may result if sufficient rainfall stimulates the growth of new grasses later in the growing season.

Cattle as contrasted to deer, will use grasses heavily all summer long if available and only with the advent of late fall turn to browse plants . On the study area the bulk of the forage of cattle is derived from browse during all seasons, including summer. This is a direct result of a lack of grasses.

In addition to the factors already mentioned, the comparative quantity of forage consumed must be considered. According to Stoddart and Smith (30), the amount of forage consumed per day by mature cattle is about 20 pounds. Studies on the Edwards Plateau of Texas (38) show that approximately 20 pounds of range forage per day maintains a 1,000 pound cow. In California it was discovered that cattle consume about three pounds of dry matter per 100 pounds of liveweight

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Table ~~FIGURE~~ 3 : COMPARARIVE DIETS OF DEER AND CATTLE IN THE MOUNTAIN BROWSE TYPE AS DETERMINED BY ACTUAL FEEDING MINUTES

Plant Species	% composition	Feeding Minutes		% of Diet	
		Deer	Cows	Deer	Cows
Gambel oak (Quercus gambellii)	32%	273	207	43.12%	46.73%
Serviceberry (Amelanchier utahensis)	19%	132	63	20.85%	14.56%
Silktassal (Garrya wrightii)	16%	76	56	12.01%	12.94%
Juniper (Juniperus utahensis)	4%	4	0	.63%	0.00%
Big sage (Artemisia tridentata)	4%	0	0	0.00%	0.00%
Snowberry (Symphoricarpos spp.)	3%	8	5	1.27%	.12%
Locust (Robinia neomexicana)	2%	2	1	.32%	.02%
Mountain mahogony (Cercarpus spp.)	2%	1	0	.16%	0.00%
Turbinella oak (Quercus turbinella)	2%	3	0	.47%	0.00%
Manzanita (Arctostaphylos spp.)	1%	0	0	0.00%	0.00%
Desert ceanothus (Ceanothus greggii)	1%	4	0	.63%	0.00%
Gooseberry (Ribes spp.)	1%	0	0	0.00%	0.00%
Bitterbrush (Purshia tridentata)	1%	1	0	.16%	0.00%
Miscellaneous weeds and forbs	10%	62	43	9.79%	9.93%
*Grasses	3%	2	21	0.32%	4.85%
Unknown *		65	47	10.27%	10.85%
TOTALS	100	633	443	100.00	100.00

Table ~~FIGURE~~ 4 :COMPARATIVE DIETS OF DEER AND CATTLE IN A BURN AREA AS DETERMINED BY FEEDING MINUTES

Plant Species	% Composition	Feeding Minutes		% of Diet	
		Deer	Cows	Deer	Cows
Silktassal (Garrya wrightii)	51%	51	83	52.58%	48.26%
Miscellaneous weeds and forbs	10%	19	48	19.59%	27.90%
Desert ceanothus (Ceanothus greggii)	4%	11	18	11.34%	10.47%
Turbinella oak (Quercus turbinella)	10%	8	99	8.25%	5.23%
Manzanita (Arctostaphylos spp.)	11%	2	0	2.06%	0.00%
Big sage (Artemisia tridentata)	3%	0	0	0.00%	0.00%
*Grasses	5%	2	12	2.06%	6.98%
Unknown *		4	2	4.12%	1.16%
	100	97	172	100.00	100.00

* Unknown: feeding minutes where thevspecies being utilized could not be determined. Much of this time probably goes to forbs or grasses.

daily, varying from 2.00 to 3.25 pounds [redacted].

Considerable research studies have also been conducted on the amount of forage consumed by deer. Nichol (24), found that mule deer require about 2.2 pounds (air dry weight) per hundred weight. Other studies [redacted] indicate a similar consumption rate. Swank (31) states the following, " In addition to the tendency of cattle to utilize browse on ranges poor in grass production, it has been found that each steer will consume 12.7 [Davis, 1952 (8)] to 18.8 [Kimball and Watkins, 1951 (16)] times as much forage as one deer. He continues ..., If we assume that digestive rates of animals are the same for both grass and brush, the tentative conclusion ~~can~~ may be drawn, using the amount of browse consumed by cattle, that on the Kaibab North, one cow eats the same amount of shrubs and trees as 4.4 deer.... On a basis of seven head of cattle per square mile, cattle one one square would consume about the same amount of deer forage as ~~[illegible]~~ 30 deer".

~~It is obvious that~~ On the Black Rock Mountain-Virgin Mountains area, where shrubs are more abundant and make up a greater proportion of the cattle diet, the consumption ration may be even higher than on the Kaibab North.

Another factor is the amount of range utilized by deer as compared to cattle. Livestock on the study area are well adjusted to the rough topography, but ~~it is safe to say that~~ deer will range over more of the ~~range~~ area than will cattle. The manzanita brush areas are receiving little use from either deer or cattle. Deer are utilizing the steeper and rougher areas to a much greater extent than cattle, although some hardy cows were seen in surprisingly rugged terrain. In addition to making better use of rough areas, deer generally are able to range much farther from water than can hereford cattle. ~~With a need for additional water development~~. Since water is lacking over some of the area, this factor may be an important factor in the utilization of this range. It may be said that deer are making greater use of the range than livestock because of their preference and ability to survive in the less accessible areas. Overall the area, deer are probably making use of 20 to 30% more range than are cattle.

Using the information compiled and taking into consideration many variable and complicating factors, it is conspicuous that on this range area direct competition between deer and cattle has resulted because of the depletion of the grass resource. Past heavy use by domestic livestock has been the primary cause of the decline in grass cover, while drought has exerted limited effects. Deer in the past have probably exerted little influence on the grasses since deer populations have been sizable only in relatively recent years. To what extent the diets of cattle and deer are overlapping is a dabatable issue, but a 70 to 80 % overlap in diets is ~~proba~~ a reasonable and conservative estimate.

Seasonal Use, Winter Range

The summer range of the Black Rock Deer Herd is centralized mainly in the higher areas of Black Rock Mountain and the Virgin Mountains, while a small portion of this herd summers on Wolfhole and Seegmiller Mountain.

The winter range of the Black Rock Deer Herd is not as well defined as the summer range since the animal dispersal is difficult to trace and the deer are scattered. Competition between deer and cattle is no problem on the winter range because there is very little concentration overlap such as occurs on the summer range.

Basically, the winter range encompasses the lower elevation slopes, valleys, canyons, foothills and other protected areas which lead up to the higher elevation summer range. Some actual migration to other close by areas seems likely. Most of the winter range is a pinyon-juniper vegetation type, with sagebrush and blackbrush being common understory plants. The deer that summer on Black Rock Mountain are spending the winter months in varying numbers on most of the foothill areas, with definite concentrations in Sullivan Canyon and Pocum Cove, which are two large well protected areas. Some additional concentration occurs on the north-western slopes where an abundance of cliffrose provides favorable winter forage conditions. The deer summering on top of the Virgin Mountains are moving down into Sullivan Canyon and westward to the lower slopes. Many deer are moving down into the Cottonwood Wash area where some winter concentrations are reported in several old burn areas.

Deer under normal conditions appear to be utilizing most of the summer range from the middle of April until mid-November, which amounts to a period of about seven months. The amount of drift from summer to winter range will vary depending on winter weather conditions, available forage, water, climate and other factors which flucuate from year to year.

Photo 21: Looking from Maple Springs Canyon on the west slopes of Black Rock Mountain to Wolfhole Mountain, part of the summer range of the Black Rock Deer Herd. The chained juniper area is on intermediate deer range.



Photo ~~20~~ 22: Winter range on the lower northern ~~slopes~~ of Black Rock Mountain. Notice dense blackbrush stands.

POPULATION DYNAMICS

DEER POPULATIONS

One of the major purposes of this study has been to carefully and objectively discover information on deer populations so an estimate of total population of the Black Rock Deer Herd could be determined. This is ane essential item since almost all management practices will be based on a reliable knowledge of deer numbers.

Several accepted survey methods as well as general observations were used to furnish the main source of population figures. The use and accuracy of pellet group counts in determining deer populations has been questioned by some wildlife workers, but in most areas if carefully used this method can provide data for an estimate of deer population.

The Pellet group method is based on the principle that the defecation rate for mule deer averages approximately 13 pellet groups per day under most forage conditions. The following description is given in the B.L.M. Manual Vol 9, section 10.3.44. By recording the pellet groups found in certain prescribed units of range such as 1/100 or 1/10 acre plots, it is possible to obtain the number of game days use per acre or actual grazing which has taken place. If the period (months or days) of use of the area is known, it is possible within reasonable limits to determine populations by dividing the total deer days use by the length of stay in the area.

Sufficient strips counts were ran through five vegetation types and sub types in order to provide a reliable sample in proportion to the area of each type. Ordinarily, counts are based on winter use and counted in the spring. For this study the current summers groups were counted in the fall. The length of stay on this summer range is approximately 7 months or 210 days. The vegetation types were taken from range survey maps and acreages were determined by use of a planimeter. All the data obtained from the pellet group counts is tabulated in figure .

In addition to pellet group counts surveys by vehicle, on foot and horseback were conducted during all hours of the day to provide generalized information on population and distribution. A total of 682 deer were classified during the

two year period.

General deer sign has some value as population indicators. Bed counts, rubbed trees, shed antlers, tracks, trails and other sign was used to provide additional general information. Degree o utilization of forage species is also used, but this is complicated by the heavy livestock use.

Figure 5 shows the population figures and densities as divided into vegetation types. It should be kept in mind that density is a relative figure since deer are constantly moving around to a certain extent.

The highest deer density of 31.2 deer per square mile is in the high carrying capacity mountain browse type discussed earlier. This high density is to be expected because of the abundance of such valuable browse species as silktassal, cliffrose, serviceberry, mountain mahogony, snowberry, snowberry, desert ceanothus, and bitterbrush.

The next highest deer density can be found on the old burned areas. Although most are more than ten years old a fairly high density is to expected because forbs and young browse plants have come back in fair amounts on most of the burn areas. Higher densities of deer can be found on a more recent burn in the Virgin Mountains area.

Some higher deer concentrations have been located around several waterholes as a result of poor moisture and forage conditions during the summer months.

The lowest density occurs in the low carrying capacity pinyon-juniper-sage type, which is lacking in favorable species because of dense growths of juniper and big sage.

The overall estimated average density of this deer range is 18.9 deer per square mile. When contrasted to densities of other deer ranges this is not an overwhelming figure. The Kaibab deer herd went from an average density of 23 in 1951 to 35 deer per square mile in 1954 (31). The Mingus Mountain Deer Herd which has some range similar to the Black Rock Deer range averaged 17 deer per square mile in 1954 to 19 in 1955(31). The coast ranges of California contain an estimated 19 deer per square mile, while the average statewide is 13 (32). The average density on Arizona deer ranges is 10(31).

Taking available forage, competition problems and other important factors into consideration

Wendall Swank in writing about Arizona conditions had the following to say (31), "It appears that under the present multiple use pattern when deer density becomes greater than ten deer per square mile an increase in harvest is in order." Taking available forage, competition problems, and other factors into consideration it appears that the present population is at or near the maximum desirable limit.

This study was concentrated in the Black Rock - Virgin Mountains area because these are the major areas of concern pertaining to competition and range management problems. The Black Rock Deer Herd range also covers a large area of fair deer habitat in the wolfhole and Seegmiller Mountain area. An additional estimated 300 deer can be found on these areas and are actually part of the Black Rock Deer Herd.

exclude Black Mountain

Table 5

~~FIGURE~~ POPULATION OF THE BLACK ROCK MOUNTAIN DEER HERD

as determined by pellet group counts in five vegetation types

Vegetation type	Average number of Pellet Groups	Acreage	Population	Density
Mountain browse	10.2	13,663	664	31.2
Burn areas	9.6	2,654	126	30.7
Pomderosa pine	8.0	2,291	87	24.2
Pinyon-Juniper-Browse	5.1	12,347	280	14.5
Pinyon-Juniper-Sage	4.0	23,540	448	12.2
		54,465	1,605	1

*Average overall density is 18.9 deer per square mile

HERD COMPOSITION

One of the most important considerations in managing deer herds is to gather information on herd composition according to sex and age. Determination of population structure is an extremly important production factor and must be used in formulating management principles.

For the purpose of this study, deer were observed and classified while traveling by vehicle, on foot and horseback. Many hours were spent watching waterholes, salt blocks, game trails and other commonly used areas. The composition was determined by observing and classifying deer with the use of binoculars at close enough ranges that all classes could be distinguished. Only those groups were counted where all animals could be classified. It is believed that a reasonably accurate classification was obtained without emphasizing the numbers of those bucks which are most readily recognized such as large bucks. The population was broken into 5 classes including (1) Adult bucks (2) Young bucks (3)Adult does (4) Young does (5) fawns.

Accurate age and sex classification is often difficult, but with experience a trained observer can reliably determine sex and age classes by certain characteristics. Some of these classifing characteristics are discussed below.

(1) Adult bucks
    (A)Well developed antlers
    (B)Fairly large body
    (C)Ears relatively short
    (D)Difference in color of muzzle
    (E)Thick solid neck
    (F)Often with other buck, seldom with family group
(2) Yearling bucks
    (A)Antlers small, undeveloped
    (B)Body slender
    (C)Long legged
    (D)Noticibly smaller than adults in summer months
    (E)fawn like
    (F)Often playful

(3) Yearling does
(A)No antlers
(B)Slender body
(C)Long legged
(D)Fawn like in early summer
(E)Usually in a family group
(F)Sometimes playful

(4) Adult does
(A)No antlers
(B)long muzzle
(C)Neck slender
(D)Usually leads in traveling

(5) Fawns
(A)Smaller than other classes
(B)Spotted coat up to about September
(C)Neck short and thick
(D)Long ears
(E)Blunt muzzle
(F)usually playful
(G)Follows doe closely

The composition data compiled during 1960 and 1961 is shown in figure .

When compared to a well managed, normally hunted deer herd, the population structure of the Black Rock Deer Herd is very unusual. Bucks make up a large proportion of the herd and large antlered bucks are common. Young animals are lacking, while much of the population consists of older animals. The unusual age ane and sex ratios and low fawn crop are the direct result of light hunting pressure and will change with increased hunting.

Table
FIGURE 6 POPULATION STRUCTURE OF THE BLACK ROCK DEER HERD

as determined by 1960 and 1961 composition counts

	1960		1961	
	#	%	#	%
Adult bucks	89	33	96	26
	32			10
yearling bucks	32	9	35	10
Adult does	97	34	127	33
Yearling does	41	14	59	13
Single fawns	31	9	45	12
Twin fawns	8	4	22	6
	298	100.0	384	100.0

PRODUCTIVITY

Numerous factors need to be considered in determining the productivity (rate of increase) of a deer herd. Some of these factors include age composition, sex ratio, fawn crop, longevity, hunting pressure, range conditions, and various mortality factors.

In most cases, the widest sex ratio which still permits maximum fawn production is best. The extent of this ratio will vary according to topography, fertility, and other factors. The figures below illustrate the potential rate of increase of herds of 1,000 deer containing a varying sex ratio ratios.

Table 6

Bucks : does	Number of does	potential increase with 1:1 fawn:doe ratio
100:100	500	50
43:100	600	60
11:100	900	90

*figures from Dasmann, Starker & Leopold

The desirability of a wide sex ratio is based on the polygamous ability of bucks to effectively breed numerous does. Areas of heavy hunting intensity in Washington and Oregon where few does are taken show sex ratios as wide as 1:14 and still maintaining a high productivity rate(34). This is an unusual spread and most normally hunted herds probably do not exceed a 1:8 ratio. The sex ratio of the Black Rock Deer Herd is at the low extreme of about 1:1, and subsequently is a definite factor limiting populatios. This extremely low sex ratio is the result of light hunting pressure. The sex ratio will become more favorable with increased removal of bucks

The age class of a deer herd is an important factor in controlling rate of increase. For maximum productivity, a relatively young herd is a necessity. In a healthy, productive, well managed herd, yearlings (23 months or less) should make up 30 to 40% of the herd, while older animals are preferably in the minority. This is because young deer have a high reproductive stability, where as animals past 4 Or 5 years old often decline considerably in their ability to successfully breed. The age ratio of the Black Rock Deer Herd reflects the light hunting kill, with older animals making up a large % of the herd, while yearlings are lacking. Like

The annual production of fawns is obviously controlled by the sex and age ratios, although other factors also exert strong influences. Another important consideration is animal health, which is a direct result of range conditions. Forage conditions during during summer and winter directly affect rate of conception, fawn crop and animal survival. Good forage often produces a substantial increase in breeding success and fawn crop, while poor range conditions can severely limit both.

As might be expected, fawn crops vary from one herd to another. A low fawn crop of 25% was reported in a New Mexico Herd (34) and a 50% production of fawns was re orted in southern and central Arizona (34). It is fairly well accepted that healthy does average a fawn to doe ratio of 150:100. Under favorable forage conditions a fair percent of yearling does will breed successfully. In addition, twin fawns are common in most Arizona deer herds.

The following figures illustrate the theoretical fawn crop of the Black Rock Deer Herd . Assuming (1)population of 2,000 deer (2) 35% (700) of the herd is breeding does (3) 100% conception (4)125:100 fawn to doe ratio (5) 20% mortality loss . The resulting fawn crop would be about 700 animals.

The fawn crop of the Black Rock Deer Herd in the past has been well ~~above~~ the potential rate of increase and probably averages about 30 to 40 %. Twin fawns were scarce in the 1960 deer surveys, but more twin fawns and single fawns were classified in 1961, which may indicate some upswing.

The low fawn crop is largely the result of four main factors and will greatly improve with increased control of buck populations. The limiting factors are (1)lack of succulent forage during summer and fall (2) Possible unfavorable winter range conditions (3) Poor age ratio (and (4) undesirable sex ratio.

RANGE CONDITION AND TREND

RANGE CONDITION & TREND Exclude

Range condition is a reflection of past use, while range trend is a reflection of present utilization. Both of these however may be diagnosed by evaluating numerous range indicators. Indicators of soil condition, vegetative condition, forage utilization, plant succession and other factors were used to discover what is happening on this range.

The history of the Black Rock-Virgin Mountain area has been a story of heavy grazing by horses, sheep, and cattle. Within the past ten years, increased deer populations have caused additional complications and concern.

For determination of degree of utilization three general methods were used. The first is a General Reconnaisance method, which is based on general observation estimates of the volume of forage removed over an extensive area. The Visual Estimate Method was also used. This method involves (1) examination of browse species to reveal the extent of cropping (2) mentally reconstruct the shrub as it appeared before cropping (3) estimate the amount of seasonal growth that has been removed. In addition, actual measurements were taken on some species.

The more important browse species taking the whole area into consideration were visually divided into form and age classes to provide additional information. The classification method is thoroughly discussed in the section on procedure. The data on form and age class were used to indicate their relative importance as forage, degree of past browsing pressure, and amount of forage currently available.

Other indicators used include close grazing of inferior species, grazing lines, dead or dying plants, plant succession, plant vigor, plant density, plant height, and other factors.

Key species are useful in measuring degree of utilization because they greatly simplify the process of measuring overall utilization since the amount of use on them is often indicative of the overall extent of browsing. This principle is applied on this study, keeping in mind that plants included as key species no matter how palatable, must be present in a large enough quantity to contribute significantly to the carrying capacity. Because of their wide distribution, abundance, and prolific forage production silktassal, serviceberry, and gambel oak are the key species on this range. Secondary species include desert ceanothus, cliffrose, mountain mahogony, bitterbrush, and snowberry.

The overall form and age classification of serviceberry, silktassal, and gambel oak may be described as mature:largely available: moderately hedged. This is a generalized statement and varying degrees of utilization occurs in different areas depending on availability of better forage plants, topography and other factors. In those areas where better forage species are lacking the extent of cropping is often over the desired limit. Browsing lines on serviceberry and silktassal are conspicuous in these areas. See photo 22.



Photo 22 23 :Browse lines on silktassal and serviceberry. Notice lack of ground cover between shrubs.

Even in the highly productive mountain browse type where silk-tassal, serviceberry, and gambel oak grow in abundance, some browsing lines can be detected. Although vigor of the key species is normal and large prolific leafing plants are common, reproduction is definitely limited and decadent plants are all to conspicuous.

Over utilization is most conspicuous on some of the secondary species. Mountain mahogony and bitterbrush, both excellent browse plants show the most severe affects of over use.

Bitterbrush is fairly common over much of this range and at one time was an important forage producer. Almost all of the bitterbrush plants remaining on this range are in a near decadent: unavailable condition and in place of annual growth practically all that remains are dead or dying leafless twigs. Of the 97 bitterbrush plants classified on various parts of this deer range all but three plants were in this category. Bitterbrush is fairly resistant to grazing in this condition because of the rigid branching, but experimental work in Utah (12), proved that such close utilization of bitterbrush can drive it from the range.

Mountain mahogony is present in scattered ampunts on the Black Rock Deer range. This highly desirable browse plant has been seriously affected by severe over use. See photos and . All of the 50 plants classified on various parts of this summer range are in the decadent: unavailable category. Very few young plants are present and completely dead or dying plants are not an oddity. Although mountain mahogony can withstand close grazing very well and has the ability to grow out of reach of cattle, experimental work (12) shows that continued overgrazing affects forage production and may even kill the plants.



Photo 24 (23): Severe over-utilization of mountain mahogony (right arrow) and silktassal (left arrow) and gambel oak (center arrow).

Although bitterbrush and mountain mahogony have never been key species on this range, at one time they were important forage producers. Many years of over use have exerted strong affects on these valuable species and at the present time bitterbrush and mountain mahogony are almost out of the picture as forage producers because of their decadent condition. Even though these plants are fairly abundant, they are much sought after by deer and cattle and excessive use on them may not be indicative of overall range utilization. Unfortunately, it definitely indicates a downward trend for these once important species. If the present heavy grazing pressure continues, mountain mahogony and bitterbrush will eventually be eliminated from this range.

Desert ceanothus, a secondary species scattered over this range also shows some overuse despite its rigid profuse branching habit. This may well be largely deer use, because deer are better able to feed among the branching system. In addition, this plant is an evergreen and subject to use all year long.

Cliffrose, an important winter browse plant, is also largely in an undesirable condition. Decadent plants predominate, but this is largely the result of drought and not over use. In many cases, however, cliffrose is lacking in annual leader growth, probably resulting from heavy use. Cliffrose on this range commonly grows out of reach of animals, rendering it practically unusable in many cases.

Unusual use of inferior forage species is often indicative of overall utilization, although it may only reflect a lack of better forage species. Turbinella oak, ordinarily a low palatable species has been moderately or in some cases heavily utilized.

The Black Rock-Virgin Mountain area has always been essentially a browse range, but grasses at one time were much more abundant than they now are. Excessive use by sheep, cattle, and horses has practically eliminated some perennial grass species, while current heavy cow use threatens to seriously reduce those few grasses which still remain. Junrgrass, muttongrass, squirreltail and other grasses are able to exist only under the protective cover of shrubs and other places where cattle cannot make use of them. See a typical grass production site in phpto. Range survey show that grasses ~~contribute very little to the carrying capicity of this area since they~~ make up only 2% of the total vegetation.

~~In addition, grass reproduction, grass reproduction is very limited, in fact almost non existent.~~ Competition by dense stands of sagebrush, pinyon, and juniper has undoubtedly reduced production of grasses to a large extent. This was well exemplified by the abundant grass growth which came in on Black Rock Mountain after the sagebrush competition was removed. Because of the reasons mentioned, grasses contribute very little to the carrying capacity of this range. The productivity of this range is only fair, but most areas have the potential to produce better stands of grasses, depending on edaphic, moisture, aspect and other ~~varia~~ site conditions.

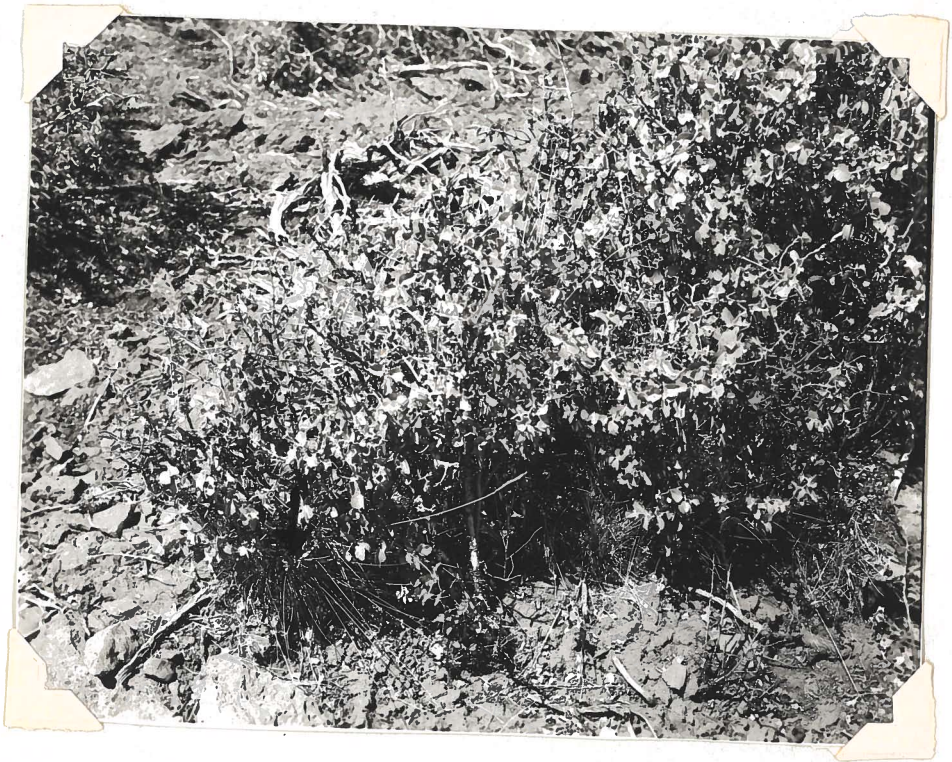


Photo 25: A typical grass production site. Muttongrass growing under the protective cover of a serviceberry plant.



Photo 26 :Mountain brome and red brome in the Mountain browse type on the Virgin Mountain slopes, proving that this range has the productive potential to grow good stands of grasses.

The basic soil type may be described as a fairly coarse textured often rocky absorptive soil of basaltic origin. Some finer textured and more productive soils can be found in drainages and bottom lands. Dense growths of shrubby vegetation in combination with accumulations of leaves, twigs, needles and other litter provide a moderately effective ground cover and erosion retardent. Most of the erosion is geologic in nature while some accelerated erosion can be detected. Erosion rills and gullies are not present to any large extent, but erosion pavement is conspicuous in most areas. The overall erosion may be described as moderate and undoubtedly has been accelerated to some extent by the depletion of grasses. Erosion in most of the old burn areas is heavy.

Summary

The overall utilization of browse on this range may be described as moderate, while many areas show definite signs of over use evidenced by browse lines, over browsed plants, decadent plants, and lack of reproduction. Gambel oak is the most frequently over-browsed key species, while serviceberry and silktassal show some signs of over-use in localized areas. Bitterbrush and mountain mahogony have been severely over-utilized and in their present decadent condition produce very little forage. Even in the mountain browse type where good forage is abundant, these two excellent are in very poor condition.

Perennial grasses have been seriously depleted resulting in some increased accelerated erosion. Most of the damage on this range is due to past and present livestock use, while deer in recent years have caused additional problems.

This important range is definitely showing signs of being in a downward ~~to~~ condition trend and will continue to decline under the present utilization. Unless increased management measures are effected in the hear future, this range will be seriously damaged and the resulting carrying capacity materially reduced.

MANAGEMENT

~~MANAGEMENT~~ Exclude

Effective management of the Black Rock Deer Range necessitates the employment of various range improvement practices as well as proper management of deer and livestock. Since livestock management has been covered in a previous report, this coverage will be largely devoted to management of the deer herd.

Deer management often seems quite difficult. In reality, the basic principles are simple. The main thing to remember is that deer have a tremendous reproductive potential and if a deer herd is not increasing steadily, something is wrong. In addition as a multiple use land management agency we must keep in mind the balance of deer and cattle numbers in relation to the carrying capacity. Actually, deer and cattle reproductive rates as well as rate of mortality are regulated by range conditions. Our main ~~deer~~ management objective should be to regulate and maintain both deer and cattle numbers at a point where the food that may be available under the very poorest conditions will support the desired numbers of both. The ideal range trend conditions will be obtained when the deer harvest keeps deer numbers nearly static and range production trends are slightly upward.

Sportsman are often over concerned about overharvesting deer herds. While this is possible, it is not likely under the prevailing conditions . The major problem with the Black Rock Deer Herd will probably be under harvest rather than over harvest. Until the 1961 any deer season hunting pressure on the Black Rock Herd has been very light. During the 1960 regular deer season only an estimated 200 deer were killed on the A izona Strip. In 1961 an either sex hunt was initiated and an estimated 400 deer were killed in the Black Rock area. This kill was well below the desired ~~limit~~ amount. In addition, most of the animals killed were bucks, subsequently the actual production of fawns was little affected.

SEASON Efforts for next years hunting season should be designed to remove 35 to 40% of the current population. Although this degree of harvest may be opposed by sportsman, the ultimate results will benefit the deer herd, livestock production and the range, providing that the desired intensity of management is exercised. With less animal numbers relatively light utilization of forage plants should allow this range to bounce back

to a certain extent and probably increase the carrying capacity. If an over harvest occurs (very unlikely) a deer season may be curtailed ~~until the deer~~ population is restored. With the high productivity rate of deer, this population build up takes only a short time ~~, while the recovery of an over utilized range takes much longer~~. On the other hand the results of under harvest of the Black Rock Deer Herd could be drastic and definitely not consistent with good range management principles. With excessive deer populations forage plants will be severely affected and the carrying capacity would probably be ~~materially~~ reduced. This means that this range would support fewer animals than previously. It takes only a short period of time ~~to~~ for a deer herd to build-up again , but it takes many years to restore an over utilized range.

The recommended kill for next year will benefit the deer herd from several aspects. At the present time the annual rate of increase is low because of the unusual sex and age ratios. With the desired removal of deer the buck:doe ratio and percentage of young animals will be immensely improved. The tremendous reproductive ability of young animals in combination with a better percentage of breeding does will increase the annual rate of increase immensly and it is not inconceivable that this herd could double its numbers in two or three years.

This is where the big problem begins, because in order to maintain static populations within the desired limits the 20 to 30 % annual "harvestable surplus" must be harvested by hunting. If this surplus is not removed the carrying capacity will soon be surpassed and create problems unheard of prior to moderate hunting. This is our challenge, for even though this range has the forage to support a sizable deer herd and maintain livestock production without proper management this deer herd could erupt in a short period of time, causing a situation extremely dangerous to proper multiple use and range management principles.

The following section is devoted to a discussion of possible methods to be used in regulating the Black Rock Deer Herd at the recommended population level. The special 1961 early any deer hunt was ~~designated~~ designed partially a success, but did not achieve the desired kill. This hunt was designed to increase the kill, especially of does in the Black Rock Deer Herd. Even though many more deer were killed than in previous years, most of those deer killed were bucks. There could be several explanations. It is possible that most of the hunters did not prefer to kill does because they could continue to hunt during the general deer

season. In addition, many ~~the~~ hunters were after only large antlered bucks. Although this type may be effective with increased numbers of hunters, it seems that other types of hunts may be more successful. Some possibilities are discussed below.

(1) Special limited "any deer" hunt during all or part of ~~the~~ the general deer season and on a first come first served basis.

(2) Special " any deer " hunt with an extra long season.

(3) Special " any deer " hunt by permit during or before the general deer season.

(4) Limited and carefully controlled " doe bonus hunt".

(5) A limited and carefully controlled combination buck: doe bonus hunt.

(6) Limited and controlled 2 deer hunt by permit.

(7) Post season any deer hunt

(8) Pre and post season hunt

CHECKING STATIONS

During next years hunting season a deer checking station should be established to cover return traffic from the Black Rock area. A multitude of useful information and data can be collected at properly located checking stations. Some of the information includes statistics on age classes, sex ratios, animal condition, locality of kill, body weights, ~~measurements, and~~ another measurements, kill trend, ~~information on~~ disease, parasites and deformities. Other information on total hunters, resident or non resident hunters ~~and other information which~~ would be useful for Bureau of Land Management public relations and recreational purposes.

Game & Fish Department IBM data from hunter report cards will provide additional information.

Access Roads

Lack of access roads is one major reason why this herd has not been hunted more heavily. Road improvement work definitely proved to be worthwhile during the 1961 deer season. The road from Wolfhole to Black Rock Mountain was graded before and during the season. This road work was particularly important because it greatly improved traveling conditions after rain and melting snow ~~added to con~~ addedvto the already poor road conditions. This road grading signifigantly improved hunter access by as much as 30 to 40 percent. Several happy and successful hunters traveling in sedans expressed appreciation for the increased efforts to promote recreational use of the Black Rock area.

Maintenance and construction of new access roads on and to Black Rock Mountain will be an integral management feature of this deer herd and may make the difference between achieving the desired harvest or permitting this herd to get out of hand. Preliminary tentative plans for a network of access roads on Black Rock Mountain was discussed during the past summer with Game & Fish Department personnel. These roads will also provide badly h needed fire control roads.

Hunting maps

During the 1961 deer season a new hunting map of the Arizona Strip ~~was distributed~~ showing deer concentration areas and major access roads was distributed. This map was successful in increasing hunting pressure in less known areas. The Black Rock Deer area was designated as a moderate to high deer concentration area and drew many hunters from the usually heavier hunted Mount Trumbull area. In addition, these maps were useful public information releases and reminded hunters to obey hunting regulations, respect ranch property, leave a clean camp, and use caution with fire. Hunting maps should be distributed in future years.

Census activities

For effective management of the Black Rock Deer Herd we need to learn much more about animal populations. Obtaining data on deer numbers is difficult since every deer obviously cannot be counted. In reality, within limits the total ~~opp~~ population is of minor importance im management techniques. When relative deer numbers are known we can make sound recommendations as to the harvest needed. In the absence of good data on numbers, the deer kill is apt to be too heavy or too light for maximum sustained yield production. The important thing ~~is~~ to know whether the herd is decreasing, decreasing or remains static over a period

of years.

Additional information on herd composition needs to be gathered by surveys and counts. This data will provide additional data to be used in determining balance between buck and does, fawn crop, and general productivity.

Browse Utilization Studies

Since deer are direct products of range plants we need to learn much more about deer forage plants, their abundance, and degree of utilization on summer and winter ranges. The district wildlife conservationist spent several days last fall working with Game & Fish biologists on setting up and reading Browse Utilization Transects on cliffrose plants in one of the main ~~wib~~ winter range areas. Additional transects need to be established on other parts of the winter range. The total yearly growth measurements made in the fall before the deer move into the winter range afford a base for comparison with measurements after the deer have moved from the winter range. Enough of these utilization transects will constitute an adequate sample of an indicator of total range usage.

Range Improvement Practices

~~The Blac~~

The Black Rock area is lacking in proper water distribution. During the hot summer months deer and cattle are concentrating in excessive amounts around waterholes causing overutilization in those areas. Many areas are only lightly used because of the distance from water. Additional water develoments on Black Rock Mountain would greatly improve distribution of both deer and cattle resulting in more uniform use of this range. This would greatly improve the present over utilization of this range and result in much better range management. The permitee on the main summer range of Black Rock Mountain has expressed interest in two or three water developments. If possible these range improvements should be constructed in the near future to relieve the present competition and over use problems.

~~Another possible range improvement practices~~



Photo 27: Cooperative efforts in the establishment and reading of Browse Utilization Transects provide valuable information on forage utilization. Here Harold Pratt and Levi Packard of the Arizona Game & Fish Department tag and measure utilization of cliffrose on winter range of North Black Rock Mountain.

~~Other range improvements~~

~~Other range improvements~~

Another possible area of improvement consists of the use of range improvement practices to increase the carrying ~~carrying~~ capacity and permit better management of livestock. Elaborate management plans including additional fencing, reseeding and chaining have been set up for the near future. Approximately 550 acres of sagebrush were sprayed with 2,4-D, resulting in a good kill of sagebrush and a better stand of perennials including muttongrass, squirreltail, junegrass and others. Although these future improvements are designed mainly to improve forage conditions for cattle, ~~but~~ they will also conspicuously benefit deer.

COMMON AND SCIENTIFIC NAMES OF PLANTS ON THE BLACK ROCK DEER HERD RANGE

Trees and shrubs

Serviceberry --Amelanchier utahensis
Manzanita --Arctostaphylos spp.
Big sagebrush--Artemisia tridentata
Desert ceanothus--Ceanothus greggii
Mountain mahogony--Cercocarpus betuloides
Blackbrush --Coleogyne ramosissima
Cliffrose --Cowania stansburiana
Mormon tea --Ephedra spp.
Flat top buckwheat brush --Eriogonum polifolium
Apache plume --Fallugia paradoxa
Silktassal --Garrya wrightii
Utah juniper --Juniperus utahensis
Nut pine --Pinus edulis
Single leaf pinyon --Pinus monophylla
Western yellow pine --Pinus ponderosa
Bitterbrush --Purshia tridentata
Chokecherry --Prunus virginiana var. demissa
Gambel oak --Quercus gambellii
Turbinella oak --Quercus turbinella
Gooseberry --Ribes spp.
New Mexico locust --Robinia neomexicana
Wild rose --Rosa spp.
Skunkbush --Rhus trilobata
Snowberry --Symphoricarpos spp.

Weeds & Forbs

Mountain dandelion --Agoseris glauca
Wind flower --Anemone spp.
Sego lillie --Calochortus nuttallii
Sedge -- Carex spp.
Mountain balm --Eriodycton trichocalyx
Wild daisy --Erigeron spp.
Annual buckwheat --Eriogonum spp.
Spurge --Euphorbia spp.
Snakeweed --Gutierrezia sarothrae
Deerweed --Lotus spp.
Lupine --Lupinus spp.
Holly grape --Mahonia spp.
Wild tobacco --Nicotiana spp.
Penstemon --Penstemon spp.

Grasses

Crested wheat --Agropyron desertorum
Western wheat --Agropyron smithii
Three awn --Aristida spp.
Six weeks grama --Bouteloua barbata
Blue grama --Bouteloua gracilis
Red brome --Bromus rubens
Mountain brome --Bromus carinatus
Junegrass --Koeleria cristata
Indian rice-grass --Oryzopsis hymenoides
Mutton-grass -- Poa fendleriana
Squirreltail --Sitanion hystrix
Sand dropseed --Sporobolus cryptandrus
Needle & Threadgrass --Stipa comata

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