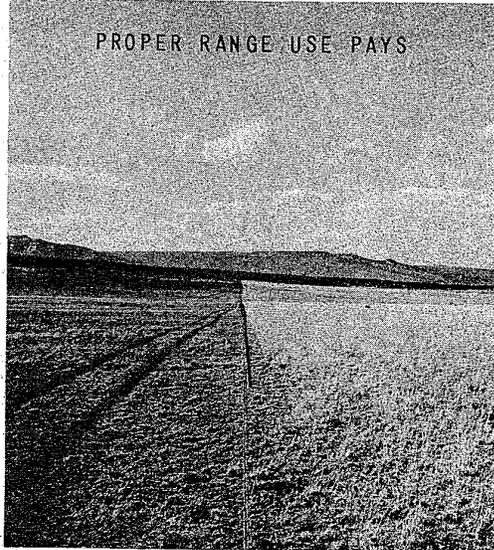


RANGE CONSERVATION - TECHNICAL NOTES

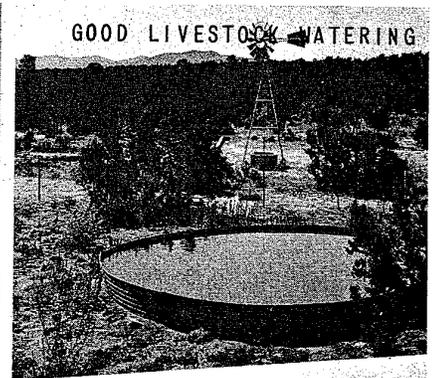
CHEMICAL PLANT CONTROL



PROPER RANGE USE PAYS



GOOD LIVESTOCK WATERING



CHOLLA CONTROL



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW MEXICO

RANGE TECHNICAL NOTE NO. 57

October 25, 1972

Re: Game Range Improvement in New Mexico

This Range Technical Note transmits Report No. 9 of the New Mexico Interagency Range Committee.

This report can be used as reference for planning and application of range practices to enhance game range improvement.

Additional copies are available from the state office. Submit requests to the Plant Sciences Section.

Attachment

AC's - 1 ea.

DC's - 1 ea.

Area Range Conservationist - 1 ea.

RTSC, Portland - 2

D. M. Whitt, Director, Plant Science Div., Washington, D. C. - 2

Report No. 9

August 1971

GAME RANGE IMPROVEMENT

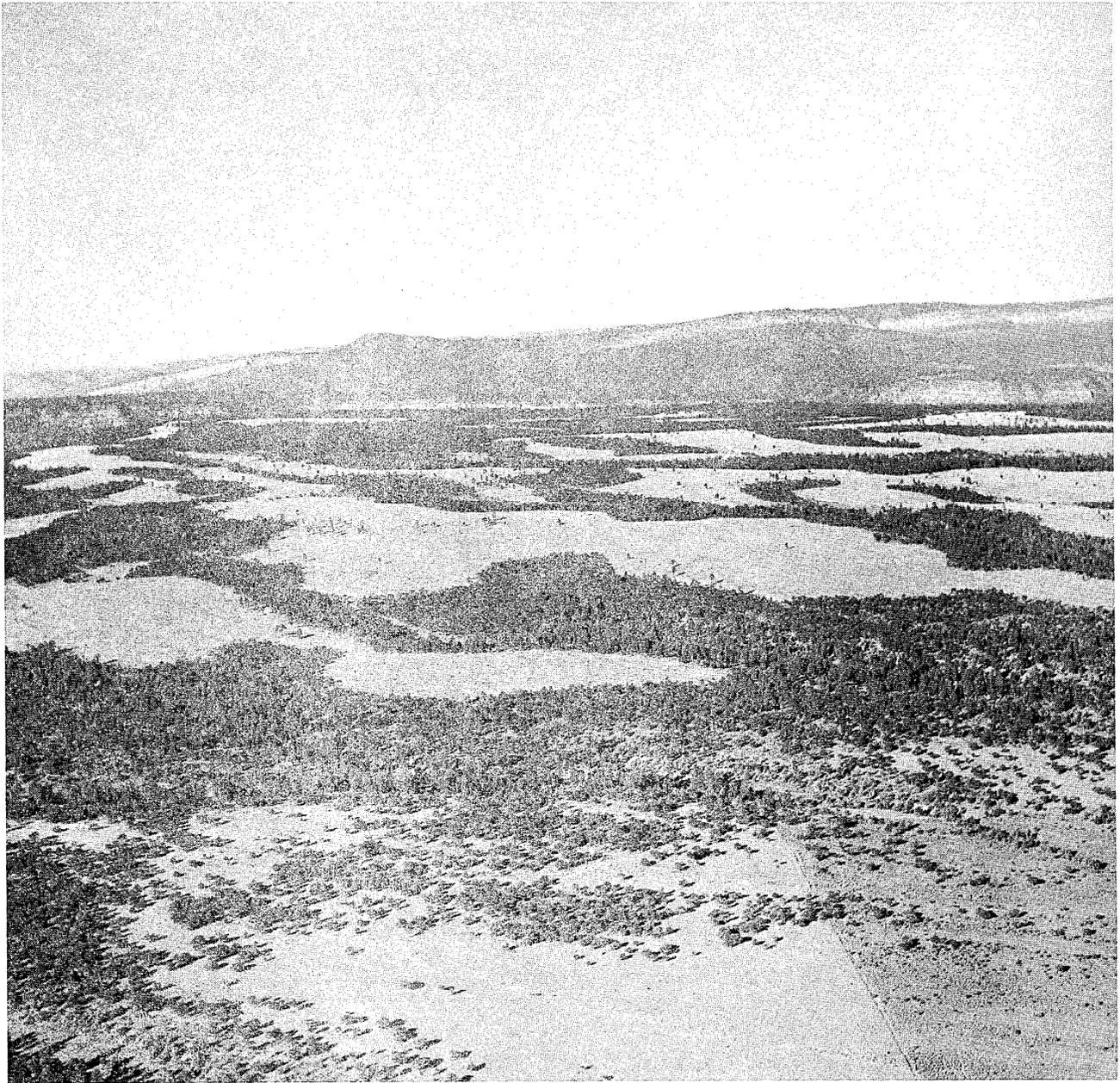
IN

NEW MEXICO

New Mexico Inter-Agency
Range Committee

Request copies from:

Agricultural Research Service
U.S. Department of Agriculture
P. O. Box 698
Las Cruces, New Mexico 88001



PINYON JUNIPER RANGE

Control of pinyon-juniper in strips and patches improves the range for domestic stock and leaves cover for game.

Preface

This paper presents the results of a field evaluation in August 1971 by the Interagency Range Committee of game range improvement practices used in New Mexico. Members of the committee are as follows:

Agricultural Research Service

Dr. Carlton Herbel, Range Scientist Las Cruces

Bureau of Indian Affairs

Wilson Gutzman, Area Range Conservationist Albuquerque

George W. Knoll, Range Conservationist Albuquerque

Bureau of Land Management

Bill Leifeste, Range Conservationist, Watershed Santa Fe

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Wayne Hickey, Range Staff Albuquerque

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* Non-members participating

** Members participating

Game Range Improvement in New Mexico
by
Samuel H. Lamb and Rex Pieper
Department of Game & Fish
New Mexico State University
Co-Chairmen

A. Introduction

When does a game range require improvement? Who will be the chief beneficiary? How shall the work be done? What machinery should be used? When should the work be done? Should the land be plowed, disked, chained, sprayed, burned or just rested? If seeding is necessary, what species of plants should be planted?

These and many other questions must be asked by the game range manager when the problem of improving a range is being considered. The whole problem is a very complex one. Economics may be the over-riding factor and evaluation of the results of the improvement practice is only one of the considerations. A committee of range improvement specialists, named the New Mexico Interagency Range Committee was formed in 1967. The committee has considered methods of range improvement from the dual standpoint of range improvement for domestic stock and for wildlife. Range improvement for domestic stock has received major emphasis but game needs have been considered at each meeting. This committee has considered in turn, improvement of ranges invaded by sagebrush, pinyon-juniper, cholla cactus, shinnery oak, mesquite and cresotebush, and has looked into grazing management systems, improvement of stock handling facilities and mechanical improvement of range. The meeting in August, 1971 was for the purpose of considering specifically game range improvement.

A tour was held to acquaint the members of the committee with work being done in New Mexico. The following stops were made; 1. The cooperative experimental work being carried on at Fort Bayard pasture by the Rocky Mountain Forest and Range Experiment Station, the Gila National Forest and the New Mexico Department of Game and Fish. In the light of what was learned there, the committee proceeded to other game ranges of the state to evaluate what various agencies are doing. 2. The Gila National Forest to consider the role of fire and timber cutting practices in ponderosa pine. 3. Farmington, New Mexico, to view the shrub orchard at the Department of Game and Fish Jackson Lake Wildlife area. 4. Southwest Colorado to observe chaining followed by burning and aerial seeding by the Ute Indians. 5. Middle Mesa to consider chaining, burning and reseeding being done by the Bureau of Land Management. 6. The sagebrush and pinyon-juniper control work, and trial plantings done by the Department of Game and Fish. 7. Chama to observe the New Mexico Department

of Game and Fish shrub experimental plantings and the Roque Wildlife Area seedings of 1967, 1970 and 1971. 8. Carson National Forest to look at tree crusher work, game water improvements and an intensively treated game plot.

After finishing the agenda of field inspections, the group met in Santa Fe to consolidate the thinking of the group concerning the various categories of game range work observed.

This report will also cover aspects of game range improvement that the group did not have the opportunity to observe. In this case the writers are drawing on experience from previous tours.

B. The Need for Game Range Improvement

Various surveys have been conducted by agencies to determine the acreage of vegetative types in New Mexico. The total state acreage of all lands is in excess of 77,000,000. Of this the total forested acreage is 18,187,000 - approximately $\frac{1}{2}$ state or private and $\frac{1}{2}$ federal.

The total acreage of brush land types in private ownership is 18,403,000. It has been estimated that 13 million acres of this need treatment. In addition, the Forest Service finds 630,436 acres of brush and poisonous plants in need of control on national forests. The BLM and BIA did not have acreage figures for types under their administration. However, the BLM estimates 520,000 acres of sagebrush on the federal lands of the Albuquerque District. This is close to the total acreage of sagebrush on BLM lands of the state. There is no estimate as to the acreages of cholla, pinyon-juniper, creosotebush, mesquite, shinners and assorted species in need of control. Considering the general location and condition of BLM lands it seems probable that at least half or in excess of 6,500,000 acres are brush infested.

It becomes readily apparent that something in excess of 20,000,000 acres of brush land may be in need of treatment.* With such vast acreage under consideration it is imperative that due consideration be given to the needs of game in all programs of range improvement.

C. Conditions That Indicate Need For Improvement

In general, a game range needs improvement when it is infested with a solid stand of brush or trees of minimal value to wildlife. Stands of a single species of brush that may furnish

* Reynolds estimated 16 million acres in 1959.

feed at one particular season and be a very poor source of feed for the balance of the year may also need treatment. Other criteria included stands of shrubs that are too dense to allow ready access to game, stands so tall that the forage is out of reach, stands that are so dense as to shade out all other forage plants or stands so dense that successful hunting is impossible.

Properly planned and executed game range improvement projects may increase game production through increasing feed supplies or improving palatability or nutritive values of the feed supply. Thus where an increase in numbers of game animals is desirable, range improvement is in order. Likewise, where game numbers have increased to the point where the supply of feed is being exhausted or the range is in a deteriorating condition, range improvement is in order. The alternative is a reduction of the game herd to the carrying capacity of the range in its present condition.

Throughout this report two alternatives in game range improvement have been considered. The first concerns the multiple use aspect of supplying the needs of wildlife in any range improvement program for domestic livestock. The other is the situation where a range is being treated solely for the benefit of wildlife. Under the latter alternative the more intensive patterns of improvement may be practical whereas it would be impractical in a broad program of range improvement for multiple use. Since by far the most range improvement will be done under the first alternative it is vital that range managers incorporate all of the recommendations for game range improvement that can be justified. In fact, there will be many instances where including a practice to favor wildlife will be less expensive than the most intensive livestock range improvement. The problem will be to sell the public on the less intensive operation. Specific examples are chaining in pinyon-juniper instead of total clean up, leaving slash in timber harvest operations, allowing some forbs and browse plants to grow in pastures, etc.

D. Game Range Improvement by Vegetative Types

1. Spruce Forest

The spruce forest is used extensively in summer by elk, mule deer, Rocky Mountain bighorn sheep and blue grouse. As the winter snows deepen use diminishes for elk, deer and bighorn but may continue quite heavy for grouse. Since grouse winter largely in the trees the depth of the snow is not a critical factor. All of these game species come into the open parks and meadows to feed seasonally.

Since little suitable vegetation for game feeding is produced under a closed spruce canopy it becomes apparent that some openings are necessary for production of feed. Research in the ponderosa pine forest by the Rocky Mountain Forest and Range Experiment Station indicates good use of meadows up to $\frac{1}{4}$ mile wide. Using this criteria it can be logically assumed that a large tract of dense spruce forest would be improved for game by spot clear cutting to encourage growth of grasses, forbs, brush and spruce reproduction available for game feed.

There does not appear to be sufficient research to show if there is a preferred shape of opening or an optimum acreage that should be cleared per section. However, if an interspersed of open acreage and dense forest can be achieved through a long period of cutting subwatersheds until the whole spruce forest is converted to an uneven aged forest by blocks, the best interest of game would appear to be served.

For spruce, clear cutting is the preferred method of harvest because of windthrow and bug damage to the residual stand if a partial cut is undertaken. Adequate reproduction generally occurs where the cut areas are not too large. Where the slash can be left more or less as it falls, the soil is protected and shelter is given to the seedling spruce, shrubs and forbs after release from the shade of the spruce canopy.

Water is seldom a problem in the spruce forest due to the prevalence of small, snow and spring fed streams.

For optimum game habitat improvement, openings should probably be no wider than 300 yards. One fifth of the forest area should consist of openings. This can be achieved by a twenty year cutting cycle with a 120 year rotation. Each newly clearcut area will remain productive for fifteen to twenty years.

In the all spruce forest the natural openings tend to be closed by spruce reproduction encroaching from the edges of the forest across the openings. Here a helpful habitat management practice consists of cutting back the small spruce trees to maintain the proper amount of open area.

Logging roads should be seeded to mountain brome grass, Arizona fescue or other available grasses suited to this high altitude.

In the spruce zone the competition for the range is often between domestic sheep and game. Elk appear to have a low tolerance for sheep, so existence of a sheep allotment on a

range will make it a poor place to do range improvement for elk. Cattle competition is less severe in this high altitude zone, but can become severe unless they are well managed.

2. Mixed Conifer Forest

The mixed conifer forest is used by elk, mule deer, turkey, grouse, bighorn sheep and beaver. Elk and deer migrate back and forth through this zone in passing from the wintering grounds in the lower mountains to the summering grounds in the high mountains. Turkeys work up into the zone from the ponderosa pine forest to a limited extent but, since the pine forest is their principle range little consideration need be given them here. Grouse work down into the upper edge of the zone as they use the mountain meadows during the summer season. In some areas bighorn sheep come down into this and the pine zone to winter. Beaver can be found along the streams wherever aspen is plentiful.

Little can be done in this forest zone for game other than the manipulation of cutting practices. Some spot clear cutting is beneficial if the spots can be kept small. Small, even aged clumps of trees can be harvested in this manner. It is beneficial to leave most of the slash although the biggest tops should be reduced. The slash protects the soil and serves as micro-nurseries for forbs, shrubs and tree reproduction. All logging roads should be seeded to Arizona fescue, mountain brome grass, tall wheatgrass, orchard grass, sweet clover, etc. In all clear cutting operations, care should be taken to preserve the aesthetic quality of the landscape.

The mature aspen trees should be harvested to promote resprouting. Large trees are of little value to game, whereas reproduction furnishes prime game food. Attention should be paid to leaving adequate aspen along the streams in this zone to satisfy the needs of beaver. In unmerchantable stands of aspen the old growth can be broken down with bulldozers to promote resprouting.

Mountain meadows that have become choked with blueflag and sleepy grass should be plowed and planted to mixtures of grasses and legumes. This practice applies more to the ponderosa pine zone but some such meadows will be found extending up into the mixed conifer zone. Gullies in the meadows should be treated to stop erosion and, in some areas more ponds and water tanks are needed to supply game water. Also, if spraying with 2, 4-D can be considered, three pounds applied when flower petals are dropping will give effective control of blueflag.

Measures should be taken to improve the streams for trout. This consists of keeping logging trash out of the stream, locating logging roads away from the stream, protecting the logging area from erosion, leaving trees adjacent to the stream to shade the water and protect the stream bank. Various types of devices may be installed in the stream bed to provide pools and assist in shaping the stream bed.

In the mixed conifer zone the chief competition between game and stock will occur in the mountain meadows and along the stream bottoms. Thus if the domestic grazing cannot be controlled, game range improvement measures in those areas may be nullified.

3. Ponderosa Pine Zone

The ponderosa pine zone is the most important of the true forest zones for wildlife. Here we find a major use area for elk, mule and white tailed deer, turkeys, beaver and squirrels. Heavy use is made of this zone by nuthatches, woodpeckers, owls, eagles, hawks, and other birds.

This zone also lends itself to a broad range of worthwhile game range improvement work. Due to the traditional effects of fire in this area this forest is more apt to be naturally many-aged. Thus it is possible to practice spot clear cutting to good advantage. Groups of mature trees can be cut to open up small areas that will produce game feed.

In any cutting plan for pine care should be taken to assure leaving turkey roost trees and groups of ~~trees~~ for Abert's squirrel nesting. Snags should be left uncut for squirrels, nuthatches, and other birds that use woodpecker holes for nests and also as perches and nesting sites for owls, hawks and eagles. Pine reproduction around mountain meadows often needs to be controlled to prevent closure of the parks.

Concerning the proper type of trees to leave for roost trees the range manager is referred to the publication, "Roost Tree Characteristics for Merriam's Turkey," by Erwin L. Boeker and Virgil E. Scott, Journal of Wildlife management, Volume 33, Number 1, January 1969, pages 121-124, from which the following quote is taken, "Turkeys prefer to roost in tall, mature, or overmature ponderosa pine trees on easterly exposures. Trees with relatively open crowns and large horizontal branches 20 - 30 feet from the ground receive the heaviest use."

The ponderosa pine zone lends itself ideally to the production of worthwhile amounts of game feed by improving the open meadows. Many of these are choked by bluf lag and sleepy

grass and other growth of low value to wildlife. A tremendous improvement can be made by disking and seeding these areas to such grasses as brome grass, orchard grass, intermediate, tall, or pubescent wheat grasses and alfalfa. That this type of game range improvement can be effective is shown in the publication, "Response of Kaibab Mule Deer to Management of Summer Range," C. R. Hungerford, University of Arizona, Tucson, Journal of Wildlife Management, Volume 34, Number 4, October 1970, pages 852-62 from which the following quote is taken, "Reseeding practices resulted in improved summer deer condition and a 24.5% better fawn crop." Further research is needed to develop additional succulent materials where alfalfa is not desirable. Many of these meadows are badly gullied so erosion control measures should be taken. Additional water is usually needed and can be supplied by constructing additional ponds and tanks for game.

Care must be taken to insure that the areas seeded for game are not preempted by domestic livestock. Certain areas should be dedicated to game use and fenced to prevent livestock use. Development of a proper grazing system, coupled with adequate supervision of the grazing operation may make fencing unnecessary.

The ponderosa pine forest is ideal for the use of fire in game range improvement. This zone is a natural fire type that has evolved under a fire regime. In the hot, dry summers with frequent lightning storms many fires are started. This natural condition has contributed to a mosaic of strands of many different ages. To exclude fire too long tends to cause a heavy load of fuel to accumulate. Then when a fire occurs the results are catastrophic. However, if a condition can be maintained wherein cool fires creep through the middle aged and mature stands the fuel accumulations will be kept under control. These slow fires tend to open up the unduly dense stands of reproduction. This keeps the forest floor open and productive of grasses and succulents. All of this is advantageous to game.

Turkeys deserve extra attention in the pine forest. For successful production turkeys need nesting sites, roosting trees, water and grassy meadows in close proximity. Careful cutting practices will leave the needed roost trees. Water can be supplied by trick tanks, rain traps or dirt tanks. Nesting can be favored by leaving some slash, and meadows can be developed by spot clear cutting. Careful plans should be developed to assure that all four elements of good turkey range are duplicated as frequently

as possible over the forest. Long range plans should be developed to assure retention of good roosting trees throughout future cutting cycles.

Gambel oak occurs extensively in the pine forest. Some of the oak should be allowed to grow to tree size to furnish oak mast, but browse can be improved by breaking back stands of small oak poles. These stands will then sprout from the roots and if browsing pressure is intense the sprouts will be held in a shrubby form for several years and provide large amounts of available browse. For additional information on the value of Gambel oak to wildlife the paper, "Gambel Oak for Southwestern Wildlife," by Hudson G. Reynolds, Warren P. Clary and Peter F. Follitt, Journal of Forestry, Volume 68, Number 9, September 1970, pages 545-547 will be of interest. It is pointed out that, due to the fact that the oak produces both valuable browse and mast, the manager will be forced to decide which role they wish the oak to play. In general, trees above eight inches in diameter are the best mast producers and should be saved where the production of mast is desired.

Competition between domestic stock and game will occur throughout this zone except in areas too rough or remote for domestic stock. For this reason steps must be taken to reserve feed developed in a game range improvement program for the game or it will be utilized by the domestic stock. This problem will be less severe if a proper grazing system is applied and closely supervised.

4. Pinyon-Juniper

The pinyon-juniper zone is of critical importance to mule deer and is used to some extent by turkeys and elk. White tailed deer make good use of this zone in the southern mountain ranges. Many species of non-game birds and mammals also make extensive use of the area.

In our area more improvement work has been done in this plant association than any other with the possible exception of sagebrush. Also more research has been conducted here than in any other zone. The requirements for game have been quite well determined by the research being done jointly by the Rocky Mountain Forest and Range Experiment Station, the Gila National Forest and the New Mexico Department of Game and Fish.

Range improvement work has included cabling, chaining, bulldozing, broadcast burning, single tree burning, individual plant treatment with herbicides, single tree cutting, tree

crushing, and various combinations. Any of these methods will achieve improvement of game range if done in a well designed manner. Research has shown that the areas cleared should be kept narrow so that deer using the openings are always close to cover. Ideally the openings should not be over 1/4 mile wide. A long, slender strip is ideal with the strip being fitted into the landscape in a naturalistic pattern. This can often be accomplished by following the meanderings of the most suitable soil type. Strictly for game purposes the manner of knocking down and disposing of the trees is not important. Other considerations may dictate any degree of cleanup from none to complete disposal of all residue. In some instances the dead tree skeletons may serve as game cover for a time at least. The tree crusher leaves the most aesthetically acceptable condition but this degree of disposal of the brush is not necessary for game range improvement.

In conducting tree crusher work consideration should be given to leaving the last swath in the center of the job and small islands that result from the tree crusher going around irregular strips. These small inner patches require an undue amount of turning on the part of the operator and cutting them serves no useful purpose. Therefore, consideration should be given to leaving them for game cover.

In every pinyon-juniper control project careful consideration should be given to adding grasses, forbs, shrubs and legumes to the vegetational complex through some type of seeding. Good stands are difficult to achieve but some success has been had by sprinkling seed ahead of the chaining; aerial seeding after chaining; aerial seeding after chaining followed by a second chaining; chaining, burning and seeding on the snow following the burn; broadcast seeding from the tree crusher; interplanting with a browse seeder after tree crushing and clean up of fire wood; by browse seeding following pushing and piling and perhaps in other ways. The critical point is to do the best seeding job possible considering the type of control work being done.

The shrubs, such as mountain mahogany, fendler bush, bitterbrush, ceanothus, fourwing saltbush, service berry, squaw-apple, etc., occurring naturally in a pinyon-juniper stand are least harmed by chaining, are well pruned by a tree crusher and many are dug up and lost by bulldozer work unless the operator is trained to miss the shrubs. Thus the abundance and condition of native shrubs on the area should influence choice of method of control. Fire has a releasing action in many sites that appears to be beneficial to certain shrubs but may be very detrimental to some strains of bitter-

brush if it burns too hot.

In developing the overall pattern for control on a larger, essentially homogenous area, consideration should be given to clearing strips not more than 1/4 mile wide leaving intervening uncleared strips not less than 1/8 mile wide, working in naturalistic patterns, and leaving uncleared a total of not less than 25% of the total block under treatment. Included in the areas to be left should be rocky points, ridges, steep slopes, areas of shallow soil, northeast exposures with slopes of over 15% and enough of the prime area to make up the 25% of the area to be left. In selecting areas to be cleared consideration should be given to areas with deep soils, southerly and easterly exposures, gentle slopes below 15% and perimeters of parks in danger of being closed by invading pinyons and junipers. If areas of pinyons known to be especially highly productive of nuts or favored by local people for collecting nuts can be recognized, these areas should be left uncleared.

Where a range can be treated for the maximum benefit to wildlife, Dr. Reynolds, in correspondence, suggests the following more intensive guidelines:

1. Reduce the width of clearings to 1/8 mile.
2. Treat only 50% of the area.
3. Clear in blocks rather than in strips.
4. Leave at least 25 tall shrubs per acre in the cleared areas.

Pinyon-junipers occur with a variety of understory stands such as

Pinyon-juniper	-	grass understory
"	"	- oak "
"	"	- sagebrush "
"	"	- rabbitbrush understory
"	"	- bitterbrush "
"	"	- cholla cactus "
"	"	- ceanothus "
"	"	- fendler bush "
"	"	- service berry "
"	"	- snakeweed "
"	"	- yucca "

If clearing is being considered where the understory is sagebrush, rabbitbrush, cholla, snakeweed or yucca it must be realized that the manager is merely eliminating one undesirable range species to have it replaced by one equally or more undesirable. In this situation consideration should be given

to confining the work to areas where an understory valuable to stock or game will be favored, such as in the case where the understory is grass, oak, bitterbrush, ceanothus, fendler bush, service berry or various combinations of these. Where desirable understory species are present a method of pinyon-juniper control least apt to damage the browse should be chosen.

Competition between game and domestic stock is potentially severe throughout this zone. Exclosure studies often show that cattle are very efficient users of the browse resources. Thus plans must be made to reserve the developed game feed for game. One of the best ways to do this is to satisfy the needs of the cattle by planting grass in the better meadow areas to confine the cattle use to these meadows and reserve the natural feed on the hillsides for the game. Even so, cattle will turn to use of browse in late fall and winter, thus a well designed grazing system will be needed to protect game feed.

5. Sagebrush

The sagebrush type is used extensively by mule deer, antelope, slightly by elk, and would be used by sage grouse if they occurred in New Mexico in significant numbers. In addition there is a large population of non-game birds and mammals. Farther north in Colorado, Utah and northward sagebrush control is opposed by game managers where these ranges are used heavily by deer in winter when sagebrush is the only feed available in abundance. This is not considered to be a serious problem in New Mexico where snows are not as deep nor as long lasting. Thus game managers in New Mexico do not oppose sagebrush control and, in fact, have done much of it. However, as with all type conversion work there are some guidelines that should be followed.

Since there is such a vast area of sagebrush in northwest New Mexico, range managers should use the funds available for improvement work on the area having the best soil where the planted grasses will be most productive. This will leave plenty of sagebrush on the steeper, rockier areas and around the fringes of the pinyon-juniper stands where sagebrush control is difficult and expensive. By achieving good stands of grass on these better soils, the permitted livestock will tend to concentrate in these areas and leave the brushy areas for game. At the same time, deer will be able to feed on the wheatgrasses in early spring when they are most nutritious. It is doubtful that it will be necessary to restrict the area of sagebrush treatment as is recommended

on pinyon-juniper control. Deer use will not be expected to be heavy in areas far from cover so the clearing of large areas is not detrimental to deer, except in areas where the sagebrush is tall enough to provide cover.

In improving sagebrush ranges the standard procedure is to fence the seeded areas to rest them until the seeding is established. This practice is detrimental to antelope. Where such fencing is considered necessary it should be done in such a manner as to give minimum restraint to antelope movement. Ideally no woven wire fencing should be done and barbed wire fences should be constructed so antelope can go under readily unless a legal fence is required. A smooth bottom wire 16 inches above the ground is recommended on game range.

In improving sagebrush ranges every effort should be made to include legumes and other succulents in seeding mixtures whenever possible. Further research is needed to provide guidelines for determining species to be used.

Added water is needed on most sagebrush ranges. Trick tanks, rain traps, dirt tanks or pipeline waterers should be provided so that game is never more than one mile from water. This will also improve livestock distribution.

The choice of method to be used in controlling sagebrush is not critical in so far as game is concerned. For game there is no need to be concerned with a high percent of sagebrush kill. A 75 to 90% kill will leave adequate brush to meet game needs. A successful seeding to grass, followed by good grazing management, will result in very slow reinvasion by sagebrush even with 75% kill. However, the range managers control work will soon be undone if the new stands of grass are not well managed.

Competition between domestic stock and game on sagebrush ranges will not be critical if the range is properly managed. However, under excessive stocking domestic livestock will then turn to the more palatable species of browse which should be reserved for game.

6. Cholla Cactus Type

The chief game species utilizing the cholla cactus type are antelope and quail, both Gambel and scaled. Deer will be found where the cholla and pinyon-juniper types have intermingled. It is doubtful if cholla control is required from

a game management standpoint, but since antelope prefer open range, where visibility is good, control could be helpful but the returns would be questionable.

The extent that cholla control affects quail is a subject of sharp debate. There is no known research that can be relied upon to give guidance. People working in the field of cholla control have often said that quail are much more numerous in controlled areas than in uncontrolled areas. How much of this apparent increase is due to increased visibility of the coveys to the workers is not known. Quail need cover just as all game species do. Quail can dart into or under a large cholla and have protection from hawks. If the cholla plants are properly piled following control, these piles will provide some escape cover for years but they tend to become havens for rats and other rodents.

From a game management standpoint it appears proper to establish the following guidelines:

1. Place the cholla plants in conveniently located piles without concern for compacting the piles.
2. Avoid cholla clearing in rocky outcrops, steep slopes and where intermingled with trees or in other areas that will not yield an economic return.
3. Increase the availability of water.

Competition between livestock and game will not be important in this type if good range management is practiced. If cholla control was followed with pitting of some type, the amount of forbs produced would be increased temporarily which would be good for both quail and antelope.

7. Chihuahua Desert Shrub

This type is important range for mule and white tailed deer, scaled and Gambel quail, javelina, desert bighorn sheep and non-game birds and mammals. The type is characteristic of the desert mountain ranges and for our purposes lies above the creosotebush - tarbush flats and out wash fans that extend to the base of the mountains. On some lower mountain ranges the type extends to the top of the hills but on higher ranges it is replaced by pinyon-juniper or the true forest types.

Principal brush species are cacti, ocotillo, fendler and desert ceanothus, hairy leaf mahogany, javelina bush, several species of condalia, littleleaf and skunkbush sumac, grey, wavyleaf, mexican blue and shrub live oak and many other minor components.

From observation, it appears that an occasional burn is the best method of improvement for this type. The old decadent bushes sprout from the roots and put out new growth that is more available than the old growth. Also burning appears to stimulate this type as was noted on the north slopes of Capitan Mountain when large areas developed a good cover of ceanothus following the Smokey Bear fire. In the desert mountain ranges that have no stands of economically workable timber no harm will be done by letting wildfires burn and this practice is recommended on a managed basis.

Also in this type water is a critical resource. Every opportunity should be used to increase available water until there is no place where game must travel over one mile to water.

Competition between domestic stock and game will be severe in this type if the cattle are crowded for feed to the extent that they browse the mountainmahogany, ceanothus and other browse. Little competition will be felt under good management where the livestock usage is limited to utilization of grass and a minimum of browse under a good grazing system properly applied.

8. Creosotebush - tarbush

The principal game species to consider in this type are scaled and Gambel quail, antelope and mule deer. Deer utilization will be largely confined to the area near wooded arroyos and around the upper perimeter of the type where it gives way to desert shrub or pinyon-juniper.

It is doubtful that improvement of range in this type will have any adverse effect on game. It is an extremely adverse type to work in and the small area that may be worked in the foreseeable future will hardly be noticed. On the other hand there is very little that can be done specifically for game in this type. Research has shown that it is futile to add waterings for quail in this type and food patch planting do not yield results commensurate with costs. Control of brush followed by seeding and mulching as has been done experimentally by the Agricultural Research Service would, no doubt, be beneficial to quail and antelope. At the present time conversion of creosotebush to herbaceous vegetation would undoubtedly be favorable for antelope populations. Such a program is still in experimental stages and economic evaluation is lacking.

Competition in this zone between domestic stock and game exists since so little feed is produced. There is not any research to show, however, whether more quail would be provided if grazing was limited.

9. Shinnery Oak - Mesquite type

Game species to be considered in this type include Gambel, scaled and limited numbers of bobwhite quail, prairie chickens, mourning doves, antelope and limited numbers of white tailed deer. Many species of non-game birds and mammals utilize this range.

The principal species of brush to be considered are shinnery oak and honey mesquite. Minor components include mimosas, western soapberry, yuccas, fourwing saltbush, allthorn, ephedra and others. This is a much more promising type in which to work at range improvement than the creosote-tarbrush or the desert shrub.

Limited research by New Mexico State University in cooperation with the Bureau of Land Management indicates that reduction of the cover of shinnery and mesquite improves the range for scaled quail. Similar research at Oklahoma State University by Douglas D. Donaldson also indicates that a reduction in cover by bushy species improves the range for prairie chickens. In his doctors dissertation, titled "Effect on Lesser Prairie Chickens of Brush Control in Western Oklahoma", August 1969 he states in part, "it has been shown that seemingly homogeneous brushy grasslands inhabited by lesser prairie chickens represents a complex mosaic, with discrete boundaries separating adjacent portions. Brush control can be used to create and maintain an interspersed of structural elements favorable to lesser prairie chickens. Brush control may, therefore, be considered as a feasible tool for habitat manipulation, favoring both the rancher and the lesser prairie chicken. The practice appears to be sound economically and ecologically. The future of the lesser prairie chicken in the light of the current findings appears to be reasonably secure." His specific management recommendations from pages 62 and 63 are as follows:

1. "Grasses are considerably important. Moderate grazing should be encouraged. Areas of rather dense grass cover with the grasses mid in stature should be encouraged in the vicinity of booming grounds. Such areas would afford good nesting cover.
2. Woody species should be reduced in abundance where they form large blocks of a closed canopy. Scattered shinnery oak motts should, however, be encouraged. Oak motts are extensively used for shade in the hot summer months. Woody species can be controlled by herbicide treatment, mechanical means, or fire. Fire should be used previous to the nesting season.

3. Brush control practices, while favoring an increase in grass cover, reduce some of the native winter food. This is particularly true for the mast crop produced in the shinnery oak grasslands. Supplemental food plots of adequate size to last through the winter should be developed.
4. Areas used for display grounds are abandoned if the vegetation is allowed to develop into a rank growth.
5. A mosaic composed of different vegetal structural elements has been shown to be preferred by the lesser prairie chicken. This condition can be created and maintained by herbicide treatment, mechanical means, or fire. Large blocks of uniform aspect should be made heterogenous. (Editor's note - A pretty sound summary of habitat management.)
6. Management should be directed not only to quality, but also to quantity and distribution."

Control of shinnery and mesquite should be limited to areas of good soil so that returns will be commensurate with costs. Any reduction in the dominance of shinnery and mesquite will increase the amount of grass and weedy growth, both good producers of seeds for quail and prairie chicken.

Mourning dove utilization of this type is largely an area for ground nesting as few of the mesquites become large enough for tree nesting. Thus control is not likely to adversely affect these birds.

As was stressed by Donaldson and has been pointed out for all the vegetation types, the central objective for game range improvement is to break up homogenous vegetation patterns into heterogenous mosaic patterns. This gives variety of feeding, nesting and resting cover so vital to all wildlife species. To a considerable extent this objective will be achieved if the areas of best soil are treated first and the areas of poorest soils are left untreated. Little of the brush control so far done can be said to be permanent. Thus as the patches treated first age, they will return to some semblance of their original bushy condition. If the control on a large area is spread over many years a mosaic will be achieved.

The shinnery-mesquite type can be improved by the addition of water but research is lacking to support construction of more waterings than are required for cattle. If any fencing is done to break up the area into small pasture

precautions must be taken to insure that antelope are able to negotiate the fences so that they can range freely.

10. Native grassland

The principal game species on native grassland are antelope and quail. Prairie chicken are important locally in the far east side of the state. White-tailed deer invade the grassland in Hidalgo county where large clumps of bear grass furnish cover but these areas are close to wooded hills or arroyos. In his masters thesis D. Glidewell showed that antelope prefer grass-forb range over brush types.

Research is lacking to show what specific improvement measures can be undertaken in grassland to improve it for antelope. If fences must be constructed they should be made in such a manner that antelope movement is not curtailed. It is very essential that antelope be able to move from pasture to pasture to find fresh feed in areas where rain has fallen, to escape their enemies and to find water. Thus all sheep-proof fencing is bad for antelope. Research has been conducted on antelope passes but the results are not conclusive. If sheep proof fences must be built they should be kept to a minimum height of 30 inches with antelope passes provided at corners or along antelope trails if they can be identified.

Since the diet of antelope is typically of forbs and other succulents and not grass it stands to reason that measures undertaken to increase the amount of such plants on the range should be helpful. Research is lacking that would demonstrate that a given increase in such plants would produce a measurable increase in the antelope population. However, when a known essential feed is lacking on any game range it may readily be hypothesized from experience with domestic animals that to increase that type of feed would benefit the species.

With this hypothesis in mind it is probable that any type of pitting, contour furrowing or other type of disturbance of the sod cover would be beneficial to antelope as forbs are generally greatly increased on such treated areas for one or perhaps two years after treatment. Thus if a mosaic of 40 acre blocks, one per section, could be treated yearly over a 16 year span the antelope would have an average of one fresh 40 acre block per section of land to feed on. Such a pattern of improvement would make a worthwhile long time research project but the results would be hard to interpret due to mobility of antelope and the natural fluctuations in numbers.

Since antelope are not basically grass eaters it is doubtful if cattle compete seriously with them unless forced into eating forbs and brush through over utilization of the grass or by choice. Reliance must be placed on a good grazing system to prevent over utilization. Such heavy utilization of grass may, however, have a long time beneficial effect in that destruction of the grass cover will permit invasion of forbs and browse species even as the soil deteriorates. Many good grass ranges have been turned to brush in this way. However, this is not a recommended way to improve range for game.

In general, good range management and good conditions for game go hand in hand but modifications in many range practices will result in improved conditions for game.

E. Summary of Suggested Game Range Improvement Practices by Game Species

1. Antelope

1. Observe guidelines in range fencing to permit free passage of antelope; i.e. no net wire fences over 30 inches high; on barbed wire fences place smooth wire on bottom 16 inches clear of ground level.
2. Take steps to improve the forb and succulent plant component of the range.
3. Control domestic grazing so that the sheep and cattle leave enough forbs and succulents for antelope.
4. Assure that water is available in all pastures through all seasons.

2. Deer

1. Provide a mosaic pattern of treated and untreated areas in any vegetative type where control work is being done and insist that no type be eliminated.
2. Avoid clearing areas more than 1/4 mile wide except in sagebrush. Decrease cleared width to 1/8 mile for intensive game management.
3. Leave a minimum of 1/8 mile strips of undisturbed cover between cleared strips.
4. Leave a minimum of 25% of the total area of any treatment block uncleared. Increase to 50% under intensive game management.
5. Avoid treatment of slopes steeper than 15%.
6. Reserve adequate cover on all exposures, but particularly so on north-easterly exposures.

7. Thin brush or tree stands to a maximum of 120 stems per acre.
 8. Plant forbs, succulents and/or legumes in any seeding mixture.
 9. Increase water to a minimum of one watering per four sections.
 10. Avoid crowding cattle on the range to the extent that they over-utilize the browse. Practice rest rotation on browse species also.
 11. Provide openings in timber stands.
 12. Preserve and improve present openings.
 13. Seed logging roads.
 14. Leave some slash for cover.
 15. Permit fires to burn over desert brush type on desert mountains on a managed basis.
 16. Conduct controlled burning or lead wild fires when conditions will result in a cool burn in ponderosa pine types.
3. Elk
1. Disk or plow mountain parks and plant orchard grass, brome grass, wheatgrasses and alfalfa.
 2. Provide openings in the forest types.
 3. Preserve present openings by control of tree reproduction.
 4. Limit cattle pressure to preserve an equitable supply of forage for elk.
 5. Favor cattle over sheep on mountain allotments.
 6. Seed logging roads.
 7. Increase waterings so that elk are not more than one mile from water.
 8. Follow the deer guidelines in pinyon-juniper control.
 9. Clear cut spruce in a pattern that will give an uneven aged forest.

4. Desert Bighorn Sheep

1. Allow desert mountain ranges to be burned periodically to effect a mosaic of vegetative patterns on a managed basis.
2. Increase waterings so that sheep are never more than one mile from water.

5. Turkeys

1. Leave roost trees as well as some suitable young trees in a short rotation to develop into roost trees in the future.
2. Develop water.
3. Develop small meadows by spot clear cutting in ponderosa pine.
4. Provide nesting cover.
5. Do the four above in a pattern so that all elements of the range will be in a close proximity to form flock home ranges.
6. Thin the thick stands of pine reproduction.
7. Plant logging roads.

6. Grouse

1. Preserve mountain meadows.

7. Prairie Chickens

1. Treat shinnery and mesquite by fire, mechanically or with herbicides to reduce the density of the brush cover sufficiently to permit development of good grass cover.
2. Reduce brush cover on booming grounds to promote higher use of grounds.
3. Encourage agricultural crop production of cereal grains for supplemental feed.
4. Control domestic grazing to preserve the grass cover.

8. Quail

1. Reduce cover of shinnery and mesquite as in prairie chicken range improvement.

For the scientific names of the trees and shrubs mentioned see Lamb, Samuel H., Woody Plants of New Mexico and Their Value to Wildlife, Bulletin 14, New Mexico Department of Game and Fish, Santa Fe, New Mexico.

The following references will provide additional and more specific details on various phases of wildlife range improvements and are listed as suggested reading.

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SPRUCE FOREST



Mountain meadows preserved by cut back of spruce reproduction.



Good growth of grass in small opening.

MIXED CONIFER FOREST



Uncut mixed conifer forest furnishes little game feed.



Grasses and shrubs gain a foothold in the slash following timber harvest.

PONDEROSA PINE FOREST



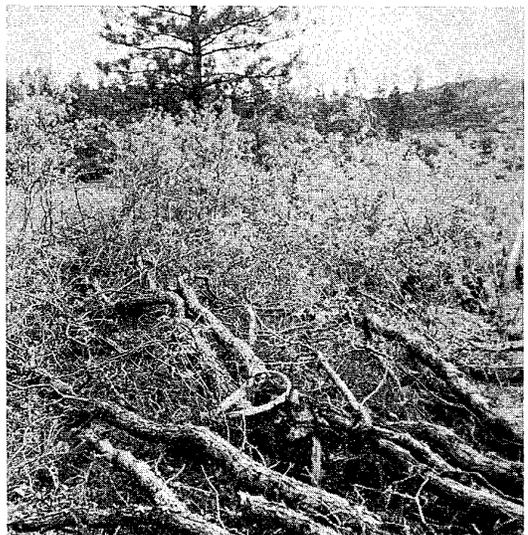
Openings can be preserved
by controlled burning.



Decadent shrubs should
be revitalized to im-
prove deer range.



Gambel oak broken down
by bulldozer

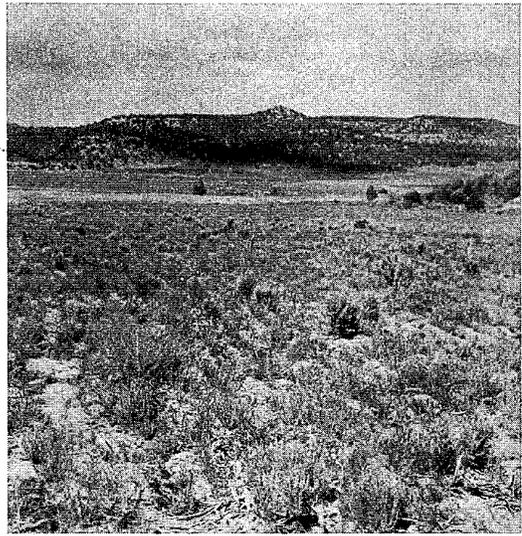


Abundant oak sprouting
following control fur-
nishes abundant game
feed.

SAGEBRUSH RANGE

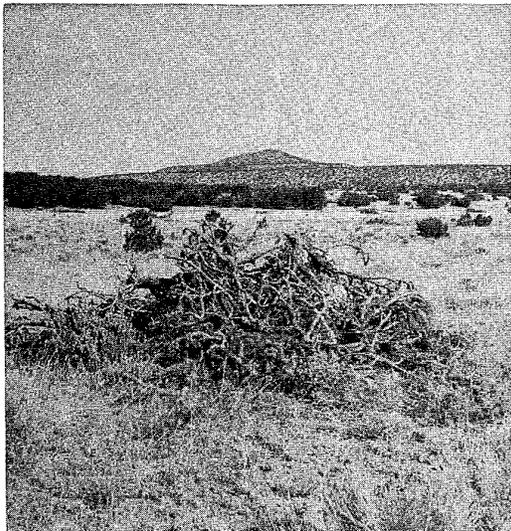


Uncontrolled sagebrush furnishes little game feed.

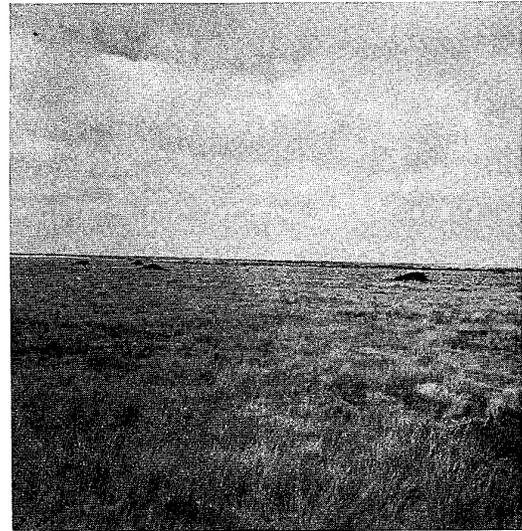


Sagebrush range diked and planted to wheat-grasses or other suitable species furnishes desirable game feed.

CACTUS AND MESQUITE RANGE

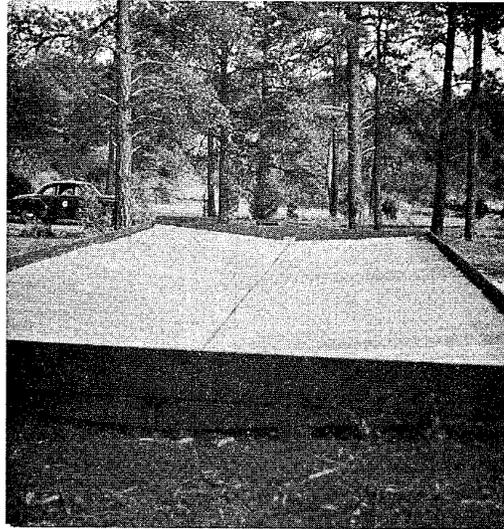


Piles of cholla cactus furnish quail cover on otherwise inhospitable range.



Piles of Mesquite furnish game cover.

RANGE IMPROVEMENTS



Supplemental water can be furnished on dry ranges by construction of various types of water catchments.



In range fencing, provision must be made for free passage of antelope from pasture to pasture.