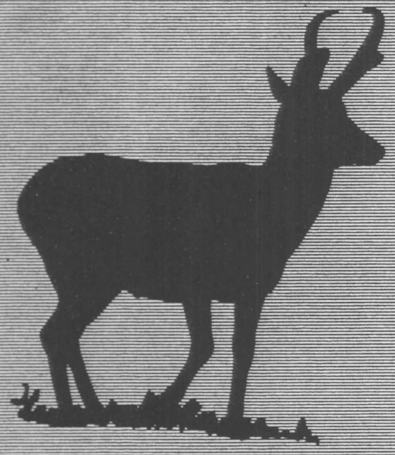
PROCEEDINGS OF THE

SECOND ANNUAL

ANTELOPE STATES WORKSHOP



February 16—17 1966

Denver, Colorado

ANTELOPE STATES WORKSHOP 1966

A compilation of papers
presented at the second
annual meeting held
February 16-17, 1966 at
Denver, Colorado

These transactions are made available through the Federal Aid Project W-40-R, Antelope Investigations. Copies of this second annual meeting may be obtained by writing to: Antelope States Workshop, Colorado Game, Fish, and Parks Department, P.O. Box 567, Fort Collins, Colorado.

INTRODUCTION

The second annual meeting of the Antelope States Workshop was held in Denver, Colorado on February 16-17, 1966. The Colorado Game, Fish, and Parks Department was the host this year. In general it was felt we had a good meeting with an excellent turnout. Representatives from the state agencies of Kansas, Nebraska, New Mexico, South Dakota, Texas, Utah, Wyoming, Wyoming University, and Colorado were present. Also present were representatives from the Bureau of Land Management, Colorado Wildlife Federation, Soil Conservation Service and U. S Forest Service. This meeting is beneficial for all agencies concerned in obtaining better antelope management practices. The group present decided to abandon the annual meeting schedule and meet only on alternate years. The next meeting will be in 1968 with the State of Wyoming acting as host. The representatives from Nebraska indicated an interest in being the host for a future meeting of the Antelope States Workshop.

George D. Bear
Chairman

REGISTER

Rex S. Zobell	Bureau of Land Management
Joe Townsend	Bureau of Land Management
Paul Applegate	Bureau of Land Management
Ralph Hill	Colorado Wildlife Federation
Harry Woodward	Colorado Game, Fish, and Parks Dept.
Wayne Sandfort	Colorado Game, Fish, and Parks Dept.
Richard Denney	Colorado Game, Fish, and Parks Dept.
Don Bogart	Colorado Game, Fish, and Parks Dept.
Bert Widhalm	Colorado Game, Fish, and Parks Dept.
Ferd Kleinschnitz	Colorado Game, Fish, and Parks Dept.
Bob Clark	Colorado Game, Fish, and Parks Dept.
Ivan Wescoatt	Colorado Game, Fish, and Parks Dept.
Donald Smith	Colorado Game, Fish, and Parks Dept.
Raymond Boyd	Colorado Game, Fish, and Parks Dept.
Robert Hoover	Colorado Game, Fish, and Parks Dept.
Donald Lengel	Colorado Game, Fish, and Parks Dept.
Louis Vidakovich	Colorado Game, Fish, and Parks Dept.
George Bear	Colorado Game, Fish, and Parks Dept.
William Hlavachick	Kansas Forestry, Fish, and Game Comm.
Harvey Suetsugu	Nebraska Game, Forestation, and Parks Comm.
Karl Menzel	Nebraska Game, Forestation, and Parks Comm.
Lloyd Vance	Nebraska Game, Forestation, and Parks Comm.
Parry Larsen	New Mexico Game and Fish Dept.
Orville Luttrell	New Mexico Game and Fish Dept.
Eddie Mustard	Soil Conservation Service
Buzz Robbins	South Dakota Game, Fish, and Parks Dept.
Dick DeArment	Texas Parks and Wildlife Comm.
Donald Beale	Utah Fish and Game Dept.
Dale Jones	U. S. Forest Service
Bill Hepworth	Wyoming Game and Fish Comm.
John Newman	Wyoming Game and Fish Comm.
Kieth Severson	Wyoming University

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ANTELOPE STATES WORKSHOP

February 16-17, 1966

Colorado Game, Fish and Parks Department
6060 North Broadway
Denver, Colorado

February 16

8:30 am Registration and introduction of participants

9:00 am Welcome - Harry R. Woodward, Director
Colorado Game, Fish and Parks Department

9:30 am Technical Session, "Antelope and Range Relationships"
Moderator, George Bear

Wyoming - "Effects of woven wire fence with cattleguards on freeliving antelope populations" - John Newman

A review of "The effects of livestock fences on pronghorn antelope movements" as reported by James Spillet and David Sill - Bill Hepworth

"An analysis of foods and feeding habits of pronghorn antelope and domestic sheep in the Red Desert Region of Wyoming" - Kieth Severson

Texas - "Antelope and range relationships in Texas" Richard DeArment

11:30 am Lunch

1:00 am New Mexico - "Pronghorn and rangeland relationships in New Mexico, A review of our research findings and analysis of our problems" - Parry Larsen

Nebraska - "Re-introduction of Antelope to the Sandhills of Nebraska" - Karl Menzel

"Antelope Mortality on Sioux Army Depot in Nebraska" - Harvey Suetsugu

3:00 pm Coffee Break

3:20 pm Kansas - "Some preferred foods of Kansas antelope" Bill Hlavachick

4:30 pm Short film on antelope trapping in southeastern Colorado

5:00 pm Adjourn

February 17

8:30 am Technical Session (continued)

Colorado - "Antelope food habits and range relationships in Colorado" - Bob Hoover

9:00 am General discussion on papers presented

9:30 am Selection of next meeting place and date

10:30 am Adjourn

EFFECTS OF WOVEN WIRE FENCE WITH CATTLEGUARDS ON A FREE-LIVING ANTELOPE POPULATION

by

John L. Newman
Wyoming Game & Fish Department

ABSTRACT

A study of the possible effects of sixty miles of new woven wire fence on an existing antelope population in northeastern Carbon County, Wyoming, was begun with the completion of fence construction in September of 1964. The resulting decrease in antelope population within the fenced area is noted. The changes in antelope distribution and numbers related to cattleguards and antelope movements through these devices is discussed. Results indicate that 72% of the antelope moved from one pasture to another pasture where three cattleguards are located in six miles of fence. Total counts in the area indicate a downward trend in antelope numbers. Changing range practices by livestock operators in the area are discussed.

With the adoption of recent range practices, coupled with economic factors, many livestock operators are deferring grazing on pastures by season of use, and in some cases these pastures are systematically grazed by both sheep and cattle. The practice of herding sheep is being discontinued by many sheep operators in south central Wyoming in favor of allowing the sheep to graze large fenced pastures. The observations presented here have been made in four such pastures of thirty to forty sections in each pasture.

The line fence and interior fence consist of twenty-six inch woven wire net, topped by two strands of barbed wire 4 and 10 inches above the top of the woven wire. The fence is strung on steel posts with brace panels constructed of discarded railroad ties. The fence was built on a bladed right-of-way.

The general aspect of the area is a moderately rolling sagebrush-grassland. The range is in fair condition on moderate to shallow soils. Moderate sheet erosion and some gully erosion is found throughout the area, with inclusions of sandstone occurring along ridges to the south.

The subject area has been utilized by antelope more extensively in the winter than in the summer, because of limited water and the somewhat broken terrain.

The land ownership is mixed federal and private land on what is locally known as "the checkerboard pattern." The area is typical of sheep range throughout much of south central Wyoming. A cooperative fencing program was begun in the summer of 1964 by the land operator and the Bureau of Land Management. The plan is to block the land into pastures of about a township in size with the fences following contours rather than section lines, to facilitate construction. During the summer of 1964, three cattleguards were installed in an east-west cross fence that appeared to show

promise in evaluating antelope movement through these devices. Periodic observations were conducted by Darwin Creek, the local Deputy Game Warden. The antelope were counted during various seasons and their numbers plotted within the large pastures to show changes that may occur in animal distribution. The gates were examined periodically to determine if antelope had utilized the openings since the last inspection. Most of the information was derived from track observations. This information was supplemented with actual sightings whenever possible. The line fences and cross fences were also checked for cases of mortality that could be associated with the fence. Three dead animals were found between the periods of November and January.

During the periods of non-use by livestock, drop gates were thrown back to facilitate wildlife movement.

No tracks crossed the cattleguards from August until mid-March of the following year. During April considerable activity was noted about the center gate. Nineteen head were seen crossing from the south to the north; nine animals crossed from the north to the south. All age groups were represented in these animals. No more crossings were observed until the following July, when a buck track crossed the west opening. About fifteen head of animals had approached the gate and milled at the opening, but only the single animal crossed. The only instances where does were known to cross these openings were when the fawns crossed with them. No crossings were noted during the months of May and June. Whether this lack of movement was due to the animals already being located for the summer, or whether the does were reluctant to jump the auto gates when becoming heavy with fawn is a matter for conjecture.

Antelope were counted from the air in September and October in 1965. This area was not open to hunting during the 1965 season, so that any changes that occurred in population or distribution had to have been caused by factors other than harvest or hunting pressures.

Comparable counts over the entire area indicate a reduction in antelope numbers since the pasture fences were constructed. The population in the area remained fairly constant from 1960 until 1964. With the completion of the fence in 1964, a July count indicated a drop in antelope numbers to only 100 animals in the area. There were 550 head of antelope in the area the previous November. The count was back up to 419 in September of 1965 and back down to 378 in October 1965. The changes in distribution that occurred, apparently through the interior fences, were facilitated by leaving drop gates open when stock was not in the area. Comparable figures showed that antelope numbers had dropped in three of the four pastures and increased by 87 antelope in the remaining pasture. The pasture to the south indicated a drop of 74 animals from the September figure. This would indicate a northerly movement of animals, and if all of the 74 animals that were missing from the southwest pasture moved to the northwest pasture to account for most of the 87 additional antelope that were found in the northwest pasture, then it would be reasonable to assume that the animals moved through the east-west cross fence with the three cattleguards in a percentage only slightly less than determined by Spillett.

It should be noted that the total counts are indicating a continual down-

ward trend in the area. The next count will be of special interest since 2,000 cows were in the northwest pasture during November, and nearly 5,000 sheep were put in this pasture during December and early January. What effect will this multiple grazing have on a third species such as antelope?

Evidence seems to indicate that the antelope population in the area is following a downward trend that was initiated about the time that some 60 miles of new fence was constructed.

The movement of freeliving antelope through cattleguards has been verified by field observations. Antelope populations shift from pasture to pasture through a fence with these gates, would strengthen this contention. Woven wire fence on antelope range will be more acceptable to these antelope if cattleguards are included in the fence than if they are left out.

Livestock grazing that follows fence construction may have more impact on antelope habitat than the actual fences.

LITERATURE CITED

Creek, Darwin. 1965. Report to Wyoming Game and Fish Commission. unpubl. 4 pp.

Spillett, James Juan. 1964. The Effects of Livestock Fences on Pronghorn Antelope Movements. M.S. Thesis, Utah State University, Logan.

A Review of "The Effects of Livestock Fences on Pronghorn Antelope Movements" as Reported by James Juan Spillett and David Sill.*

by

William G. Hepworth
Wyoming Game and Fish Commission

ABSTRACT

A study on effects of various fences and fence crossing devices on pronghorn movements was conducted 6.5 miles north of Wamsutter, Wyoming from March, 1963 through November, 1964. This was cooperatively supported by the BLM, Wyoming Game and Fish Commission, Utah State University, National Wildlife Federation, Wyoming Stockgrowers and Wyoming Woolgrowers Associations. The objectives were to evaluate the capability or willingness of antelope to cross livestock fences, to determine the kinds of fences which permit movements or migration of antelope and still hold sheep, and to evaluate the learning ability of antelope to jump or cross different types of livestock fences. Animals were tested in 20 X 40 rod enclosures. Sixteen fence types and five fence crossing devices were tested. Tests were carried out to evaluate the interaction of fence types and crossing devices, age class, sex, season and replicate. Net wire fences 32 inches or less in height were crossed by most adult pronghorns and some immature animals. Wire fences, particularly those with the bottom wire 15 inches above the ground posed no problem to most adult and immature antelope. Sheep, unfortunately, also easily cross these wire fences. Mature pronghorns more readily crossed fences than did yearling animals and fawns. Adult antelope appeared to possess an inherent ability to cross fences and definitely have the ability to jump fences up to 6 feet high although most seemed unaware of this capability.

Introduction

The effects of livestock fences on the movements of game animals has long been a controversy among land management, livestock and game interests. To investigate the effects of fences on pronghorn antelope movements, a cooperative study was carried out 6.5 miles north of the town of Wamsutter in south-central Wyoming. Financial support for this investigation was through the Bureau of Land Management, Wyoming Game and Fish Commission, Utah State University, National Wildlife Federation, Wyoming Stockgrowers and Wyoming Woolgrowers Associations.

The specific objectives of this study were: (1) to evaluate the capability or willingness of antelope to cross different types of livestock fences, (2) to determine the type or types of fences which will permit

*Spillett, James Juan. 1964. The Effects of Livestock Fences on Pronghorn Antelope Movements. M.S. Thesis, unpl. Utah State Univ., Logan.

Sill, David. 1964. The Effects of Livestock Fences on Pronghorn Antelope Movements. Special Report. Dec. 31, 1964. Utah Cooperative Wildlife Research Unit. Utah State Univ., Logan.

movements or migration of antelope and yet satisfactorily hold sheep, and (3) to evaluate the learning ability of antelope to jump or cross different types of livestock fences.

Testing of animals was done in 1963 and 1964 by Mr. James Juan Spillett, a graduate student at Utah State University, and in 1964 by Mr. David Sill a student from the same institution who was hired by the BLM to complete tests on additional fence types and devices after the graduation of Mr. Spillett.

Time for this presentation does not permit me to cover in any detail all of the aspects of these investigations. Remarks will therefore be limited primarily to the fences or devices tested and the degree of success animals had in crossing them.

Methods and Procedures

The area chosen for the study site was selected for several reasons: (1) antelope were readily available, (2) these animals had not been faced with fences for several generations, and (3) the area was quite accessible during all seasons of the year.

A five section area of land at an elevation of 6,800 feet was fenced outside with a 6-foot-high fence consisting of 47-inch net with 3 barbed wires placed at 54, 62 and 71 inches. The section to contain the trap and test enclosures was fenced on all sides with this antelope proof fence.

Originally it was desired to test effects of direction, slope, wind direction and desire for water on antelope. Eight enclosures, 20 X 40 rods in size were constructed (Fig. 1). Each enclosure was so located that animals in one test area could not see or be seen by animals in any other enclosure. All enclosures could be seen by the observer from a special watch tower outside the test area.

Before the fences were placed, the outside perimeter of each test enclosure was graded to facilitate seeing tracks of escaping animals. Test fences were placed so that one side and one end had the wire on the inside and one side and one end had the wire outside the posts.

Half of a 50-gallon barrel split lengthwise was set flush with the ground inside next to the fence in each enclosure to provide water.

Antelope were trapped, placed in a box in a truck and hauled to each test enclosure as desired. Antelope which escaped from a test enclosure had to be retrapped for further testing and this became very time consuming as well as resulting in a high casualty rate to the animals. To overcome this problem, six test enclosures of the same size were constructed as before, but in a row and each was enclosed within a larger 47-inch net wire antelope proof enclosure. A lane connected all six areas to the trap (Fig. 2).

This design allowed animals to be moved from the trap to a test area or from one area to another without individually handling each animal.

Animals which escaped a test area remained in the outside enclosure. Animals which did not escape could be combined with the same or other test groups and moved to another test area.

In the original test procedure, test groups consisted, as nearly as possible, of one adult buck, one adult doe and one fawn or a yearling. Each animal was marked for identification.

Animals were observed at 1-hour intervals from dawn to dark with a 20 power spotting scope for a 10 day test period.

The second test procedure using the six connected enclosures was changed somewhat. Test groups were made up of either all adult bucks, all adult does, all fawns or yearlings and various combinations of sex and age classes.

All animals were marked and tested as before except that each group was moved progressively from test enclosure No. 1 to the next and so on at the completion of an observation period.

Sheep were tested by Spillett in the fence types that showed the most promise in allowing antelope movement.

After Spillett completed his work, Sill continued through November of 1964 to test animals in the second test layout or arrangement.

His test period was shortened from 10 days to 3 days. Otherwise, the procedure was about the same.

Both Spillett and Sill recorded test information on the following: fence type, age and sex of animal, replicate, season, date, days required to escape, time of day of escape, number of hours to escape, method of escape, type and amount of stress animal under at time of escape. Spillett also recorded information on direction of escape.

Sixteen different fence types or variations of fences were tested (Fig. 3), and five fence crossing devices were tested, standard and simulated cattleguards (Figs. 4 and 5) and dirt ramps (Fig. 6).

Results

The fence types and devices tested, season of testing, number of antelope tested and escapes are presented in Table 1. Although it can be seen by the number of animals tested on certain fence types that some were inadequately tested, it can also be seen that the Rouse-type net fence and similar specifications were found to be quite antelope proof.

Wire fences, the 3 barbed and 2 smooth wire and the standard 5 strand barbed wire Rouse-type fence, allowed movement of most antelope including fawns. The 26-inch net plus 1 barbed wire at 30 inches allowed most adults to cross, but few young fawns. All of these fences with barbed wire caused severe injuries to many animals which did escape. Injuries were lessened by use of smooth wire.

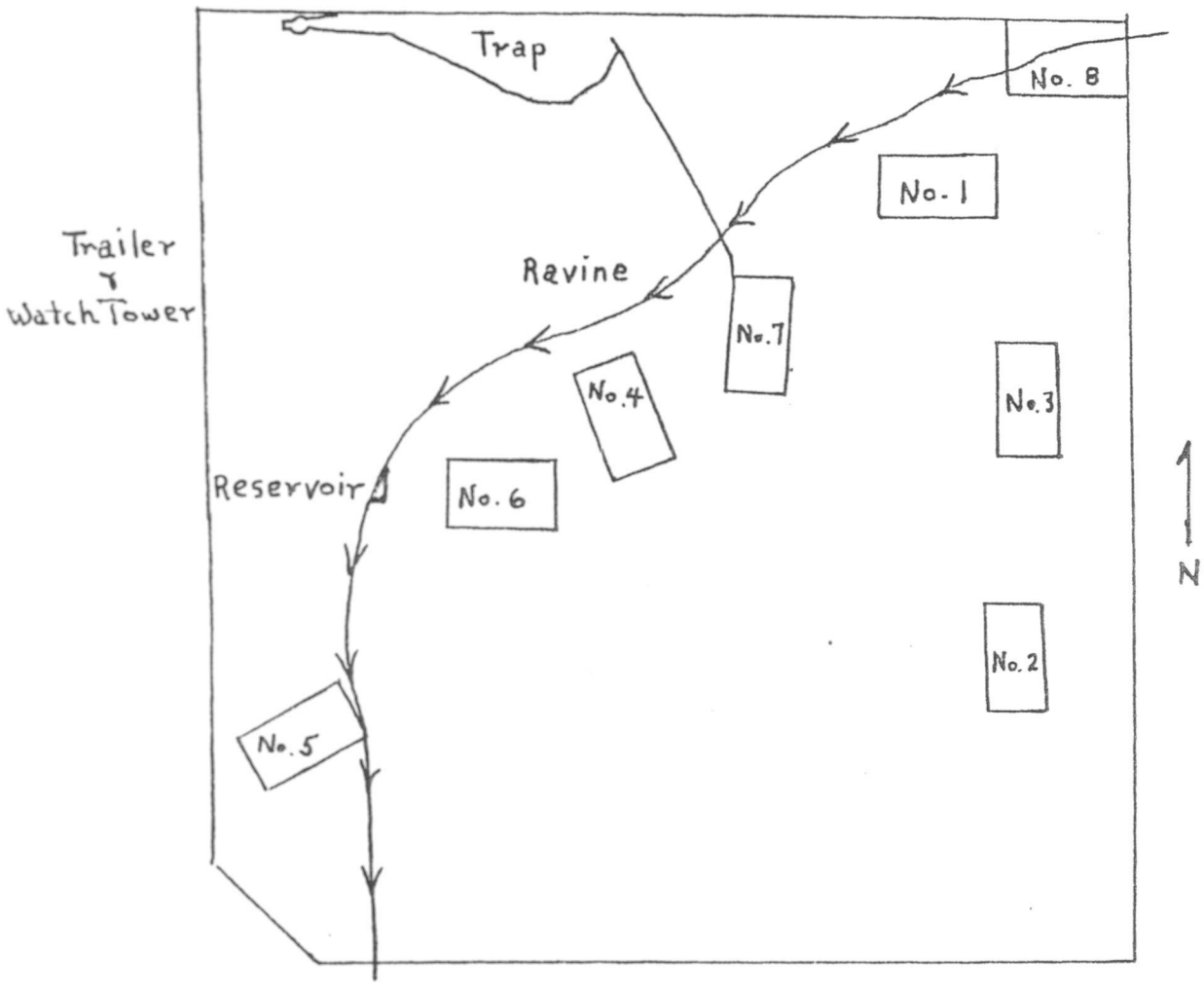


Figure 1. Diagramatic sketch of initial study layout used by Spillett.

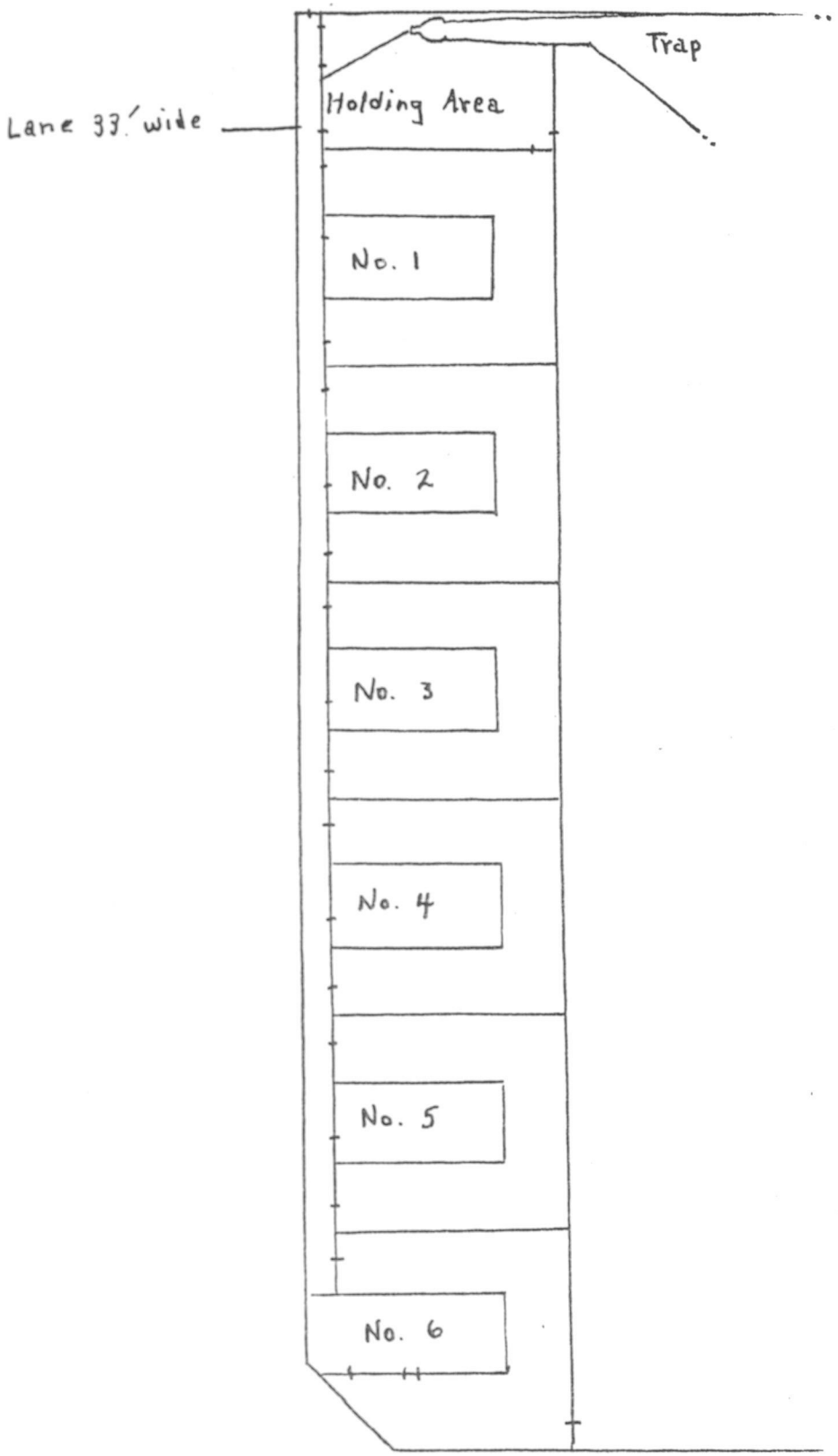


Figure 2. Diagramatic sketch of final study layout used by Spillett and Sill.

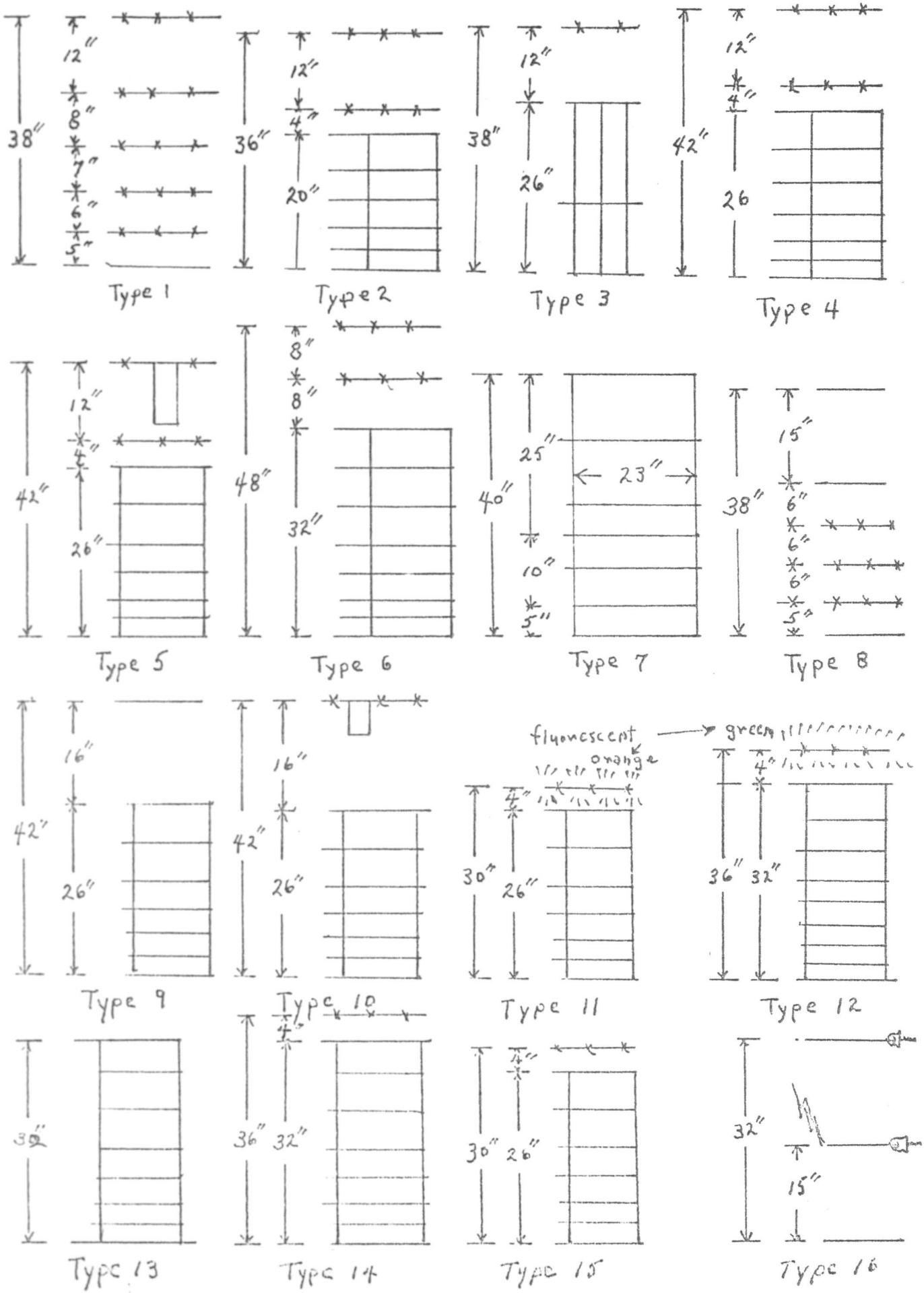


Figure 3. Diagram of the fence types tested.

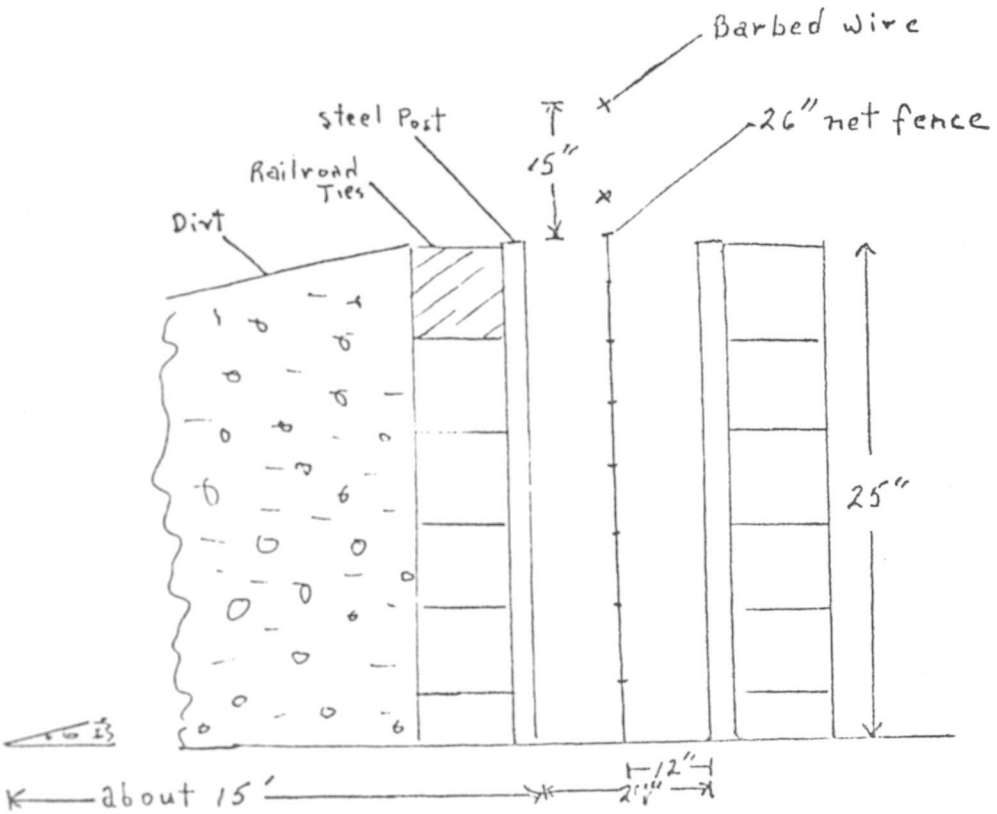


Figure 6. Diagram of dirt ramp tested by Sill.

TABLE 1

SEASON OF TESTING AND ABILITY OF ANTELOPE TO ESCAPE
FROM VARIOUS FENCES AND FENCE CROSSING DEVICES

Fence Description		Season	Antelope	Antelope	Percent
No.	Type	Tested	Tested	Escaped	Escaped
1	5 strand barbed wire, 5, 11, 18, 26, 38 inches (R)	S W	8 14	13	59
2	20-in. net + 2 barbed wires, 24 and 36 inches	S W Sp	5 18 20	23	53
3	26-in. net + 1 barbed wire, 38 inches	S	2	0	0
4	26-in. net + 2 barbed wires, 30 and 42 inches (R)	S	6	0	0
5	26-in. net + 2 barbed wires, 30 and 42-in. + dangler	S	6	0	0
6	32-in. net + 2 barbed wires, 40 and 48 inches	S	2	0	0
7	40-in. net with 10 X 23 in. openings + 2 smooth wires, 5, 10, 15, 20, 30 and 40 inches	S W	8 15	5	22
8	5 strand wire, 5, 11, 18 (barbed), 26, 38 (smooth)	Sp	18	11	61
9	26-in. net + 1 barbed wire, 42 inches	W	15	4	27
10	26-in. net + 1 barbed wire + danglers, 42 inches	Sp	19	9	47
11	* 26-in. net + 1 barbed wire + 12-in. fluorescent orange at 12-in. intervals, 30 inches	F	24	9	38
12	32-in. net + 1 barbed wire + fluorescent green, 36 in.	F	16	4	25
13	32-in. net	W *S	18 20	10 8	47
14	32-in. net + 1 barbed wire, 36 inches	Sp *S	18 21	7 3	25
15	26-in. net + 1 barbed wire, 30 inches	Sp *S	21 13	18 6	70
16	* Electric fence, 2 smooth wires, 15 and 32 inches	F	25	18	72

TABLE 1
(continued)

Fence Description Type	Season Tested	Antelope Tested	Antelope Escaped	Percent Escaped
Cattleguard (fenceline) and Simulated Cattleguard (corner and fenceline)	S	7	7	100
Standard Cattleguard (fenceline and corner)	Sp	27	24	86
	*S	18	15	
Dirt Ramp (fenceline)	*S	17	7	41
(corner)	*F	22	17	77
Horizontal net panel, 4' X 10' set 9-in. above ground (corner)	*F	13	8	66
Horizontal net panel, 6'3" X 10'6" set at ground level above 18-in. hole	*F	20	16	80

Data from Spillett, J.J. 1964. The Effects of Livestock Fences on Pronghorn Antelope Movements. M.S. Thesis Utah State Univ. Logan and Sill, D. 1964. The Effects of Livestock Fencing on Pronghorn Antelope Movements. Special Report Dec. 31, 1964. Utah Cooperative Wildlife Unit, Utah State Univ., Logan.

* The data from Sill is designated by an asterisk.

TABLE 2

NUMBER AND AGE CLASS OF ANTELOPE TESTED AND NUMBER AND PERCENT OF ESCAPES

Fence Type Number	Number of Animals Tested		Percent Escaped	
	Adult	Fawn	Adult*	Fawn
1	10	12	50	67
2	30	13	53	54
3	2		0	
4	5	1	0	0
5	6		0	
6	2		0	
7	12	11	17	27
8	18		60	
9	7	8	43	13
10	19		9	47
11	7	6	71	17
12	15	1	27	0
13	16	22	62	36
14	29	10	34	0
15	28	6	82	17
16	23	2	70	100
Standard Cattle-guard	40	5	89	60
Simulated Cattle-guard	7		100	
Dirt Ramp	28	11	80	18
Horizontal Panel	12	1	67	0
Horizontal Panel above 18" hole	19	1	84	0
Average Percent Escape			47	29

* This class includes all animals older than fawns

It is interesting to note that the straight 32-inch net did not permit as large a percentage of animals to cross as the 26-inch net and 1 barb at 30 inches. This may be due to the fact that a large number of fawns were tested and relatively few were able to cross the 32-inch fence. Too, it also indicates that two inches between 30 and 32 inches is a critical distance.

Table 2 shows that, overall, fawns are less likely to cross fences and fence crossing devices than are adults. Only 29 percent of all fawns tested were able to cross whereas 47 percent of antelope in the yearling and older age classes were successful.

Data from Spillett shows that only 28 percent of the yearlings were successful compared to 69 percent of the older animals. It is possible that yearlings being somewhat leaderless at this age are unable to cope satisfactorily with fences. Spillett noted that if they were unsuccessful on the first attempt they seldom tried to cross a second time.

As can be seen by Table 3, where method of escape was recorded, 76 percent of all animals jumped the fence and only 24 percent crawled through.

TABLE 3

METHOD OF ESCAPE OF ANTELOPE FROM TEST ENCLOSURES

Escape Method	Fence Type Number and Number of Escapes									
	1	2	7	8	9	10	13	14	15	%
Jumped Over	9	15	4	4	2	4	7	3	15	76
Crawled Through	1	1				3			1	24
TOTAL	10	16	4	4	2	7	7	3	16	69

Spillett reported that where replications were made, adult antelope appeared to have an inherent ability to learn to cross fences. He further stated that yearling antelope showed a decreasing tendency to cross fences with an increase in number of replications. This was also true of fawns.

Standard cattleguards, simulated cattleguards and horizontal panels and dirt ramps all showed possibilities. Corner locations where animals had a greater tendency to find them appeared to be the best locations.

Cattleguards and similar devices have some problems connected with them. Heavy run off can fill the excavation, debris can accumulate above ground and drifting snow can form a passage for sheep and cattle as well as antelope. Judgement must be used in the placement of these devices.

Statistical analysis of the variables studied by Spillett showed the following to have significant three way independent Chi-square values:

1. Adult antelope more readily cross fences than younger age-classes.

2. The sex of an antelope appeared to have no influence on its ability or willingness to cross fences.

3. Females of an age-class (fawns, yearlings, adults) could be expected to cross just as readily as the males.

Spillett tested sheep on fence types 2, 8, 13, 15 and simulated and standard cattleguards. Both adults and lambs readily crossed simulated cattleguards and the modified Rouse-type 5 wire fence (3 barbed wires and 2 smooth wires). Adult sheep tested readily crossed the 20-inch net with two barbed wires placed a vertical 24 and 36 inches above the ground. Standard cattleguards prevented the movement of most sheep even though attempts were made to force them over the device. The 32-inch net fence and 26-inch net with one barb at 30 inches effectively held sheep.

Discussion

Since these tests were carried out under artificial circumstances and relatively few animals were used, the results may be somewhat biased and misleading. Because of the extra stresses placed on these animals it is probably safe to assume antelope crossed some fence types more readily than they would under more normal circumstances. Failure of the animals to cross certain fences under test conditions certainly indicates they would be less likely to cross them under normal range conditions.

Almost any fence or device constituted a severe barrier to young animals and thus fences are shown to be critical where daily or seasonal movements to food and water are mandatory to the survival of a population.

Combinations of fence types and devices appear to be necessary to permit movement of all age classes under normal range conditions.

Admittedly some exceptional individuals could jump fences of 6 to 8 feet in vertical height when placed under extreme stress. On the other hand, a fence of 47 inches total height was almost 100 percent effective in containing animals under more normal circumstances. Occasional individuals, usually adult males, would repeatedly jump over fences to 47 inches high. These exceptional individuals should not be given undo weight in evaluating the abilities of a species. The abilities of the majority and particularly the female and sub-adult segments should be of primary consideration.

With neither researcher was there an attempt to evaluate losses which occurred as a direct result of injuries incurred through contact with fences. Spillett particularly mentioned that some animals which crossed a fence type later died of injuries. Other animals were frequently found to suffer severe cuts, scrapes, dislocations and fractures. These animals were still reported to make successful crossings of the fences.

Spillett added metal danglers to the top wires of fences and Sill added fluorescent paint to the top wires. Both workers felt the animals might jump more readily if they could see the wires more easily. Neither addition was an important improvement although the dangler on the 26-inch net and one barbed wire at 42 inches did result in a larger percent of adult animals crossing.

In conclusion it seems clear from these studies that the Rouse-type, sheep-tight fence is a severe barrier to antelope. A height of 32 inches appears to be the maximum fence height adult antelope will readily cross. Standard cattleguards facilitate the movement of adult antelope and prohibit the crossing of most sheep. Dirt ramps show promise in allowing adult and sub-adult animals to cross fences. Further field tests of these promising fences and devices are necessary to determine which are most desirable.

Discussion

DeArment: What was the average fence size up there?
Hepworth: Thirty-eight inch sheep tight fence for Wyoming.
Hlavachick: Could they clear the fence when they attempted to jump it?
Hepworth: It depended on the fence height, the lower fences, 30-32 inches, could be readily cleared; fences 42 inches high were more often hit.
Robbins: The statement was made in a report "sheep tight fences interfere with free movement of antelope".
Townsend: We do not believe this and asked it to be struck from the report.
Zobell: The report said fencing was a necessary management tool. We are trying "antelope paths" (short cattleguards) in the Big Horn Basin area and some in connection with guzzlers in North Rock Springs area. Even though the fence right-of-ways are graded, often fences are four inches above the ground so the antelope can dig under.
Robbins: Do you think this is a fair statement?
Hepworth: Yes, it is fairly true on the basis of the information we have.
Jones: When do these mortalities occur that are associated with these fences?
Newman: Fawns were the age group at which the mortality occurred.
Hepworth: It was hard to pinpoint the time at which the mortality occurred, because it could occur in the summer or winter.
Jones: Is it partially associated with sex groups?
Hepworth: If the does are on a low level of nutrition in winter months, readsorption of embryos or fetuses might occur, or if the fawns are born alive nutritional failure might result in immediate fawn losses.

AN ANALYSIS OF FOODS AND FEEDING HABITS OF PRONGHORN ANTELOPE AND DOMESTIC SHEEP IN THE RED DESERT REGION OF WYOMING

by

Kieth E. Severson
Range Management
University of Wyoming

ABSTRACT

During the spring of 1964 the Wyoming Game and Fish Department, the Bureau of Land Management and the Plant Science Division of the University of Wyoming began a study on the foods and feeding habits of pronghorn antelope and domestic sheep in the Red Desert region of Wyoming. Most investigations were conducted on a specially constructed pasture system six miles north of Wamsutter, Wyoming. Observations were also made in other areas of the Red Desert. Feeding trials were conducted with antelope at the Sybille Wildlife Experimental Unit at Wheatland, Wyoming and with sheep at the University of Wyoming's Experimental Range Farm at Laramie.

Data on food habits were collected by range sampling methods and by stomach analysis. Samples from 50 antelope and 50 sheep were collected throughout the year from the study pastures. These samples were analyzed by the Wyoming Game and Fish Department. Observations on feeding habits were made with binoculars or a spotting scope.

There is very little overlap of species used by antelope and sheep during the summer and fall. The antelope preferred shrubs, chiefly Chrysothamnus viscidiflorus var. pumilis which was second in abundance to Artemisia tridentata, and the sheep preferred grasses, primarily Oryzopsis hymenoides and Stipa comata. Agropyron dasystachyum was the most abundant grass, but was not preferred compared to the other two. Both animal species tended to use Poa secunda early in the spring but only for about 2 - 3 weeks. This was the first species to initiate spring growth and was apparently relished by both herbivores. In the winter all animals used more Artemisia tridentata because of availability, most of the grasses and other shrubs were covered by snow.

The feeding habits of sheep and antelope are notably different. The antelope are more delicate feeders and tend to move more while cropping forage. An antelope appears to consume about two-thirds the amount of forage as does a sheep.

The information used in this discussion was obtained in a cooperative study initiated by the Bureau of Land Management, the Wyoming Game and Fish Department and the Plant Science Division of the University of Wyoming. The primary objectives of the study are to determine the degree of overlap in use of native vegetation and to determine grazing capacities of pronghorn antelope and domestic range sheep. The study area is located in the Red Desert region in the south-central part of Wyoming north of Wamsutter. The greater portion of the

observations are being taken from a pasture system which was designed and constructed by the Bureau of Land Management and consists of six pastures; 2 of 120 acres, stocked with antelope indicated by the letter A; 2 of 120 acres, stocked with sheep indicated by the letter S; and 2 of 240 acres, stocked with both antelope and sheep indicated by the letters A and S. The pastures are located in a uniform big sagebrush community. The major species in the study are; big sagebrush, Artemisia tridentata; Douglas rabbitbrush, Chrysothamnus viscidiflorus var. pumilis; thickspike wheatgrass, Agropyron dasystachyum; needle-and-thread, Stipa comata; Indian ricegrass, Oryzopsis hymenoides; squirreltail, Sitanion hystrix; winterfat, Eurotia lanata; Sandberg bluegrass, Poa secunda and needleleaf sedge, Carex obtusa.

The methods and procedures that are being used are all based on standard range analysis methods. Percent compressed crown cover and percent utilization by weight of the plant species are being estimated from plots 1' x 10' in size. Ninety of the plots were analyzed during each sample period. Production was determined for all species except sagebrush by clipping 96 caged plots, 2' x 4' in size. Sagebrush production was obtained by clipping 15 plots, 4" wide x 50' long, in an exclosure adjacent to the pastures. Sagebrush utilization was estimated by examining 150 plants in each pasture. All sample numbers were obtained by statistical analysis and all weights given are oven dried weights.

Under the direction of the Wyoming Game and Fish Commission two antelope and two sheep were collected for rumen samples each month. Other data collected at the same time included body, viscera and organ weights, jaws for age determinations and information on internal parasites.

Forage production varied significantly between 1964 and 1965 (Table I). The most significant increase was noted in the annual production of big sagebrush, from 147 lbs/acre to 266.7 lbs/acre. All species except Douglas rabbitbrush and winterfat demonstrated some increase. The difference in annual production between 1964 and 1965 can be explained by variations in climate. Annual precipitation has been increasing every year since 1962 when 4½" were recorded. Five inches fell in 1963, 5½" in 1964 and through October of 1965, 6.7" were recorded. The long term average for the Wamsutter station is 5.47". I would also like to call your attention to the forb production for this area. The minor contribution by forbs to the vegetation is fairly characteristic of the entire desert, except in disturbed areas where Russian thistle and halogeton are found. This is the reason that the information we have obtained in Wyoming doesn't even remotely resemble that collected in Texas by Buechner (1950) or Russells (1964) studies in New Mexico. In both of these areas forbs were predominant in both the flora and antelope diets. The forb category as shown on the chart includes one species each of Arabis, Penstemon, Astragalus, Allium, Cryptantha and Gayophytum. Of these only Arabis was utilized.

Utilization figures are given in pounds consumed per acre over a particular season - which is measured in animal days use (Table II). This table compares data gathered in the summer of 1964 with that collected over the same period in 1965. The excellent replication demonstrated by thickspike wheatgrass is, at best, unusual. It does, however,

TABLE I

PRODUCTION

(lbs/acre - oven dried)

	1964	1965
Big sagebrush	147.0	266.7
Douglas rabbitbrush	89.4	88.7
Thickspike wheatgrass	51.6	57.2
Needleandthread grass	19.3	21.1
Indian ricegrass	14.5	19.2
Squirreltail grass	13.0	14.9
Winterfat	10.0	6.7
Sandberg bluegrass	3.6	7.7
Needleleaf sedge	3.1	8.1
Forbs	T	2.6
Total	351.5	492.9

TABLE II

	Summer, 1964		Summer, 1965	
	Antelope	Sheep	Antelope	Sheep
Thickspike wheatgrass	.1	1.8	.1	1.8
Douglas rabbitbrush	9.5	.2	10.1	.3
Indian ricegrass	.1	1.0	.1	2.7
Needleandthread grass	T	6.6	-	3.7
Sandberg bluegrass	T	.3	T	.9
Winterfat	-	T	-	.1
Big sagebrush	1.2	2.4	1.5	-
Squirreltail grass	.1	1.3	.0	.4
Needleleaf sedge	T	T	T	-
lbs used/acre	11.1	13.6	11.8	9.9

demonstrate the trend that will become obvious after examining the entire table - and that is the preference for grasses by sheep as compared to antelope. The shrub trend is indicated by Douglas rabbitbrush which is preferred more by antelope than by sheep. Indian ricegrass and needle-and-thread are taken infrequently by antelope, but are the two most important species in the sheep diet. Needle-and-thread appears to be more preferable than Indian ricegrass. There is some difference in sheep use of these two species from 1964 to 1965, notably a decrease in use of needle-and-thread and increased use of Indian ricegrass. I will discuss the possible reasons for these a little later. Sandberg bluegrass follows the same trend - that is, use to a greater extent by sheep. However, both animal species tend to use this plant heavily in the spring because it is the first species to exhibit green growth, but sheep utilize it further into the summer. Winterfat, in the summer, is used infrequently by sheep and not at all by antelope. Big sagebrush, another important species in the antelope diet is utilized to a rather small extent in the summer, but still ranks number 2. Sagebrush use by sheep is quite variable. This difference, as well as all other major differences between 1964 and 1965 probably could be explained in two ways; (1) either as sampling error or (2) through differences in the growing seasons. Big sagebrush did present a problem when it came to determining use. The growth form of this plant is, generally speaking, very low, scrubby and with very tight, knotty leader groups. We tried measuring use quantitatively by tagging twigs and weighing browsed and unbrowsed leader groups but the time involved and the sample numbers necessary made these methods infeasible, so we ended up using ocular estimates which of course, are subject to human bias. However, the antelope use was well replicated between years. Also the number of sagebrush plants examined in each pasture was increased from 100 to 150 for the second year, which would facilitate any determination of use if any were present. The second reason for the differences could be the length of growing seasons. Green growth was available from the end of April to mid-July in 1964 and from the end of April to mid-August in 1965, or about one month longer. Sagebrush use has been detected on the pastures in the November transects run this year so it appears that it is not used by sheep until the grasses have died back. The next species, squirreltail grass, is also more important to sheep than to antelope and again there is a substantial difference from 1964 to 1965 in the sheep diet. Needleleaf sedge is fairly common in all pastures but utilization of this species is minimal by both animals. The total lbs/acre used by antelope in 1964 is based on use for 833 animal days, - in 1965, 1041 animal days. This comes out to 1.6 and 1.4 lbs used/animal/day, or the two summers. The total pounds used by sheep in 1964 is for 750 animal days as compared to 864 animal days for 1965. This comes out to 2.1 and 1.4 lbs/animal/day.

The winter column on Table III should be corrected to read fall and winter, 1964, and the total 1964 column represents averages for the entire year. Sheep data are absent from the fall and winter column and also, of course, from the summary column, for the year 1964 because of the severity of last winter. Enough sheep were lost from these pastures to render the data invalid and weather conditions made restocking completely infeasible. As for antelope, thickspike wheatgrass use was absent in winter and contributed very little to the yearly total. Douglas rabbitbrush use decreased from summer to winter but was still very important. Most of the utilization shown in the fall-winter column was from September to mid-November,

TABLE III

	Winter, 1964		1964	
	Antelope	Sheep	Antelope	Sheep
Thickspike wheatgrass	-		.2	
Douglas rabbitbrush	10.4		20.1	
Indian ricegrass	-		.1	
Needleandthread grass	-		T	
Sandberg bluegrass	-		T	
Winterfat	.8		.9	
Big sagebrush	11.6		13.2	
Squirreltail grass	-		.1	
Needleleaf sedge	-		.1	
lbs used/acre	22.8		34.7	

TABLE IV

ANTELOPE

Daily Consumption

Feeding Trials	Pastures
18 observations	10 observations
Range 0.5-2.6 lbs/day	Range 1.3-1.8 lbs/day
Average 1.5 lbs/day	Average 1.7 lbs/day

TABLE V

SHEEP

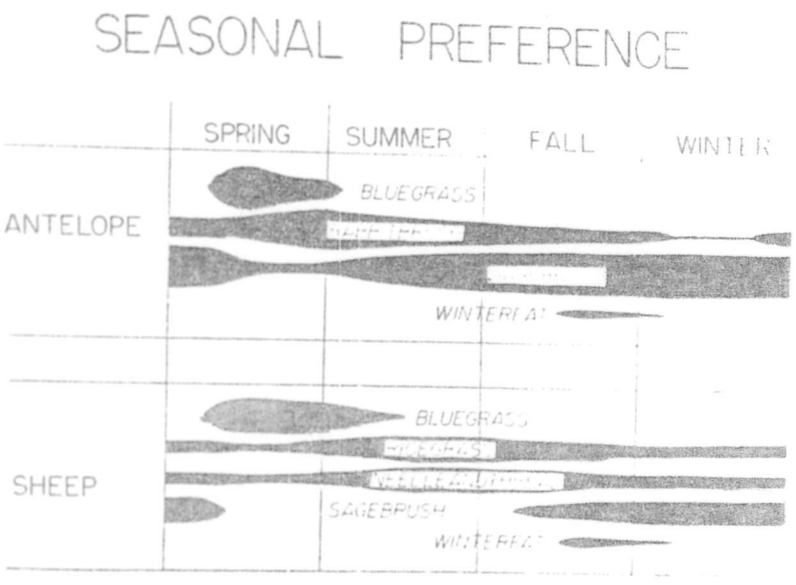
Daily Consumption

Feeding Trials	Pastures
12 observations	6 observations
Range 1.7-4.4 lbs/day	Range 1.0-2.3 lbs/day
Average 2.9 lbs/day	Average 1.5 lbs/day

after which it was pretty well covered by snow. In the yearly total this is the most important species. Indian ricegrass and needle-and-thread use was not found in winter and both were unimportant as to their contribution to the animal's diet. Sandberg bluegrass follows this same grass trend in the antelope foods and is only important early in the spring. Winterfat use demonstrated a notable increase over summer but, like rabbitbrush, its use was limited to fall, as it was covered by snow from November on. Big sagebrush was the most important species in the antelope diet in the winter, primarily, I suspect, because of availability. The snow depths ran from 6 inches to 4 feet in drifts last winter and sagebrush was the only visible species on some areas. Most of the use indicated in the winter column of this chart was after mid-November. Squirreltail grass was relatively little used. No use was found on needleleaf sedge during the winter and this plant also contributed to the final total. This year, the fall datum was separated from the winter data and although I haven't presented this in the utilization chart I have used the 1965 data to arrive at conclusions as to when the species listed here were used. The total lbs/acre used in winter is based on 1544 animal days and calculates to 1.7 lbs used/animal/day. The yearly summary is based on 2377 animal days and comes out to 1.8 lbs used/animal/day. The data from the combination pastures has not been presented here but utilization on these pastures does show intermediate results when compared to the single use pastures. Closely controlled feeding trials were also conducted with penned animals (Table IV). Here, several animals were given various combinations of different plant types in excess of what they would need and the following day, that remaining was weighed, subtracted from that given, and this, divided by the number of animals used. Again, all weights are based on oven dried samples. Eighteen days of data were collected in this manner for antelope and compared to data collected from the pastures. Each of the ten observations from the pastures is an average derived from one season's use. For example, antelope averages 1.7 lbs/day during the fall and winter. This explains the smaller range noted in the pasture data. When the two means were compared, using a simple t-test, no significant difference was noted. There was however, a significant difference in daily consumption by sheep (Table V). Sheep consumption in feeding trials averaged almost twice as much as was found by the range analysis methods. I think that this can be explained by observing the feeding habits of sheep. They appear to use as much forage as possible when it is offered to them in such a manner that they didn't have to work to obtain it. In other words, the time spent in seeking preferred plants on pastures is used in eating when feeding from a trough. Palatability may also influence this, some alfalfa was used in the feeding trials along with native forage - however, the largest daily consumption found (4.4 lbs/day) was on native hay. Because the sheep in the pastures were feeding primarily on grasses, some utilization may have been obscured by regrowth, which could help account for the lower figure reached through range analysis methods.

Table VI is presented as a summary of the food habits over a year. It was made up in a qualitative sense from data collected by range sampling methods and stomach sample analysis. Sandberg bluegrass, as mentioned before, was taken quite readily in early spring by both antelope and sheep because it was the first species to initiate spring growth and for a period of 10-14 days it is the only green plant in the pastures. As soon as Douglas rabbitbrush starts to grow, antelope start to use it, and it remains the species most used by antelope from late spring to mid-summer. As

TABLE VI


SEASONAL PREFERENCE
SPRING
SUMMER
FALL
WINTER
ANTELOPE
BLUEGRASS
WINTERFAT
SHEEP
BLUEGRASS
SAGEBRUSH
WINTERFAT

late summer-early fall approaches, rabbitbrush either decreases in palatability or sagebrush increases, but whichever there is a notable trend in increased sagebrush use that reaches a peak in winter - one of the reasons for this is availability governed by snow depth. The narrow line for rabbitbrush in winter represents limited availability rather than a drastic decrease in palatability. Winterfat is not really used by either antelope or sheep until late fall and its use again, as with rabbitbrush, is terminated by decreased availability. Grass use by antelope, with the exception of bluegrass, could be represented by a very thin line for the entire year. Sheep went to Indian ricegrass and needle-and-thread as soon as these species started to grow and they were utilized quite heavily until availability was limited by snow depth. Use was less on these species in the early spring when they were seeking the green bluegrass. Some sagebrush use was noted when the grasses dried up and this use increased through the winter, again, because of availability, not palatability. Douglas rabbitbrush, thickspike wheatgrass and squirreltail grass use by sheep could be indicated by rather narrow lines for the whole year.

There isn't too much that can be said about the feeding habits of antelope that hasn't already been noted in previous studies. Antelope move about much more than sheep while feeding, covering about 1½ times the distance in an equal period of time. Antelope are much less gregarious than are sheep. From early spring to late August they remain well distributed over the pastures as singles or in groups of 2 to 3. Also, they have no apparent pattern to their daily movements, they don't play follow the leader like sheep do. Antelope act quite independently even when found in groups. The pronghorn is also a very delicate feeder, they take less of each plant grazed than a sheep will. This is so common, especially on sagebrush, that it becomes very difficult to determine utilization. Sheep, on the other hand, tend to be much more gregarious. Generally speaking, when one is feeding all are feeding and so on. Sheep also feed, primarily, early and late in the day, especially in the summer. Antelope, apparently less affected by heat, feed on and off all day.

It can be concluded from the preceding information that there is little competition between pronghorn antelope and domestic sheep for range forage in this particular area. The two major species in the antelope diet are big sagebrush and Douglas rabbitbrush as compared to needle-and-thread and Indian ricegrass in the sheep diet. There is some overlap in use of winterfat, Sandberg bluegrass and big sagebrush. However, two of these species, Sandberg bluegrass and winterfat, contribute so little to the annual production for the area that they could be designated as sacrifice species if need be. Also, both Sandberg bluegrass and big sagebrush have wide ecological tolerances, both are common increasers in this area. The only notable overlap is with big sagebrush, but again, this probably isn't critical because the basic definition of competition states that the resource for which two organisms are competing must be in short supply, but, believe me, sagebrush in Wyoming's Red Desert can be called anything, except "in short supply".

LITERATURE CITED

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Discussion

Jones: What caused the increase use of big sagebrush in the summer?
Severson: It was probably related to the essential oil content of the plant. During the period of most active growth, from May to mid-July, the essential oil content of the plant seems to be higher. When growth slows down the odor of the essential oils decreases and it is at this time palatability decreases.
Beale: What is the rainfall in the area?
Severson: Five and one-half inches.
Clark: Have you correlated the data from the stomach analysis with what you obtained from the range analysis methods?
Severson: We have, roughly. With sheep we have a real good correlation. They seem to be comparable. But with antelope the stomach analysis show a higher percentage of sagebrush than we get with the range methods. It should be kept in mind, however, that the range data is on a weight basis and the stomach analysis are on a volume basis, and I don't know if these are on a comparable basis.
Hepworth: Do you think the abundance or absence of sage have an effect on antelope?
Severson: Yes. I think there is a difference between something that is essential to an animal and one that is important. In Pre-columbian times antelope distribution was greater. If we go into areas with spot control of sagebrush, it would give antelope a more varied choice of plants.
Hepworth: I think you are right.
Hepworth: Does the Bureau recognize sagebrush is essential on ranges where antelope exist?
Townsend: I think we realize it is essential. In Montana the BLM and Montana are cooperating on a sagegrouse study. We are studying spray and mechanical methods of control; we also work on antelope, deer, and elk on the same area. Glen Cole did some work and has a back log of data. We have control areas around the area, some of it is on private land because we needed a large area.
Hepworth: In some instances you inject a program on your own evaluation.
Townsend: The Bureau is looking at those things.
Hepworth: Does this come down to the district office?
Townsend: Any department can have conflict within the department on their own policy. The Washington administrative level policy states we are to have one wildlife man in each state office; they also have other duties.
Zobell: One statement I would like to add to this. Sometimes if we can sit down with the game and fish people and discuss the area, it would help if the game and fish people have their plans for this area.
Hepworth: There is a need for the policy to come down to the field level.
Applegate: We are bringing in a man to take over the range work.

Townsend: We hope to get a wildlife man in each district; a trained man who will have time to get in and plan with the state agency. Many states are getting long range plans on game species. These are things the Forest Service and the Bureau can fit in and work with you on.

Hepworth: There is a need the Bureau of Land Management and the states to see the recreational needs of the public when considering these programs.

ANTELOPE AND RANGE RELATIONSHIPS IN TEXAS

by

Richard DeArment
Tommy Hailey
Jack Parsons

ABSTRACT

Three major antelope herds occur in Texas. The largest, of approximately 6,000 animals, is found in the Trans-Pecos region; the second largest, of approximately 3,000 animals, is found in the Panhandle region; and the third largest, of about 1,500 animals is found in the Permian Basin region. All antelope herds are located on private lands and must compete with livestock. Any activity of the Texas Parks and Wildlife Department must be coordinated with the landowners.

The Trans-Pecos herd has fluctuated from a peak population of 12,017 animals in 1961 to a low of 4,963 animals in 1964. Studies revealed that the drouth plus sheep fences forced the antelope to feed on the toxic tarbush (Flourensia cernua) resulting in a high death loss and low reproduction. A correlation was found between the total precipitation between January and May and the reproduction percentage. New studies initiated in September 1965, and covering all aspects of antelope research, has given little information to present.

Research in the Panhandle has dealt primarily with herd dynamics correlated with disease studies. Herd reproduction studies have been intensified and the results indicate only a general correlation with weather.

The Permian Basin herd is a relatively new herd and no research has been initiated to date.

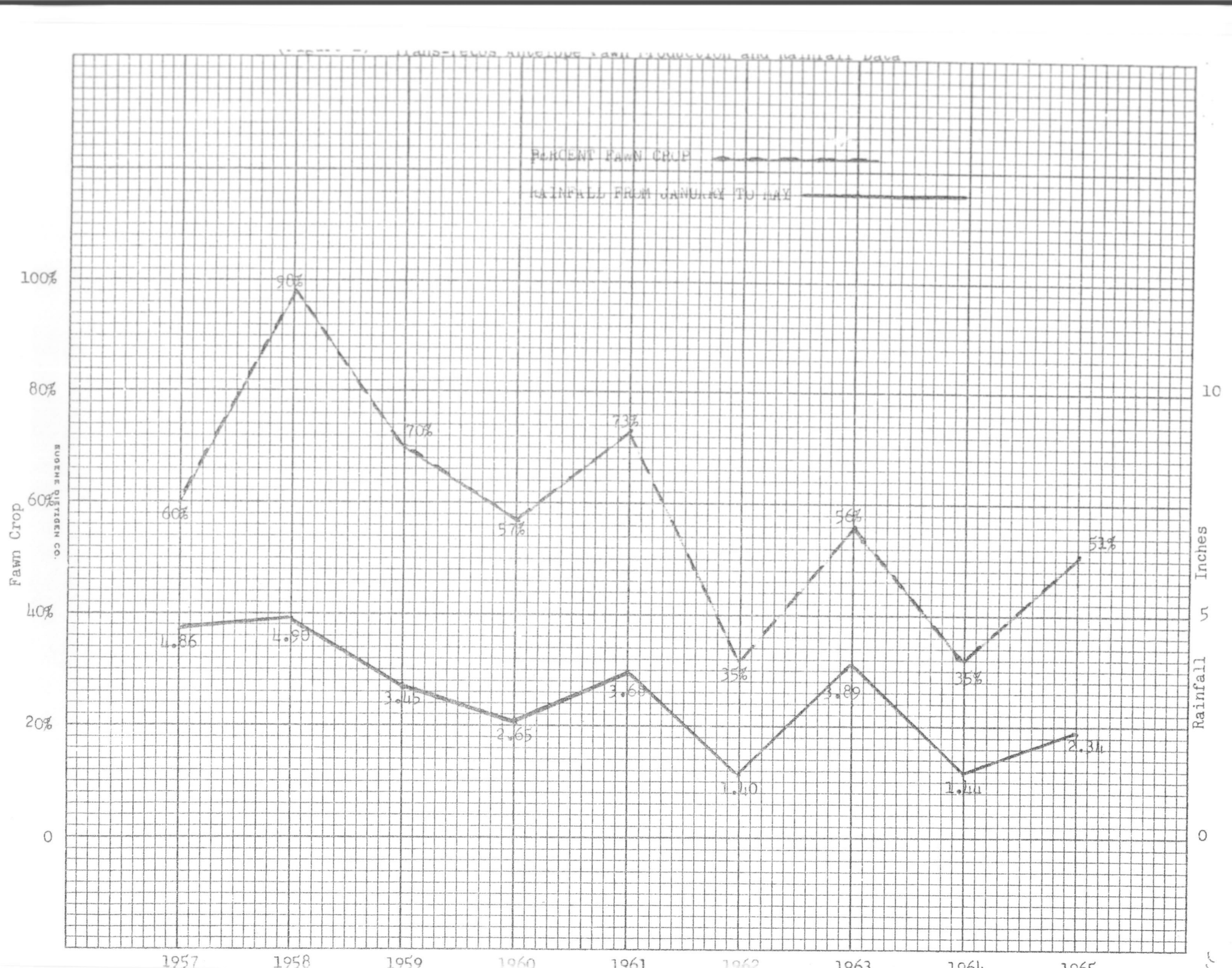
Texas Antelope

There are three major herds of antelope in Texas having approximately 10,000 animals. The Trans-Pecos herd has the largest number with about 6,000 animals. The Panhandle is next in number with about 3,000 animals; and the Permian Basin, a relatively new herd, has about 1,500 animals. All herds are located on private land; consequently all research and management must be on a cooperative basis. Sheep fences are a problem in the Trans-Pecos, but not in the Panhandle. The Permian Basin herd will not be discussed in this paper because there have been no research or management studies completed.

Trans-Pecos Antelope*

During the mid-fifties a severe drough condition prevailed in the Trans-Pecos region of Texas. When the drought ended in 1957 the Trans-Pecos

* Tommy Hailey, Biologist, Texas Parks & Wildlife Dept.


PERCENT FAWN CROP
RAINFALL FROM JANUARY TO MAY
100%
80%
60%
40%
20%
0
Fawn Crop
EUGENE DIETZGEN CO.
10
5
0
Rainfall Inches
90%
70%
60%
57%
73%
35%
56%
35%
52%
4.86
4.90
3.45
2.65
3.60
1.40
3.89
1.44
2.34
1957
1958
1959
1960
1961
1962
1963
1964
1965

antelope herd numbered 7,302 animals. The herd increased to an all time high in 1961 when 12,017 animals were counted during the annual survey. From 1961 to 1964 the herd suffered great losses and only 4,963 animals were counted in 1964. This sharp decrease immediately brought up the question of what was the cause of the decrease. It seems unlikely that any one factor could affect the herd to such an extent causing this large decrease in animals.

The antelope population in this section of Texas range on private ranches and management of the animals is accomplished by coordination between the Parks and Wildlife Department and landowners through a permit issuance basis. In all instances the ranches are fenced and in many cases net wire is used on outside fences and cross fences. Predation is also known to occur on the young as well as adults. Because of the annual harvest being carried out on an individual ranch basis excessive wounded mortality may occur in some areas.

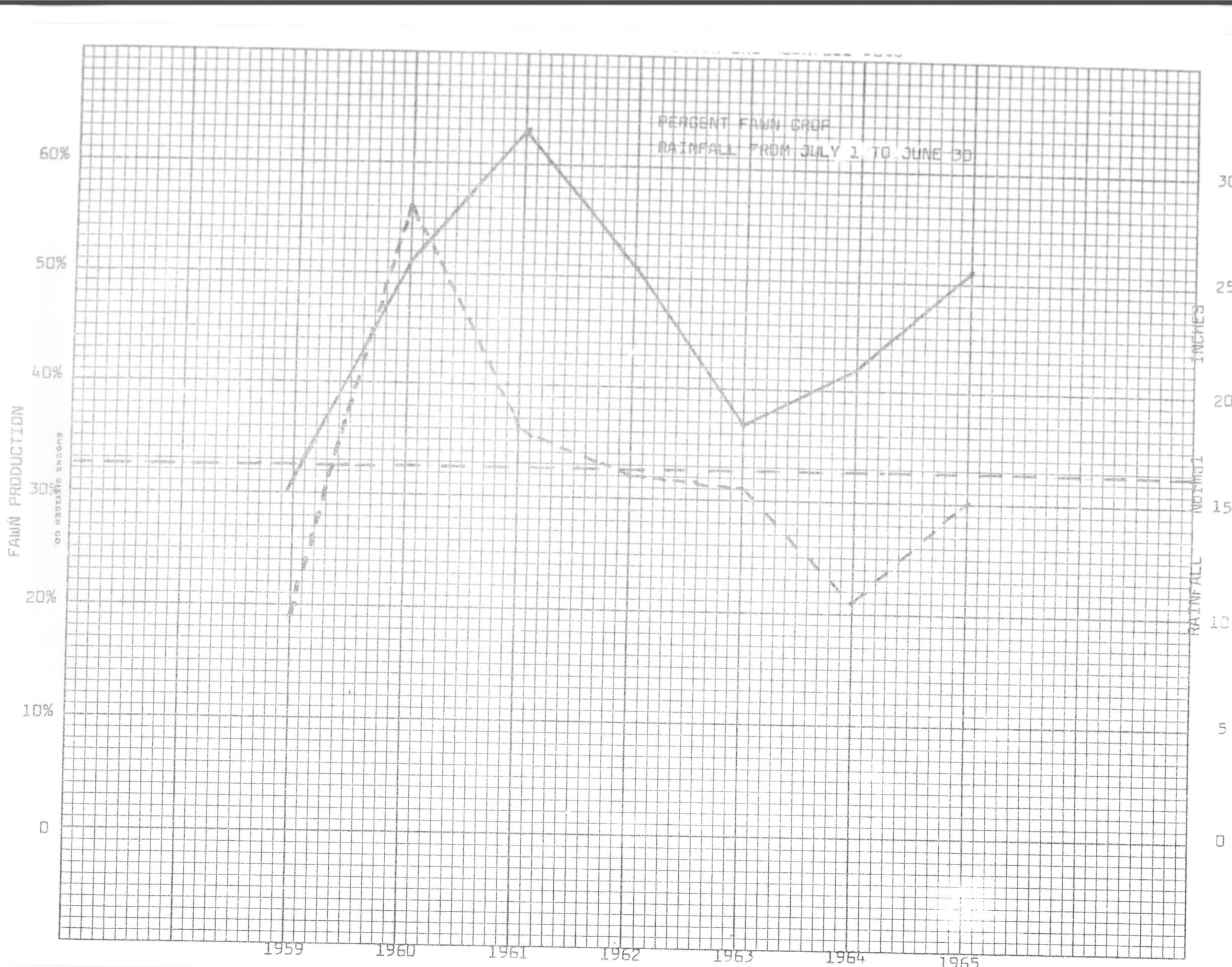
Of all the factors that seem to have some affect on herd production, weather conditions seem to play the largest role. Although sufficient rainfall may fall during the entire year to reach the yearly average, it is the amount of moisture received from January through May (Figure 1) that seems to directly affect the reproduction capacity of the herd.

From rainfall data received from the Alpine, Texas weather station, which is located near the center of the antelope range, there seems to be a direct relation in the amount of moisture received from January through May and the following fawn production.

In January 1965 a dieoff of antelope was noted in an area southeast of Marfa, Texas in Presidio County. During a three day period 54 antelope were found dead. Most of the animals had been dead only a short time and some died during the period that the survey was being conducted.

Twelve pronghorns were necropsied and rumen analysis and observations of feeding animals revealed that their diet was composed almost entirely of tarbush (Flourensia cernua) during the period. Malnutrition complicated by tarbush toxicity was fixed as the cause of the losses. Resorbed embryos were found in three of four gravid females necropsied. The area where the dieoff occurred was extremely dry with little browse other than tarbush available to the animals. The ranches in the area where the dieoff occurred lay in a large flat and most of the fencing around the ranches was net wire. From June 1964 to June 1965 the population of the ranches involved declined from 484 to 148. Of this number 274 died from causes other than hunting.

Due to the fluctuation of the Trans-Pecos antelope herd a research program was initiated in September 1965, to study the dynamics of the population. The study is designed to determine the seasonal and mandatory movements and total range, correlation of net wire fences and antelope enclosed by those fences, making necropsies to determine extent and transmission of infectious disease and parasites, evolving reasonable and systematic methods of defining age-classes for Trans-Pecos antelope, and determination of sex-age structure of the antelope herd.


PERCENT FAWN CROP
RAINFALL FROM JULY 1 TO JUNE 30
FAWN PRODUCTION
RAINFALL
INCHES
NORMAL
60%
50%
40%
30%
20%
10%
0
30
25
20
15
10
5
0
1959
1960
1961
1962
1963
1964
1965
EUGENE DIETZGEN CO.

The study has been in operation for only five months and little information is available at this time. Two antelope, one male and one female, are collected each month. A necropsy was performed on each animal. Blood samples were collected from each animal plus collections from various ranches during the regular hunting season in October. Blood slides were prepared and sent to the Department of Veterinary Pathology at Texas A & M University for examination. The examination of the slides revealed no disorder. Other data collected to date has not been analyzed.

Panhandle Antelope

Very few range and food-habits studies have been made on antelope in this region. Population and disease studies correlated with weather and general range conditions have been emphasized. Herd economics has changed landowner attitude toward antelope from indifference and hatred to interest and tolerance in the last decade. In the past hunting was free but at present as high as $100.00 per permit is charged. With this income came a greater interest for and appreciation of research and management by the Department, particularly in the area of population dynamics and disease.

Antelope population in the Panhandle has fluctuated from a low of 722 to a high of 3,252 in the last 13 years. Doe:fawn ratios varied from a low of 1 doe to 0.11 fawns in 1953 to 1 doe to 0.63 fawns in 1961. Does have increased over bucks from 1 buck to 1.26 does in 1953 to 1 buck to 2.16 does in 1963.

Population fluctuations, particularly the extremes in doe:fawn ratios, indicated a need for research in this area. As a result rainfall versus fawn production was compared to determine their correlation. Rainfall (July 1 to June 30) was compared with fawn production for a seven year period (Fig. 2). Only a general correlation was found and in 1964, fawn production increased despite the decreased rainfall. January to June rainfall was also tried but less correlation was found for this period.

Because of the generalized leptospirosis infection in cattle throughout the antelope range seralogical tests, plus tissue examination, were made throughout the herd area to determine its presence and/or influence on fawn production. The rapid plate agglutination test for leptospirosis, using bovine antigen, proved undesirable - too many positive cross reactions without any infection showing in the kidneys. No positive reaction for bangs was found.

In 1964 a 58,000 acre ranch was selected as an experimental area in order to concentrate research efforts. The ranch has a history of leptosperosis in cattle. A 22 percent fawn crop was produced in 1965 while the surrounding area had a 51 percent fawn crop. The antelope herd increased 550 percent (42 to 271), in 9 years, after all but 42 were trapped and taken away, and despite the fact that 196 were harvested, 81 of which were does. A total of 51 does were harvested in 1965 to determine the effect of a heavy harvest on fawn production; however the results will depend on this years harvest.

Necropsies were performed on three bucks and the results proved them to be healthy animals. Serological studies compared with kidneys proved by pathologists that the rapid plate agglutination test using bovine antigen is inaccurate for antelope.* One series of serum was tested for I.B R. (infectious bovine rhinotracheitis) with one out of 15 samples being positive. No Theileria was found after a series of blood slides were checked. Fawning studies were conducted along with the above studies in 1965 and no aborted or dead fawns were found during this study on the experimental area.

It is hoped that future studies will determine the cause of the low fawn production on the experimental and general areas.

*Dr. Robinson and staff, Department of Veterinarian Pathology, Texas A & M University.

Discussion

Hepworth: Of course, we have seen one similar to that but it usually correlates with the precipitation of the previous year. Where we had snowfalls it would be true, but where you had rainfall it should be correlated with the year. If there is a correlation.

_____: You indicated these antelope were becoming an important source of income to some of your ranchers? Are they following this up by decreasing the cattle stocking rates?

DeArment: No. Of course, in that area it depends on the ranch, but haven't yet, cattle are still an important economic factor. In this one area of 57,000 acres, the money that comes from the hunting goes to the foreman and he lives on the place. That's his Christmas bonus. The landowner is an absentee owner; not too interested, but the foreman is.

Bogart: I am wondering what kind of hunting season on this group of animals in this one herd where you have almost as many bucks as you have does. What kind of hunting pressure are you putting on those animals?

DeArment: Well, last year on this, we had 85 bucks, 152 does, and 34 fawns on our airplane count and we took 80 animals off the place. In other words, 50 of them were females, we were getting desperate on that 152 females to 34 fawns. Something was going wrong someplace. So the foreman is happy to take that many, because that's money in his pocket; we needed the information. That is the only way we can get it; all indications, this is one of the best ranges we have, from back in 1956 to go from 42 animals to 271 which isn't bad. It might not be good when you get one to one reproduction like you get in your area. That's not even good for us.

Jones: Have you done anything from the predator standpoint? Do you have any information on the effect of predation?

DeArment: No, we don't. We have golden eagles and coyotes. We assume that they take their normal amount. What normal is depends from year to year on the coyote population and the buffer species available. We haven't had any indication that they

would..... This area of 57,000 acres is the only area that they had that low reproduction rate. The rest of them averaged 51%; it had 22% and that's pretty drastic.

Newman: Did I understand you to say that you lost 264 animals from factors other than from hunting in this Transpecos area? What method did you use to determine this?

DeArment: To be honest, I don't know what method he used. This is the information he wrote. I have heard him say at times I don't know whether it is just finding them there or actually picked them up. Some of these areas they can keep a pretty close watch on because of sheep fences.

Hepworth: Dick, what is the density of your population there? Do you have a large area that these animals are contained in, are they in small herds, primarily, or are they well distributed throughout the area?

DeArment: Pretty well distributed. Some of this 57,000 acres, say about half of it doesn't have any antelope. It isn't good antelope country. They are small herds, but they are pretty well distributed. But they can move, there is nothing other than roadways which might limit them. Ordinarily going right through the middle of the ranch there is blacktop road; they have unlimited movement.

Hepworth: One reason I ask this is in relation to your disease problem; if you have your animals pretty well distributed it might be that a disease unless there is an important vector there, it might be that some of your diseases like Leptospirosis would not be transmitted readily from one antelope to another. I wanted to ask you too, what two serological types of Lepto did you have in this area?

DeArment: pomona and ictohaemorrhagiac.

Hepworth: Well, I thought I might mention here, we have what apparently is an outbreak of Leptospirosis in Wyoming that occurred in August, September and October. It occurred in three counties in the northeast area. The animals affected were primarily fawns of the year, although some adults were affected. Now the reason I say, "what apparently is a Leptospirosis outbreak," is that we get positive serological tests, but we have been unable to isolate the organism. Now this might be due to our poor technique, yet we had three different laboratories working on it with the material we supplied them. We get a very high titer to icto and also a titer to pomona, which tend to cross react anyway on cattle tests. But the disease seems to be very debilitating and quite frequently fatal, and if it is Leptospirosis then apparently it is not a normal disease of antelope because it too easily kills them. Now, we have tried to infect some animals held at Sybille through inocculation, and they died within five days after inocculation. Which indicates that it is extremely fatal. Now, is this important to your fawn crop? I don't know. It might be important to your overall population, if it is something similar to what we have. Now maybe we have a disease other than Leptospirosis involved that simply cross reacts with the antigens that we normally use to test for this disease. I think that there is a real good possibility that you did have

something like that. I wouldn't discount the fact you got this positive Plate Glutination Test. We are going to do a study on this and we hope to have some results within a years time to further pinpoint this.

DeArment: This area that we are working in has a history of Lepto in cattle and many have to vaccinate every year, in fact, all of the ranchers vaccinate for Lepto, it is a must just like blackleg. But we have never been able to see an animal that was sick. We have the rancher on the lookout and that boy this summer did not find a sick animal. Of course, they are easy to miss.

Hepworth: Well, I could describe the symptoms in the animals that we observed and collected. They first seem to show quite an extensive diarrhea and then about the third day they leave the herd and begin to wander by themselves and then become progressively weaker, and then about the fourth or fifth day go to an area where there is water, usually lay down and don't get up again. There doesn't seem to be any other visual means in which you can determine an illness, but apparently, this is so rapid that your chances of picking one up, unless you had a large number infected at any one time, you might not see it.

DeArment: You'd said it was five days?

Hepworth: Well, apparently this is about the length of time. Now on all those animals that we infected at the Sybille Unit, this was the maximum period.

DeArment: Did you give a light dose to any of them to see if they.....

Hepworth: Well, we haven't done this yet to any of them because we don't have sufficient experimental animals. This is what we plan to do next year, is to get a large group of antelope and test this from small doses through large doses and see also, if we can maintain a titer in these animals. You see, we did a serological test throughout the state in 1963 and we didn't find a single positive Leptospirosis reaction in deer, elk, or antelope throughout the state. Yet this fall we found in the animals that we checked, quite a large number; almost 10% of our animals in this area taken by hunters showed positive Leptospirosis tests; and all of the animals we saw ill and and killed so far.

DeArment: What type of test, serological test?

Hepworth: We are using this standard Plate Glutination Test.

Robbins: At what level? What titer?

Hepworth: 1-160; 1-640. Rather high. Very significant as far as cattle go.

Robbins: .....at Belle Fourche, near the Wyoming line last antelope season the hunters killed two sick animals and hauled them in to the Vet and the Vet said Lepto, so we took samples and got a hold of one carcass and sent them to the State Vet. He checked them out and said "no." We collected five antelope and took the material to the Vet in Belle and he checked them out and he said "Lepto." And then going back to the Vet at Belle and told him I double checked. He kind of backed off a little bit. What he considered a positive Lepto test wasn't the same as the State Vet considered. The State Vet said 1-100. The Vet at Belle said 1-10. Just how do you interpret the test?

Hepworth: Well, it is difficult to say, because you don't know how long a titer remains in an individual, and sometimes you can have a high level of infection and yet it hasn't been present long enough in the animals for the titer to develop. Now, did you examine kidneys; did you do tests on urine as well?

Robbins: Yes.

Hepworth: We are talking about the same group of antelope.

Robbins: We are talking about the same Vet, too. I think the fellow at Belle Fourche is working in the northeast Wyoming.

Hepworth: Well, he was over in there. We have our own Department of Veterinary who spent three months up there, also. Our State veterinarian and the Animal Disease Irradication Specialist ran most of the tests and the pathological results correlated well with the serological results. In other words, there was definite kidney damage which is a result of the Leptospiremia which occurs. We are still not convinced that is what it is, but we think that seems to be the most logical.

Robbins: I think we had better get together.

Hepworth: We should. Definitely should.

Robbins: In that area the ranchers claimed that real lousy reproduction last year. Didn't show up on our doe-kid crop, but counted it with a different area.

Hepworth: Well, there has definitely been a decline in that particular herd segment. But we should definitely get together on this.

PRONGHORN AND RANGELAND RELATIONSHIPS IN NEW MEXICO
A REVIEW OF OUR RESEARCH FINDINGS AND ANALYSIS OF OUR PROBLEMS

by

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Introduction

Our antelope research the past three years has been directed primarily at the enigma of chronically low kid survival rates in the sandhills habitat type. To present a synopsis of New Mexico's involvement in problems of antelope-rangeland relationships, I must necessarily borrow heavily from other workers.

Trapping and Transplanting

The New Mexico Department of Game and Fish initiated the trapping and transplanting of antelope in 1937. This program was repeated annually, except for an interval during World War II, and by 1956 over 4200 pronghorn had been transplanted. By this time all immediately suitable habitats were considered to at least have adequate foundation stock, and trapping was discontinued. More recently, beginning in 1963, we reinstituted a program of removing surplus antelope from private land ranches which are not open to hunting. This trapping is normally done during the winter, and each year approximately 200 animals have been moved to reinforce marginal herds or to make trial plantings in small areas of suspected suitability. It is expected that trapping and transplanting of antelope will, in the foreseeable future, continue to be of secondary importance in our over-all management. Two large areas of suspected high antelope potential, the Navajo Indian Reservation and a tightly fenced sheep dominated region in the center of the state, would be ripe for large scale reintroductions of pronghorn if a modified emphasis of desirable rangeland utilization could be cultivated.

Food Habits

Fairly intensive antelope food habit investigations were conducted in New Mexico by Paul Russell between 1956 and 1959. Systematic collections of antelope and rumen contents were made seasonally on four widely separated study areas representing distinctive vegetative communities. Even though the four collection areas are vegetatively dissimilar, each is considered to be prime antelope habitat. The four antelope herds represented have continually been among the most productive in the state. Collections were made from each study area over a three-year period, with each month of the year being represented. For analyzation purposes, these were combined into winter, spring, summer, and fall groupings. One hundred and eleven rumen contents samples were obtained. All were examined in the California Department of Fish and Game, Wildlife Investigations Laboratory, Food Habits Section, Sacramento. This unit had previously conducted food habits studies for California, Oregon, Montana and Wyoming. The analyses are presented in complete form and discussed in a recent publication, The Antelope of

New Mexico, by T. Paul Russell, Bulletin Number 12, New Mexico Department of Game and Fish, 1964. The bulletin is available upon request, so a repetition of the data here would be superfluous. These studies do indicate that New Mexico pronghorn apparently are more dependent, yearlong, on annual forbs than are many of the more northern herds inhabiting Artemisia dominated ranges. It is evident that one herd inhabiting the San Augustine Plains in the southwestern portion of the state utilize browse, largely Artemisia species, to a considerable extent. Our largest populations, ranging in the eastern third of the state, apparently are far more dependent upon forbs than upon browse. It seems likely that forb availability varies more with fluctuations in soil moisture than does forage produced by browse species. Perhaps this partially explains why we seem to have wider variations in antelope productivity than most of the other states. We also feel that these seasonal fluctuations in forage availability are closely associated with our pronghorn-restrictive fencing problem. We don't have the severe winter problem of the more northern ranges, but the smaller net wire pastures seriously restrict the ability of the antelope to move widely following intermittent precipitation and succulent forage. This type of fence may also prohibit access to drinking water as wells or pipeline tanks may be allowed to dry up when pastures are not being used by domestic livestock. Thus, we share with the other states the concern over increased use of net fencing, but perhaps have a different problem of rangeland utilization. The effect may be different, but the cause, "serious restriction of antelope movements" is the same, and we hope to be able to cooperate with other agencies in finding a satisfactory solution.

Nutrition

Because of our concern over the possible affects of seasonal moisture fluctuations upon vegetation and the impact of this relationship upon productivity rates, we have begun to investigate in a small way various physiological responses, and to associate them with nutritional levels.

On our Mesa Study Area, during the summer of 1964, we suffered an intense short-term drought. Due to low winter moisture the range was very dry in the spring and almost no rain fell until mid-August. The resident antelope herd of approximately 200 individuals was under serious nutritional stress. Only slight improvement was noted in body condition by the begining of the normal breeding season in mid-September. We had good information on the fetal implantation rate in females from this herd prior to this drought, so we felt that we had an excellent opportunity to determine the effect of poor body condition upon the breeding success rate. We collected nine adult female antelope during early winter, and recorded an average fetal rate of 1.67. This compared with a fetal rate of 1.95 tabulated the previous year from a sample of 22 females from the same herd. A pooled t-test indicated that at the 95% probability level, there was no significant difference in the average fetal rate between the two years. The slight reduction recorded the second year is largely attributed to a single barren female in the small sample of nine. This doe, aged at six years plus, had no ovarian scars of any kind and had a uterine tract typical of juvenile antelope. A lifelong abnormality of her reproductive processes is indicated. This is the first individual

in a total of 55 breeding-age females analyzed over two years in which this permanently sterile condition has been noted. Our limited data so far, indicates that severe nutritional stress prior to and during the breeding season by itself does not significantly reduce breeding success. The does from this drought area had shed an average of only 3.5 ova. This is approximately one half the ovulation rate recorded previously, and on other areas. This reduction could be a reflection of the nutritional deficiency present in the females, but it did not reach a low enough level to impair successful reproduction. We assign tentative ages to all fetuses we collect, and attempt to determine the height and span of the breeding season. Fetuses taken from does after the 1964 drought suggest that the height of the rut took place at the normal time, but that perhaps the breeding season was more prolonged than usual.

We plan to collect additional female antelope during late gestation from our sandhills habitat type to determine viable fetal rate just prior to parturition. At this time we will collect blood samples and have them analyzed to determine Vitamin A and Carotene levels. Tests will also be conducted to suggest if the Calcium-Phosphorus ratios are in accord with those recommended for domestic sheep. We have previously done a little work with antelope blood-Vitamin A and Carotene levels in late gestation. Deficiencies at this time would be expected to have the greatest influence on normal reproduction. The females tested had an average Vitamin A mcg. % of 73% and an average Carotene mcg. % of 13%. These levels are apparently more than adequate. I have not been able to locate any desirable levels for pronghorn, but based on requirements for sheep the veterinarian at Colorado State University indicated that "if these were domestic livestock samples, we would consider the Vitamin A levels very high." Of these various tests, we will be most interested in the indicated Phosphorus levels. New Mexico lies in a recognized Phosphorus deficient zone based upon analysis of range grasses. Of course the forbs utilized by our antelope may not show the same low levels of Phosphorus as a dormant grass, but sheep utilize much the same foods and are known to commonly suffer Phosphorus deficiencies which cause reproductive abnormalities. Once again desirable levels for pronghorn are unknown but recognized blood quantities of .25% for white tail deer and .16% for pregnant ewes will be used to suggest minimum levels until more precise data are available.

Our Current Antelope Productivity Study

For the past three years our antelope research efforts have been concentrated at determining factors responsible for chronically poor kid crop in our sandhills habitat type. We have collected over 50 female antelope from our study areas following the breeding season and conducted examinations to determine basic rates of ovulation, fertilization, and fetal implantation. These were entirely satisfactory. We have conducted tests for the diseases which are commonly associated with abortion. Bacteriological smears and cultures were prepared of both male and female reproductive tracts. Intensive parasitic studies have been completed. None of these tests have revealed any widespread source of reproductive failure. We have maintained intensive observations during the kidding season, and have yet to discover any significant juvenile

mortality. To the contrary, of the kids we observed last spring, at least one week of age, over 80% live until our kid:doe ratio census was flown in mid-July. Our tests and observations have not yet revealed the source of loss in our potential productivity, but we have nailed down the time of loss to an approximate three week interval. This includes the late stages of gestation and/or the period shortly after parturition. Several possibilities such as late abortion, stillborn or abnormal kids, abandonment, or infant mortality, may be responsible for our loss. It should be pointed out that last spring, our effective observations began too late, and we missed a considerable portion of the period which our final conclusions indicated was the most important. With this in mind, we plan to have eight biologists in the field this spring during the indicated time of loss and hope to be able to pinpoint our major limiting factors. We also will collect approximately 10 female antelope adjacent to the study area in April to determine viable fetal rate just before parturition.

As these studies have developed over the past three years, it has become increasingly apparent that the circumstantial evidence makes significant levels of coyote predation upon very young antelope kids a distinct possibility. This sandhills habitat type has always been choice coyote range and control activities have been greatly decreased in recent years. With this in mind, we recently instituted a maximum coyote removal program in a sandhills treatment area adjacent to our study area. We have three years of pre-treatment, antelope kid:doe ratios on the coyote control area. We are in the midst of a trapping, 1080, and strychnine campaign on the treatment area and this will be carried out until just prior to the antelope kidding season. During the kidding period we will fly morning helicopter surveys on the area where coyote numbers were greatly reduced. We feel the helicopter work will enable us to determine the effectiveness of our control program. We will also be able to observe the remaining coyotes and their activities in relation to antelope. We also plan to shoot as many coyotes as possible, land, and conduct stomach contents examinations. The resulting kid:doe ratios on this area will be compared to previous years and to the primary study area where no control is practiced. We feel that either positive or negative results will contribute to our understanding of the coyote-antelope interrelationship.

Changes in Rangeland Suitability

I hope I will be allowed to editorialize on some observations of the game management responsibilities of the states in relation to federal land administration agencies. I feel that the federal agencies in recent years have shown an unquestionable improvement in their attitudes towards recreational and wildlife uses of public lands. For instance, I can recall not many years ago when we felt that the Forest Service was interested almost exclusively in timber harvest and grazing of domestic livestock. We almost begged them in many cases for consideration of wildlife needs. This began to change as the multiple use concept gained acceptance. Wildlife staff men were added to each forest until in many cases they had better information than we did on game populations, trends, forage supplies, etc. We then began to "holler" for them to back off, stating that WE were responsible for the wildlife. An interesting paradox, but I believe it was

good for us, as the challenge forced us to examine our program more critically and to perhaps plan more carefully our immediate and long range management goals. More recently, the same transition in emphasis in land stewardsmanship has been evident in Bureau of Land Management policies. The state offices have been adding wildlife specialists and I believe the trend is obvious. As specialists in management of antelope, we are going to be most closely involved with B. L. M. concepts of rangeland utilization. If we are going to intelligently request consideration for antelope needs, then we (the state game departments) should anticipate some of the sources of conflict of interests and conduct investigations to provide workable answers. We can be sure that the B. L. M. is going, in the future, to manage public grazing lands far more intensively. Increased fencing and higher forage productivity through brush and scrub timber eradication are future certainties. It will not be enough for the states to protest against any change, but rather we should be in a position of suggesting modifications or alternatives which will reflect the needs of antelope populations. For instance, Wyoming has been a leader in experimenting with possible types of acceptable fencing. These recommendations should be tested under field conditions to determine the practical application. Not only do we need to ascertain types of fences and/or structures which will allow sufficient antelope movement, but for the various main habitat types we need to be able to make recommendations on minimum pasture sizes. That is, what are the minimum antelope herd units which can perpetuate themselves, and what combinations of seasonal ranges must be available so that the herds can withstand the most severe environmental conditions.

Another aspect of rangeland modification sponsored by federal agencies which should concern state wildlife departments is the obtaining of good advanced information on the effects of brush control. Can wildlife needs be serviced by leaving strips or patches of brush or by a less complete brush kill? What constitutes a good balance between antelope forage species and a near dominance of grass species? Shouldn't the Game Departments be experimenting with plant species suitable as antelope forage and developing sources of seed to be available when cleared areas are reseeded? If suitable species desirable for antelope can be found and are suitable for reseeding, would it be better to grow them in intermittent, dense patches or have them scattered throughout the reclaimed grassland?

These closing statements only suggest a few possibilities, but I believe they indicate present and future stages of habitat manipulation in which the states should be able to offer recommendations based on sound research findings. I am confident that the state game agencies will be deficient in their roles as wildlife protectors if they assume only the negative position that all changes in present range status are undesirable. The changes in rangeland utilization and management will come and we should be in a position of advocating practices based on reliable ecological information, which will contribute to the improvement of antelope populations.

Discussion

Beale: When you locate these fawns, how do you follow these through as individual groups so that you know your percentage of survival

isn't staying up because of better observations day to day or age period?

Larsen: We didn't have them marked.

Beale: In the later part of the year your fawning percentage is staying up, but maybe it is because you're seeing a larger group of the fawns. In otherwords, the observability of an individual antelope is greater as the animal gets older. Say, when they are a week old you may be seeing 50 percent of them, later on 75 percent of them.

Larsen: We have had two months in this area and have killed a number of females. Last year on the study area there were only about 25 females. This country is kind of broken, it is not just a flat open basin. The antelope don't seem to move more or less at random. We would see a female or two and two or three kids, and we could almost pick them up in within a square mile any morning. Some mornings you might miss them, they may be bedded down or something. The next day they would be right back in there. We wondered about this, whether we were seeing different antelope, perhaps. In a few cases the female would be individual enough by some body characteristic we could definitely pick her out. These things were spread out enough that we had individual code numbers for them, so if one or the other of us saw them we could code them by that number. In our own mind we were certain we could do this, but we weren't sure there weren't more or they weren't moving. So as we began to get these pinned down we began to work other areas, where we hadn't seen antelope with kids at all, quite closely to see if there were any antelope we hadn't found at all or they weren't just moving. When we finally ended up flying we found the antelope and the kids we had been seeing all the time and knew almost exactly where they were. And again this was largely in our mind and we didn't have them marked but with the other things we saw this tied in pretty closely.

Beale: Essentially then, you were seeing all the population that was there.

Larsen: Not everyday. We would see this one today, that one tomorrow. We had it tied enough together; a highway bisects the study area. We did most of our killing of females for samples south of the highway so we did our observations north of the highway. It is only about a 100 section area.

Townsend: What kind of aerial survey? Did you use a helicopter?

Larsen: No, this is a fixed-wing and narrow strip count.

Townsend: Mile strips?

Larsen: No. What are they Orville, quarter mile, 100 foot? Of course, on this small of an area we tried to make an optimum condition survey. We hit it right at daylight while the antelope are still up moving around, and we have advantage of the low altitude sun by the time we quit. We can do this in a little over two hours, so I'm sure these flights are considerably better than the ones we get on the regular census flights and they're pretty good, I think.

Townsend: Did you make complete coverage of this study area?

Larsen: Definitely, very narrow strips. As good as we can make it, I'm sure. Might be better with the chopper. I don't know. I think the chopper will help on this coyote thing because we see anywhere from 0 to 20 some coyotes on a morning flight. This varies

a lot from day to day.

Townsend: There is much more chance for duplication on a chopper-type flight.

Larsen: Too low and scattering the antelope? I wouldn't doubt that at all. But, on this coyote thing the chopper will allow us to get right down in the brush and perhaps jump a lot of coyotes we would miss with the fixed-wing. I don't think you can count coyotes at all with a fixed-wing, varies completely from day to day. We are at least hoping we can be pretty effective on that part with the chopper.

Hepworth: Were these day by day observations or did you have elapses in your observations?

Larsen: No, day to day. Everyday there were at least one of us and then on a weekend or something....or say almost every day there was two but if a weekend or something just one, but this was staggered. There was at least one every day for about almost three months. This coming year it will only be three weeks with approximately eight of us.

RE-INTRODUCTION OF ANTELOPE TO THE SANDHILLS OF NEBRASKA

by

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Historically the pronghorn ranged throughout most of the "Great Plains," of which much of Nebraska is included. A 1925 publication cited that 10 small bands, totaling 187 antelope, remained in Nebraska.

The panhandle herd increased to about 3,500 by 1955. However, antelope remained at a low level in the Sandhills.

During a 5-year period starting in 1958, 1,042 pronghorns were successfully trapped and transplanted from the western range to the Sandhills for the purpose of establishing a population of harvestable animals.

In 1964 an experimental season on adult bucks was held in portions of the Sandhills. During 1965 sex and age restrictions were removed from the season regulations.

Recovery of ear tags revealed that some animals lived about eight years. Movement data are discussed.

Population densities will probably not approach those in the panhandle. However, the 20,000 square miles of the Sandhills will contribute significantly to the antelope resource of Nebraska.

Re-establishment of Antelope in the Sandhills of Nebraska*

Historical records show that antelope once ranged throughout most of what is now Nebraska. With the advent of agriculture and uncontrolled shooting, antelope were extirpated from most of this former range until only a remnant population remained in the extreme northwest portion of the state. Under complete protection, initiated in 1907, antelope gradually increased and eventually occupied most of the suitable range in the panhandle region of Nebraska. The first hunting season in recent years was held in 1953, and limited hunting has been permitted each year since with the exception of 1958.

Although antelope occupied most of the panhandle, their distribution in the late fifties included only the very western portion of the Sandhills. Trapping and transplanting has proved to be an efficient method of re-establishing pronghorns, and it was felt that artificial restocking could accelerate natural dispersion by at least 20 years.

The Sandhills of Nebraska occupy about 20,000 square miles in the north-central part of the state. Average rainfall varies from about 23 inches in the east to 18 inches in the western portion. The topography is a

* Material in this report a contribution of Federal Aid Projects W-31-D and W-15-R

succession of sharply rolling hills and irregular ridges, relieved occasionally by level valleys or basins of different sizes. Shallow lakes of varying size are distributed throughout much of the region, many of them supporting lush stands of submergent and emergent vegetation.

The soil type of most of this region is described as dune sand. The surface layer is loose and incoherent and varies from 10 to 15 inches in thickness. Both topsoil and subsoil are non-calcareous and poorly supplied with organic matter. The organic matter is insufficient to prevent the soil from blowing when the protective cover of grasses is removed.

The Nebraska Sandhills are characterized by mixed grass associations and a great variety of forbs. Characteristic native grasses of the region include: prairie sand reed (Calamovilfa longifolia), grama grasses (Bouteloua spp.), switch grass (Panicum virgatum), panic grasses (Panicum spp.), dropseed (Sporobulus spp.), sand blue stem (Andropogon hallii), and little blue stem (A. scoparius). Several genera of the sedge family are common. Scattered growths of cactus (Opuntia fragilis and O. hemifusa), and soapweed (Yucca glauca) are relatively common, particularly in overgrazed areas. A representative list of forbs would include:

western ragweed -	(Ambrosia psilostachya)
green sagewort -	(Artemesia caudata)
gray sagewort -	(A. frigida)
cudweed sagewort -	(A. gnaphalodes)
loco weed -	(Astragalus and Oxytropis)
bee flower -	(Cleome serrulata)
umbrella plant -	(Eriognonum spp.)
sunflower -	(Helianthus spp.)
lupine -	(Lupinus spp.)
blazing star -	(Liatris spp.)
coneflower -	(Ratibida pinnata)
lance-leaved sage -	(Salvia spp.)
goldenrod -	(Solidago spp.)
clovers -	(Irifolium spp.)

Trees are limited almost entirely to stream courses or areas where planted by man. Additional woody vegetation, varying from common to uncommon, includes wild rose (Rosa spp.), snowberry (Symphoricarpus albus), wild plum (Prunus americana), chokecherry (P. melanocarpa), poison ivy (Rhus radicans), lead plant (Amorpha canescens), and sand cherry (Prunus bessevi).

Land use in the Sandhills is almost entirely haying and grazing. Alfalfa and occasionally corn are grown in scattered areas. Attempts at producing cultivated crops have been largely unsuccessful, due to the loose soil and wind erosion accompanying tillage. Cropland accounts for less than five percent of the total acreage in the Sandhill counties. In Cherry County, which comprises 30 percent of the Sandhill area, only slightly over one percent of the land is devoted to use other than haying or grazing, and alfalfa makes up about two-thirds of this one percent.

Human population is quite sparse. For example, Cherry County has a population of 1.4 persons per square mile. Most of the land holdings are large,

averaging about 3,500 acres for the Sandhills as a unit.

Public land constitutes less than three percent of the total area of the Sandhills. Since most of the antelope releases were to be made on private lands, it was mandatory that landowners be sympathetic toward the project. To assure landowner cooperation, antelope were not released until a cooperative agreement, specifying management of the antelope, was obtained from landowners controlling a tract of land commensurate with the expected ranging habits of antelope. Signatures were secured through the efforts of resident sponsors. About 1,700,000 acres, roughly 13 percent of the Sandhills area, were signed up under cooperative agreements.

After a release site had been signed up, a reconnaissance survey of each site was undertaken to determine: general character of the vegetation; land use; availability of water, both natural and artificial; topographical features; natural and artificial barriers to movement; abundance of predators; remoteness, and landowner attitudes.

The basic antelope trap was constructed from plans provided by the Montana Department of Fish, Game and Parks. The Colorado Game, Fish and Parks Department was also helpful in describing trapping techniques based on their experience.

The trap itself consisted of a framework of iron pipe with a suspended nylon net of 1/4-inch rope with three-inch mesh. The trap was oval in shape, 100 feet long, and 40 feet wide at the center. A double gate was located at the entrance, which was closed by a rope and a system of pulleys. A single gate was located at the rear, from which the antelope were removed from the trap.

The basic trap was constructed within a quarter section (or less) of land, fenced with five-foot woven wire fence. A woven wire fence was also constructed to serve as a wing leading into the mouth of the trap. One side of the fence was left down on the ground.

Selection of the trap site was determined by the size and location of antelope bands, their ranging habits, and topographical features. When the trap was completely set up, the pilot would haze the antelope across the let-down fence into the fenced quarter section. The hidden ground crew would then raise the let-down fence and enclose the antelope in the quarter section. The antelope were then forced into the wings of the trap with the airplane and several vehicles. The final hazing was done by men on foot with a length of burlap suspended between them. When the antelope entered the trap, a man hidden at the end of the rope would close the gates.

The antelope were usually left in the trap overnight for a rest. The following morning they were ear-tagged and loaded into two-ton trucks for transportation to the release sites. The trucks were completely covered with canvas to make a dark interior. Generally about 25 antelope were transported in each vehicle.

The trap was set up ten times during the winters of 1959 to 1962. Antelope were captured at all but the first trap site, with few unsuccessful

trapping attempts. The largest number trapped at one time was about 100. The total number of antelope removed by trapping was 1,116. Forty-six animals, or 4.1 percent of the total, died prior to release. Known post-release mortality was about 2.0 percent of the total released.

The first antelope released in the Sandhills were obtained from the Pueblo Ordnance Depot in Colorado. All others were trapped in Nebraska. A total of 1,077 antelope was released at 20 sites between January 1958, and February 1962. Individual releases varied in size from 28 to 72 animals. The sex ratio at an individual site was run of the trap, with a prepoderance of females in most cases. Of the total released, 61.8 percent were females.

Cost of the project was $40,430.90 or $37.54 per head. At the current fee of $10.00 for antelope permits, the cost of the project will be amortized with the future issuance of 4,043 permits.

Population surveys subsequent to the releases have included landowner contacts and ground and aerial surveys. With the exception of one year, productivity, as indicated by doe:kid ratios, has been lower than in the major antelope range. This has varied from a low of 34 kids:100 does to a high of 128:100. An accurate population estimate is not available at this time, but guesses based on indicated productivity, assumed mortality and tag returns would indicate about 3,000 antelope in the transplant areas.

The ultimate objective of this program was to establish a pronghorn population capable of supporting an annual harvest by sportsmen. Earlier hopes were for an average of one antelope per square mile, or a total of 20,000 antelope in the Sandhills. Because of landowner tolerance it does not appear that this can be realized. However, the population in our major antelope range is only about 4,500, and if the Sandhills can carry even five to ten thousand antelope we will have doubled or trebled the statewide population.

Initial expectations were for a hunting season by about 1968 or 1970. Although the antelope population is very low over the area as a whole, winter bands of 40 to 100 animals congregate on the limited alfalfa fields and have caused imaginary or real damage problems. As a result, it was necessary to hold limited hunting seasons in 1964 and 1965.

The first season in 1964 included about 80 percent of the transplant area and some area with "native" antelope. Three hundred permits were issued for an essentially bucks only season. Hunter success was 68.3 percent with a kill of 205 antelope, considerably higher than had been expected. Based on locations of kill, transplanted antelope and their progeny contributed about 78 percent of the harvest (160 antelope), and 13 tagged antelope were taken.

In 1965 the open area was reduced somewhat to include primarily areas of depredation complaints. Three hundred permits were issued and antelope of either sex were legal. Success was 70 percent with a harvest of 210 antelope. About 165 antelope were the result of transplants and ten tagged animals (2 bucks and 8 does) were taken.

In order to speed population increases, seasons during the next few years will be held primarily only in areas of depredation complaints and at times when damage is considered excessive.

Recoveries of tags from 59 antelope provided data on longevity and movements. At the time of tagging, age was recorded as young or adult. Therefore, unless the animal was a kid when released, the age represents only a minimum. Of the ten tagged antelope taken in 1965, three were eight years or older, three were seven years or older, one was seven years, and the remaining three were five to six years or older. The youngest tagged animals available during this season would have been four years old.

Movements of the 59 antelope ranged from zero to 125 miles, with an average of 26 and a median of 20 miles. Nineteen (32 percent) moved ten miles or less from the release site, and seven (12 percent) moved 60 miles or more. Of 28 antelope which moved over 20 miles, movements were approximately evenly divided between the four quadrats, so there was no apparent preference for direction of movement.

Six of the seven antelope which moved sixty miles or more were does, which may indicate that females are more mobile. However, the sample size was too small to permit any definite conclusions.

In summary, 1,077 antelope were transported to historic but unoccupied range in the Sandhills of Nebraska. This program is expected to double or treble the statewide antelope population. Two hunting seasons, with limited permit numbers, were held in 1964 and 1965. It is anticipated that regular, less restirictive seasons can be held within four or five more years.

ANTELOPE MORTALITY ON SIOUX ARMY DEPOT IN NEBRASKA

by

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ABSTRACT

In 1958, 27 antelope were released on the Sioux Ordnance Depot near Sidney, Nebraska. A study was conducted to follow the population dynamics of the confined herd.

An estimated 63 percent herd loss occurred during the period January 24 to February 22, 1963, following a brief period of low temperatures accompanied with 8 to 10 inches of snowfall. A total of 40 carcasses was reported and 37 examined. Rumen samples were taken for laboratory examinations; one antelope was collected and visceral samples were taken for analysis; and bone marrow examinations were made.

Laboratory tests were negative on arsenic, lead and nitrate poisoning. Cultures for pathogenic bacteria indicate that an infectious desease was not involved.

Examination of bone marrow indicates the antelope were in poor physical condition. Although there were high fetal and kidding indices during the summer of 1963, survival was poor. The mortality was apparently caused by malnutrition.

Antelope Mortality on the Sioux Army Depot

An antelope die-off occurred on the Sioux Army Depot located near Sidney, Nebraska during the winter of 1962-1963. At this time a 63 percent reduction of the estimated population occurred.

In 1958, 27 antelope were transferred from a Colorado Ordnance Depot to this Installation and through the subsequent years they were studied for population data. The antelope numbers increased from 27 to an estimated 130 in five years, when the losses occurred. As a result of these mortalities the population was reduced to 62.

During a visit to the depot on January 24, 1963 a report was received that seven mortalities occurred since December 1962. Two antelope apparently had died from sodium dichromate poisoning due to an inefficient sump used in munition processing and five others appeared to have died from canine attacks. One antelope survived the attack but died four days later, apparently as a result of injuries. These mortalities had apparent causes so other than keeping a sharp eye out for free running canines and correcting the sump no special precautions were taken.

On January 28 six more mortalities were recorded. Five of the six carcasses did not indicate any cause for death, however the sixth was badly mutilated.

The conclusion drawn at that time was that a canine attack was possibly a secondary contributing factor while the primary cause of death was as yet unknown. Thus five carcasses were brought back to headquarters.

A local veterinarian was contacted to examine the animals. Internal organs appeared normal except for eroded abomasa. It was suggested that the rumen contents be analyzed for heavy metal poisoning. Results of the laboratory analyses were negative for lead, arsenic and other toxins.

Dr. Grace of the Veterinary Science Department of the University of Nebraska suggested we look for nitrate and chlorate poisoning as other missile installations had experienced some livestock losses in the past. After contacting the depot's officials this source of loss was ruled out since no missile development had as yet taken place.

An infectious disease was considered since some antelope losses had occurred in a neighboring state which were attributed to "Epizootic Hemorrahagic Disease." Samples of internal organs, eg. liver, kidney and spleen, were frozen and shipped air express to Dr. Daniel O Trainer, Veterinary Science Department, University of Wisconsin for tissue culturing. The cultures indicated that an infectious disease was not involved in this die-off.

The losses appeared to have been confined to a four week period; however, 78 percent of the losses occurred in a two week period from January 28 through February 9. From January 13 through January 21 severe weather was experienced through the panhandle. Drifted snow made travel on the base difficult and prevented a thorough coverage of the base for locating all antelope mortalities. Some carcasses were not located until

some weeks after they had died.

A total of 40 antelope carcasses was reported and 37 were examined. Depending upon the stage of decomposition various physiological data were collected.

Eighteen animals were posted and all had very little or no internal fat. Eleven of the 18 were also examined for their bone marrow condition. Only two were judged as 25 percent fat content, with the others approaching the 1.5 percent level (based on deer bone marrow criteria). Eight additional antelope were examined for bone marrow condition but were not posted because of the advanced stage of decomposition. All showed very low fat content of the marrow.

Sixteen of 18 animals had inflamed abomasa while two appeared normal. A veterinarian examined two of the animals and his diagnosis was that internal stomach poisoning caused death. Dr. Grace stated that sloughing of intestinal lining and hemorrhagic conditions are not necessarily diagnostic of poisoning. This condition may be caused by bacterial content of the intestine, heat or fever and decomposition.

The 1963 production period did not reveal anything unusual. Observations before and during kidding indicated from 16 to 18 pregnant does. The peak of kidding occurred on June 13 compared to June 11 in 1962.

Marking and tagging operation resulted in a capture of 18 kids and observations indicated production of at least 27 young. Using 1.8 young per adult doe there would be a possible 29 to 32 young produced. Thus the reproductive index was still high at the time of kidding.

The following winter census showed a population of 55 antelope of which 17 were young-of-the-year. Apparently between the 1963 production period and the time the census were made a minimum of 41 percent post-natal mortality occurred.

Reviewing the data collected on the depot several things appear in evidence and suggest malnutrition as the principal cause of the losses.

The confined herd, with an original release of 27 antelope in January 1958, increased to 41 in late 1958; 55 in 1959; 82 in 1960; 96 in 1961, and an estimated 130 prior to the die-off which reduced the herd to 62 in 1962.

Examination of carcasses revealed very little or no visceral fat. Bone marrow examinations showed dark gelatinous to almost liquified conditions in adults, while juvenile antelope had liquified bone marrow.

Malnutrition was suspected, based on the fact that in deer, bone marrow is waxy or greasy and white in a healthy animal. To substantiate this conclusion, the bone marrows of antelope and deer were examined at every opportunity during the winters of 1963 and 1964. Without exception, the bone marrow from these animals appeared normal. Also, animals in the wild had good quantities of body fat which was lacking in the antelope that died on the Depot during the winter of 1962-1963.

Another fact corroborating malnutrition is a high post-natal mortality that apparently occurred during the year following the winter die-off. Productivity figures suggest minimal losses took place during the first three years. However, the herd suffered increasingly heavier post-natal mortality during the fourth and fifth years.

Based on the following year's kid production and fetal data collected at the time of the die-off (1962-1963) a lower conception rate or pre-natal mortality may be ruled out. During the 1962-1963 winter when 40 antelope carcasses were found and examined, seven were females two years and older. Of the seven, five had twin fetuses. The other two carcasses were partially eaten by scavengers and the reproductive tract was missing.

Vegetative cover on the Depot cannot be considered good antelope range. Discussion with personnel who worked on the area in 1957 indicates that the range has now improved considerably over the abusive situation present in those years. However, the improvement in vegetative cover is towards crested wheatgrass and a reduction of forbs and weeds, thus lowering the quality of the range for antelope.

The main antelope range is located on approximately 21 square miles of the 36 square miles comprising the base. The area has a considerable number of buildings and other installations. Highest density of antelope occurred just prior to the heavy winter loss, with 4.6 antelope per square mile. At present a density of 2.6 antelope per square mile is indicated. This is still considerably higher than the normal density of antelope in the wild in Nebraska.

In closing, we realize that extensive data were not presented and things other than starvation can cause the depletion of body fat and bone marrow conditions. Based on negative analytical laboratory results, the failure of cultures to indicate any infectious disease, and the lack of another cause, malnutrition seems to be indicated.

Discussion

Townsend: These low areas which were not seeded; were they pretty well covered with snow in the winter time?

Suetsugu: When this die-off occurred, travel on the Depot was highly restricted and I don't know if these areas were covered. All I can say it probably would have been covered, this low wet area. In fact, when the kidding period occurred these low areas were still wet. I imagine that is why the cattlemen go around these areas.

Vidakovich: Harvey, what is your population now, present time?

Suetsugu: The Depot is being phased-out this summer, 1966, and we don't know what the disposition of the Depot will be. The number of antelope went down to 62, then decreased the next year, it is back up now where we have about 65. However, that 65 is an incomplete count this year. I like to think it is an incomplete count because we didn't count the adult buck that should be on the area.

Bogart: Harvey, did you make any studies to see it there is any overlap between the plants on the P.O.D. and the Souix Depot?

Suetsugu: No, we haven't. I don't know what you have down at Pueblo, but they were doing real good. Until the 96 or 92 going into the reduction year, the die-off, then we estimated we should have had 130 as result of reproduction. And 130 confined to a small area puts the density at 0.6, which we felt is quite high.

Bogart: Well, the range we have down here doesn't look anything like what you have there. I wondered if the change in the vegetation might have effected the antelope.

Suetsugu: Well, crested wheat grass now comprised about 80 percent of the Depot. And like I say very little good antelope range remains. And it has become a very competitive thing.

Hepworth: That change in diet should show up early instead of waiting to build up.

Suetsugu: It seemed like with 24 antelope on the place to begin with, what forbs were available, say if the weedy patches comprised 40 or 50 percent of the area; it seems 27 antelope could make a go of it, 130 would dimish the percentage. I don't think this would look too good.

Bogart: You don't know if you lost any plants when they built up that might have been vital to them?

Suetsugu: We felt the browse species would be very important for the sustenance of the antelope during the winter period, the critical period. However, we don't have big sage, I don't think there's a single big sage on the Depot.

Vidakovich: What browse species do you have available, if any to the antelope?

Suetsugu: In the area its self? I haven't seen any browse species on the Depot itself.

Menzel: We had high-lining on one of the red cedars at the headquarters.

Suetsugu: The only woody plant listed for the Depot on a list made by the Fish and Wildlife Service, Russian thistle and it doesn't seem yellow sweet clover should be included but this is the designation given here.

SOME PREFERRED FOODS OF KANSAS ANTELOPE

by

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ABSTRACT

Food preferences of Kansas antelope (Antilocapra americana) were investigated from September, 1963 to August, 1964. A total of 323 minutes of antelope feeding time were recorded on 13 species of plants. Recordings were taken at 10 stations during the summer, fall and winter.

Forbs accounted for 20 percent of the diet; browse, 18 percent; cactus, 40 percent; and grasses, 22 percent. No accurate estimate of winter wheat consumption could be made, however it is evident that antelope spend considerable time on winter wheat fields in the late fall, winter and spring.

The purpose of this paper is twofold: (1) to determine the food preferences of antelope in Kansas in order to better facilitate the choosing of future transplant sites and (2) to gain information from a geographical area where food habits data are largely non-existent.

The area referred to is in extreme western Kansas, in Wallace and Sherman counties. Recent aerial censuses indicate that this entire area is the winter range to some 80 antelope and the summer range of approximately 50. Thirty of the winter population migrate between Kansas and Colorado during the summer. Recent introductions from Montana during the fall of 1964 have brought the number of wintering antelope to approximately 150.

Methods

The antelope-minute technique described by Buechner (1950) was used in this study. Some changes were made to conform to local conditions and situations. The technique is described as follows: a) Direct observation (with binoculars, spotting scope and the unaided eye) of the antelope feeding on various plant species, b) pinpointing the exact spots of feeding activity on individual plants, c) spotting a small area where at least 30 seconds of feeding time took place, and d) making an attempt to locate all freshly clipped plants and estimating the amount of time spent on each species. The small area involved was marked off by tall, outstanding vegetation such as yucca (Yucca sp.), sand sage (Artemisia filifolia) and snow-on-the-mountain (Euphorbia marginata). This area was then transected, on foot, at three-foot intervals to locate all freshly clipped plants.

Findings

Through direct observation, 13 species of plants were utilized as pronghorn forage during the observation periods. Ten different stations of

feeding activity were involved and 323 minutes of feeding time recorded.

As soon as the antelope were visually contacted they would usually move out of sight. I would wait a few minutes, and then, using the topography as a barrier, make an approach to get into position to observe feeding areas without being observed by the animals.

During the winter and early spring months many antelope preferred to feed on winter wheat. Wheat fields are found at the periphery of the occupied range and, in some cases, extend into the native pastures. Antelope would spend the morning and late evening hours on these fields and the remainder of the day in adjacent pastures or Conservation Reserve fields. No accurate feeding time could be obtained for antelope using winter wheat. The wheat fields are usually flat or rolling with no concealment available. Also, no vegetation exists that can be used to determine boundaries of any one feeding station. Ranchers usually run cattle and horses on these same wheat fields from November to March. Mule deer (Odocoileus hemionus), utilize some winter wheat for forage during the spring and winter. I have observed 15 antelope, 16 mule deer and an unknown number of cattle feeding on the same wheat field within ¼ mile of each other. Although no percent forage consumption for winter wheat by antelope was estimated, it is noted that winter wheat does make up a considerable portion of the overall diet and seems to be a preferred food at certain times and in certain areas. There have been no crop damage complaints to date.

There were three bands of antelope numbering 8, 15, and 25 respectively, which were known to spend all or part of the winter months on wheat fields. The bands numbering 8 and 15 utilized Conservation Reserve fields during the middle of the day instead of travelling to the native pastures. This seems to be a relatively unnatural occurrence as most of these fields are overgrown with fireweed (Kochia scoparia) and sand lovegrass (Eragrostis trichoides). Fireweed grows to a height of four or five feet and the lovegrass to three feet. It would seem that this tall vegetation would keep the antelope from entering these areas but, evidently, it had no such effect.

Forage Consumption

Table 1 summarizes the forage consumption data for those spring and summer months when collected.

Forbs taken were many flowered aster (Aster multiflorus), silver psoralea (Psoralea argophylla), and scarlet globemallow (Sphaeralcea coccinea). Sagewort (Artemisia kansana) and sand sage were the browse species consumed. Blue grama (Bouteloua gracilis), sand dropseed (Sporobolus cryptandrus), and red three-awn (Aristida longiseta) were the grasses utilized. The cactus which was taken avidly was prickly pear (Opuntia macrorhiza). Antelope actively sought the fruits of this plant, especially in the fall (Table 2).

Table 1. Antelope forage consumption during April, June, July and August, 1964.

	No. Plants Taken	No. of Species	Antelope Minutes	Per Cent
Forbs	49	3	30.5	23
Browse	19	2	29.5	22
Grass	9	3	21	15
Cacti	34	1	54	40
Totals	111	9	135	100

Table 2. Antelope forage consumption during September, October and November, 1963.

	No. Plants Taken	No. of Species	Antelope Minutes	Per Cent
Forbs	21	2	5	5
Browse	8	1	4	4
Grass	12	1	15	15
Cacti	62	1	76	76
Totals	103	5	100	100

Fall plants taken include few-flowered scurfpea (Psoralea tenuiflora), scarlet globemallow, sagewort, blue grama and opuntia. Opuntia made up the majority of the fall diet as the antelope seem to prefer the fruits of this species over all other plants. Fruits of the prickly pear are mature at this time and are succulent and tasty. In this area blue grama is not used by cattle while growing in close proximity to patches of cactus which assures the grama of reaching maturity. These plants produce many heads which, it is felt, are taken incidentally by antelope while feeding on the cactus. Blue grama seems to be taken in this fashion in a larger proportion than would be found without the attendant cactus.

During the months of December and January, 88 antelope minutes of feeding time were recorded (Table 3). A higher proportion of grass was taken during this period than in any other season of the year. Also, there was no recorded feeding time on cactus. This is probably due to the fruits being desiccated and fallen from the plants. Those plants utilized were skeleton weed (Lygodesmia juncea), snow-on-the-mountain, sagewort, sand dropseed, red three-awn, and sideoats grama (Bouteloua curtipendula).

Table 4 summarizes the yearly consumption data recorded and the total percent utilization by species. Although the antelope spent 40 percent of the time recorded feeding on cacti the observations were limited to a three month period in the fall. This indicates a high degree of preference for cactus fruits at the time of their greatest palatability. The 18 percent browse utilization figure probably reflects the paucity of browse plants, while the greater percent use of grass indicates its dominance in the habitat.

Table 3. Antelope forage consumption during December 1963 and January, 1964.

	No. Plants Taken	No. of Species	Antelope Minutes	Percent
Forbs	13	2	30	34
Browse	34	1	23	26
Grass	35	3	35	40
Cacti	0	0	0	0
Totals	82	6	88	100

Table 4. Summary of all forage consumption recorded, by species.

Species	Frequency at Ten Stations	Antelope Minutes	Percent
Forbs			
Aster multiflorus	1	28.5	9
Euphorbia marginata	1	18	6
Lygodesmia juncea	1	12	4
Psoralea tenuiflora	1	2	T*
Psoralea argophylla	1	1.5	T
Sphaeralcea coccinea	2	3.5	1
Total Forbs	7	65.5	20
Browse			
Artemisia filifolia	1	6	2
Artemisia kansana	6	50.5	16
Total Browse	7	56.5	18
Grass			
Aristida longiseta	2	5.5	2
Bouteloua curtipendula	1	30	9
Bouteloua gracilis	2	16	5
Sporobolus cryptandrus	3	19.5	6
Total Grass	8	71	22
Cacti			
Opuntia macrorhiza	5	130	40
Totals		323	100

*Less than one percent.

Discussion

There is a decided lack of browse plants throughout the occupied range. Sand sage is found in a narrow strip along the major streams and their tributaries. These streams include the Smoky Hill River, Goose Creek and Turtle Creek. Sagewort is a low growing (6-8 inch) species that resembles a forb more than a browse plant. It is included with the browse species to avoid confusion due to its generic name. Sagewort is scattered throughout the occupied range and is taken where found.

As table 4 shows, sand sage makes up only 2 percent of the overall diet even though antelope tend to congregate along the major stream valleys during the winter months where this sage is most prominent. This tends to confirm the suggestions of Deming (1963) concerning the use of sagebrush by antelope on the basis of its availability and not as a preferred food. With the supply of other forage available in Kansas sagebrush does not appear to be an important food item.

Broom snakeweed (Gutierrezia sarothrae) is a relatively abundant shrubby species but no feeding time was obtained for it. Actually there were no indications that antelope would use snakeweed as a forage plant. Snakeweed matures in late summer and early fall, producing flowering heads at this time. During the winter and spring months it is stemmy and dry, seemingly with little value as a forage plant.

Antelope tended to use more grass in Kansas than has been recorded in other states such as Colorado (Hoover, Robert L., C. E. Till, and Stanley Ogilvie, 1959), Wyoming (Federal Aid Project, 1956) and Oklahoma (Buechner, 1950). This may be due to a lack of browse or because the antelope prefer grass. Greater grass utilization may reflect the antelope's habit of feeding on winter wheat during the winter and spring. Since wheat is a grass it may be that a relation exists between the palatability of wheat and that of native grasses thereby influencing the over-all ingestion of grass. Also, grass makes up 67 to 77 percent of the total pasture habitat (Hlavachick, 1963). This would indicate a preponderance of grass in the diet due to abundance alone.

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Discussion

Mustard: I understand the people want to burn the rangeland in the area.

Hlavachick: Yes, they do. It keeps the areas in grass and causes stooling and what used to be summer stocking is now grazed the year around.

Hepworth: What is the average snow cover; say in November to March?

Hlavachick: Eight inches.

Hepworth: Is this why browse is not used?

Hlavachick: I believe they prefer grass and it is usually above the snowline.

ANTELOPE FAWN PRODUCTION AND SURVIVAL ON SEMI-DESERT RANGE IN WESTERN UTAH [1/]

by

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and

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Progress Report
Not for Publication

A cooperative study on the pronghorn antelope (Antilocapra americana) was initiated in 1959 by the Utah State Department of Fish and Game, Utah State University, and the Intermountain Forest and Range Experiment Station. It was hoped that some of the factors responsible for the low population level of this species on semi-desert ranges might be discovered. Historically, Utah had moderate antelope populations but since the drastic decline in numbers over most of its original range in the early nineteen hundreds, populations have remained low as compared to other states.

The Intermountain Forest and Range Experiment Station is providing facilities for the study at the Desert Experimental Range near Milford, Utah. A herd of antelope has been confined to an enclosed portion of this Range seventeen square miles in size, thus providing opportunity to follow productivity of a specific antelope herd and relate production and survival to habitat. Water is provided for the antelope in troughs at several sites in the area to exclude it as a limiting factor.

The study area is typical of many intermountain valleys in western Utah and eastern Nevada. Elevations range from about 5000 to above 8000 feet. The vegetation is comprised of the various communities of the northern desert shrub formation (Shantz 1925). Forage composition in the enclosure as measured in the fall, averages about 55 percent shrubs, 33 percent grasses, and 12 percent forbs by weight. The major plant species in order of abundance are, shadscale (Atriplex confertifolia), Indian ricegrass (Oryzopsis hymenoides), winterfat (Eurotia lanata), galleta (Hilaria jamesii), snakeweed (Gutierrezia sarothrae), dropseed (Sporobolus spp.), black sagebrush (Artemisia nova), and rabbitbrush (Chrysothamnus spp.). In fall and winter, these eight species make up over 80 percent of the available forage. Total production, however, is greatly influenced by both annual and seasonal fluctuations in precipitation (Hutchings and Stewart 1953).

[1/] This report is a contribution from Federal Aid in Wildlife Restoration Program, Utah Pittman-Robertson Project W-105-R. Project is cooperative with Utah State Department of Fish and Game, Intermountain Forest and Range Experiment Station, and Utah State University.

Forage production in the central part of the enclosure and over that part used most by antelope averaged 122 pounds per acre dry weight for 1962 through 1964. Precipitation for that same period averaged 5.91 inches annually.

The antelope herd has exclusive use of the enclosure except for about two months in the winter when it is grazed by sheep as part of the Desert Experimental Range grazing studies. The enclosure contains two grazing units. These units are grazed during one of three designated periods. Sheep use the north unit in midwinter, January 4 to February 23, and the south unit in early winter, November 15 to January 3, or late winter, February 24 to April 10. During the three winters, 1962-63 through 1964-65, the south unit received an average of 8.3, and the north unit 11.7, sheep days use per acre. For the duration of the study antelope have had access to forage ungrazed by livestock until February or March each year.

Although the enclosure is 17 square miles in size, part of it is mountainous and not used by antelope. Over a period of a year antelope spend approximately 70 percent of their time in six square miles and the remaining 30 percent in an additional five square miles. The most intensively used portions of the enclosure receive approximately 4 antelope days use per acre. Since 1961, the total antelope population in the enclosure has ranged from ten to about fifty-five animals.

Results and Discussion

Antelope use and distribution within the enclosure varies with the season and the forage species available. During spring and summer most of their time is spent in the central portion where forbs are most abundant and are available in the greatest variety. During fall and winter their distribution tends to follow that of black sagebrush which is present in the north part of the enclosure and the washes of the central part. The predominant factor influencing distribution seems to be availability of preferred forage species.

The common plant species present in the enclosure and the preference antelope show for them, are presented in Table 1. The preference rating was derived from a large number of observations of antelope feeding-sites. These observations were made shortly after the antelope left the sites and when evidence of use was still relatively easy to observe. Estimates were then made of the amount of use and the abundance of each species. The preference which antelope have shown for each plant species in the enclosure is expressed as zero, low, moderate or high (Table 1). This is a somewhat subjective classification but on the other hand forage preferences of antelope are highly variable and depend on many factors which together make a completely objective classification of preference practically impossible. The succulence of plants, stage of plant development, plant species available, variety of species, and to some extent, season of year all influence the preference antelope show for a particular species at any one time.

In general the antelope in the enclosure have shown preference for forbs and when available they form a major part of their diet. The new growth

of several shrub species particularly black sagebrush is also used extensively. When the availability of forbs decreased as a result of dry conditions the amount of use on black sagebrush and other shrubs increased. By winter their diet has been almost entirely browse and in the enclosure 80 percent or more of this was black sagebrush.

The only time grass has been used to any extent by the antelope in the enclosure is in early spring when new growth starts and in fall when regrowth has occurred as a result of rains. In spring, antelope have shown high preference for the new growth on some species of grass, particularly Poa secunda. As the grasses mature the antelope gradually shift to forbs and browse. By the first of May, use of grass has been very light, and restricted largely to the seed heads.

Table 1. Common plant species present within the enclosure, showing antelope preference by season of use.

	Preference*	Season of Use			
		Spring	Summer	Fall	Winter
Shrubs:					
Artemisia nova	H	x	x	x	x
Artemisia spinescens	M	x			x
Atriplex confertifolia	L				x
Brickellia longifolius	M		x	x	x
Cercocarpus intricatus	M				x
Chrysothamnus spp.	L				x
Cowania stansburiana	M				x
Ephedra nevadensis	M	x			
Eurotia lanata	L				x
Gutierrezia sarothrae	L		x		
Polygala acanthoclada	0				
Prunus fasciculatus	M	x	x		
Solidago petradoria	0				
Salvia carnosa	L	x	x	x	x
Tetradymia spinosa	0				
Forbs, perennial:					
Aplopappus nuttallii	M	x	x	x	
Cryptantha spp.	L	x			
Enceliopsis nudicaulis	L	x			
Erigeron concinnus	H	x	x	x	
Eriogonum spp.	H	x	x	x	
Hymenopappus lugens	H	x	x	x	
Oenothera canescens	H	x	x	x	
Penstemon spp.	H	x	x	x	
Sphaeralcea spp.	H	x	x	x	
Forbs, annual and biennial:					
Aster spp.	H	x	x	x	
Astragalus spp.	L	x			
Chaenactis macrantha	H	x			
Chenopodium spp.	L	x			
Eriogonum spp.	H	x	x		
Euphorbia ocellata	H	x	x	x	
Halogeton glomeratus	0				
Lappula occidentalis	0				

Table 1 Con't.

	Preference*	Season of Use			
		Spring	Summer	Fall	Winter
Lepidium scopulorum	L	x			
Linum lewisii	H	x	x	x	
Phacelia crenulata	L	x			
Salsola kali tenuifolia	H	x	x		
Towsendia florifer	H	x	x	x	
Grasses:					
Aristida spp.	O				
Bouteloua gracilis	L	x			
Bromus tectorum	M	x		x	
Hilaria jamesii	L	x			
Oryzopsis hymenoides	M	x			
Poa secunda	H	x			
Sitanion hystrix	M	x			
Sporobolus spp.	L	x			
Stipa comata	L	x			

* O = no observed use, L = low preference, M = moderate preference, H = high preference.

Data obtained on antelope fawn production and survival in the enclosure from 1961 through 1965, and the corresponding forage conditions for each seasonal period are presented in Table 2. The fawn survival figures are derived from total counts except for July in 1964 and 1965, when survival was calculated from a number of fawn-doe ratio counts. Forage condition is classified into four categories, poor, fair, good, and excellent. This classification, for spring, summer and fall periods, is based on the availability of green succulent forage, primarily forbs. Winter forage quantity and quality is largely a reflection of growing conditions during the previous spring and summer, and the classification for this period refers to the production and succulence of current shrub growth. Black sagebrush makes up approximately 80 percent of the winter diet of antelope in the enclosure and is the species given most consideration.

A number of factors must be considered in assessing the reproductive responses of the enclosed herd. Nutrition, predation, old age, disease, and possibly poisonous or toxic plants are among the more probable and important ones to consider here. In some cases handling of young fawns has been a contributing factor to early fawn mortality but the amount this has affected the total antelope population in the enclosure is probably small.

Nutrition appeared to be an influencing factor during some years of the study. Early fawn losses were less pronounced when green, succulent forage was abundant in spring and summer. Also, high fawn productivity appeared to follow years when fall forage condition was excellent. For example, in 1964 the actual observed fawn crop was nearly equal to the maximum potential or physiological natality and followed what were excellent forage conditions the previous fall. Under such conditions the does seem to gain weight rapidly and recover from the strain of nursing fawns in the summer and thus go into the winter in better physical condition. Theoretically, a good body condition should contribute to higher conception but a study in New Mexico (Larsen 1965) of conception rates of antelope in poor physical condition suggest that this may not be an important factor. A more probable significance of excellent fall forage, is a higher fetal and neonatal survival resulting from the better physical condition of the mother. During the five years of the study in the enclosure (Table 2) 32 percent of the potential fawn crop has not been present by May or June. It therefore seems that if heavy losses are not occurring during gestation then they occur shortly after parturition. A large proportion of does observed in June have only single fawns and lend support to this possibility. In 1965 considerable mortality occurred with both fawns and adults during excellent forage conditions. In view of the exceptionally good year forage wise, lack of adequate nutrition does not seem a likely cause.

The degree to which population levels in the enclosure are density dependent are open to question. Yearly and seasonal changes in forage abundance of course must be considered here. In spring forb production over much of the range used by antelope during good or excellent years may reach 100 pounds per acre dry weight. When available in this amount it seems unlikely that forage is a density dependent factor at existing population levels. During poor or only fair forage years or periods,

Table 2. Seasonal forage condition and antelope production and survival of a confined herd.

Year	Forage Condition[1]				Total mature does	Known fawn prod.	Fawn survival			Percent herd mortality in winter
	Spring	Summer	Fall	Winter			Late June	Late July	Nov.	
1961	Fair	Poor	Good	Good	10	8 (3 marked)	5	4	1	0
1962	Excellent	Poor	Poor	Poor	10	10 (4 marked)	7	6	5	20
1963	Good	Fair	Excellent	Good	15	15 (9 marked)	5	4	4	0
1964	Excellent	Fair	Poor	Fair	16	29 (9 marked)	24	20	15	20
1965	Excellent	Excellent	Excellent	Excellent	16	20	19	13	6	6
			Total			82	60	47	31	
			Percent Average Fawn Survival				73%	57%	38%	

[1] The classification of forage conditions in spring, summer, and fall is based on availability of green succulent forage, primarily forbs. Poor refers to little or no such forage, and excellent refers to an abundance of succulent forage with forbs available at nearly 100 pounds per acre dry weight. Winter forage quality and quantity is largely a reflection of growing conditions the previous "growth year" and the classification here refers to production and succulence of current growth on shrubs.

even thirty head may provide enough competition that forage might conceivably be a density dependent factor. In 1964, by mid-December antelope had utilized 34.7 percent of current growth on black sagebrush. This was the highest use received at this date for any year and was due to a larger number of animals, and fair to poor forb production in summer and fall which caused a shift to shrub species. With use this intense, and with about three months of winter remaining it is possible that available forage becomes limiting.

The extent that sheep grazing in the enclosure in winter affects the antelope population is not known. Buechner (1950) speaks of antelope populations declining under competition with domestic sheep but he is mainly referring to summer use. The only forage species in the enclosure that for practical purposes could be said to present an area of competition between sheep and antelope in winter is black sagebrush. Since this species makes up only 10 percent or less of the total forage and is highly preferred by both sheep and antelope, severe competition could feasibly exist. In some years the combined antelope and sheep use on black sagebrush has appeared excessive. In the spring of 1964, use on black sagebrush was estimated at about 85 percent of previous years growth. However, antelope have had exclusive use of at least one grazing unit until late winter, and therefore, competition has not been as great as it might otherwise have been.

The part predation may have with antelope mortality is difficult to determine. More often than not, the remains of animals that die are not found, and those that are have usually been fed on by ravens and foxes, which makes cause of death difficult to ascertain. Potential predators in this part of Utah include the coyote, golden eagle, cougar and bobcat.

Coyotes are occasionally seen in the enclosure but have never been observed molesting or attempting to capture antelope. Golden eagles are common near the enclosure during the fawning period, but here again no attempts to capture fawns have been observed by us, and a cumulative total of many hundred hours have been spent observing during the fawning period. In 1959, just after the initial herd had been introduced a fawn carcass was found which may have been killed by an eagle. Hinman (1961) conducted a study of the feeding habits of the golden eagle in western Utah on range occupied by antelope, and did not find strong evidence of antelope predation. Cougar occasionally kill sheep in the vicinity of the Desert Experimental Range but this is not common. During the period of this study, no definite incidents of predation have been confirmed. In winter of 1964-65, the remains of seven adult antelope were found in the enclosure, and in these cases predation did not appear evident. This mortality apparently occurred between December, 1964, and March, 1965. Age may have been a contributing factor, since four of the seven found were six years of age or older. In the summer of 1965, mortality seemed to occur indiscriminately among adults, as well as with the fawns. The reasons for loss here at this time are purely conjectural.

In 1961, escape from the enclosure probably contributed to the losses, for a plastic ear marker, like that used on two animals put in the enclosure in 1960, was found outside the enclosure. The places of possible

escape were then secured in 1962.

Poisonous or toxic plants do not appear to be a factor. Halogeton is found in the enclosure, particularly in places disturbed by rodents but there is no indication that antelope utilize this species. Several species of Astragalus spp. are found in the area, some of which may be poisonous, but these are infrequently used by antelope. It is still possible that antelope may be picking up something toxic and this should be investigated further.

At this time it does not seem as though the apparent high mortality of antelope fawns in the enclosure over the past five years can be attributed to any one factor alone. However, it seems that ultimate fawn productivity is most seriously reduced during two critical periods. The first occurs during gestation or shortly following parturition, and the second occurs about mid-July when the fawns are from six to ten weeks of age.

With the exception of 1965, the highest mortality in the enclosure has occurred during or following drought periods and when forage was in poor condition. During the summer and fall of 1965, this did not seem to be the case, because succulent forage was available in the greatest variety and abundance since the study has been in progress. In this case, it is doubtful if any summer or fall fawn mortality can be attributed to lack of nutrition. Certainly much still remains to be learned about ecological relationships of antelope on semi-desert range and the factors necessary for high reproductive success before management can be directed at alleviating limiting factors and providing a larger population and resource for the sporting public.

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ANTELOPE FOOD HABITS AND RANGE RELATIONSHIPS IN COLORADO

by

Robert L. Hoover

ABSTRACT

Stomach samples were collected from 320 antelope throughout the year. The contents were passed through graduated screens, the contents sorted, and the percentage of each food classification was determined by air dry weights.

There was a wide variety of plants eaten but some species were found to occur frequently in the samples, while others were only occasionally taken. In the short-grass plains region, browse constitutes the major portion of the diet during the fall and winter periods. Forbs are utilized to the greatest extent during the spring and summer months. Grasses constitute a very minor portion of the diet. Cacti, although not constituting a major portion of the diet, are taken sparingly throughout the year. It was found the annual diet of antelope in the short-grass areas consisted of 40.02 percent browse plants, 42.96 percent forbs, 11.00 percent cacti, 5.84 percent grasses, and 0.12 percent miscellaneous materials. Utilization of wheat by antelope in these areas is confined to the months of November through April. Wheat constitutes a major portion of the diet of antelope ranging in the vicinity of green wheat fields.

A limited number of stomach samples taken from antelope ranging in the mountainous regions of Colorado indicated these antelope utilized browse plants to a greater degree than antelope ranging in the short-grass plains.

The degree of competition between antelope and horses and cattle is very negligible, while that with sheep is considerable. Competition between pronghorns and livestock has been based primarily on types of forage used by each. Antelope readily consume, without any apparent detrimental effects, many plants known to be toxic to domestic stock.

Introduction

A knowledge of the feeding habits of antelope is necessary to determine the carrying capacity of various ranges; to wisely select transplant sites; to better understand the inter-relationships between antelope and other grazing animals foraging on the same range; and to evaluate crop depredation by antelope.

The diet of herbivorous mammals changes with the changing seasons, which not only effects availability of forage, but also palatability and nutrient properties. It is, therefore, important that stomach samples from antelope be collected at various seasons of the year. The following remarks are based on the analysis of 320 stomach samples.

Method of Collecting Samples

Three means were used to collect samples: hunting season kills, animals taken on control work, and those collected by biologists to fill the gaps. In collecting samples, the stomach contents were stirred and a double handful of material was collected.

Method of Analyzing Samples

The collected samples were passed through graduated screens and the contents of each screen were floated in water for sorting onto blotters for drying. Sorting was done as to browse plants, forbs, grasses, cacti, cultivated crops, and miscellaneous.

Although food items were seldom sorted as to species, a check list of species was compiled.

The percentage of each food classification was determined by air dry weight.

Results and Discussion

Qualitative Analyses

A seemingly endless variety of plant life was found in the samples, including fifty-one different forbs, sixteen different species of browse plants, ten grasses, five cultivated crops, two cacti, plus sedges, lichens, mosses and mushrooms. Also found were such things as insects, soil, sand and gravel, which were more than likely accidently ingested.

The large variety of food items consumed by antelope may be partially attributed to the fact that samples were taken in several different vegetative types. Nevertheless, many different species were found to be utilized within a vegetative type. Furthermore, individual samples showed considerable variation.

Selective Feeding Habits

With such a variety of plant species utilized, one might conclude that antelope are promiscuous feeders, but this is not true. Some species were found to occur frequently, while others were only occasionally taken.

Quantitative Analyses

Quantitative analyses were generally confined to dividing the contents of stomach samples into the major forage groups. Separate analyses were made for the different vegetative types represented by the stomach samples.

Short-grass Plains of Eastern Colorado

The short-grass plains of eastern Colorado are characterized by vast expanses of grasses, consisting primarily of blue grama and buffalo grasses, with varying densities of browse, forbs and cacti. Cultivated crops are interspersed throughout much of the antelope range here and often supplement the diet at certain times of the year.

Composition

Of the 192 samples analyzed from this area, browse plants occurred in 99.5 percent of the samples, forbs in 98.4, grasses in 88.0 and cacti in 64.4.

Seasonal Variations in Diet

Samples representing the months of January, May, September, October and November were considered adequate. Others, though not as numerous, were considered to be of some value with the exception of June, for which there was only one sample. Since the data were not adequate for a monthly analysis, monthly data were lumped together by seasons to evaluate seasonal variations in food habits. The seasonal grouping yielded 74 winter, 15 spring, 73 summer and 30 fall samples. (Table 1).

The amount of browse in the diet is highest in the fall, when it averages 71.6 percent. It continues to constitute the largest portion of the diet in winter, 54.2 percent. In spring and summer, about equal portions are taken, 24.7 and 22.3 percent, respectively. Variations in the amount of browse plants in the samples varied from 0.0 to 100 percent.

Forbs are utilized to the greatest extent during the summer, when they constitute 65.6 percent of the diet. The consumption of these plants drops sharply to 22.1 percent in fall and continues at about this low level, 26.0 percent, through the winter. In spring, forbs again become the most important item in the diet, making up 50.5 percent. Individual samples varied greatly.

Grasses occur in very small quantities, averaging less than five percent during the winter, summer and fall seasons. The average consumption of grass in the spring jumped to 20.3 percent. Individual samples contained as high as 75 percent, while some samples were without grasses at all seasons.

Cacti, although not constituting a major portion of the diet, are taken sparingly throughout the year. These plants are eaten in the largest quantity in winter, when they average 15.1 percent. The consumption of this food is 10.7 percent in summer and five percent or less in spring and fall. While many samples were without cacti, some contained as much as 94.4 percent. Miscellaneous food items made up less than one-tenth of one percent.

The reasons for antelope altering their diets at different seasons can only be postulated. Factors which might cause these seasonal variations

TABLE 1 - PERCENT OF MAJOR FORAGE GROUPS CONSTITUTING ANNUAL DIET OF ANTELOPE IN SHORT-GRASS TYPE, EASTERN COLORADO.[1]

Season and Months	Number of Samples	Conversion Factor	Browse		Forbs		Grasses		Cacti		Misc.	
			Average Seasonal Composition	Portion of Annual Diet	Average Seasonal Composition	Portion of Annual Diet	Average Seasonal Composition	Portion of Annual Diet	Average Seasonal Composition	Portion of Annual Diet	Average Seasonal Composition	Portion of Annual Diet
Winter (Nov.-Mar.)	74	5/12	54.2	22.50	26.0	10.83	4.6	1.92	15.1	6.29	0.1	0.04
Spring (Apr.-May)	15	2/12	24.7	24.7	4.12	50.5	20.3	3.38	4.3	0.72	0.3	0.05
Summer (June-Sept.)	73	4/12	22.3	7.43	65.6	21.87	1.3	0.43	10.7	3.57	0.1	0.03
Fall (Oct.)	30	1/12	71.6	5.97	22.1	1.84	1.3	0.11	5.0	0.42	Trace	-
Total (Ann. Diet-%)	192	-	-	40.02	-	42.96	-	5.84	-	11.00	-	0.12

1 Computed by multiplying the average percent seasonal consumption by the number of months constituting each season and dividing by 12, number of months in the year.

2 Average seasonal composition multiplied by conversion factor to yield portion of annual diet percent.

TABLE 2 - MONTHLY PERCENTAGES OF COMPOSITION FOR DIFFERENT GROUPS OF FORAGE FOUND IN ANTELOPE STOMACHS CONTAINING WINTER WHEAT.

	No. of	Browse		Forbs		Grasses		Cacti		Wheat		Misc.
Month	Samples	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
Nov.[1]	82	14.0	0.0-67.5	8.8	0.0-57.7	0.4	0.0-14.9	4.5	0.0-63.6	72.3	4.3-100.0	T[4]
Dec.[2]	-	-	-	-	-	-	-	-	-	-	-	-
Jan.	10	4.5	0.0-17.6	11.4	T-33.4	0.0	None	2.8	T-20.8	81.3	45.8-97.2	0.0
Feb.	1	0.0	None	0.0	None	0.0	None	0.0	None	100.0	None	0.0
Mar.	2	11.7	6.4-17.0	0.0	None	T	None	0.0	None	88.3	83.0-93.6	0.0
Apr.	3	6.9	1.6-11.9	12.9	3.6-20.8	0.0	None	3.2	0.0-8.6	77.0	69.0-88.3	0.0
Ave.[3]	98	12.6	0.0-17.6		0.0-57.7	0.3	0.0-14.9	4.1	0.0-63.6	74.0	4.3-100.0	T

1 Although 30 samples were collected in October, wheat first appeared in November samples.

2 No samples were taken in December, but utilization of wheat was substantiated by field observations.

3 Computed by taking an average of the total composition percentage of 98 individual samples.

4 Trace (T), less than one-tenth of one percent.

may be availability, palatibility, succulence, individual needs and preferences.

Availability of these groups of forage is not a major consideration, as they occur in varying densities throughout the vegetative type and well within the daily cruising radius of the antelope.

It can probably be said, without fear of contradiction, that antelope on the short-grass prairies of eastern Colorado prefer forbs over any other type of native forage. The fact that forbs continue to be present in sizeable quantities in the winter diet, even when their palatability is reduced, would lead one to believe this type of forage is highly relished by the pronghorn.

The consumption of browse plants during the fall and winter months overshadows that of forbs, probably because of their higher palatibility and nutrient content at this time of year. The fact that in spring there is a sudden increase in the amount of forbs eaten, with a corresponding decrease in that of browse, seems to indicate a preference for forbs over browse when both are high in palatibility and nutrient values. A reversal of the diet takes place in the fall after the first killing frost. Despite these seasonal changes, the importance of browse plants in the spring and summer diets must not be overlooked, as such plants continue to provide 23 percent of the diet.

The amount of grasses eaten during the summer, fall and winter seasons is so slight that one might believe grasses are not intentionally eaten, but only accidently ingested with other foods. However, certain individual animals are notable exceptions. The high consumption of grasses in the spring provides a sharp contrast.

It is commonly believed that cacti are eaten by antelope to satisfy their need for additional moisture which these plants can provide. There is some evidence to support this belief. Many samples contained as much as 50 percent of these plants and a few had over 90 percent. Although there is evidence to indicate that cacti are eaten to fulfill the need for moisture, it must not be concluded that this is the sole reason for pronghorns consuming these plants. Possibly there is some nutrient property cacti provide that is not found in other forage. The fact that cacti are sometimes consumed even where water is available is significant.

Food Preference

Although the department studies did not deal with food preference, two Colorado State University students (Scarvie and Arney, 1957) did make such a study during the month of October on the short-grass plains of eastern Colorado.

They reported preference indices of 15.0 for browse plants and 6.0 for forbs, thus indicating a high degree of selection. These workers reported 1.5 for cacti and 0.009 for grass.

Composition of Annual Diet

Besides the seasonal variations in the diet of antelope, the proportions of forage types in the annual diet are important. It was found that the annual diet consisted of 40.02 percent browse plants, 42.96 percent forbs, 11.00 percent cacti, 5.84 percent grasses, and 0.1 percent miscellaneous.

Cultivated Crops in the Diet

No discussion of the antelope food habits of eastern Colorado would be complete without an analysis of the amount of cultivated crops consumed. The following discussion is based on 98 samples which contained winter wheat that were excluded from the analysis of other samples collected from the short-grass prairies of eastern Colorado.

It is evident that utilization of wheat is confined to the months of November through April. The available data would seem to indicate an increase in consumption of wheat from November to February or March, followed by a decline in April.

For those animals ranging in the vicinity of green wheat fields between November and April, wheat constitutes the major portion of their diets, 74 percent. That all antelope in the vicinity of wheat fields utilize wheat during this period is established by the fact that samples collected in these localities almost invariably contained wheat.

If all the wheat had been excluded from samples and the percentage composition of other food items recomputed, the percentages would be close approximations to those of samples that contained no wheat.

Mountain Bunch Grass Type of South Park

The mountain bunch grass type of South Park is in a sub-climax stage dominated by short grasses at the present time. Browse plants are in the minority and there is a great variety of forbs present, although they are less abundant than grasses.

Only 15 samples, collected from August through October, represent the antelope food habits studied in this area. Obviously, there isn't sufficient data to permit a detailed analysis. It would appear from the scanty information available that browse plants are much more important in the diet here than on the prairie of eastern Colorado. The proportion of forbs in the diet seems to be lower, while grasses were utilized in similar amounts. Cacti were not present or occurred in small amounts in this vegetative type, never constituting over 2.6 percent of the samples.

Mountain Brush Type of Moffat County

The mountain brush type of Moffat County is best typified by a high density of browse plants. This vegetative type is represented by only seven stomach samples, all of which were collected in September. These

samples averaged 93.7 percent browse plants, 2.0 forbs, 4.3 grasses and only a trace of cacti.

Intermountain Desert Shrub

Seven stomach samples collected in September provide the only Colorado data from this vegetative type. These samples averaged 37.0 percent browse plants, 60.1 forbs, 1.1 grasses and 1.8 cacti. The amount of browse plants and forbs in the samples here are in sharp contrast to those amounts in the samples collected from the nearby mountain brush type during the same month.

Carrying Capacity

The foregoing presentation on the food habits of the pronghorn antelope clearly indicates that this species is partial towards browse plants and forbs and that cacti are next in importance, with grasses being rather insignificant except for the spring months of April and May. It may be stated, then, that ranges dominated by about equal proportions of browse plants and forbs, with some cacti and a minority of grasses would provide the highest carrying capacities, considering only food habits. The better quality mountain-brush-type ranges of Moffat County come the nearest to fulfilling these requirements.

Food Relationships with Livestock

Livestock operators are likely to be apprehensive when they observe large numbers of pronghorns grazing on their ranges. It is only logical that with the limited information available, it is possible to draw some general conclusions in regard to competition with domestic livestock. The very insignificant amount of grass taken by antelope, less than 6 percent of the annual diet, makes competition with horses practically non-existent. The same may be said for cattle on grass ranges in good condition.

Because their diet is high in browse plants and forbs, antelope are in direct competition with sheep.

The degree of competition between pronghorns and domestic stock may be more accurately measured by comparing the volume of various types of forage consumed. Using the best available information on the amount of different forage types required by different grazing animals, it is possible to conpute conversion factors which indicate the number of antelope needed to consume the same as one head of livestock. These data indicate 117 pronghorns are required to take as much forage as one horse, and 105 antelope are equal to one cow. Since the diet of sheep comes the closest to that of antelope, arriving at a single conversion factor that would include all types of forage is difficult. However, the data indicate a conversion factor of 0.7 to 1 for browse plants and forbs, or seven antelope consume as much as ten sheep. The precise diet of sheep on short-grass ranges was not known so had to be estimated, thus subjecting the computed conversion factor to some error.

Even though some of the foregoing conversion factors are based on estimates, it is clear that the degree of competition between antelope and horses and cattle is very negligible, while that with sheep is considerable. To better illustrate the relationship between cattle and antelope in Colorado, all the antelope in the state (9,000) would not eat enough grass to feed 100 head of mature cattle.

Competition between pronghorns and livestock has been based primarily on types of forage used by each. When the plants making up these groups of forage are considered, the degree of competition is even less, as many plants eaten by antelope are not readily taken by livestock because of being poisonous, injurious or otherwise undesirable.

Poisonous Plants Eaten by Antelope

Strange as it may seem, antelope readily consume, without any apparent detrimental effects, many plants known to be toxic to domestic stock. Often these plants are taken in large quantities. By utilizing these plants, antelope provide a valuable service of which the livestock raisers are seldom aware. It is conceivable that the consumption of poisonous plants by antelope may more than repay stockmen for the amount of livestock forage eaten by antelope.

Noxious Plants Eaten by Antelope

Many plants are eaten by antelope, and often in large quantities, which are considered by ranchers to be noxious because they cause mechanical injuries to livestock, or are unpalatable to stock and therefore tend to crowd out desirable forage species and dominate the range. Such undesirables as bull thistle, Russian thistle, cacti, cockle burs and snakeweed are eaten by antelope.

Some people might question the value of antelope in reducing poisonous or noxious plants even though they are eaten. Although no specific range surveys have been made to determine the effects of grazing on undesirable plants, some observations on the feeding habits of a one-month old captive fawn were made. This fawn was confined to a section of lawn 40 by 20 feet that contained numerous dandelions, plantain, other weeds and cultivated flowers. Within two weeks, not a single leaf of these herbaceous plants could be found despite the fact that other foods were being artificially supplied. Even though antelope have been observed to feed in rather a dainty fashion, the presence of soil between their teeth is an indication that they often crop plants below ground level.

It may be safely concluded that the food habits of the pronghorn antelope are very erratic in comparison to those of domestic stock, and it is this erratic nature that makes them an asset on cattle and horse ranges and not completely obnoxious on sheep ranges. Not only do antelope aid in keeping ranges in balance by using many plants that are avoided by domestic animals, but it is possible that if a sufficient number of pronghorns use these plants, range conditions for domestic stock might improve. The trend in recent years of livestock men changing to dual use by sheep and cattle with good range results, illustrates

how antelope may be beneficial on livestock ranges.

Discussion

Jones: Bob, is the wheat damage mainly in the spring or is it also in the fall?

Hoover: There is no damage to amount to anything in the fall. The real damage comes at a time when there is no longer any green forage available on their native range; and when the range plants are pretty well dried up and the wheat starts germinating and coming up it looks pretty good to those antelope. They move on to it in large number.

Jones: This is the winter wheat?

Hoover: Winter wheat, yes.

Jones: Does this actually damage the wheat or a.....

Hoover: That's where I got off the antelope project.

Townsend: It seems to me there are quite a few ranchers and farmers who graze their own winter wheat up until about April and there have been a number of studies made on goose grazing of wheat. It actually increased the yield.

Hoover: There are three schools of thought on the antelope damage to wheat or the effects of antelope grazing on wheat. One school of thought you get from the ranchers is that the antelope goes in there and he doesn't bite it off, in this loose soil he pulls the plant completely out of the ground and you've lost the plant. In some cases this is true. In analyzing an antelope stomach sample you will find the roots of a wheat plant, but it is not often this occurs. Then there is the other school of thought in grazing of domestic stock on wheat fields to make the plants stool out and increase the yield. Some ranchers hold to this. Then, the other school of thought is though they do not damage the plants themselves but in some of these loose soils they break the crust with their hooves and the wind comes along and starts this soil to moving and then the field blows out. Those are the three ways of thinking you get when talking to some of these ranchers. There is some evidence of this later, but again I don't know what we can do about this. There are a lot of these areas planted wheat which shouldn't have ever been taken out of virgin prairie.

Beale: What plants do you find that are toxic to sheep and cattle that antelope eat?

Hoover: They'll take larkspur, some of your vetches; those are the ones that come immediately to mind. They will often occur in sizeable quantities in the samples.

Vidakovich: What about halogeton, Bob?

Hoover: We have taken so few samples on the west slope, Lou, we have not found this to occur. The fact is they take Russian thistle in eastern Colorado, which is a close relative to halogeton. This makes me think they would take halogeton in western Colorado and eastern Utah.

Beale: We have Russian thistle and halogeton both in western Utah. Russian thistle they use considerably, halogeton very very little. The sheep can eat ten times the halogeton the antelope could.

Townsend: Glen Cole in his Montana study on antelope and wheat relationship did a little bit on evaluating the wheat production with and without antelope grazing on it. He found if the grazing extended up beyond May 1st, or there about, when the culms were elongated then there was a reduction in wheat production. But there was not a reduction in wheat production if the antelope moved off before the first of May.

Hoover: In his experiment did he have the antelope confined to this area so only the wheat was available to them?

Townsend: No, this was on a plot sampling basis.

Hoover: The experience I've had in eastern Colorado, as soon as the stem makes its first joint the antelope don't have anything to do with it.

Townsend: Well, he couldn't demonstrate any effect after the first of May because they were all off. He had to go in and clip.

Hoover: Well it certainly is available to antelope in eastern Colorado, and there are antelope adjacent to these fields in May. But about the only thing you see is once in a while they'll go out and fawn in the wheat fields and maybe bed-down. This may cause some damage. But I seriously question damage by eating after April.

Bogart: Bob, I hate to contradict you on this, but we have goats all over the wheat fields in eastern Colorado now.

Hoover: You don't have anything else, they have to stay there.

Bogart: You're wrong there; and the big majority of that wheat is jointed. There is even some of it in the blooming. The antelope have stayed on it all winter. Of course, this is the only green thing; this is an unusual year, we have jointed wheat everywhere. But they haven't left it when it jointed. Normally in the spring that is true, though.

Hoover: Is there evidence they are eating this after it is jointed?

Bogart: Well I don't know, if you consider their green behind and that's the only green in the country, yes.

Hoover: That's pretty good sign. Scour to beat the devil.