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a problem in multiple use in northeastern California

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PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
BERKELEY - CALIFORNIA

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

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A PROBLEM IN MULTIPLE USE IN NORTHEASTERN CALIFORNIA

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
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FOREWORD

In 1956 the Forest Service started research on management of deer habitat in the California Region. Mule deer are the principal big game animals. This project analysis for northeastern California is the initial report under that program. It has three purposes:

1. To evaluate existing conditions of deer habitat and their associated management problems.

2. To evaluate the present status of research and research needs, and

3. To suggest a rational program of research to furnish the information required to improve the management of deer habitat.

SUMMARY

Big game is one of a number of wildland products. The abundance and quality of the game crop is determined largely by the way the associated products are handled. Man's agriculture, forestry, and range management have produced great changes in the environment of big game--some beneficial, some detrimental. During the exploitation years, 1848-1900, some species became extinct or were severely reduced in numbers because of their slaughter and the destruction of their habitat by farming, fire, and grazing by livestock. Other species (particularly the deer) adjusted to the new conditions and were even benefited. Logging and fires opened the forests and allowed forage species to grow.

When land use turned to conservation about 1900, deer, antelope and bear constituted the big game resource of California. Much attention was given to protection from man and predators. But the habitat still remained subject to the activities of the foresters, farmers, and graziers.

Undoubtedly man's influence on big game habitat will continue to be exerted primarily through his land management activities. Management of the habitat directly for wildlife will be important only locally and sporadically. Of great importance, though not of direct concern in the present study, is the role of management of the big game itself and the need for close cooperation with the California Department of Fish and Game which is responsible for that management.

The greatest opportunities for wildlife habitat management lie in the modification of farming practices, grazing management, and forestry. Some of these practices, such as timber harvesting, automatically improve the big game environment; they can be modified to achieve even better effects. Other practices are destructive of game habitat. Often these can be modified to reduce or eliminate their detrimental influences. The challenge is not simply to produce and improve the habitat--although that is part of the objective. We must also integrate habitat management with the management of all other resources--livestock forage, timber, water, and the like. The greatest influences on the habitat have resulted as byproducts of the management of other resources. At the same time, deer have greatly affected the production and use of those other resources.

Our present knowledge includes much about the management of each resource alone. It includes too little about managing resources jointly. The problem is to produce the most and best of each resource while at the same time minimizing adverse effects on the production of other resources.

To improve multiple-use management we need research. Such research should be accomplished on northeastern California's deer ranges by these means:

CONTENTS

1. Classify the ranges into broad functional categories.

2. On each class of range select a representative study area.

3. On each area study interrelationships of all resources represented. Bring to bear on these multiple resources all available research effort from the different resource fields--timber management research, watershed management research, range management research, etc.--together with their related disciplines in the fundamental sciences.

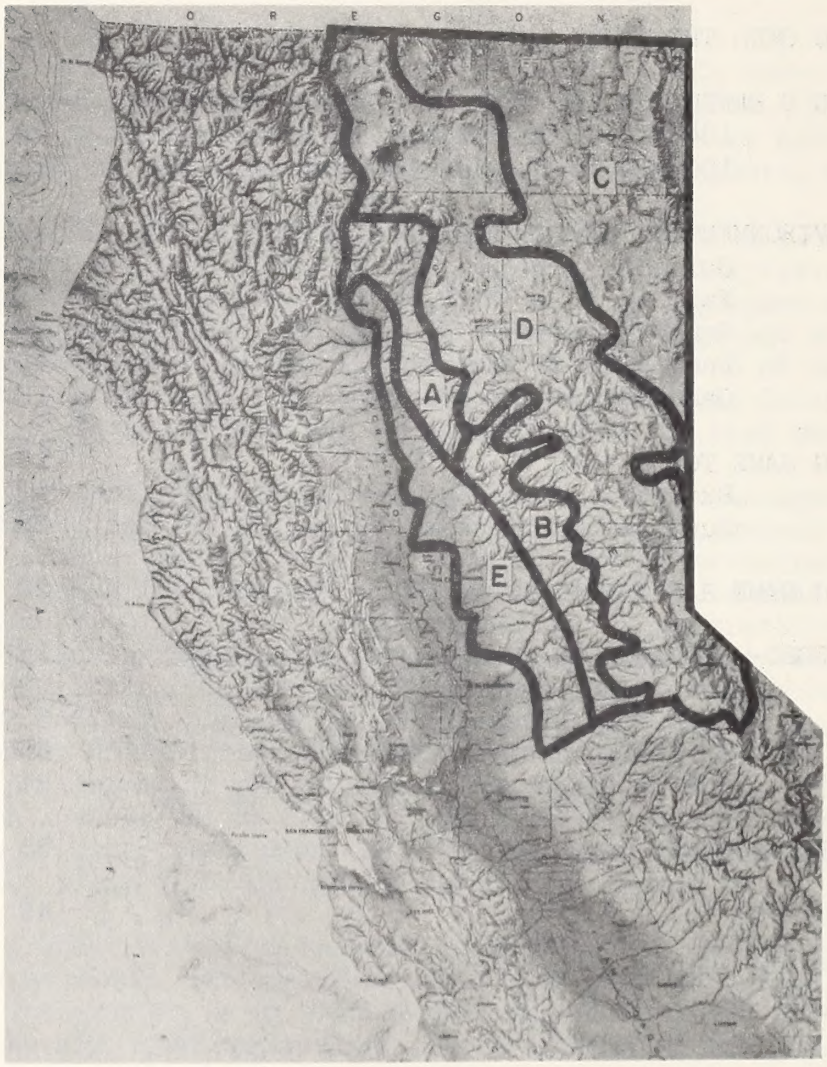

Figure 1.--Study area in northeastern California, subdivided into five types: A, West side winter range in brushland. B, West side winter range in conifer timber. C, East side winter range. D, Summer range in the mountains. E, Historic range, now urban and agricultural.

BIG GAME HABITAT MANAGEMENT . . .

A PROBLEM IN MULTIPLE USE IN NORTHEASTERN CALIFORNIA

By Lowell Adams

As popular demands for outdoor recreation grow, land managers and researchers need to give increasing attention to production of big game for recreation. In large measure, production is limited by the condition of the big-game habitat, but its condition is influenced greatly by the results of land management for other crops--in agriculture, forestry, and livestock grazing. How can we integrate game habitat management with other land-use practices? This is the question the Experiment Station is seeking to answer.

We are concentrating at the start on a 14-county sector of northeastern California (fig. 1). This 32,000-square-mile area has varied topography, climate, and vegetative cover. The Sierra Nevada-Cascade cordillera lies along its central axis and slopes down on the east to the Modoc Plateau, on the west to the valleys of the Sacramento and Klamath Rivers. The mountains receive plentiful precipitation and produce dense forests. The lower valleys and plateau are more arid and grow brush and grass. Deer, bear, and antelope are the chief big game species, and of these, deer are by far the most important. In terms of deer habitat, the study area can be divided into five broad ecological types (fig. 2):

A. the west side winter range in the brushland type.

B. the west side winter range in the conifer timber type.

C. the eastside winter range on the sagebrush type.

D. the summer range in high mountain conifer timber.

E. the Sacramento Valley agricultural zone, which has little value as deer habitat.

Figure 2.--The four types of deer range in northeastern California: A. west side winter range in brushland; B. west side winter range in conifer timber; C. east side winter range in sagebrush-juniper; D. summer range in high mountain conifer timber.

C

D

THE WILDLAND RESOURCES

On about one-fifth of the land area of California, this region produces more than one-fourth of the State's timber and about one-sixth of its sheep and cattle. It is recognized as one of the State's most attractive sectors for all types of outdoor recreation. It contains nearly all of California's antelope and produces more than a third of the State's deer harvest. On the whole, it produces water far in excess of its local needs and is second only to northwestern California in production of surplus water.

WATER

The importance of water as a product of land cannot be too greatly emphasized. The California Department of Water Resources (1951, 1955, 1957) has divided the State into major drainage areas. Parts of three of these areas--the North Coastal Area, the Central Valley Area, and the Lahonton Area--occur in the project area, though the North Coastal Area is represented only by a small part of the Klamath basin in north central Siskiyou County.

The Lahonton Area is the Modoc Plateau (except the area drained by the Pit River) and the east-side desert areas. Here water deficiency is paramount. There is not sufficient water to irrigate all irrigable lands or to supply any appreciable amounts for industries. For example, the Department of Water Resources estimates that in the combined Surprise Valley, Madeline Plains and Honey Lake Basin some 172,000 acre-feet of water are being channeled into consumptive use. Right now that area needs 268,000 acre-feet of water--a current deficit of 96,000 acre-feet per year. Ultimately the need will be even greater.

Of the Central Valley drainage, 18,300 square miles are in northeastern California. These are the lands drained by the Sacramento River; their average annual runoff is more than 20 million acre-feet. Only in the far upper reaches of the Pit River is the water supply deficient for local use. Examples of water supply and need for a few sample local drainages are shown in table 1.

Plans of the Department of Water Resources call for tremendous public works to capture and control the State's waters, convey them to areas of need and to develop and use the resource. Developments will provide for flood control, recreation (including fish and wildlife), and power generation.

In all this vast planning for water management in California, the Department of Water Resources recognizes that much of the success of the plans hinges on healthy watersheds. Two primary requisites are (1) to keep soil out of the streams as much as possible, and (2) to maintain maximum water production. Clearly there is need for management of deer habitat to meet these watershed requirements.

Repeatedly the plans of the Water Resources Department recognize fish and game requirements in water management. More information is needed regarding the effects of the water developments on deer. Often deer drown in conduits. Maintenance roads on water installations provide access for hunters. In dry areas there is need to develop watering places for deer. These are but examples of the many favorable and detrimental influences of water development which should be taken into account in the management of the deer and their ranges.

TIMBER

Second to water in the economics of land utilization on the deer ranges in the project area is timber production. In 1956 the timber harvest in the project area was valued at nearly 30 million dollars (table 2).

Exploitation of the timber resource has accelerated rapidly in the past 20 years (May, 1953). However, it is expected that in the next 10 to 20 years the rate of timber use will catch up with timber production. Then the exploitation rate will tend to level off at the level of the production rate. The Forest Service estimates that the allowable annual cut on the National Forests of northeastern California at that time will be about 400,000,000 feet, board measure.

LIVESTOCK

Livestock production is a major industry although its impact on the economy of the area studied, is less than that of other land uses. Livestock numbers have been decreasing on the mountain ranges of northeastern California, but livestock are more dependent on these ranges than in the State as a whole.

In 1954, only 5.2 percent of the State's sheep and 5.1 percent of the cattle grazed on national forest allotments. Additional grazing occurs in the mountains on private, state, and federal lands other than the forests, but records of the numbers of livestock so grazed are not available. About 314,000 head of cattle and 275,000 sheep used the forage resources of this area in 1955. Of these livestock, about 60,000 cattle (19 percent) and 80,000 sheep (29 percent) grazed on national forest ranges.

Livestock numbers may continue to decrease on the higher mountain ranges. However, on the better ranges, at lower elevations, stocking rates will remain relatively high. Much of this land is in private ownership and some of it is heavily used by deer in winter.

RECREATION

Recreational facilities are considered a prime asset, second only to water in value and ranking alongside timber values. These wildlands are easily reached from large urban centers such as San Francisco, Los Angeles, Sacramento, and other smaller centers of the coast and central valley. Several fine highways, railroads, and airplane routes furnish quick, easy transportation from the urban centers to these outdoor playgrounds. In summer the cool mountain heights with their streams and forests offer respite from city pavements. Picnicking, camping, touring, boating, fishing, and hunting are some of the activities enjoyed. In winter thousands of people use the area for winter sports.

The recreational use will increase markedly in the next few years. The increase in California's population and improved transportation facilities will bring ever-increasing numbers of recreationists. The State's population increased from 10,600,000 in 1950 to 13,000,000 in 1955, a 22 percent increase in 5 years. Projections for 1970 (U. S. Bureau of the Census, 1957) show an expected population of over 20,000,000 persons. In addition, California is a recreational mecca for visitors from outside the State.

It appears that recreational use is increasing even more rapidly than the State's population. While the population increased by 22 percent from 1950 to 1955, recreational visits to national forests increased nearly 75 percent from 1950 to 1954 (table 3). This may be a result, in part, of increased leisure time and an increased interest in outdoor recreation. Presumably recreational use will continue its rapid rise.

What part of the recreational use is concerned with deer hunting? We know that about one-third of California's annual deer harvest comes from the area studied (table 4). We have no direct information on the numbers of hunters involved in this harvest. However, it seems reasonable to estimate that a third of the State's licensed hunters used this area.

WHO OWNS THE LAND?

Land ownership forms an amazingly intricate crazy-quilt pattern. This pattern marks the current status of a long history of ownership exchanges. "When California entered the Union, title

to its entire land area was vested in the United States with the exception of some 8,850,000 acres in Spanish and Mexican grants. Congress has since disposed of 46,500,000 acres in grants to the State and to railroad corporations and by sales and grants to individuals. The State and railroads in turn disposed of much of the area granted them" (Nelson, 1957).

It is not worthwhile here to try to assemble the vast data that would be required to show the land ownership pattern in any detail. It is sufficient to recognize that the pattern is intricate and that the complexity of administration is proportional to the length of boundary lines between types of ownership. Much effort is expended continuously by many agencies to block out manageable land areas by purchase, sale, and exchange of outlying small holdings.

Private lands are mostly in the lowlands--the Sacramento Valley and the tributary valleys in the mountains where farming and ranching are feasible. Public lands are generally in the more mountainous uplands. A few timber companies also own large tracts in the uplands.

Forest lands--both commercial and non-commercial--make up 68 percent of the 21,000,000 acres in the 14 counties of the project area. This land is distributed among six classes of owners and administrators[1/] as follows:

Privately owned	42 percent
Publicly owned	
National Forest	50 percent
Bureau of Land Management	5 percent
National Parks	1 percent
Indian and other Federal	1 percent
Total Federal	57 percent
State, County and Municipal	1 percent
Total Publicly Owned	58 percent

1/ Data furnished by the Division of Forest Economics Research, Pacific Southwest Forest and Range Experiment Station.

We have no information about the ownership of the 7,000,000 acres of non-forest land. Much of this is the privately owned agricultural valley lands usually not available for deer range and therefore of no immediate interest in deer management. On the Modoc Plateau much non-forest land is of the sagebrush and desert range types. These types have high value for deer, antelope, and livestock. Most of these lands are owned by stockmen, but some are in national forests and other public holdings.

MAN'S EFFECT ON BIG GAME AND THE ENVIRONMENT

Three peoples have left their historical imprint upon the lands of northeastern California--the Indians, the Spaniards, and the Americans. Today the effects of the Indians and Spaniards have largely disappeared. Time and the processes of nature have erased the Indians' influence. The Spaniards left little to be erased since they advanced only to the southwestern edges of the area.

1848-1900, THE EXPLOITATION PERIOD

The Americans have had a tremendous impact continously since their arrival in 1846. Edwin Bryant (1936) gives us a glimpse of what it was like then as he rode horseback down the east side of the Sacramento Valley where "Game is very abundant. We frequently saw deer feeding quietly one or two hundred yards from us, and large flocks of antelope.....The plain is furrowed with numerous deep trails, made by droves of wild horses, elk, deer and antelope, which roam over and graze upon it. The hunting sportsman can here enjoy his favorite pleasure to its fullest extent.....Herds of elk were numerous. Some of them numbered at least two thousand, and with their immense antlers presented, when running, a very singular and picturesque appearance. We approached some of the herds within fifty yards before they took alarm. Beef in California is so abundant, and of so fine a quality, that game is but little hunted and not much prized. Hence the elk, deer, and even antelope, are comparatively tame and rarely run from the traveler, unless he rides very near them."

This was the valley lands, mostly written off as deer range today because they are too valuable for pasture and cultivated crops. Written off too are the elk and antelope that relied on those lands for subsistence.

The deer of the Sacramento Valley apparently migrated into the higher mountains in summer just as they do now. The 49'ers found deer there in summer. The importance of such finds to the weary travelers is epitomized by Altrocchi (1945) in describing the

Donner Party. "In December, 1846 the Forlorn Hope, a group of fifteen men and women, were finally trailing out on homemade snowshoes from the [Donner] lake. They were almost dead of starvation. Here [just over Donner Summit] where the valley of the [Bear] river widens out, William H. Eddy sighted a deer and, in spite of hands that trembled with weakness, brought it down. He and Mary Graves, the nineteen-year-old beauty of the expedition--doubtless at the time of the Forlorn Hope fairly hideous through starvation--rushed to the life-giving animal and drank the warm blood as it poured."

Other hard-pressed Argonauts, sorely debilitated by their recent desert crossing, appreciated the deer they found in the mountains. Geiger and Bryarly (1945) crossed the Donner Pass in August, 1849, and then "many of our men went hunting, but one buck only was killed" on August 24 "...one of our mess...killed two very fine bucks". The latter deer were killed about 12 to 18 miles west of Donner Summit.

Three years earlier, in 1846, Bryant (1936) had passed the same way that Geiger and Bryarly traveled, and reported on August 27, "The sign of the grizzly bear and of the deer have been numerous since we crossed the Pass of the Sierra Nevada, but not one of these animals has been seen on this side."

Bruff (Read & Gaines, 1944) who camped at 4,200 feet elevation east of Lassen's Ranch in the winter of 1849-50, subsisted on deer in the fall. These deer were migrating into the foothills and by November 24 they had all moved down and Bruff had to subsist on dead oxen left by the immigrants. Later Bruff moved to Roberts' cabin at 3,800 feet. From there his hunters were able to kill deer by hunting below the cabin.

Gold was discovered in 1848. In 1849 and 1850 the gold rush was in full swing and a swarm of humanity descended upon California.

The period of the gold rush and the subsequent period of settlement were disastrous for much of California's big game. One prominent member of the big game fauna, the California grizzly bear, was wiped out for all time to make the area safe for domestic livestock. The bighorn sheep was eliminated from the northeastern counties. The elk were also eliminated from that area, but a small herd was reintroduced several years ago and exists in the mountains northeast of Redding. Antelope were exterminated in the Sacramento Valley and were greatly reduced in numbers on the Modoc Plateau. The deer lost their lush winter ranges in the Central Valleys and were confined to the foothills and mountains. From 1849 to 1900 the deer, too, were drastically reduced in numbers. "Probably unregulated hunting was the most widespread influence, but locally overgrazing, snowy winters and/or agriculture or urban development may have been even more important. In any event by 1900 and for a decade or more thereafter deer were scarce over most of California". (Longhurst, et al., 1952).

1900-1958, THE CONSERVATION PERIOD

By 1900 the pioneering and settlement period of the American era was drawing to a close. The people had learned through their experiences with the grizzly bears, bighorns, elk and antelope that the great wild herds could be destroyed. Thoughtless exploitation gave way to conservation urges--urges that were expressed in both national and state conservation laws.

Man's conservation of wildlife usually follows a historical pattern which was pointed out by Leopold (1933): "History shows that game management nearly always has its beginnings in the control of the hunting factor. Other controls are added later. The sequence seems to be about as follows:

1. Restriction of hunting.

2. Predator control.

3. Reservation of game lands (as parks, forest, refuges, etc.).

4. Artificial replenishment (restocking and game farming).

5. Environmental controls (control of food, cover, special factors, and disease)."

In reviewing the history of big game management in northeastern California we find that the historical pattern follows approximately that which Leopold describes. In the project area, item 4, artificial replenishment, has been of little importance in big game management. (The elk planting near Redding is a minor exception to this generalization). All the other items are represented in varying degrees, and approximately in the "proper" sequence. At present, we are in the initial stages of applying environmental controls.

Hunting restrictions began to be applied early in the American era, and have become increasingly more stringent with time. Longhurst, et al. (1952) have presented the history of hunting restriction for deer in California in a succinct table which is reproduced in the appendix (table 5).

Since 1950 game managers have attempted to liberalize deer hunting to try to reduce deer numbers on overstocked ranges. So far this effort to reverse the well-established policy of restricted hunting has had little effect on general hunting laws.

Predator control has had a most prominent place in game and livestock management in California since the beginning of the Spanish era. Final extermination of grizzly bears and wolves occurred in the early 1920's, even before the modern conservation period got well under way. Since the early 1900's the Fish and Game Commission has maintained a continuing program of bounties and predator control by state-employed trappers and hunters. The U. S. Fish and Wildlife Service has also contributed to predator control in California. Longhurst, et al. (1952) attribute some of the growth of California's deer herds to the predator control program: "Unquestionably this control contributed to the rapid increase of deer in the period 1910-1930, and in fact it is an important factor that has led to local overpopulations of deer in more recent years." In the past few years less effort has been put into predator control for deer than was formerly customary. Until deer numbers can be adjusted to range capacities by more intensive hunting, there seems to be little purpose in controlling the predators except insofar as they affect livestock.

In addition to the restriction of hunting and predator control, protection has been given deer by the reservation of game lands. Cronemiller (1943) reported that of some 45,000,000 acres of deer habitat in California, 2,500,000 acres were deer refuges which were closed to hunting. Since then some of the refuge lands have been re-opened to hunting. In 1950 Longhurst, et al. (1953) reported 1,750,000 acres of deer refuge in the state. In addition, there are about 1,700,000 acres in the national parks which are closed to hunting. Still more closures occur on military reservations, Indian reservations, federal game refuges, and state parks.

The northeastern sector has about 380,000 acres of deer refuges and another 151,000 acres in a national park and monument. Additional lands in military reservations are closed to hunting.

There is a general trend towards abandoning those game refuges in California which are not needed for some specific purpose in game management. However, the abandonment of refuges moves slowly since the need for them still seems apparent to the public.

The final element in the historical pattern of game management which Leopold (1933) lists is environmental controls. As applied to the deer and antelope of the project area it may be that environmental controls have had more effect on game numbers than all the other influences (restriction of hunting, predator control and reservation of game lands) together.

ENVIRONMENTAL CONTROL THROUGH LAND USE

During the American era man has profoundly changed the land and its vegetation, and what has been done to the land and vegetation has affected the game--sometimes drastically. Most of these influences have come about quite independently of any intent to manage game. Rather, the changes in the deer and antelope environments have resulted from land management practices other than for game. Mostly these practices were concerned with mining, farming, livestock grazing, and forestry. Only in the past few years, and then in few places, have land management practices been applied with game culture as a primary objective.

GOLD MINING

Activities of the gold miners affected deer habitat in three ways--by digging up the soil and sluicing it away, by cutting timber, and by slaughtering deer. The results were not all unfavorable to the deer. There was some benefit.

Certainly the sluicing away of ton after ton of soil nutrients was of no benefit to wildlife. Many soils of the Sierra Nevada are highly erodible, and any disturbance of the binding vegetative mantle results in much soil movement. Even today as one flies the commercial air routes from Reno to Sacramento over the 100-year-old gold fields, many of the great placer scars are still sharply visible, and their displaced gravel chokes the stream bottoms. Gilbert (in Lindgren, 1911) has estimated the total displacement of soil by gold miners as follows:

Feather River	100,000,000 cubic yards
Yuba River	684,000,000 " "
Bear River	254,000,000 " "
American River	257,000,000 " "

This debris was deposited in the lower valleys of those rivers, and in the Sacramento River. Before 1850, ocean tides reached up the Sacramento River to the mouth of the Feather River. Now they reach only to a point some miles below the city of Sacramento, which is 15 airline miles below the mouth of the Feather River. Mining debris has filled the Feather-Sacramento River basin to depths of 5 to 6 feet at Oroville, 13½ feet at Yuba City, 3 to 5 feet at the mouth of the Feather River, and 7 feet at Sacramento.

The removal of such vast quantities of soil mantle from the slopes of the Sierra Nevada must have had tremendous influence on the productivity and fertility of those slopes. Not until 1893 was hydraulic mining stopped by the federal "Hydraulic Mining Law". Today we give little thought to the high price in soil values we have paid for the gold. What's done is done. But we are left with a scarred land on which to produce our wildland crops.

Another impressive effect of the mining in the Sierra Nevada was the land clearing that accompanied the mining. Timber was used for construction and fuel and undoubtedly the miners started many fires. This land clearing must have been beneficial to the deer in opening up climax forest stands so that forbs, grasses and shrubs could grow and produce food. How much of this kind of effect the miners had can only be conjectured.

Gold mining also affected deer through their direct exploitation for meat and hides. Market hunters took large numbers of deer in California until as late as 1903. Longhurst, et al. (1952) give many details of the commercial use of deer and point out the probability that such use effectively reduced deer numbers locally and temporarily.

One wonders whether in that period of commercial hunting we had some of the best deer management California has ever known. Logging and fires were clearing new land at a rapid rate. At the same time heavy hunting pressure was cropping the resultantly increasing herds. Probably the economics of commercial deer harvesting served to protect breeding stock, for when the stock was reduced the cost of harvesting rose and curtailed the hunting pressure. Meanwhile the hunting of the more populous herds may have served to keep deer numbers adjusted to the capacity of their ranges.

Of course this is not to advocate market hunting as a solution to today's overstocking of deer ranges. Our modern concept of hunting for sport rather than subsistence presents other means of utilizing animals which are surplus to range capacity.

In general we can summarize mining influences as a mixed evil--predominantly destructive because land was destroyed, partly constructive in its side effects of land clearing which improved deer range, accompanied by heavy use of the burgeoning herds.

FARMING

The effects of farming on big game have been largely negative. The big game which could live only on the rich valley lands did not "mix" with intensive cultivation. Farming destroyed the habitat of the elk and antelope in the Sacramento Valley. Thus a simple, effective solution was found for the conflict between farming and those wildlife species.

For deer, this conflict has not found such a quick, easy and complete solution. The deer could continue to exist by withdrawing to the mountains and foothills. But this withdrawal has not been complete. There are broad areas of overlapping of farm lands and deer range. Here occur some of California's most difficult problems of deer management. Crops are being damaged by deer, and deer hunters are finding it difficult to gain access to these private lands to hunt.

Usually there can be no habitat management to favor the deer in farming areas. This land must be dedicated to farming exclusively, the main objective of deer management must be to eliminate the deer or to alleviate damage by the use of fences, repellents, permits to kill deer that are causing damage, etc. From this it is apparent that the problems lie outside the province of the present analysis which is concerned with big game habitat management.

RANGE MANAGEMENT

The livestock industry in California has had great influences on big game habitat. These influences were born in the severe drought of 1862-64. Some stockmen took their cattle into the mountains to try to save them from the drought conditions of the valley. To their surprise they found "an abundance of nutritive grasses, sufficient to feed all the stock in California during the entire season" (Brown and Show, 1944). Concurrently with this discovery of rich ranges in the mountains, the livestock industry was rapidly shifting from cattle to sheep as the principal range animal.

Sheep production reached the maximum in 1876. Then there were about 7,700,000 sheep in the State. Today there are about 2,000,000. "During the prosperous sheep days of the 19th century, the bulk of the sheep in the State were maintained on free, open range the year around, feeding their way from lower to higher ranges and back again to fit the seasons" (Brown and Show, 1944). The mountains were subjected to severe damage. ".....the trampling of almost countless thousands of [the sheep's] sharp hoofs, combined with the close-cropping feeding habits of sheep when grazing on grass, broke up the protective ground cover and when winter rains came, erosion started" (Brown and Show, 1944).

Uncontrolled burning was liberally practiced by the sheep herders to clear brush, windfalls, and logs to make it easier to move the sheep about. Also the fire induced lush plant growth in the succeeding year. "Most of the burning was done as the sheep were taken from the mountains in the fall..... This was usually in September. Burning at that time, (1870's and 80's) became such a practice that people knew when sheep were leaving the mountains by the number of fires set. Smoke from the fires was so thick that at times it was hard to see at midday. No attempt was made to stop the fires unless someone's place was threatened. Then back fires were set and usually the fire went some other direction" (W. J. Lord, in Brown and Show, 1944).

Many of the bare rock slopes and the dense brush fields that characterize today's Sierra may have originated from grazing by sheep and uncontrolled burning by sheepherders.

Where the burning resulted in the clearing of forests, and where it was not too hot or too often repeated, some benefit may have accrued to deer. But it appears that more often than not the fires were too hot and too often to result in good deer range. What little benefit there may have been was offset many times over by the destruction of vegetation by grazing, trampling, and fire, and by the erosion that ensued. Longhurst, et al. (1952) believe that the sheep may have been the major cause of known deer scarcity in the southern Sierra in the period 1890-1915.

While much emphasis has been given here to the sheep industry, it must not be supposed that cattle were of no significance. The number of beef cattle has generally increased through the years with only temporary sporadic decreases. In 1910 there were 1,195,000 beef cattle in California, 1,400,000 in 1950. On the mountain ranges they increased until 1920 (207,000 head on national forest allotments), and then decreased (to 117,000 head in 1950). The cattlemen competed with the sheepmen for summer ranges in the mountains, and they too practiced fall burning.

LUMBERING

A fourth major influence on wildlife habitat has been forestry. The first sawmill in the project area was the one built by Sutter at Coloma in 1848. Never finished, that historical mill served only to implement the discovery of the gold in its millrace which set off the gold rush which in turn created a demand for lumber. As a result of this demand many "small sawmills came into existence up and down the Sierra Range during the 1850-1870 period, engaging in the manufacture of lumber for local use" (Brown and Show, 1944).

Lumber production increased only gradually from its inception in 1849 until after 1900. Since 1900 the production rate has accelerated rapidly. May (1953) has presented a graph for lumber production in California and Nevada (Nevada's production was a small percentage of the whole and did not appreciably affect trends). The trend in northeastern California closely follows that for the two-state total, except that the local timber production did not rise so sharply in the 1940-50 period as did total production (fig. 3).

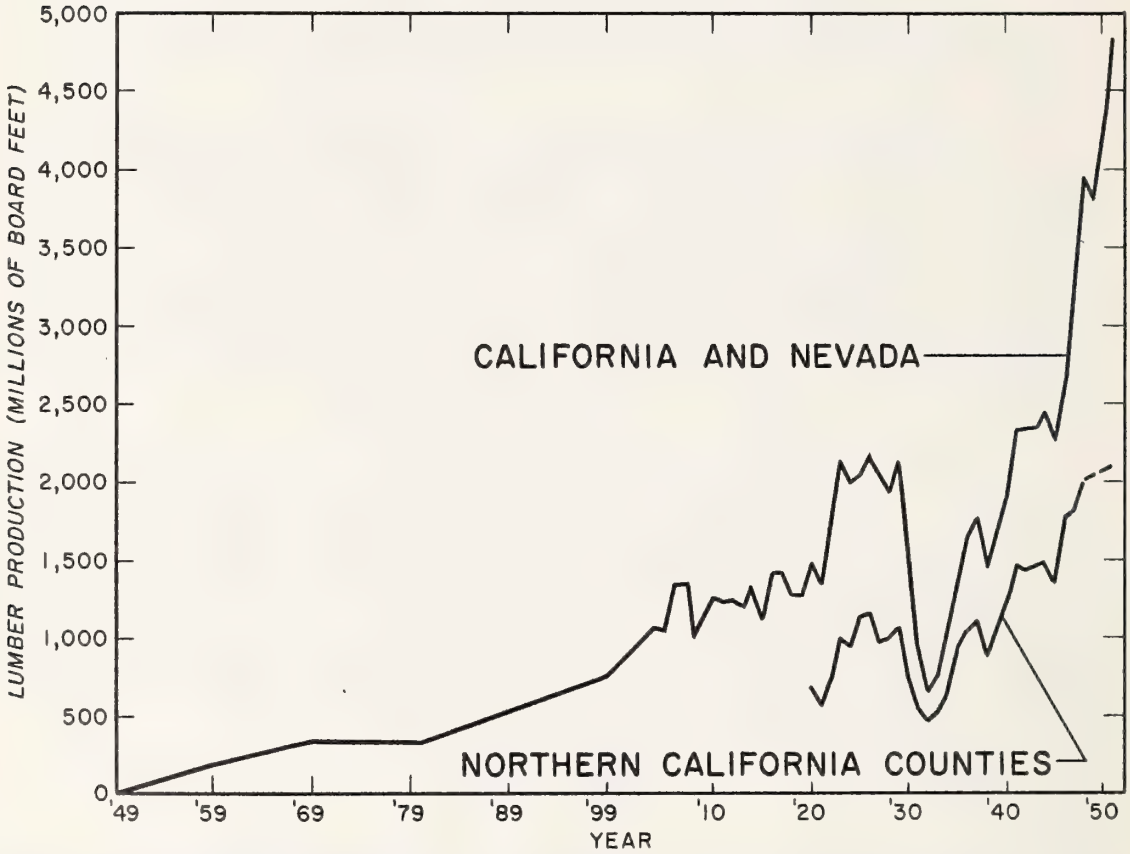

Figure 3.--Lumber production in California and Nevada, 1849 to 1951, and in northeastern California, 1920 to 1951.

Our interest in lumber lies in the fact that its production is related to the acreage of land that has been cleared of the forest overstory. Data on volume of timber cut shows us the historical trend of harvesting intensity, but does not tell us how many

acres have been cut over. Our information on acreages is limited to data from U. S. Forest Service lands only. For the national forests of the project area (table 6), timber had been harvested on about a fourth of the commercial forest land in 1955; three years later (1957), on nearly a third. The average annual acreage of timber harvest is more than 80,000 acres.

What effect does this have on deer ranges? How do the various cutting practices modify the effect? Where is the cutting in relation to deer ranges? These and many other questions can and should be answered by surveys of forest practices in relation to deer range management.

The effect of logging on deer habitat has not been reported for California forests. Pengelly (1953) studied the succession of deer browse following logging in the Douglas-fir type in northern Idaho. He found that the amount of available deer browse increased for about 16 to 20 years after logging, then gradually decreased over the next 30 years. The available forage had returned to the low pre-logging level 50 years after logging. At the peak of its post-logging development, deer browse was almost 10 times as abundant as it was before logging.

What has been the effect of logging on California deer? The great increase in logging since 1900 has been accompanied by a comparably great increase in deer numbers. That these two phenomena occurred concurrently strongly suggests the possibility that they may be causally related to each other--that the increase in deer may have been effected in a large measure by improved habitat conditions resulting from logging (fig. 4). Of course, it must not be overlooked that other influences favorable to deer were developing at the same time that the acceleration occurred in logging: the curtailment of hunting, predator control, game refuges, and the like. Also the great reductions in numbers of livestock and their time on the public ranges has undoubtedly benefited big game.

Forestry has had many supplementary effects on game habitat besides the removal of overstory. Access roads built to transport logs from the wildlands have given the public entry into those lands. Log skidding and road building have sometimes accelerated erosion. The threat of man-caused fires has increased with the increased use of the woods by the public. All of these have had their effects on the game and the game habitat--some of these effects have been beneficial, some have been detrimental.

Figure 4.--Logging thins the overshadowing forest and allows the undergrowth to develop for deer food.

At the same time that tires and logging improve deer habitat, they present new obstacles for the forester. The low-growing vegetation that furnishes deer food on burned and logged areas also competes with the tree seedlings that are required to produce the next timber crop. The deer themselves add further complications. They eat tree seedlings and thus hinder reforestation. But the deer also suppress the competing vegetation and thus aid seedling survival. Is there a proper stocking level at which competing vegetation will receive maximum use while tree seedlings are damaged only within tolerable limits? There is some evidence that with further knowledge such a condition can be achieved. Furthermore, it appears that such a stocking level nearly approaches the optimum for best deer range management.

GAME MANAGEMENT

There are good reasons why big game management has had little effect on environmental control as compared with other land management practices. Part of the reason is to be found in the status of game as a product of the land, and in the legal status of the game manager.

Deer have usually been regarded as a secondary product of the land. First concern in land administration has been for the crops of highest economic value--farm produce, livestock, and forest products. The land has been administered for the benefit of these economically important products. It is true that the values of wildlife recreation, esthetics, and other "byproducts" have often been recognized and even emphasized under policies of multiple use. But little money has been budgeted to land administrators for the management of the "byproducts".

At the same time, primary responsibility for wildlife management has been given to agencies (primarily state fish and game departments) who are not land administrators--who have little or no land to administer. These agencies have no place to apply environmental controls.

Had we set about purposely to immobilize the administration of environmental controls, we could hardly have devised a more effective plan than this divorcing of game management from the land administrator and of land administration from the game manager.

Under these conditions two courses are available to the state game managers in applying environmental controls. One course is to acquire land. The second course is to enlist the cooperation of land owners and administrators in applying management methods for wildlife.

The policy of the California Department of Fish and Game governing acquisition of land for big game management was expressed in 1950 (Gordon, 1950): "The purchase of rangeland for big game by the State Fish and Game Commission should, as a rule, be limited to very important key areas only." Previously the Commission had purchased two tracts of winter deer range--30,000 acres in Tehama County and 11,000 acres in Lassen County. No such purchases have been made since then. Objections to land acquisition for deer management are based on three points (Longhurst, et al., 1952): (1) Problems of heavily used deer range cannot be solved simply by purchasing the land, and the solution to this problem--reduction of herd numbers--is usually applicable regardless of land tenure.

(2) Withdrawal of productive lands from taxation is not desirable. (3) Acquired lands bring added burdens of administration. It seems unlikely that there will be any appreciable amount of land acquisition for game management beyond that which has already occurred.

Jurisdiction over public lands for purpose of game management, may be obtained by state fish and game departments under the U. S. Coordination Act of 1946. In 1956 the California Department (1956) had requested jurisdiction over 542,903 acres under this law. How much of this is for big game is not stated. However, since there are approximately 50,000,000 acres of deer range in California, it is apparent that only an infinitesimal part of that range is likely to come under State jurisdiction.

The State is also applying environmental controls to lands administered by others. In 1956 the State's largest project under the Pittman-Robertson program was its game habitat development program. This consisted of water developments, brush clearing, revegetation, and construction of access roads and trails. Most of the brush conversion work was on deer ranges. "Over 5,000 acres of small plots were cleared of brush by burning, chemical spraying or by mechanical means. .....A total of 2,470 acres of cleared or burned areas were seeded. .....Browse plantings--5,352 individual plants were set out for game cover and feed" (California Department of Fish and Game, 1956).

The division of responsibilities--the State's responsibility for the game and the landowner's for the habitat--clearly specifies management methods. Since wildlife and its habitat cannot be managed independently, the State and landowners must maintain the closest possible cooperation. This cooperation has to be arrived at by the establishment of management objectives that are mutually acceptable, followed by synchronized management operations.

BIG GAME TODAY

Originally there were eight species of big game in northeastern California--two species of elk, two species of deer, bighorn sheep, pronghorn antelope, and two kinds of bear. These eight were:

Roosevelt elk	*Cervus canadensis roosevelti* Merriam
California dwarf elk	*Cervus nannodes* Merriam
White-tailed deer	*Odocoileus virginianus ochrourus*
Mule deer (three subspecies)	
Rocky Mountain mule deer	*Odocoileus hemionus hemionus* (Rafinesque)
California mule deer	*O. h. californicus* (Caton)
Columbian black-tailed mule deer	*O. h. columbianus* (Richardson)

Pronghorn	Antilocapra americana oregona V. Bailey
Mountain sheep	Ovis canadensis californiana Douglas
Grizzly bear	Ursus klamathensis Merriam
Black bear	Ursus americanus californiensis (J. Miller)

Most of these are now extinct or very rare. Only the mule deer, antelope, and black bear are sufficiently plentiful to be hunted.

EXTINCT OR RARE SPECIES

The extinct and rare animals are of interest as subjects for possible reintroduction and nurture in the area.

The Roosevelt elk's former range was the west slopes of the Cascade Range in Washington, Oregon, and California to Mount Shasta, westward to the humid coast belt and inner coast ranges south to San Francisco Bay (Miller and Kellogg, 1955). Their range overlapped the study area near Mount Shasta. They were considered to be extinct in that area for many years. A few years ago a small herd of Roosevelt elk were re-introduced northeast of Redding (Dasmann, 1958). This was a private enterprise. The elk still exist there, but no studies have been made of them to reveal the subsequent history and welfare of the transplanted animals. Because elk require winter range in the lowlands, now usually occupied by farms and ranches, game managers are reluctant to try to foster elk in new localities. Probably no effort will be made to develop elk as a game animal in the project area. However, it will be of interest to follow the history of the Redding herd.

The California dwarf elk formerly occupied the central valleys "north at least to Butte Creek, in Butte County, and south to vicinity of Bakersfield, Kern County; west through southern inner Coast Ranges.....to San Luis Obispo County" (Miller and Kellogg, 1955). At present no dwarf elk exist in the project area. Nor does it appear advisable to try to re-establish them there, for reasons already mentioned in connection with the Roosevelt elk.

Although there have been many reports of white-tailed deer in the project area, almost all of them are hearsay or sight records or records of mounted antlers or heads in private homes, saloons, and restaurants. To my knowledge there is no authentic specimen of white-tailed deer to verify their existence in northeastern California. The nearest approach to such a specimen is a pair of antlers (only) from southeastern Modoc County. These are in the collection of the California Academy of Sciences.

It appears that the area, though submarginal for the white-tailed deer, has been sufficiently congenial to allow occasional incursions from the main areas of distribution to the northeast. But it has not been suitable for their establishment and for the development of a resident herd. This seems to offer sufficient evidence that the area is not adapted to the culture of white-tailed deer. Therefore it is not recommended that such culture be attempted.

A western subspecies of bighorn sheep formerly ranged from "British Columbia south through the Cascades of Washington and Oregon and Sierra Nevada of California to the vicinity of Mount Whitney" (Miller and Kellogg, 1955). Until recently this subspecies was found in California only in the southern Sierra Nevada. Oregon has introduced bighorns from British Columbia in the northern Warner Mountains. According to recent unverified accounts some of these have drifted south into California. This is a species that should be nurtured in the Warner Mountains and possibly in adjacent areas (fig. 5).

The grizzly bear, now extinct in California, lived on the large wild ruminants of the Sacramento Valley and adjacent mountains, just as the grizzlies of the Great Plains lived on the buffalo, elk, and antelope east of the Rocky Mountains. With the advent of farming and ranching, the grizzlies were intensively hunted. They were finally exterminated in the 1920's. It is usually conceded that grizzlies and livestock do not "mix". Certainly in the period when sheep and cattle thronged the Sierra Nevada, there could be no quarter for the grizzlies. If the use of the high summer ranges in the mountains lessens through the years, it is possible that some "living room" may again become available for these striking animals. It is generally assumed that they are too ferocious and destructive to be tolerated in proximity to people and livestock. But I have observed them in parts of Montana where they are confined to relatively small wilderness country adjacent to valleys where livestock are raised. Also in Yellowstone National Park grizzlies and great numbers of people live in close proximity to each other with difficulties rarely occurring. The dangers and difficulties of grizzly management should not be underrated. At the same time it should be recognized that much of this animal's reputation for intractable ferocity is undue exaggeration.

At present the grizzly occurs only in Montana, Wyoming, Mexico, and possibly Colorado and Idaho. Only a few hundred of them remain in the United States. There is need for a decision by those responsible for the Nation's wildlife whether this species is to receive the measure of special attention necessary to maintain it as a part of the country's heritage. One kind of attention needed is to establish and maintain stocks of the bears in as many wild localities within their former range as possible.

Figure 5.--The Warner Mountains where it may be possible to restore the bighorn sheep to its ancestral range.

HUNTABLE SPECIES

The three big game animals that are hunted in northeastern California are the black bear, antelope, and mule deer. Of these the three subspecies of mule deer are most important in numbers and the interest of sportsmen and other recreationists.

Black bears inhabit only forested lands, and therefore are absent from the central and eastern Modoc Plateau, and from the foothills and valley of the Sacramento (Grinnel, Dixon and Linsdale, 1937).

The hunting seasons open in early August on the coast and in late September in the inland mountains. They close in mid-January. The bag limit is two bears.

In the absence of any field studies of the black bear, we have little information on the relationships of these animals to their environment. Rather uniform kill figures from year to year seem to indicate a stable population. This implies a fully stocked range and stable range conditions. This stabilization does not necessarily indicate that the range is in good condition. The population could be in equilibrium at a sub-optimal level if the habitat is in a deteriorated condition.

Antelope inhabit about the same range in northeastern California today (fig. 6) as when their distribution was mapped 15 years ago (McLean, 1944).

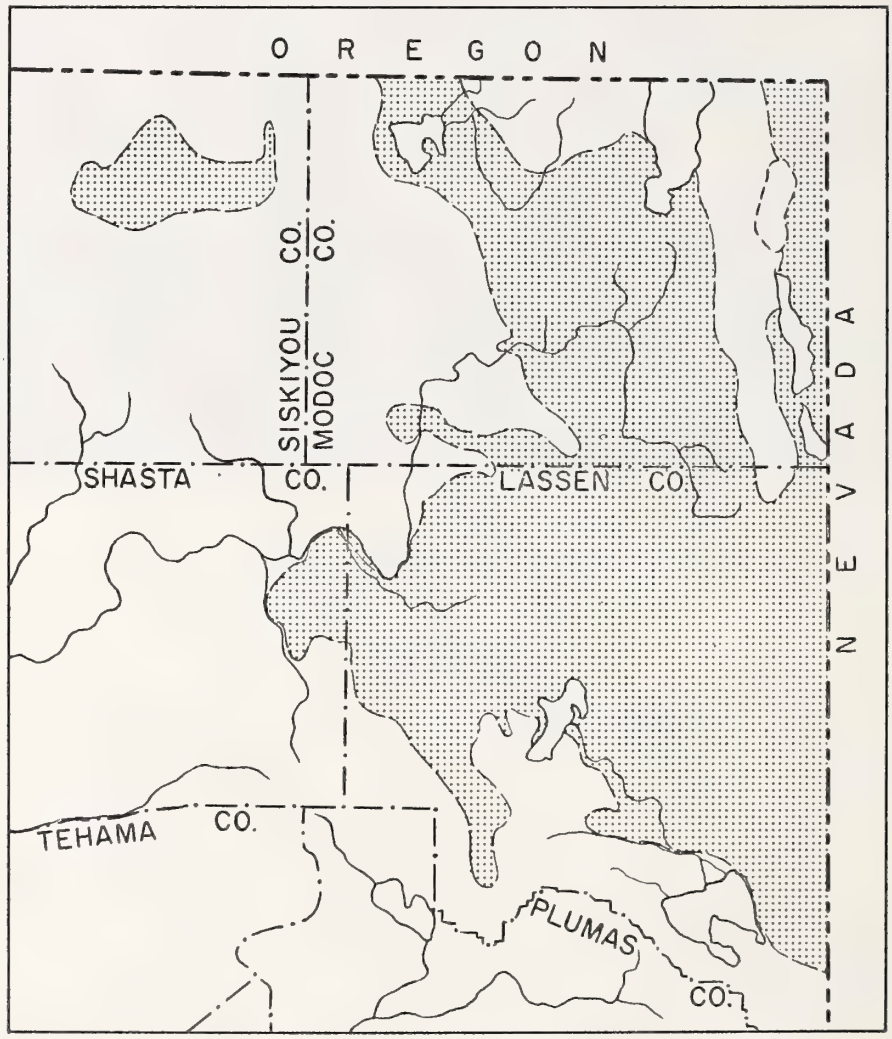

Figure 6.--Antelope range in northeastern California (after McLean, 1944).

Numbers of antelope were at a low ebb at the turn of the century. About 1900 the few small herd remnants began to increase and to reinvade former ranges (Horne, 1925). Numbers increased until the late 1940's. Legal hunting was started in 1942, and special hunts occurred in 1942, 1943, 1945, 1949, and 1951. Antelope numbers decreased considerably--from over 6,000 in 1944 to 2,300 in 1952. In 1957 there were still about 2,000 antelope in the State.

Perhaps antelope numbers increased during the first four decades of the present century as a result of protection from hunters and predators, and because of range improvements such as stock watering developments, hay fields, and decreased sheep use. Then the range deteriorated under too heavy use by the antelope, causing a decrease in herd numbers about 1950. The hunting pressures of the 1942-1951 decade were too light to prevent overstocking of the range. Now the population numbers have become adjusted downward to the deteriorated carrying capacity of the range and are stabilized at that level.

Unfortunately no detailed studies have been made of the antelope and their range to test the validity of the theory just outlined. Hjersman and Yoakum (1958) suggested that the birth rate of the pronghorn in Lassen and Modoc counties is governed by range conditions. These authors emphasize the need for studies of the antelope range and its joint use by antelope and livestock.

Mule deer are the game animal par excellence of California. This deer far outranks all other species of big game in the amount of territory occupied, the numbers of animals, the annual hunter harvest, and the attention received from sportsmen, game managers, and the general public.

Although there is but one species of mule deer in the State, several subspecies are readily distinguishable in the field. Two of their distinguishing characteristics are listed for the three subspecies of northeastern California:

Subspecies:	Tail color	Animal size
Rocky Mountain	Black tip.	Largest
California	Black tip and stripe to base of tail.	Intermediate
Black-tailed	Black over all of outer surface.	Smallest

Their ranges overlap (fig. 7), and in the areas of overlapping ranges cross breeding occurs. The offspring have characters intermediate between those of the parents.

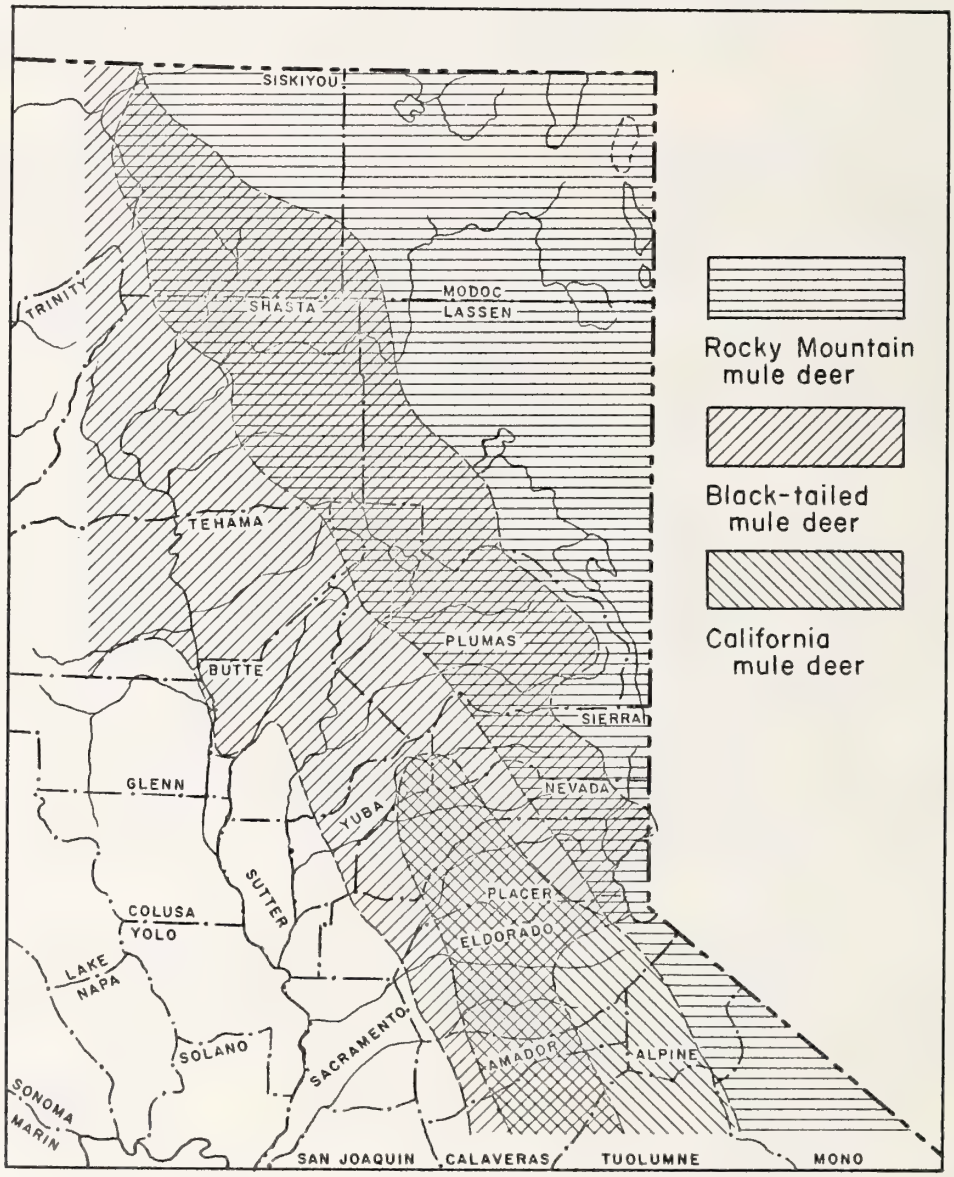

Figure 7.--Distribution of the subspecies of mule deer in northeastern California.

Most of the area's deer are migratory. In the Sierra Nevada-Cascade areas summer ranges lie in the high mountains (fig. 8). Winter ranges are on the lower slopes on the east and west sides of the mountain chain. On the Modoc Plateau fall migrations are also from the higher elevations, such as the Warner Mountains and the mountains to the north in Oregon.

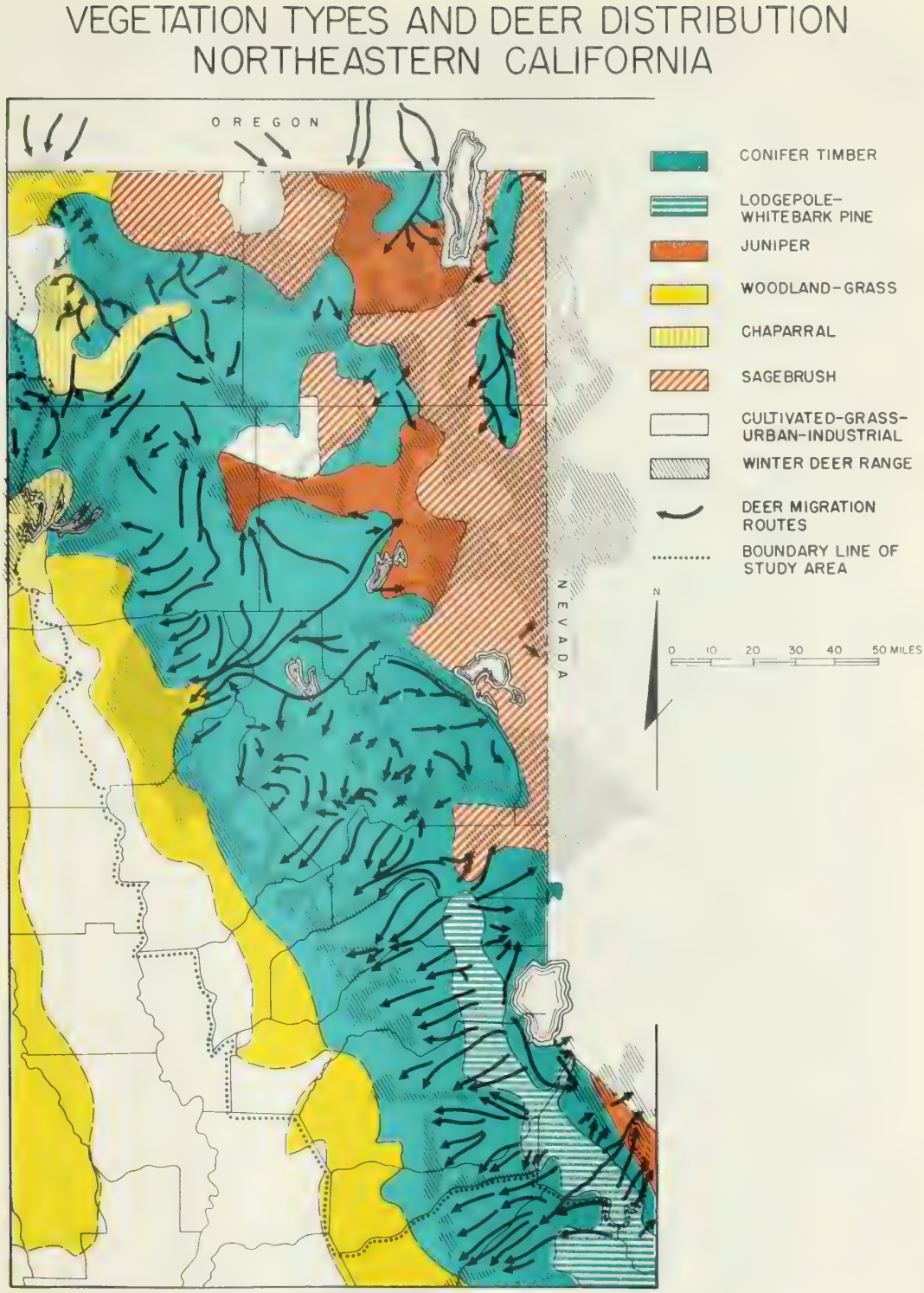

Figure 8.--The winter deer ranges and migration routes of northeastern California in relation to vegetation types. The deer ranges are shown somewhat diagrammatically and should not be literally interpreted in detail. (Vegetation types from Jensen, 1947.)

A few deer are resident all year on the winter ranges; these are of little interest in the present study. In most areas they are scarce. In the two areas where they are abundant on the west slopes of the Sierra Nevada, they occur mostly on private lands and conflict with orchards and other crops. The primary management problem is to keep their numbers small.

Deer numbers and stocking rates vary from one range unit to another. Longhurst, et al. (1952) have divided the State's deer range into natural units and subunits based on topography and the distribution of individual deer herds. In the project area there are 11 units (fig. 9) and 30 sub-units (table 7).

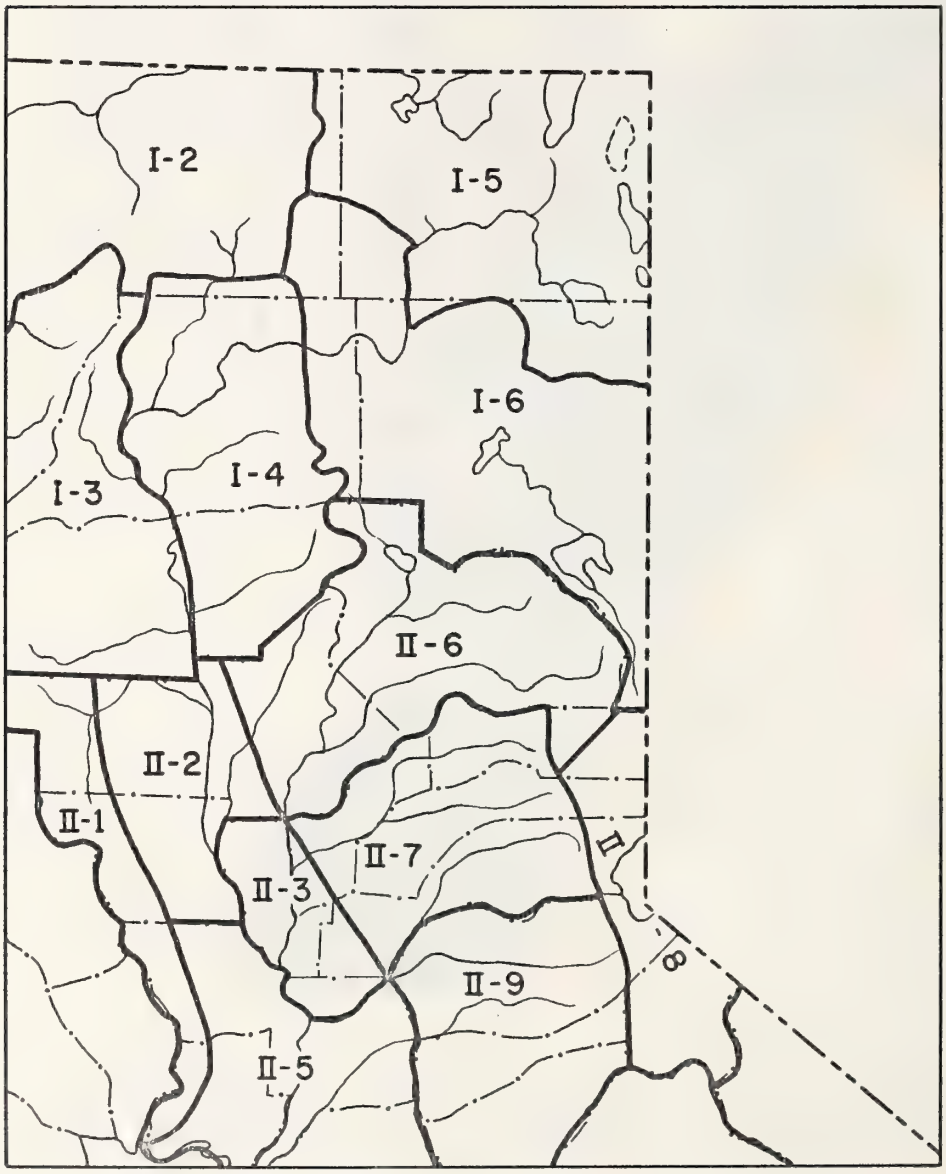

Figure 9.--Deer range management units. (After Longhurst et al., 1952.)

The primary problem in deer management today is how to adjust and maintain herd numbers at the proper stocking levels of their ranges. The deteriorated range conditions have long been obvious. The obvious solution--heavier cropping by hunters--has also been recognized by game managers for many years. But California has operated under the buck law for 75 years. Transition to enlightened management is coming--but it comes slowly and painfully. The Devils Garden herd has had either-sex hunting in Oregon since 1950, and in California in 1950, 1951, 1955 and 1956; the Lassen-Washoe herd in Nevada since 1949 and in 1951, 1955 and 1956 in California. In 1956, for the first time since 1883, a general either-sex season was incorporated in the regular deer season. Thus California slowly adopts the liberalized cropping program that has already become commonplace in many of the neighboring states.

California is fortunate in having a potential hunter pressure which is probably adequate to harvest the full annual deer crop in most areas. At present the buck law prevents this harvesting potential from realizing the needed annual kill of deer. For example, in 1955 in California, 410,205 deer hunters killed 71,126 deer--an 18 percent success ratio. In 1956 with a general either-sex hunt in 38 counties, 444,927 hunters killed 108,452 deer--a 25 percent success ratio; the hunter success ratio increased approximately in proportion to the number of huntable deer made available to them. In 1956 the 108,500 deer harvested was less than 10 percent of the total deer population. According to experience in other states hunting regulations could be further liberalized to allow a kill of 25 percent or more.

BIG GAME HABITAT TODAY

To discuss the problems of big game management in northeastern California, it is convenient to distinguish among the types of game range. The range can be classified into four types according to the seasons of use and types of vegetation (figs. 1 and 7).

Season of use:	Vegetation type
Winter	Sagebrush Woodland-grass brushland Conifer timber
Summer	Conifer timber

Winter ranges lie at the lower elevations east and west of the Sierra-Cascade mountains. Summer ranges are in the central mountainous area.

Vegetative characteristics are of two broad types--brushland and timberland. There are two types of brushland--west side woodland-grass and east side sagebrush.

Overstocking of both winter and summer ranges has caused their deterioration. Dasmann and Hjersman (1958) have presented data indicating that the rate of overstocking is about the same on the winter ranges on both sides of the mountains. They use doe-fawn ratios as an index of fawn survival, which is in turn an index of range productivity. The ratios vary a good deal from year to year and from range to range (fig. 11). This holds true for the ranges on both sides. The important point to be made here is that the doe-fawn ratios of the west side are not appreciably higher or lower than those of the east side. This is the doe-fawn ratio in the fall. Presumably these data reflect summer range conditions for the preceding summer. Spring records (fig. 10) reflect winter range conditions. Here again the west side ranges have doe-fawn ratios whose overall average appears to be about the same as that of the east side.

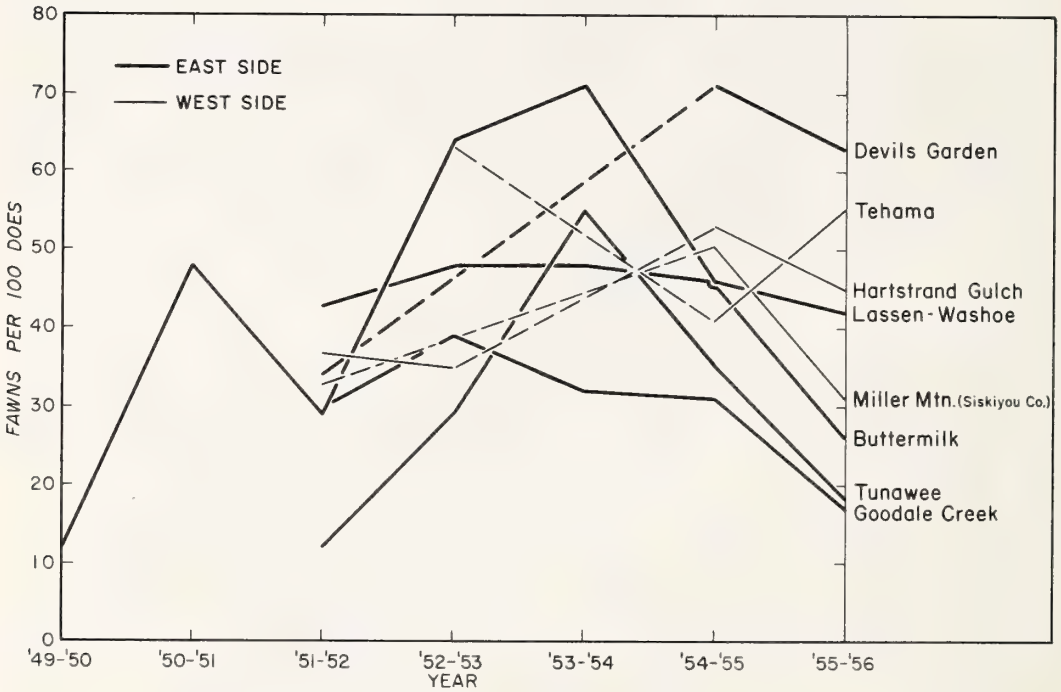

Figure 10.--Doe-fawn ratios (fawns per 100 does) in spring on selected deer ranges of California (from Dasmann and Hjersman, 1958).

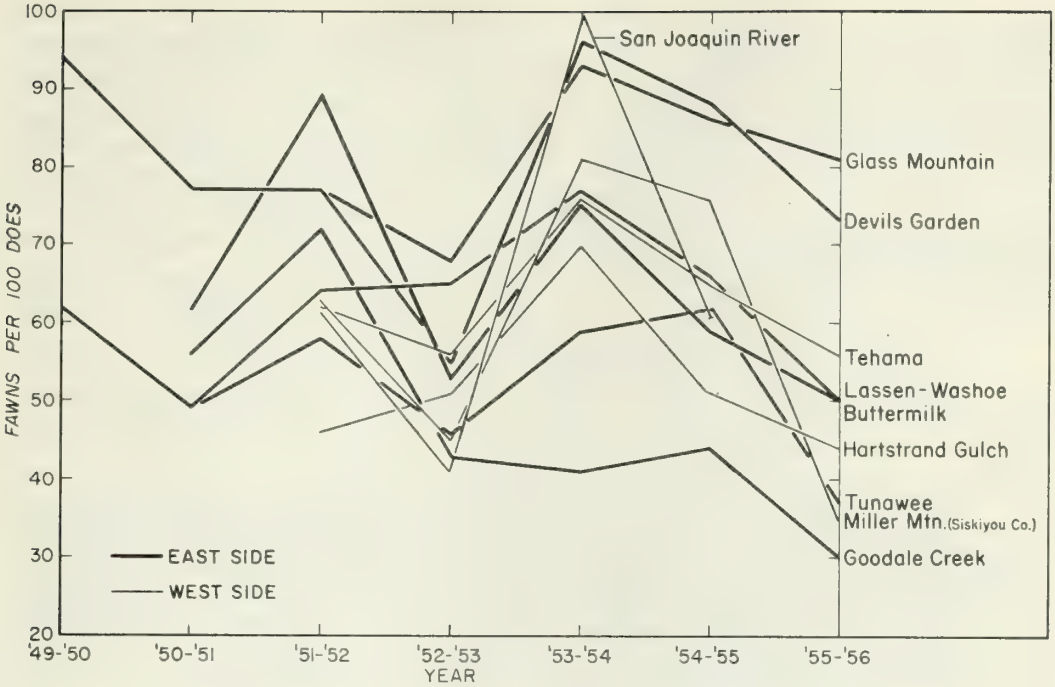

Figure 11.--Doe-fawn ratios (fawns per 100 does) in fall on selected deer ranges of California (from Dasmann and Hjersman, 1958).

Dasmann and Hjersman (1958) report the extent of excessive utilization of the key species, bitterbrush, on the east side ranges (table 8). On all seven ranges, deer cropped bitterbrush in excess of the allowable use--60 percent of the current growth. Within the ranges they excessively browsed 20 to 52 percent of the bitterbrush stands (averages for deer less the averages for cattle in table 8).

Because the large areas of summer ranges have fewer deer per acre than the winter ranges, deer managers have thought that summer ranges are no problem. In recent years several game biologists have been inclined to question this assumed abundance of summer range. Although the total acreage of summer range is greater than that of winter range, and the numbers of deer per acre are fewer, it does not necessarily follow that the carrying capacity is greater on summer range than on winter range.

Sumner (1958) describes a number of summer ranges depleted by too heavy deer browsing in the central Sierra Nevada and in the vicinity of Lassen National Park. Probably there are other such depleted summer ranges as yet unreported.

Summer range depletion may result from local concentrations of deer, or it may be a result of general stocking of the ranges beyond their capacity to produce adequate forage. Acreage alone is not sufficient criterion of capacity. Productivity of the range must also be considered. Possibly summer ranges are less productive than winter ranges. This could be a result of less logging, fewer fires, more impenetrable brush fields, shorter growing season, or any of several other ecological factors, or of some combination of factors.

NEEDED--RESEARCH IN MULTIPLE-USE MANAGEMENT

We recommend that on each of the four types of deer range a project be established to study multiple-use management.

The first step is the selection of multiple resource experimental areas that are representative of the respective deer range types. Inventories of the pertinent conditions of forest, livestock range and watershed within the type furnishes the basis for selecting the experimental area. This selection, as well as all subsequent planning and operation, is coordinated in relation to the three management fields.

Second, a program of multiple resource management is instituted. Initially, the program for each resource will be the one or ones which according to our present knowledge is best adapted to that resource at that place.

Concurrently with the management program is a research and development program to measure the results of management and to develop and test improvements. Those improvements are aimed at both the increased production of individual products and the coordination of their combined production.

As an overly simplified example: On the west side conifer winter deer range we select an experimental multiple-use area in one of the islands of winter deer range. We apply the forestry practices which timber management research has developed for that timber type. We measure the effects of the management on deer and livestock forage production and on watershed conditions. At the same time on different parts of the area we test various modifications of the timber management method to try to improve deer and livestock conditions without unduly curtailing timber production. Appurtenant techniques for controlling erosion or improving water production are developed and tested on the area. These are but examples of the multiple inquiries coordinated on the area.

As the applied management, testing, and development progress, the need for basic knowledge in the associated disciplines becomes apparent. Then project personnel or cooperators trained in those disciplines (e.g., plant physiology, pathology, and genetics, animal physiology and behavior, soil sciences) will bring their research specialties to bear on the project.

Specific conditions on each type of deer range will lend emphasis and direction to the course of research on each multiple resource project.

EAST SIDE SAGEBRUSH WINTER RANGE

In the east side sagebrush, the dry climate restricts vegetation growth. Plant succession progresses slowly. Destruction of range vegetation by fire, insects, and heavy grazing are particularly serious because of the slow recovery that ensues. In affected areas nutritious shrubs and bunchgrass are replaced by low-value plants such as cheat grass. These plants compete for the precious soil moisture and thus for long periods prevent return of the better range species. Artificial revegetation is a prime necessity for hastening range recovery. Protection from destructive forces is even more important than on other ranges of the project area where there is more abundant moisture.

WEST SIDE BRUSHLAND WINTER RANGE

The west side brushland has more precipitation than the sagebrush type. Under such conditions the vegetation consists of annual grass and herbs, shrubs, and hardwood trees. The shrubs and trees tend to replace the herbaceous plants, forming impenetrable thickets. Such low value woody plants not only form barriers to grazing animals, they are generally less nutritious than the annual plants. One of the management problems, therefore, is the control of invading brush.

Information is needed on the comparative values of low value brush and grass in production of nutrients for deer and livestock. This would permit evaluation of brush control for the two classes of animals. Information is also needed on proper methods of controlling brush for deer and for cattle. We need to understand the commensal and competitive relationships of the cattle and deer using the same forage resource.

WEST SIDE CONIFER WINTER RANGE

Timber is the main cash crop on winter range in the west side conifer type. A relatively small but locally important cattle industry is a secondary cash crop. Watershed management is of particular importance, for there are many steep hillsides and the soil is highly subject to erosion. The small islands of winter deer range are of importance beyond their size because they carry through

winters the deer that are distributed over all the much larger summer ranges higher in the mountains.

Here the problem of integrating multiple-use management is epitomized. Brush species furnish food for deer and cattle, but interfere with forest regeneration. Browsing by deer and cattle helps to suppress the plant competition, but occasionally deer and cattle also suppress tree seedlings by trampling or browsing. Forest harvesting opens stands for more ground vegetation, which furnished more forage for deer and cattle. Some soils are not suited for growing forests but may be suitable, with the development of proper cultural methods, for growing forage for deer and cattle.

All these interrelationships coupled with the all-pervading problems of watershed management constitute "the problem" on this range type.

SUMMER RANGE

The land uses and accompanying problems of management are the same on summer range as on the preceding type. Timber, livestock, deer, and watershed uses are all present. In some places Douglas-fir and fir or lodgepole pine replace the ponderosa pine type of the winter ranges. Timber brushlands and the high mountain meadows are radical variations from the timber types. Less deforestation by fire and logging has occurred here than in the more populous lower winter ranges. In the highest parts great expanses of bare rock occur. But over most of the area the problems are the same: forage and forest; timber, livestock, and deer; unstable soils and heavy precipitation.

This range has been studied less than any of the others. Strong indications are that troubles of overstocked deer range have long been developing. While attention has been centered on the winter ranges, considered to be critical for deer culture, the summer range has developed browse lines and muddy streams.

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APPENDIX

Table 1.--Runoff, ultimate consumptive need and remnant waters of a few drainage units in the central valley area [1/]

Drainage unit	Runoff	Local ultimate consumptive need	Remainder[2/]
	Acre-feet	Acre-feet	Acre-feet
Goose Lake	68,000	80,000	-12,000
Pit River	3,430,000	478,000	2,952,000
Feather River	4,600,000	547,000	4,053,000
American River	2,849,000	217,000	2,632,000

1/ Sources: Calif. Dept. Water Resources, 1951, 1955.

2/ Available for non-consumptive use and for export.

Table 2.--Volume and value of timber harvested on the project area in 1956 1/

Species	Volume	Value
	M bd.-ft.	Dollars
Ponderosa pine	632,548	16,155,000
Sugar pine	172,877	5,530,000
White & red firs	515,354	4,006,000
Douglas-fir	219,393	3,436,000
Incense-cedar	71,464	275,000
Other	6,438	4,000
Total	1,618,074	29,406,000

1/ Source: Division of Forest Economics Research, Calif. Forest and Range Expt. Sta., Forest Serv., U. S. Dept. Agr.

Table 3.--Number of recreational visits (not including highway travel) to national forests [1/]

Forest	Number of Visits		
	1946	1950	1954
Klamath (part)	14,000	22,000	27,000
Modoc	19,800	34,400	64,200
Shasta (part)	700	800	1,000
Lassen	110,000	199,300	294,500
Plumas	62,800	90,100	135,200
Tahoe	154,100	129,400	250,400
Eldorado	245,500	363,000	694,000
Total	606,900	839,000	1,466,300
All Forests in Region 5	3,912,000	3,695,000	6,808,000

1/ Source: California Region, U. S. Forest Service, San Francisco

Table 4.--Annual harvest of deer in the northeastern counties and in California 1/

County	Average 1927-51	1952	1953	1954	1955	Average 1952-55
Siskiyou	1,843	2,187	2,768	4,036	4,220	3,303
Tehama	1,372	1,623	2,932	4,180	3,137	2,968
Shasta	1,115	1,940	2,566	3,423	3,167	2,774
Lassen	1,398	1,962	1,519	2,643	3,366	2,372
Plumas	1,507	1,671	2,285	2,762	2,543	2,315
Modoc	1,922	1,794	1,076	2,151	2,535	1,889
Alpine	523	1,277	1,638	1,765	1,896	1,644
Eldorado	801	937	1,185	1,637	1,394	1,288
Butte	448	849	1,040	1,229	1,158	1,069
Sierra	658	795	1,032	1,322	1,014	1,041
Placer	431	531	671	833	686	680
Amador	198	322	485	550	418	444
Yuba	96	167	244	368	205	246
Total	12,312	16,055	19,441	26,899	25,739	22,033
California Total	34,532	50,667	58,992	75,602	71,126	64,097
Percent of California Total	36	32	33	36	36	34
Deer Tags Sold (State)	175,448	369,149	370,938	397,566	400,000	--
Est. No. hunters who hunted in N.E. counties	63,161	118,000	122,000	143,000	144,000	--

1/ Source: California Dept. Fish and Game, Sacramento

Table 5.--A chronological summary of California deer hunting regulations

Year	General seasons	Bag limit	Hunting license	Deer tag	Remarks
1852 - 82					Deer protected 6 months of each year
1883 - 92					Antlerless deer protected
1893 - 94	Sept. 1 - Oct. 15				
1895 - 1900	July 15 - Oct. 15				
1901 - 02	Aug. 1 - Sept. 30	3 bucks			Night hunting and sale of meat and hides prohibited
1903 - 04	July 15 - Oct. 31	3 bucks			
1905 - 06	Aug. 1 - Oct. 15	2 bucks			
1907 - 10	July 15 - Sept. 30	2 bucks	$1.00		
1911 - 14	July 1 - Oct. 31	2 bucks	$1.00		Six game districts established in 1911, changed to 7 in 1913.
1915 - 18	Aug. 1 - Oct. 14	2 bucks	$1.00		Four game districts
1919 - 20	Aug. 1 - Oct. 14	2 bucks	$1.00		Six game districts, spike bucks illegal
1921 - 24	Aug. 1 - Oct. 15	2 bucks	$1.00		
1925 - 26	Aug. 1 - Oct. 15	2 bucks	$1.00		Forked-horn bucks illegal in District 1-3/4[1]
1927 - 34	Aug. 1 - Oct. 15	2 bucks, except 1 in Dist. 1-3/4	$2.00	$1.00	

Table 5.--A chronological summary of California deer hunting regulations (Cont'd)

Year	General seasons	Bag limit	Hunting license	Deer tag	Remarks
1935 - 36	Aug. 1 - Oct. 15		$2.00	$1.00	Forked-horn bucks legal in District 1-3/4
1937 - 45	Aug. 1 - Oct. 15	2 bucks, except in Dist. 1-3/4, 4-1/2			Forked-horn bucks illegal in District 1-3/4
1946	Aug. 7 - Oct. 21	2 bucks, except 1 in Sierra and San Diego Co.	$2.00	$1.00	
1947	Aug. 7 - Oct. 15	"	$2.00	$1.00	22 game districts
1948	Aug. 7 - Oct. 15	1 buck, except 2 in Central Coast	$3.00	$1.00	
1949	Aug. 7 - Oct. 15		$3.00	$1.00	Special season, either sex on Catalina Island, Nov. 1 - Jan. 31.
1950	Aug. 7 - Oct. 15	"	$3.00	$1.00	Special seasons-(1) Mineral King Refuge, either sex, Sept. 16-Oct. 15; (2) Devils Garden, Modoc Co., Anterless, Nov. 4-12.

1/ Modoc and Lassen Counties. Source: Longhurst *et al.*, 1952.

Table 6.--Areas of commercial forest land 1/ in national forests that are deforested (by fire), cutover, and uncut 2/

Forest	Area as of 1955			cutover since 1955		
	Deforested	Cut-over	Uncut	1955	1956	1957
	Thousand of acres					
Modoc	54	282	201	24.1	22.1	10.1
Lassen	74	251	317	9.4	21.3	8.8
Plumas	100	309	457	16.3	15.3	13.0
Tahoe	103	197	235	7.1	4.9	5.0
Eldorado	23	87	255	8.1	6.8	4.6
Klamath	70	221	819	9.3	17.6	(3/)
Shasta-Trinity	151	141	1,044	14.2	11.6	13.8
Total	575	1,488	3,328	88.5	99.6	55.3

1/ Exclusive of national forest lands in recreational areas, reserved areas, and all private lands.

2/ Data furnished by Regional Office, U. S. Forest Service, San Francisco, Calif.

3/ Data not available.

Table 7.--Deer range units and subunits and their respective rates of stocking and total deer numbers (Longhurst, et al., 1952)

Unit No.	Unit	Sub-unit	Summer deer range area	Winter deer range area	Deer per sq. mile (1947-1949) Estimated summer deer density	Estimated winter deer density	Estimated total deer
			Sq. mi.	Sq. mi.	Number	Number	Number
8	Shasta	A-McCloud	1,650	720	11	25	18,000
		B-Whitmore	680	460	6	9	4,000
	Unit total		2,330	1,180	9	19	22,000
9	Tehama	A-Tehama	1,950	750	20	52	39,000
10	Yuba	A-Bucks Mt.	710	230	10	30	7,000
		B-Mooretown	580	180	7	22	4,000
		C-Sloat	540	280	20	39	11,000
		D-Downieville	720	250	12	36	9,000
		E-Nevada City	430	210	10	19	4,000
		F-Camp Beale	1,000	1,000	10	10	10,000
	Unit total		3,980	2,150	11	21	45,000
11	El Dorado	A-Blue Canyon	800	240	9	33	8,000
		B-Pacific	500	90	16	89	8,000
		C-Grizzly Flats	380	160	10	25	4,000
		D-Placerville	1,160	1,160	11	11	13,000
	Unit total		2,840	1,650	12	20	33,000
15	Little Shasta	A-Copco	330	80	6	25	2,000
		B-Bogus Mountain	300	210	13	19	4,000
		C-Miller Mountain	820	410	11	22	9,000
		D-Mt. Dome	450	270	11	19	5,000
	Unit total		1,900	970	11	21	20,000
16	Devils Garden	A-Glass Mountain	500	270	14	26	7,000
		B-Bryant Mountain	320	90	3	11	1,000
		C-Interstate	1,330	630	11	24	15,000
		D-Pitt River Rims	850	380	8	18	7,000
	Unit total		3,000	1,370	10	22	30,000
17	Warner Mountains	A-West Warners	1,340	720	10	18	13,000
		B-East Warners	1,600	1,350	6	7	9,000
	Unit total		2,940	2,070	7	11	22,000
18	Fall River	A-Day	700	140	13	64	9,000
		B-Lake Britton	430	80	8	37	3,000
		C-Hat Creek	1,410	490	11	31	15,000
	Unit total		2,540	710	11	38	27,000
19	Eagle Lake	A-Eagle Lake	1,890	1,500	8	11	16,000
20	Sierra Valley	A-Doyle	1,250	490	12	31	15,000
		B-Loyalton-Truckee	1,180	440	20	52	23,000
	Unit total		2,430	930	16	41	38,000
21	Alpine	A-Carson River	650	210	11	33	7,000
	Total		26,450	13,490	11	36	299,000

Table 8.--Percent of bitterbrush stand overbrowsed, in specific areas and years (percent of plots on which utilization averaged 60 percent or more) 1/

Year	Devils Garden	Lassen-Washoe	Verdi	West Walker	Butter-milk	Goodale Creek	Tunawee Canyon	Average
After summer livestock use:								
1949-50	-	5	-	-	8	-	-	6
1950-51	2	18	-	-	5	-	-	8
1951-52	0	7	-	-	0	-	-	2
1952-53	1	14	5	0	0	0	-	3
1953-54	0	8	16	7	0	0	-	5
1954-55	2	9	6	11	4	0	-	5
1955-56	0	4	3	8	0	0	-	3
Average last 4 years	1	9	8	7	1	0	-	-
After winter deer use:								
1949-50	40	63	-	-	78	-	-	60
1950-51	20	64	-	-	43	47	77	50
1951-52	17	52	-	53	18	33	22	33
1952-53	5	33	35	54	10	0	0	20
1953-54	11	28	32	57	21	60	100	44
1954-55	46	56	43	70	38	0	83	48
1955-56	20	31	18	54	78	60	0	37
Average last 4 years	21	37	32	59	37	30	46	--

1/ Source: Dasmann and Hjersman (1958, p. 70).