PROCEEDINGS OF THE

THIRD BIENNIAL

ANTELOPE STATES WORKSHOP

FEBRUARY 5-6, 1968

CASPER, WYOMING

P R O C E E D I N G S

of the

THIRD

ANTELOPE STATES WORKSHOP

Casper, Wyoming

February 5-6, 1968

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Chairman

John L. Newman

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INTRODUCTION

The third meeting of the Antelope States Workshop, was the first meeting to be held on a biennial basis. This decision was made at the 1966 meeting at Denver, Colorado. The 1968 meeting was held February 5th and 6th at the Ramada Inn in Casper, Wyoming.

This meeting was well attended, with ninety-eight representatives of various organizations attending the two day session. The general concensus of the group was that the meeting was a successful one. The papers were well prepared and the presentations were made in an interesting manner. The program included two panel discussions, and an impromptu field trip at the end of the program on the second day.

While the discussion may have been somewhat restricted because of the size of the group, an informal attitude prevailed.

It is felt that these meetings are not only justified, but serve a real purpose in considering the many, and often complex, problems encountered in managing populations of pronghorn antelope. The many types of seasons, differences in state organization of management agencies, differences in laws, considerations of federal land management agencies, and certainly the variations of biological, climatic, and ecological factors encountered in the antelope's distribution all heighten the interest of such a meeting.

An invitation was extended by representatives of the Nebraska Game, Fish and Parks Department to host the next workshop. The offer was accepted by the group, and it was decided that the 1970 meeting will be held in Nebraska.

Agencies represented at the meeting included the following:

New Mexico Game and Fish Department
Texas Parks and Wildlife Department
U. S. Forest Service
U. S. Bureau of Land Management
Nebraska Game, Fish and Parks Department
Montana Fish and Game Department
Utah Fish and Game Department
U. S. Bureau of Sports, Fisheries and Wildlife
Colorado Game, Fish and Parks Department
South Dakota Game, Fish and Parks Department
U. S. Soil Conservation Service
University of Wyoming
Izaac Walton League
Wyoming Game and Fish Commission

John L. Newman
Chairman

PAST CHAIRMEN AND MEETING PLACES

Date	Chairman	Meeting Place
April 14-15, 1965	William S. Huey	Santa Fe, New Mexico
February 16-17, 1966	George D. Bear	Denver, Colorado
February 5-6, 1968	John L. Newman	Casper, Wyoming

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Third Biennial

ANTELOPE STATES WORKSHOP

February 5 - 6, 1968

RAMADA INN
Casper, Wyoming

Program Theme: Intensive Management of Antelope Herds

February 5

8:00 A.M. - Registration

8:30 A.M. - Welcome - James B. White, State Game and Fish Commissioner
Wyoming Game and Fish Commission

9:00 A.M. - A Review of Distribution and Abundance of American Prong-horn Antelope

Jim Yoakum, Wildlife Management Biologist
BLM, Reno, Nevada

9:45 A.M. - Coffee

10:15 A.M. - A Review of Antelope Fence Crossing Devices (Panel Discussion) Panel Members:

George Bear, Assistant Wildlife Researcher
Colorado Game, Fish and Parks Department
Richard Kerr, Wildlife Management Biologist
BLM, Santa Fe, New Mexico
Rex ZoBell, Wildlife Management Biologist
BLM, Cheyenne, Wyoming
Larry Pate, Big Game Biologist, Wyoming
Game and Fish Commission

Moderator: William I. Crump, District Supervisor
Wyoming Game and Fish Commission

12:00 Noon - Lunch

1:15 P.M. - Water Consumption by Antelope and Distribution in the Red Desert

Charles Sundstrom, Biologist
Wyoming Game and Fish Commission

1:45 P.M. - Antelope Herd Population Dynamics Versus Diseases in the Texas Panhandle

Richard DeArment, Biologist
Texas Parks and Wildlife Department

2:15 P.M. - Diamond Ring Antelope Fencing Studies

Larry Pate, Big Game Biologist, Wyoming Game and Fish Commission
John Crawford, Wildlife Specialist
BLM, Casper, Wyoming

2:45 P.M. - Coffee

3:00 P.M. - Effects of Fenced Pastures and Grazing Practices on Public Use and Antelope Management (Panel Discussion) Panel Members:

Rex M. Corsi, Assistant State Game Warden
Wyoming Game and Fish Commission
Dr. Morton May, Professor, Range Management
University of Wyoming
Fred Knowlton, Wildlife Biologist, U. S. Bureau of Sports, Fisheries & Wildlife, San Antonio, Texas
Dr. Ken Diem, Professor, Zoology and Game Management, University of Wyoming

Moderator: John L. Newman, Big Game Biologist
Wyoming Game and Fish Commission

5:00 P.M. - Adjourn

February 6

8:30 A.M. - Ten Years of Antelope Management in the Gillette Area of Wyoming

Marvin Hockley, Big Game Biologist
Wyoming Game and Fish Commission

9:00 A.M. - Hunter Harvest and Population Trend of a Small Herd of Antelope Located in Moffat County, Colorado

George Bear, Assistant Wildlife Researcher
Colorado Game, Fish and Parks Department

9:30 A.M. - A Review of Harvest and Population Changes in the Big Piney - Muddy Creek Area

James H. Straley, Big Game Biologist
Wyoming Game and Fish Commission

10:00 A.M. - Coffee

10:30 A.M. - Summer Range Habits of the Pronghorn Antelope in Central Montana with Special Reference to Proposed Sagebrush Control Study Plots

Harold James Wentland, Research Biologist
Montana Fish and Game Department

Food Habits, Range Use and Home Range of Pronghorn Antelope in Central Montana during Winter

Steve Bayless, Game Management Biologist
Montana Fish and Game Department

Ecological Effects of Chemical and Mechanical Sagebrush Control

Duane Pyrah, Research Biologist
Montana Fish and Game Department

11:30 A.M. - Summarization - Selection of next meeting place - Adjournment.

WELCOME ADDRESS

by
James B. White, Commissioner
Wyoming Game and Fish Commission

Good morning, welcome to Wyoming and Casper. I thought as I was driving up yesterday, it's so seldom that we have time any more to really sit back and think. I believe about the only time that I have any right to think is when I'm driving down the road or away from the office, any other time the telephone is ringing or I've got some problem that is forced upon me.

Among my scattered thoughts yesterday, as I was driving up, I couldn't help but think of some of the problems that I've had. Some of the things that, as the kids would say, 'bugged me' in the last several weeks. I can remember a word and I think that it's one I have heard more than any other in the last several days. I don't think there is anything that causes more pain, creates more drudgery and is a block to progress any more than the word consistency. I think to be constant is to stay on the narrow path, to never go from the known to the unkown; and so, I hope that as you gather here today that you won't follow the calf path.

I would like to read a poem that I cut out of a small newspaper which is called "The Calf Path".

"One day through the primeval wood
A calf walked home as good calves should;

But made a trail all but bent askew,
A crooked trail as all calves do.

Since then three hundred years have fled,
And I infer the calf is dead.

But still he left behind his trail,
And thereby hangs my moral tale.

The trail was taken up next day
By a lone dog that passed that way;

And then a wise bell wether sheep
Pursued the trail o'er vale and steep,

And drew the flock behind him, too,
As good bell wethers always do.

And from that day o'er hill and glade
Through those old woods a path was made.

And many men wound in and out,
And dodged and turned and bent about,

And uttered words of righteous wrath
Because 'twas such a crooked path;

But still they followed . . . do not laugh,
The first migrations of that calf.

This forest path became a lane,
This crooked lane became a road,

That bent and turned and turned again,
Where many a poor horse with his load

Toiled on beneath the burning sun
And traveled some three miles in one.

And thus a century and a half
They trod the footsteps of that calf.

The years passed on in swiftness fleet,
The road became a village street;

And this, before men were aware,
A city's crowded thoroughfare.

And soon the central street was this
Of a renowned metropolis;

And men two centuries and a half
Trod in the footsteps of that calf.

Each day a hundred thousand rout
Followed this calf about

And o'er his crooked journey went
The traffic of a continent,

A hundred thousand men were led
By one calf near three centuries dead.

They followed still his crooked way,
And lost one hundred years a day;

For thus such reverence is lent
To well established precedent.

For men are prone to go it blind
Along the calf-paths of the mind,

And work away from sun to sun
To do what other men have done."

I think this is apropos to some of our great problems, I hope we don't follow the calf path. I hope you will resolve here today to have the courage to change and the guts to gamble. In view of this philosophy, I would suggest that you deliberate in the next two days over the real problems, discuss your successes but at the same time fear not to admit your mistakes for it may be those that will pave the way to solutions. Share with each other your knowledge, stick with each other in temporary defeat and in the long run I think that you will win.

This concludes my brief comments except that since this is, I believe, the third Antelope Workshop I would like to tell you people who are from outside of Wyoming just what the antelope has contributed to our department since 1948. From 1948 to 1967 the total income to the State of Wyoming was $8,738,970 from antelope alone. It might be interesting to you to note that $1,693,765 of this total was contributed by residents, the rest was contributed by non-residents.

I think the first of this particular type of meeting which I attended was the Mountain Sheep Workshop about fifteen years ago. Since then we've had Sage Grouse, Elk, Antelope and many of the other species, and I don't believe there is any way we can contribute more to management than to trade ideas and ideology.

Jack, it's been a privilege to be here this morning. Thank you.

A REVIEW OF THE DISTRIBUTION AND ABUNDANCE OF AMERICAN PRONGHORN ANTELOPE

by
Jim Yoakum
Wildlife Management Biologist
Bureau of Land Management, Reno, Nevada

Abstract: It is estimated 35,000,000 pronghorns inhabited North America prior to the arrival of white man. Within 75 years, this population decreased to less than 20,000 animals. For the past 40 years (1924 to 1964) the population has increased over 1,000 percent. The recent population increases have been accomplished concurrently with annual harvests for the past decade totaling twice as many harvested antelope each year as existed in the world during 1924. Antelope are today the second most important big game animal in North America with over a million animals harvested during the past 30 years. Uncontrolled hunting and decreased habitat were major reasons for the decline during the late 1800's. Effective law enforcement, return of habitat, and wildlife management techniques, such as trapping and transplanting, were important contributing factors for accelerated population increases to an approximate half million pronghorns today.

INTRODUCTION

In 1805 when the Lewis and Clark expedition saw the vast pronghorn (Antilocapra americana) herds, it was estimated there were possibly 35,000,000 antelope in North America (Nelson 1925:4). Within 100 years the population was decreased to less than 20,000 individuals and it was predicted they were doomed to extinction. But by the mid 1920's, the herds had increased to over 30,000. Then for the next 40 years the North American antelope population increased over 1,000 percent. This story of wildlife management has not been thoroughly documented. The objective of this paper is to analyze and record the reasons for this phenomenal case of antelope population recovery -- from historical records of abundance, to pioneer days of exploitation, to present day practices of conservation and management.

Commencing in 1965, while the author was guest lecturer in Big Game Management at Humboldt State College, Arcata, California, this study was a continuim through 1967. The majority of the antelope ranges were visited during this time. Many contacts with representatives from state and federal conservation agencies were made, and it is with this cooperative assistance that much of the data was gathered to document this report.

PROCEDURES

The following two major methods were used to collect data.

1. A questionnaire was mailed to all states in the U. S. maintaining antelope herds. In addition, each providence of Canada and Mexico was contacted. The contacts were requested to furnish (1) data on estimated antelope population numbers for 1964; (2) a map outlining areas occupied by antelope in 1964; and (3) data by year (1934 to 1964) of legal harvested antelope. Information for these questionnaires was obtained for all states of the U. S. and all Canadian providences. No reliable information to any of the questions was received for Mexico.

The data was then compared to similar studies conducted in 1922-24 by Nelson (1925). Results from these comparisons provided information for the last 40 years.

2. Antelope population data for historical conditions and the early 1900's was procured while researching literature for another publication (Yoakum 1967).

RESULTS

Distribution:

The pronghorns' range in the early nineteenth century covered most of the Great Plains, as well as the high sagebrush plateaus and grassland valleys in the western states, parts of south central Canada and northern Mexico (Nelson 1929:2, and Einarsen 1948:2). By the 1920's, this ancestral range had been reduced considerably (Figure 1). Actually, the antelope range did not cover all the area outlined by Nelson and Einarsen, but these early publications documented the antelope's general distribution pattern for North America. There were areas in the range not inhabited by antelope, such as the Rocky Mountain crest, however, these areas were not delineated. One slight modification to Nelson's original distribution map, is recent reports from Washington disclosing that there is no documented proof antelope existed north of the Columbia River in the early 1800's (J. B. Lauckhart, personal communication).

Today's ranges occupied by antelope are outlined in Figure 1 as indicated by reports received from states and providences. Antelope occupy most of their former regions except states east of the Mississippi River. Reintroductions since the 1920's have extended the range back to some unoccupied regions of South Dakota and Texas. In addition, antelope have been translocated to three states that never had antelope during historical times--Florida, Washington, and Hawaii. The transfer of antelope to Hawaii marks the first successful establishment of the pronghorns outside of the North American continent.

Abundance:

Just how many antelope roamed the continent prior to the arrival of white man is not known for sure, but it is conservatively estimated there were 30 to 40 million or more (Nelson 1925:4). It has been judged pronghorns exceeded bison (Bison bison) numbers during the pre-Columbian period.

During the early nineteenth century the herds began to decrease gradually. However, by the latter part of the century, the numbers were decreasing at an alarming rate. By the first decade of the twentieth century, less than 20,000 were estimated (Leister 1932:185) in the United States. This was the population's lowest level. In 1922-24, Edward Nelson conducted the first extensive census of antelope and recorded a little over 26,600 in the States (Table 1). Within the next decade the population skyrocketed to over 130,000, again to 246,000 by 1944, and 360,000 by 1954. At this time the population began to reach a leveling point for it increased only another 5,000 by 1964, making a present total of 365,000, which is well over 1,000 percent increase from the original census in 1924 (Tables 1, 2, 3).

Population estimates for Canada show a similar pattern of increased numbers. Actually the counts jumped from 1,330 in 1924 to 20,260 in 1964, or a remarkable increase of around 1,500 percent (Table 2).

Data for Mexico is lacking in detail compared to its northern neighboring countries. In 1924 it was estimated 2,390 antelope ranged throughout Mexico. The most reliable current data (Baker 1958) discloses that very possibly half this number of animals, or a 50 percent decrease, exists today.

Density:

When dividing the surface acres of habitat by the estimated number of animals, average density figures were determined for each state (Table 4). Wyoming was the only state averaging two antelopes per square mile. States possessing one antelope per square mile were all Great Plains states. States averaging less than one antelope bordered the periphery of the antelope's entire range. No density figures were determined for Canada or Mexico.

These density figures were calculated only for state-wide averages. Some areas, such as parts of the Great Plains ranges, averaged more than two animals per acre, but other parts of the ranges within the state ranged much less. Some states, such as California and Nevada, had densities averages of only a fraction of one percent.

Harvests:

In 1934 three states (Idaho, New Mexico, and Wyoming) held open seasons on antelope and harvested less than 2,000 head. Thirty years later, in 1964, a total of 14 states maintained hunting seasons and some 75,000 antelope were harvested (Table 5). This is more than twice the number of existing pronghorns during Nelson's survey in 1924. Wyoming itself has averaged a harvest of over 25,000 animals for each of the past 15 years. Well over a million pronghorns have been harvested during the past 30 years, thereby making the antelope the second most important big game animal in North America.

DISCUSSION

Reasons for Decline: Why did antelope herds decrease from 35,000,000 to less than 20,000 in 75 years, is the basic question so frequently asked about the American pronghorn. Upon reviewing the literature, it is apparent the antelope decreased rapidly as white man moved west across the North American continent (Leister 1932; Buechner 1960; Forsyth 1942; Grinnell 1921; Bailey 1926; Baker 1958; Beer 1944; Dalquest 1953; Leopold 1959; Ligon 1927; Murray 1932; Newberry 1855; and Villa 1951).

White man first saw antelope in Mexico. He has been associated with these animals here the longest. Reports document that herds in Mexico have been, and still are, declining (Baker 1958; Dalquest 1953; Gusman 1961; and Leopold 1949). The only two pronghorn subspecies (*Antilocapra americana sonoriensis* and *A. a. penisularis*) presently on the world list of endangered wildlife (IUCN 1967) mainly inhabit regions of Mexico.

The vast central valley of California is another example of antelope herds vanishing as civilized man occupied the land. Prior to the influx of settlers in 1850, reports documented, "Though found in nearly all parts of the territory of the United States west of the Mississippi, it is probably most numerous in the valley of the San Joaquin, California. There it is found in herds literally of thousands..." (Newberry 1855). But only two decades later, after the gold rush days brought a mass migration of humanity, Caton (1877) stated, "It was very abundant in California twenty-five years ago... They are very

scarce, if any exist in that state now." Although these historical reports document the pronghorn density as the greatest in the world in the vast San Joaquin Valley, they have been extirpated by man and are now extinct in this region. Extensive agriculture practices and human development were the reasons for the loss of the ancestral habitat.

Other antelope ranges experienced similar accounts of declines. Always the basic reason was the same, although expressed in different terms--market hunting, railroads, highways, livestock competition, homesteaders, changes in land pattern, poaching, agriculture, etc. It was the advancement of white man's civilization that directly and quickly decreased the herds by relentless year round shooting of herds for food and pleasure. He then perpetuated the decreased herds by occupying their preferred habitats and not allowing their numbers to regain former abundance. It was a double spear head factor, one of direct killing, and the other of decreasing habitat.

It is true that natural mortality factors such as hard winters (Allred 1943), predation (Nelson 1925), droughts (Beer 1944), played a part in taking their annual toll of herds each year. But they likewise did this during the pre-Columbian days and the herds still remained in dozens of millions. It was only when white man and his civilization came to North America that the herds decreased to a fraction of their pristine abundance.

Reasons for Increases: Possibly the lowest ebb in the pronghorn's numbers existed during the first decades of the twentieth century. Slowly at first, then with quick momentum, the population soared to a thousand percent increase in 40 years (1924 to 1964). It appears as though the population curve is presently leveling around 400,000 for all of North America.

Many wildlife managers and conservationists pose the question of why did the pronghorn population increase during the last half century at such a record rate. A review of the literature indicates there are three important reasons: (1) controlled hunting (Buechner 1960, Mathison 1962, Rush 1944); (2) return of historical range to antelope habitat (Leister 1932, Benson 1946); and (3) accelerated wildlife management practices (Buechner 1960, Forsyth 1942, Russell 1937, Baker 1948, Willcox 1963).

The control of man's hunting activities is without a doubt the greatest single contributing factor to the antelope's increase. Although laws prohibiting the killing of antelope were passed by State legislations in the late 1800's and early 1900's, these laws did not by themselves correct the problem. However, when State wildlife agencies became active in the 1920's and 1930's to enforce these laws--then the herds began to increase. Hand in hand with an agressive law enforcement program could be cited the important element of public concern and demands backing conservation ethics to manage the herds. An enlightened public to the welfare and perpetuation of the endangered pronghorn prompted laws and enforcement which aided in turning the tide of events in the pronghorn's destiny.

At about the same time the herds began to increase there was a return of former rangelands to habitat for antelope. The early homesteaders and settlers, not successful on their open prairie small dry farms, departed for the cities and other "greener pastures", thereby reverting much of the plains to antelope habitat. This human movement was taking place in Canada as well as the United States, all to the pronghorn's benefit. No longer was man everywhere on the open rangelands eking a living off the land, plowing up the rich grasslands to

plant wheat and shooting every available game animal possible to provide meat for growing, expanding families.

By the 1940's, North Americans were delving further and deeper into the science of wildlife management. New practices and techniques were being developed for the purposes of increasing wildlife numbers and improving the habitat. One of the most outstanding examples of management practices devloped was the method of trapping and re-establishing formerly inhabited ranges. Such methods were soon put into effect for practically every western state and many thousands of animals today are products of these ventures. The success of these management practices have truly proven that man is capable of improving many biological problems that he brought about originally himself.

Another example of man's ability to improve conditions for the antelope is the practice of improving water on the open ranges. Both State and Federal agencies as well as private individuals have improved hundreds of water developments presently used by antelope (Mace 1949, U. S. Bureau Land Management 1965). In many areas inhabited today by the heaviest density of antelope per square mile, the distribution of water has been improved over its quantity in the nineteenth century.

It is interesting to note the historical parallel conditions between the saiga antelope (Saiga tatarica) of Russia (Bannikov, A. G. et al) and the American pronghorn of North America. Both antelope existed in the millions during the early 1800's. Both decreased to near extinction by the 1920's. However, after an aroused public interest and effective law enforcement, each species experienced a return to a half million or more during the last 40 years. Both species are now major animals of importance providing thousands of recreation days for hunters and aesthetic enhancers of wildlife.

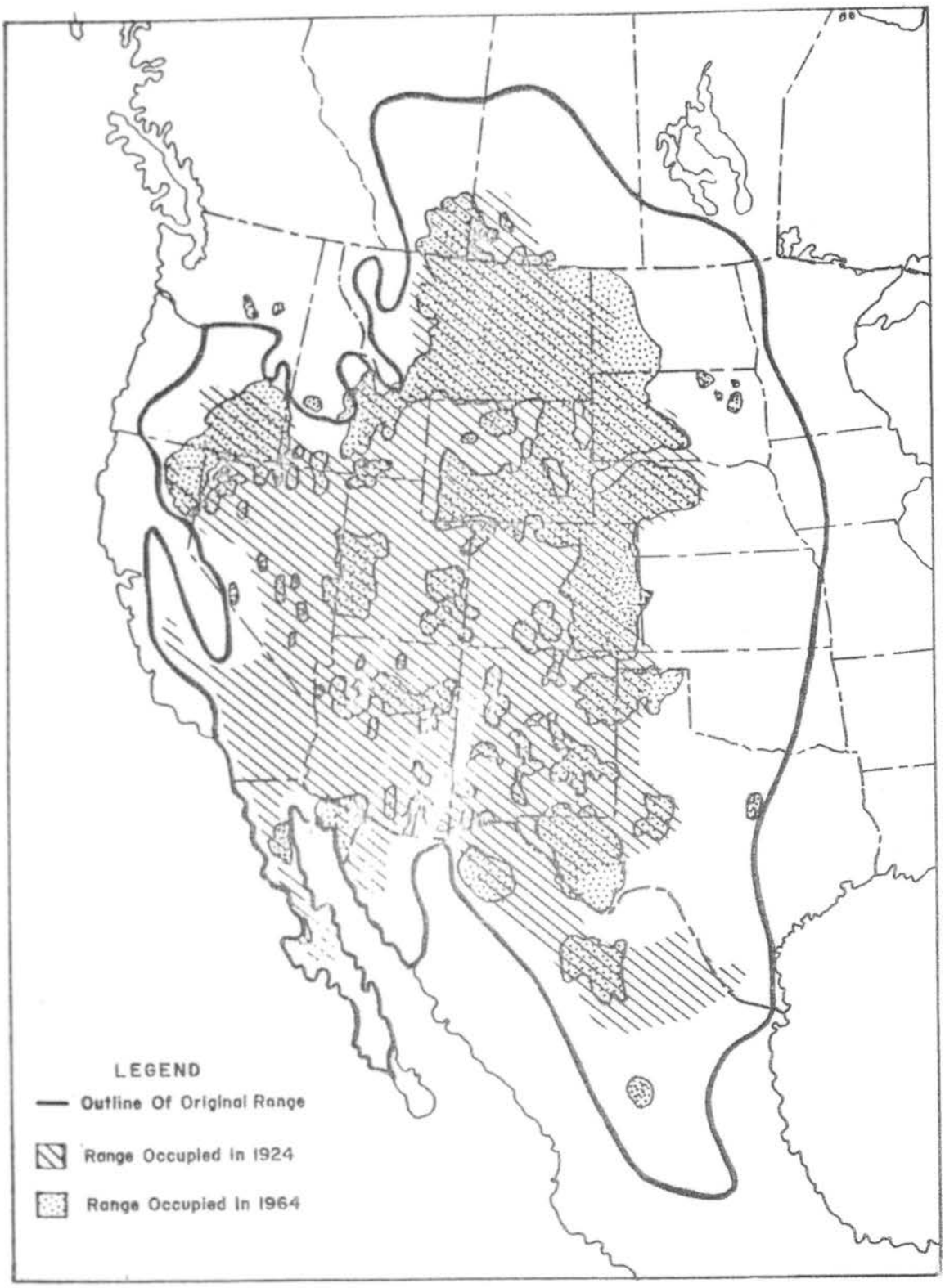

Figure 1. Past and present distribution of the American pronghorn antelope in North America. Information relative to the "original" distribution and range occupied in 1924 adapted from Nelson 1925:2.

Table 1. A comparison of estimated pronghorn antelope numbers in 1924 (Nelson 1925:3) with 1964 for the United States.

STATE	1924*	1964	Difference between 1924 & 1964	
			No. of Animals	Percent Increase
1. Arizona	650	10,000	9,350	1,438
2. California	1,060	2,690	1,630	153
3. Colorado	1,230	15,250	14,020	1,140
4. Hawaii	---	130	130	---
5. Idaho	1,480	4,700	3,220	217
6. Kansas	10	140	130	1,300
7. Montana	3,030	95,000	91,970	3,035
8. Nebraska	190	9,000	8,810	4,637
9. Nevada	4,250	4,500	250	6
10. New Mexico	1,680	22,500	20,820	1,239
11. North Dakota	220	14,240	14,020	6,373
12. Oklahoma	20	180	160	800
13. Oregon	2,040	8,950	6,910	339
14. South Dakota	680	27,410	26,730	3,931
15. Texas	2,410	9,380	6,970	289
16. Utah	670	970	300	45
17. Washington	---	120	120	---
18. Wyoming	6,980	140,000	133,020	1,906
TOTAL	26,600	365,160	338,560	1,273

* Original published figures rounded to closest tenth.

Table 2. A comparison of estimated pronghorn antelope numbers in 1924 (Nelson 1925:3) with 1964 for North America.

REGION	1924*	1964	Difference between 1924 & 1964	
			Number of Animals	Percent Increase or Decrease
Canada:				
Alberta	1,030	16,000	+ 14,970	+ 1,453
Saskatchewan	300	4,260	+ 3,960	+ 1,320
CANADA	1,330	20,260	+ 18,930	+ 1,423
MEXICO	2,390	1,200	- 1,190	- 50%
Summary:				
Canada	1,330	20,260	+ 18,930	+ 1,423
Mexico	2,390	1,200	- 1,190	- 50%
United States	26,600	365,160	+ 338,560	+ 1,273
TOTAL - NORTH AMERICA	30,320	386,620	+ 356,300	+ 1,175

* Original published figures rounded to closest tenth.

Table 3. Estimated antelope population increases at ten year intervals from 1924 to 1964 in the United States

Year	Population Estimate 1/	Source of Data
1924	26,600	Nelson 1925
1934	131,500 2/	U. S. Bureau Sport Fisheries and Wildlife 1939
1944	246,100	U. S. Bureau Sport Fisheries and Wildlife 1946
1954	360,000	U. S. Bureau Sport Fisheries and Wildlife 1956
1964	365,200	This report

1/ All figures rounded to closest hundred.
2/ No data available for 1934, consequently, figures for the closest known year (1937) were substituted.

Table 4. Estimated density of antelope per square mile of inhabited range in the United States for 1964.

Two Antelope Per Square Mile	One Antelope Per Square Mile	Less Than One Antelope Per Square Mile
Wyoming	Montana North Dakota South Dakota Nebraska New Mexico	Arizona California Colorado Idaho Kansas Nevada Oklahoma Oregon Texas Utah Washington
140,000 antelope	168,150 antelope	56,880 antelope

TABLE 5. RECORDED HARVESTS OF ANTELOPE FROM 1934 TO 1964 IN THE UNITED STATES

STATE	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	TOTAL
Arizona								286	487	522	NOS	NOS	NOS	NOS	NOS	437	352	548	739	828	1,146	578	297	205	301	605	722	755	612	729	844	10,993
California									405	362	322	307	NOS	NOS	NOS	349	NOS	280	NOS	NOS	NOS	NOS	NOS	NOS	NOS	120	NOS	NOS	NOS	NOS	183	2,328
Colorado												834	1,113	NOS	NOS	1,129	2,148	1,646	1,922	4,456	3,338	3,167	2,969	3,302	2,262	1,900	1,713	1,905	2,903	4,023	4,885	45,615
Idaho	69	144	124	142			400	555	790	700	1,470	605	NOS	461	419	383	539	1,349	1,520	1,254	970	822	919	1,001	821	679	696	573	549	771	839	19,364
Montana										553			1,800	2,800	2,800	3,762	7,668	8,177	18,096	22,000	20,000	26,000	22,971	14,438	14,002	15,600	15,000	19,300	23,000	22,240	27,000	287,208
Nebraska																NOS	NOS	NOS	NOS	134	421	796	748	783		219	422	683	967	1,018	1,090	7,201
Nevada										10			386	371		NOS	125	233	NOS	133	203	187	80	63	126	135	146	211	152	182	204	2,947
New Mexico	116	NOS	280	234	387	453	516	455	547	657	601	286	NOS	441	466	652	768	692	1,080	907	910	647	1,099	1,088	1,640	2,026	1,305	3,906	1,639	742	859	25,399
North Dakota								NOS	NOS	NOS	NOS	NOS	NOS	NOS	NOS	NOS	NOS	913	986	NOS	1,800	1,500	1,150	1,381	1,770	2,100	2,050	2,950	2,960	2,500	3,510	25,570
Oregon			175	214			399	1,378	601	690	712	328	NOS	NOS	NOS	586	679	600	448	181	334	358	318	294	314	448	459	418	277	333	378	10,922
South Dakota									475	1,000	480	NOS	684	1,875	2,400	NOS	759	3,151	7,880	4,800	5,200	4,281	5,616	3,800	3,000	4,950	6,500	8,000	6,500	8,000	6,050	85,401
Texas													391	578	629	NOS	375	480	NOS	621	NOS	1,240	1,179	834	926	1,370	1,584	2,081	1,970	1,669	691	16,618
Utah												45	62	85		43	26		NOS	NOS	64	56	47	34	33	74	99	92	74	50	56	940
Wyoming	1,800	1,419	1,714	2,235	1,805	2,362	3,267	5,337	6,050	14,863	10,573	17,143	9,109	10,521	15,912	11,340	22,792	39,315	41,020	34,909	30,776	33,090	23,013	25,708	23,910	26,542	31,674	34,873	37,444	35,590	28,965	585,051
TOTAL	1,985	1,563	2,293	2,825	2,192	2,815	4,582	8,011	9,355	19,357	14,158	19,548	13,545	17,132	22,626	18,681	36,231	57,384	73,691	70,223	65,162	71,722	60,406	52,932	49,105	56,768	62,370	75,667	79,047	77,847	75,534	1,125,757

NOS - No open season

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EVALUATION OF STRUCTURES PLACED IN NET WIRE FENCES TO FACILITATE ANTELOPE MOVEMENTS*

by
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ABSTRACT

This study was conducted in northwestern Colorado in areas where newly constructed fences interfered with antelope movements. Several crossing devices were evaluated; miniature cattleguard-like structures (antelope pass and Powder River Pass) and Paul's Pass. The antelope passes measured 4 feet wide by 3-3½ feet across, it was set on two railroad ties. The placement of this pass was tested by placing it in the original fenceline, and by constructing an offset in the fenceline and placing the pass in the offset. Powder River Pass is a standard cattleguard cut in half and placed in the fenceline over a two-foot deep pit. Paul's Pass is a rectangular pen (50 feet by 100 feet) constructed in the fenceline. The periphery of the pass is constructed with a four strand barbed wire fence. A 26-inch net wire fence bisects the center of the enclosed area. A section of 32-inch fence was also evaluated in this study.

The antelope pass appeared to be the best type of structure for allowing antelope movement. Use was nearly doubled by placing the pass in an offset rather than merely inserting it in the original fenceline. However, this structure needs some modifications to reduce sheep use. Paul's Pass and Powder River Pass received very light use. The 32-inch fence permitted movement of yearling and adult antelope, but less than half of the fawns (3-5 months old) crossed.

INTRODUCTION

The selected study area is located in Moffat County, northwestern Colorado. A series of net wire fences were constructed in this area in 1964 to separate grazing allotments and subdivide other allotments into smaller pastures. Sheep-tight fences were constructed of net and barbed wire to an over-all height of 44 inches and 42 inches. Many of these new pastures lacked water development. Antelope were seen walking the fence lines in effort to find routes to formerly used waterholes; fifteen animals were found hung-up in the fences. They became entangled in the wire while attempting to jump across or force their way under the fence. This situation resulted in a cooperative study between the Bureau of Land Management and the Colorado Game, Fish and Parks Department to find devices for permitting free movement of antelope. The Bureau of Land Management furnished the finances and supervision necessary to install the structures mentioned in this paper; while the Colorado Game, Fish and Parks Department supplied the vehicles, personnel, and other materials needed to evaluate the structures.

* This paper is a contribution from the Federal Aid Project W-40-R (Antelope Investigations), Colorado Game, Fish and Parks Dept.

METHODS

Structures - A combination of "Paul's Pass" and antelope passes were used in the study. Paul's Pass was designed by Paul Applegate with the Bureau of Land Management. It is a rectangular pen 50 feet across and 100 feet long constructed in the fence line. The periphery of the pass was constructed with a four strand barbed wire fence. The spacing on the wires were: the first was placed 16 inches above the ground; the spacing on the other wires was 6 inches, 8 inches, and 10 inches (Figure 4). The fence bisecting the center of the enclosed area (on the same plane as the original fence) is a 26 inch woven wire in one of the Paul's passes and 26 inch slotted wire in the other pass (Figure 2 and 3). The general theory behind the construction of this type of pass is the outer barbed wire fence will prohibit the movement of cattle, but will allow the antelope to crawl under. Then the inner fence (net wire) will prohibit the movement of sheep, but is of a minimum height to facilitate antelope crossing over it. The wire in the second Paul's pass was cut so there were slots approximately 5 inches by 12 inches in the bottom tier. The slotted wire was to be evaluated in respect to allowing antelope fawns to crawl through the fence until they were old enough to jump over the top.

The third structure in the group was a miniature cattleguard-like structure called an "antelope pass". This structure was constructed out of 1 inch steel bar. It's overall dimensions were four feet by four feet. Due to the light construction of these passes they will not support motored vehicles, thus, they were made only four feet wide to prohibit vehicles from passing through. The overall length of four feet was suggested as a minimum length which might prohibit the movement of domestic livestock. It was intended in the initial planning that the span which an animal would have to clear should be four feet, but in constructing the passes the structure was overlapped on the ties so the actual open span was three to three and one-half feet. The spacing between the cross bars was 4 inches. The pass was set on a pair of railroad ties (one at either end) to hold it up off the ground (Figure 5). It was felt that by elevating this structure, rather than placing it over a pit as done with cattleguards, would keep this pass from collecting blowing snow, soil, or other items. Therefore, it would reduce maintenance.

The structures were grouped in each study area as follows: Paul's pass with 26 inch woven wire; a 100 foot interval; and antelope pass; another 100 foot interval; and a Paul's pass with slotted wire (Figure 1). There were five "groups" of these structures under surviellance.

In addition to the structures mentioned above, some antelope passes were placed in offsets of the fences (Figure 6). This was done by altering the direction of the fence by placing a 90 degree turn in the fence and running this leg of the fence out for 25 feet then angling it back toward the original fence line, so it intersected the original fence at a point approximately 100 feet from the 90 degree turn. An antelope pass was place in the center of the 25-foot leg of the offset. The theory is an antelope moving along a fence line is more apt to encounter an antelope pass placed directly across his direction of movement, than an antelope pass placed in the original fence line. This study compared the two techniques for placement of the antelope pass.

In addition to these newly installed structures, there were two "Powder River Passes" and a section of 32-inch high fence which were evaluated. These structures and fence had been installed about one year in advance of this study. The Powder River Passes were made by cutting a standard cattleguard in half,

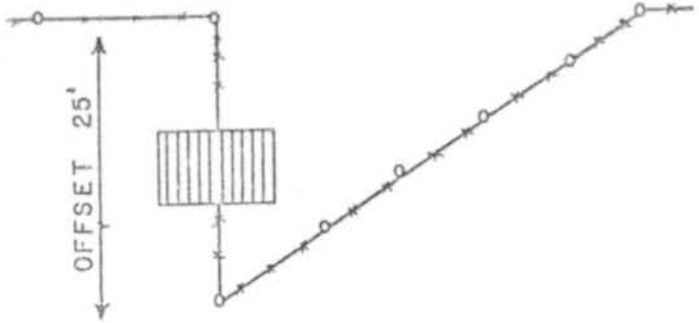

FIG. 6

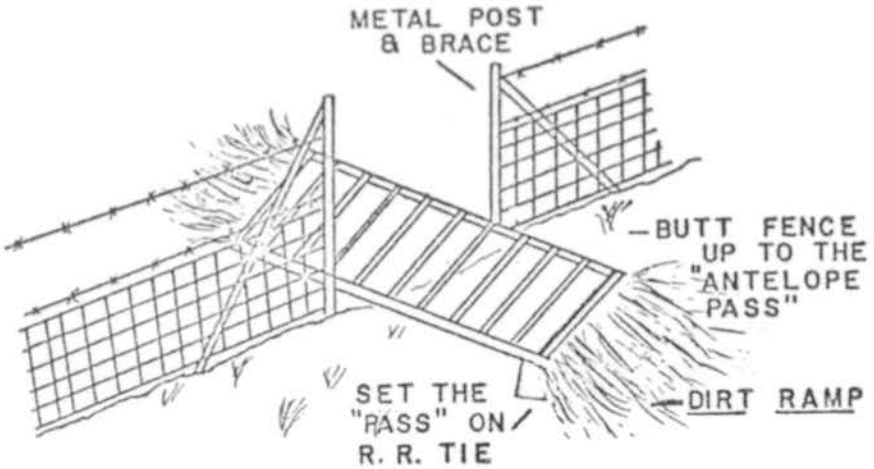

FIG. 5

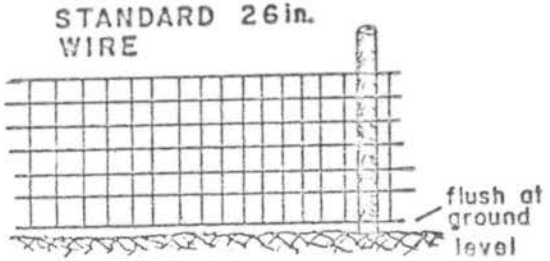

FIG. 2

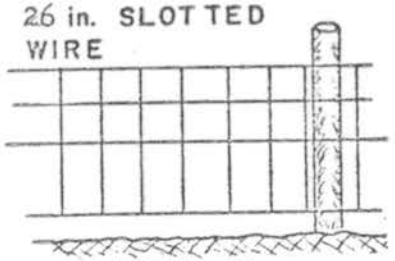

FIG. 3

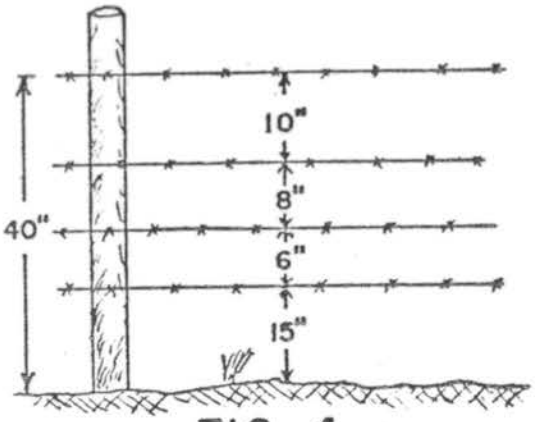

FIG. 4

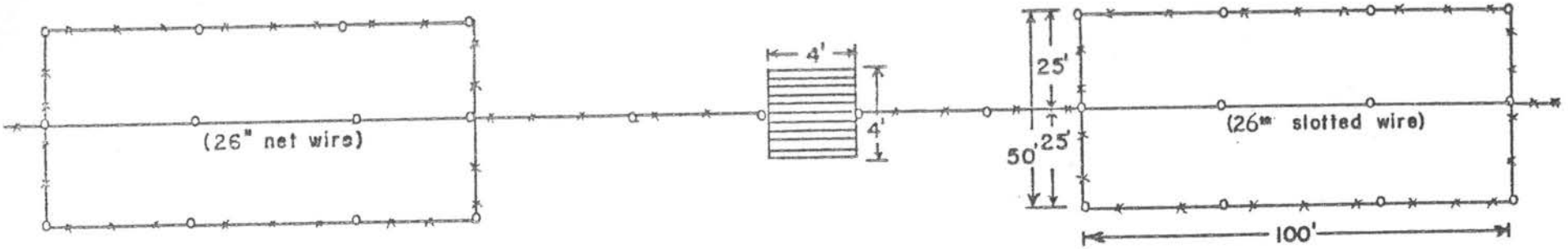

FIG. 1

thus giving a miniature cattleguard measuring four feet wide and six feet long. This structure was placed in the fence line over a two-foot deep pit. Wooden posts were angled down from the fence to the outer corner of the pass. These posts are to force animals to cross the full six-foot span of the pass. These passes were installed in a fence constructed with 26-inch net wire placed 2 inches above the ground and one strand of barbed wire 4 inches above the net wire for an overall height of 32 inches.

Evaluation of antelope and livestock movements - Movement of antelope and livestock through the structures was determined by track counts and direct observations. These observations were limited to the period from June 1 to November 1. The structures were built on graded or cleared areas, which facilitated the track counts. The observer recorded the number of animals that crossed each structure and the number which approached the structure but didn't cross. During the summer period (when fawn tracks are noticably smaller than adult tracks) the counts were divided into adults and young categories. Four track counts (two-day intervals between counts) were made at each structure during a ten-day period each month. The tracks were erased with a garden rake following each count.

In addition to the track counts, an effort was made to obtain information by direct observation of the animals using the structures whenever the opportunity permitted. The following information was recorded: date; time of day; total numbers crossing; number refusing to cross; sex; age (adult, yearling, fawn); and behavior upon approaching and using the structure.

RESULTS

Track Counts:

Cattle - All the structures effectively prevented movement of cattle across the fences. The number of animals approaching the structures were as follows: offset-pass, 74; antelope pass in the straight fence, 53; Paul's pass with net wire, 65; Paul's pass with slotted wire, 73; and Powder River Pass, 11. Two animals were recorded to have crossed the structures, both using the offset pass. One animal was a very small calf, which walked between the cross bars. The other was a yearling animal which jumped the pass.

Sheep - Sheep readily crossed the antelope passes, but the Paul's passes effectively limited movements across the fenceline. There was a total of 370 sheep which had approached the offset-pass and 70 of these crossed. While 285 approached the antelope pass in the straight fence line and 24 crossed. In June very few of the sheep attempted to cross these structures and those that crossed walked between the cross-bars. Later in the summer more sheep started crossing these structures and they started jumping across rather than walking between the bars.

There was a total of 275 and 87 sheep which approached the Paul's pass with net wire and Paul's pass with slotted wire, respectively. Three sheep crossed through Paul's pass with net wire and two through the Paul's pass with slotted wire. These crossings occurred in June and July. In the early part of the summer sheep moving down the fenceline readily walked through the barbed wire portion of the exclosure and out the far side. Later in the summer very few entered the exclosure, but walked around the periphery of the barbed wire fence. There weren't any sheep observed in the vicinity of the Powder River

Passes during the study period.

Antelope - Antelope use was extremely light on the Paul's passes and the Powder River passes; they more readily used the antelope passes. A total of 30 antelope approached the antelope pass-set in the straight fenceline and 9 of them crossed. There was a total of 66 antelope which approached the antelope pass in the offset and 38 of these crossed. Track counts in June and July indicated only the adult animals were crossing the passes. There were 53 and 47 antelope that approached the Paul's pass with the net wire and Paul's pass with the slotted wire, respectively. Only two adult animals crossed the fenceline using these structures. They both entered the barbed wire exclosure and jumped over the net wire and moved out the other side, without any apparent hesitation. A total of 206 antelope approached the Powder River passes, however, none of them used these structures.

Direct Observations:

Very little success was attained in observing the animals using the various structures. Antelope were observed in the vicinity of the structures on occasion but none were observed to cross. A total of 17 antelope were observed to approach the Powder River passes, look them over, but refuse to jump. We had reports of some people observing sheep jumping across the antelope passes.

The 32-inch high fence was located across the travel route of antelope which watered at the Yampa River in late summer. Several observations were obtained while the antelope traveled this route. A total of 80 antelope (45 adults and 35 fawns) were observed to approach the fence. Only one of the 45 adults refused to jump the fence, while 20 fawns refused to cross and 15 crossed. These observations were made in September and October when the fawns were about three months old and older. Most generally the fawns which jumped the fence cleared it very easily. On one occasion a fawn milled around the Powder River pass for about 8 minutes, then went over to the side of the pass and attempted to jump the fence. It got its hind leg caught between the net and barbed wires. However, the fawn struggled free when I attempted to free it. Another fawn (estimated to be 2-3 months old) was found hanging in this fence in the same locality; it was dead. Most adult and yearling animals seemed to have little difficulty in jumping the fence. However, on October 15, there was a herd of 15 animals observed jumping across this fence; 11 cleared it with no difficulty, while the other 4 jumped almost straight in the air and landed astraddle the fence and wriggled on over. In spite of being able to jump the fence, most antelope milled around the fence or walked along it for as much as 10-15 minutes before jumping across.

DISCUSSION

The antelope pass appeared to be the best type of structure for allowing antelope movement. Use was nearly doubled by placing the pass in an offset rather than merely inserting it in the original fenceline. However, sheep use of this pass was also quite high. Therefore the structure needs to be modified to reduce sheep use and hopefully not reduce antelope usage. The open span of the pass must be increased. Just how much is uncertain, possibly to five or even six feet. This should be tested further. At the same time the structure should be modified to discourage sheep from walking between the bars. This might be done by reducing the space between the bars, possibly to three inches. The pass was set on a railroad tie, which raised it off the ground six inches.

Table 1. Antelope and livestock movement around and across structures.

Type	Cattle			Sheep			Antelope		
	Number Crossing	Number Attempts	Percent Crossing	Number Crossing	Number Attempts	Percent Crossing	Number Crossing	Number Attempts	Percent Crossing
Antelope Pass (offset)	2	74	3	70	370	19	38	66	58
Antelope Pass	0	53	0	24	285	8	9	30	30
Paul's Pass (net wire)	0	65	0	3	275	1	2	47	4
Paul's Pass (slotted wire)	0	73	0	2	85	2	0	53	0
Powder River Pass	0	11	0	-	0	-	0	206	0

This height should be at least doubled. All these modifications should be tested so that the structure can meet the minimum requirements which are necessary to contain sheep yet present a minimum of a barrier to antelope. Young antelope must be given serious consideration in this evaluation; if the young are endangered in any way the net increment into the population is going to be lowered. It was evident in this study that there was a learning period for the animals. Use increased as the animals became familiar with the passes; and the sheep didn't bother to enter the barbed wire exclosure of Paul's pass as time progressed. This should be given consideration in evaluation of any new devices. Apparently cattle are not much of a problem because these 3-3½ foot passes adequately contained them, surely a larger pass will do likewise.

Serious consideration should be given to the 32-inch fence. This fence permitted movement of yearling and adult animals. The rancher using this allotment said this fence contained the cattle and sheep. We need more information on the fawn class in regard to when they might start crossing a 32-inch fence in greater numbers than indicated in this study. If these fawns can negotiate a 32-inch fence by the time the winter migrations start; a 32-inch fence which an antelope could cross anywhere would be much better than a few crossing devices scattered in a higher fence. Again, we need additional information as to whether or not a 32-inch fence will effectively contain livestock under range conditions.

Paul's pass effectively contained livestock, but received little antelope use. Tracks indicated the two antelope that used these structures didn't have any difficulty in crossing through them. This looks like basically a good idea but the antelope didn't cooperate. It appeared that the antelope were so used to net wire fences that they did not even attempt to crawl under the barbed wire; because no antelope entered the barbed wire exclosure other than the two that crossed. It appeared that the Paul's pass with the slotted wire had little advantage over the Paul's pass with net wire. By the time the fawns were freely moving with the adults they were fairly large in size and it is doubtful if they would crawl through these slots.

The Powder River passes were of little aid to antelope movements. However, it must be remembered that these passes were set in a 32-inch fence which antelope could jump. On the other hand, 17 antelope were observed to stand directly in front of this structure and look it over as if trying to gather up enough nerve to jump across; they refused to jump. It would appear that this structure needs some modifications. Personnel with the Wyoming Game and Fish Commission had suggested using metal posts for brace posts next to the antelope pass and omitting the wooden posts which angled down from the fence to the corners of the pass; for this tended to turn animals out and away from the pass. Observations certainly indicated this to be true. If this pass were placed in an offset, it would likely increase use.

There were many problems suggested in this study. Until we find some answers to these many problems fencing on our important antelope ranges should be held to a minimum.

A DISCUSSION OF THE WOVEN-WIRE FENCE ANTELOPE SITUATION ON BLM LANDS IN NEW MEXICO

by
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Prior to 1964, there was some concern among game managers that woven-wire fences on New Mexico antelope ranges were having an adverse effect on antelope populations. T. Paul Russell included wire fences in his list of factors which have considerably reduced the antelope range.1/ Other game managers in the State continued to be concerned over the construction of woven-wire fences on antelope ranges. This concern led to meetings between the Bureau of Land Management and New Mexico Department of Game and Fish. Since this time, the Bureau of Land Management has installed various antelope-escape devices and attempted to keep the construction of woven-wire fences to a minimum on antelope ranges. We have used several types of escape devices as follows:

1. Standard eight-foot light cattleguard.

2. Standard four-foot antelope guard as provided by BLM specifications.

3. Dirt ramps which are constructed with the use of wooden frames which provide approach and descent ramps in combination woven-wire and barbed-wire fences.

4. Construction of combination woven-wire and barbed-wire fences 31 inches high.

5. Replacement of woven-wire fences with barbed-wire panels.

6. Leaving gates open on seasonal ranges when livestock are not using the pastures.

Over 30 of these ramps or guard devices have been constructed in the San Antonio Mountain area near the Colorado State line, while some nine or ten have been constructed in the Roswell District and southeastern New Mexico.

Our observations have been that the guard and ramp-type devices have allowed some antelope to pass through or over fences. The observations of use have been few. No observations of use were made immediately after the construction. About a year after the construction, a few observations of use have been made. One observation has been made of an antelope jumping over a 31-inch fence. Since the construction of the devices, rainfall has been favorable as well as range conditions. Consequently, pressures to move may have been reduced somewhat. Almost immediate use was made where panels of woven-wire were replaced with barbed-wire in one instance.2/ The ultimate success or failure of these devices in our areas so far as solving the antelope movement problems through

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1/ Russell, T. Paul. ANTELOPE OF NEW MEXICO, New Mexico Department of Game and Fish, page 98, paragraph 4.

2/ Records of the Albuquerque District, Bureau of Land Management. Clark Ronnie D.; Henrickson, Gerald S.; Roberts, Edward; and Woody, Montford H.

woven-wire fences is yet to be determined since, in subsequent years, more antelope may learn to use them or improvement of our evaluation system will show more use.

With all the concern about fences, antelope and escape devices, it appears that some correlation must be made between the reproductive success of an antelope herd and the effect of newly constructed woven-wire fences. I believe that it is necessary to determine why barriers--particularly woven-wire fences--might have an adverse effect on net reproduction of an antelope herd or band. Some antelope have been observed to hurt themselves physically in attempting to pass through woven-wire fences. However, I think that most game managers will agree that this effect of the fence is minor. The game manager then needs to ask himself what is the effect which might cause herd numbers or potential herd numbers to decrease.

The New Mexico Department of Game and Fish continues to conduct studies relevant to determining the reasons for low reproduction in antelope herds in New Mexico. This concern for low reproduction is shared by the Bureau of Land Management since, under the Classification and Multiple Use Act, one of the functions of BLM-administered lands is recognized as being for the production and utilization of wildlife. We are concerned with providing the proper habitat for antelope on BLM antelope ranges. My three years of making general observations in New Mexico seem to indicate that herds in the northern areas and on cattle ranges reproduce better than herds on southern ranges in confined areas.

Let's look at an antelope herd in New Mexico that is doing well as far as reproducing is concerned. I call this herd the Tres Piedras herd. It ranges from the Colorado State line north of Tres Piedras between the Rio Grande and the Carson National Forest and south from Tres Piedras about 20 miles. A good part of the range--if not the majority--is found on BLM lands in the northern part of the area. This is where the largest bands are found--the San Antonio Mountain vicinity. Even though the plantings were made in the southern portion of the area, the northern part is now the best occupied. Between 1938 and 1955, 133 antelope were planted in the southern portion of this area.3/ In 1965, 100 percent aerial survey, 257 antelope were counted. In 1967, in a two-hour aerial survey, 505 animals were counted. A reasonable estimate of totals then would have been 300 in 1965 and 700 in 1967. Antelope harvests show 47 during the 1965 hunting season, 50 during the 1966 hunting season and 72 during the 1967 hunting season.4/ Reproduction counts by employees of the Albuquerque District, Bureau of Land Management, show that in 1966 the doe-fawn ratio was 1 to .88 (143 does were counted); in 1967 the doe-fawn ratio was 1 to .93 (109 does were counted).

The topography of the area is relatively flat plain with several tall peaks which are volcanic cores breaking the flat areas. The tallest of these peaks is San Antonio Mountain which has an elevation of 10,908 feet. This being about 3,000 feet higher than the lowest areas of the surrounding plains. Vegetative types range from pinon-juniper woodland, grama grass grasslands, winterfat and sagebrush associations to spruce-fir type on the mountains. Antelope use the entire range including the uppermost parts of the mountains at certain times of the year.

3/ Russell, T. Paul. ANTELOPE OF NEW MEXICO, New Mexico Department of Game and Fish, Table 27, page 58.

4/ Aerial count and harvest figures from the New Mexico Department of Game and Fish.

This is a healthy growing herd, apparently on good antelope range. There are some woven-wire fences in the area but not enough to severely interfere with critical antelope movements. A game manager naturally asks himself what is the factor here that makes this herd better reproductively than our problem areas in some of the southern portions of the State.

In order to come up with an answer, we need to examine the State in general. Let's look at topography. Topography as well as latitudinal differences causes vegetative differences on antelope ranges in the southern part and northern parts of the State. Spruce-fir, aspen, and yellow-pine types tend to be much higher up on the mountains in the southern part of the State, and they are usually, therefore, outside of antelope ranges. This vegetative difference also indicates that better moisture supplies are also higher up on the mountain in the southern part of the State as compared to the northern part. In general, New Mexico has a mild, arid climate with relatively light precipitation and low relative humidities.

> Topography plays a major role in determining the climate of the State, and this is particularly true in considering the climate for any specific location.5/

> The average annual precipitation for the State ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan Valleys to more than 20 inches at higher elevations over the State. July and August are the wettest months, especially in the eastern and southern sections of the State where these 2 months normally produce from 30 to 40 percent of the year's moisture.6/

Graphs of mean precipitation by month furnished by the U. S. Department of Commerce, Weather Bureau, for five stations (Tres Piedras, Raton, Lordsburg, Quemado, Oro Grande) show generally that the months preceding fawning or in which does are in latter pregnancy are generally dry times of the year. Even June is undependable so far as effective moisture is concerned.

T. Paul Russell states:

> All ages ordinarily select the more succulent parts of several kinds of plants while they pass by other plants that are equally or more abundant. These facts are readily determined by observing feeding antelope from moderate distances with the aid of binoculars and by examination of fresh antelope tracks and equally fresh clipped plant stems at the observed locations.7/

We have observed that on areas planted with forbs and green grass for elk that antelope have moved in like gluttons. Many considerations then seem to point to the necessity of antelope being able to reach green forage when it is available especially in the spring and summer months. Stoddart and Smith

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5/ Von Eschen, G. F. CLIMATES OF THE STATES - NEW MEXICO, U. S. Department of Commerce, Weather Bureau, page 1, paragraph 5.

6/ Ibid., page 2, paragraph 2.

7/ Russell, T. Paul. ANTELOPE OF NEW MEXICO, New Mexico Department of Game and Fish, page 63, paragraph 2.

recognize the importance of Vitamin A in the growth of young animals' maintenance of vigor and normal reproduction.8/

Morrison in FEEDS AND FEEDING recognizes that Vitamin A is first in importance among vitamins in feeding of domestic animals.9/ The carotene which converts to Vitamin A in the bodies of range animals is obtained mostly from green forage.

The importance of a proper carotene diet is indicated in NUTRIENT REQUIREMENTS OF DOMESTIC ANIMALS. The authors further found that storage and reproduction three and five times the minimum antinyctalopia levels, respectively, were required.10/

The lack of a proper carotene diet during latter pregnancy can cause sheep to be born dead or die shortly after birth.

Considering these facts and circumstances which surround the antelope situation in New Mexico, it appears to me that there is a very good possibility that one of the major determining factors in reproduction in our antelope herds is the availability of green forage in the spring and summer months, not only to provide proper body condition and fetus growth in later pregnancy but also to provide for storage of Vitamin A in the body during the summer months for carrying over into the winter. In the spring and summer time, succulent forage is probably also important for antelope in providing sufficient Vitamin A for lactating females.

This idea is forwarded by Elliott and Snyder:

> Critical Period (Figure 3). This represents the moisture during the two critical times in the antelope reproductive cycle and plotted against the yearly recorded antelope productivity. The first critical period is during September when breeding takes place and the second is during April, May and June which are the last months of gestation and the first month of lactation. The total moisture for these four months is plotted against the antelope production figures for the year. This gives a meaningful relationship in many instances, although there are still discrepancies in some years. Precipitation and annual weed shortages during these two periods could adversely affect the kid crop production and survival.11/

We can now enter into our hypothesis the possible damage being done by woven-wire fences in New Mexico for testing. It appears to me that the adverse function of the fence then is restraining antelope from reaching areas of green

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8/ Stoddart, Laurence A., and Smith, Arthur D. RANGE MANAGEMENT. Second Edition, McGraw Hill Book Company, Inc., Copyright 1955, page 259, paragraph 6.

9/ Morrison, Frank B. FEEDS AND FEEDING, Twenty-second Edition, The Morrison Publishing Company, Copyright 1956, page 121, paragraph 191.

10/ Pope, A. L.; Cook, C. W.; Dinusson, W. E.; Garrigus, U. S.; and Weir, W. C.; NUTRIENT REQUIREMENTS OF DOMESTIC ANIMALS. National Academy of Sciences--National Research Council, 1957, page 16, paragraph 2.

11/ "Job Completion Report", State of New Mexico, W-93-R-8, Work Plan 4, Job 4, Game Surveys, Antelope Study Range Conditions, New Mexico Department of Game and Fish, February 24, 1967, page 11, paragraph 2.

forage in the spring and summer months. We observed that the Tres Piedras herd always has access to green forage during the spring and summer because of the topography-induced vegetative type variations belted around the mountain peaks. That is to say there will always be green forage at some altitude on the side of San Antonio Mountain during every growing season. This green forage may not always be available in the south because of the lack of sufficient elevation changes or because woven-wire fences have been placed between the antelope and the green forage.

Because spring and early summer rains are undependable and sometimes lacking, it appears essential that antelope have a large enough area of movement which will provide in some place therein green forage. Small pastures in which antelope are fenced prohibit their taking advantage of scattered rain showers which may be one or two miles distant. Had the pastures in which the antelope are enclosed been considerably larger, there would be a much greater chance of having a rain shower within the pasture which would provide subsequent green forage.

In order to test this hypothesis, the Bureau of Land Management in New Mexico intends to institute in the comingfiscal year a method of intensively studying antelope band ranges. An outline of this proposed study method is attached. You will note that we propose to do this study in four areas within the State, checking one against the other in an attempt to correlate moisture available, forb and browse production and the doe-fawn ratio. If the method is successful and further supports our hypothesis, we can then look intensively to determine what particular areas must be available to antelope in order to encourage reproduction. Further development of the study would contemplate a rating system for antelope ranges on the basis of succulent forage available during the spring and summer months of the year.

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A REVIEW OF ANTELOPE CROSSING DEVICES
FIELD TRIALS OF ANTELOPE PASSES IN BUFFALO BASIN

by
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Following the Wamsutter study recommendations of having field trials for fence crossing devices, the BLM and Wyoming Game and Fish set up a study in 1965 in the Buffalo Basin in the Worland, Wyoming BLM district. BLM was planning allotment fences and the enclosed basin would afford an opportune location for studies. The 17,000 acre enclosed basin would have a sheep-tight fence crossing it from east to west. One hundred to 150 antelope had year-long habitat in the basin and migrated in the area with weather, water and other stresses. Modifications were made in the fences with antelope passes, and cattleguards, and later a dirt ramp. The area has good accessibility with oiled and dirt roads. With extensive oil activity also in the basin, no attempt has been made to evaluate cattleguards, but 6 antelope passes and 1 dirt ramp have been under study since construction; with 3 winters' and 2 summers' observations being made on most structures.

Antelope passes were located in fence corners, fence offsets, fenceline and on established antelope routes. The Wyoming Game and Fish made aerial census of the area several times to determine which side of the fence antelope were on, and field observations were made by Wyoming Game and Fish, and BLM personnel. Wildlife workers, Ken Winters, Wyoming Game and Fish; and Ray Mapston of BLM, were assigned to head up the field studies. Most of the observations were by Bill Dooley, Wyoming Game and Fish warden of Meeteesee, Wyoming; and Ray Mapston.

Originally the standard 4' x 6' antelope pass devised by the BLM was installed with the recommended A-frame bracing; these were placed on 12" timbers on the ground. Only one observation of use was noted. It was believed the bracing interfered with, or obstructed the antelope's view of the passes, so the A-frame bracing was modified. Posts were set next to the grill and the fence wired to the post, and also steel posts were set at an angle and the fence tied to the posts. These modifications appeared to give a better view of the opening the structures provided. Also the opening widths of the grills were widened from 4' to 5' and 6', and the structures were placed over a shallow pit 15" to 20" deep.

With these modifications, an observation was made in the spring of 1966 of an antelope pass in a corner which had a 6' opening and a 5' jump and angle post side bracing. A herd of 22 antelope were observed to jump this pass. Shortly after this a rancher reported cattle also trying to force their way across the pass; so the side bracing was modified back to a vertical post set next to the grill which was placed over a shallow pit - this stopped the cattle.

At another location an observation was made of antelope crossing under a 5-wire fence in a fence corner location. A 4' x 6' antelope pass was placed in this location and almost immediately after installation an observation of use by antelope was made with the antelope being under stress during a hunting season. Tracks were also noted after the observation indicating other periods of use. Additional observations were made, and then the 5-wire fence was modified to a sheep-tight net-wire fence, and a 6' x 6' antelope pass installed in the fence corner with fence stay vertical side bracing placed over a shallow pit, and

with a natural dirt approach. Observation of use was noted in the winter of 1967, and again in the early spring of 1967. Measurements of the jump distance were made by Mapston and he found that mixed groups of antelope were easily jumping 7 to 7½ feet going over the antelope pass. Apparently after antelope found and started using this pass, whole herds started using it when occasion demanded that they pass through the fence. This antelope pass was in a fence corner and used extensively by antelope approaching with the fence cornering effect; however, when approaching the area from the other side, apparently some animals couldn't find the structure. Therefore, a fence wing of sheep-tight net-wire was installed from the non-cornering side, and shortly after this one observation was made of a small herd of antelope using the structure utilizing the fence wing.

On the fence-line locations no observations of use have been noted, and one observation of use has been made in a fence offset. However, tracks indicating use have been made on several of the structures.

Cattleguards were also placed in the fence, mainly to facilitate human access, but due to heavy use by people working in the vicinity, no evaluations of use have been made. However, these structures are available to antelope if they wish to use them; and on occasion we have suspected antelope of using them when we have seen animals on one side of a fence and a short time later they were observed on the other side and a cattleguard was in the vicinity. This suggests use; however, use had been noted at the Wamsutter study, and at many other locations, so no real effort was made to evaluate cattleguards.

To date no observations of use have been noted on the dirt ramp; however, tracks have been noted on the approaches. Use of these structures was noted at the Wamsutter study.

The corner locations of antelope passes have provided the most observations of use. Observations have indicated that through experience and familiarity, use can be expected to reach 100% of a group of antelope, even when under stress. It appears that as wide an opening as possible, placed over a shallow pit, and with a dirt approach, and a minimum of side bracing is the most effective type installation of an antelope structure.

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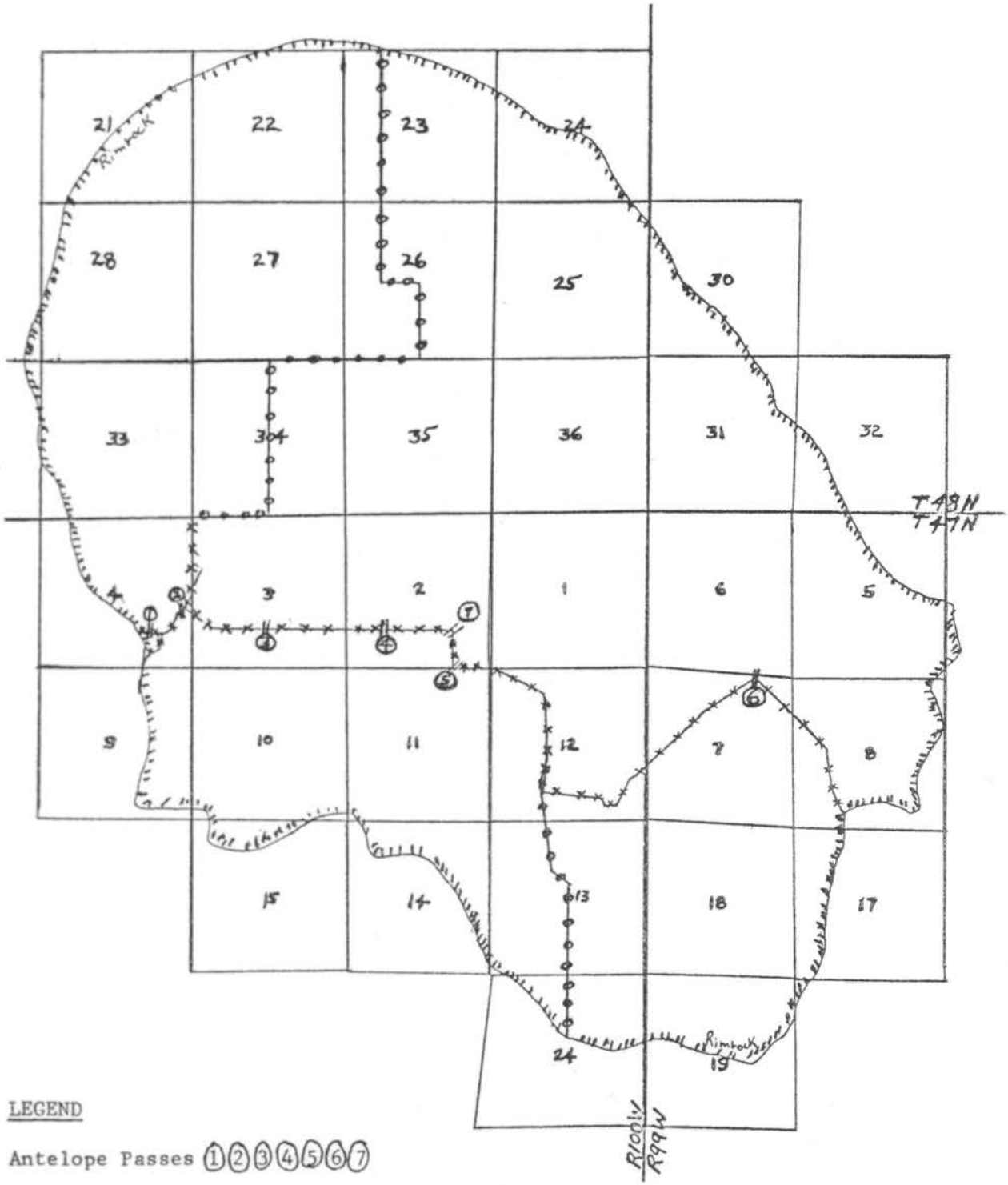
10 selected slides showing structures and modifications to them, shown.

FIGURE 1: Buffalo Basin Antelope Study



LEGEND

Antelope Passes ①②③④⑤⑥⑦

Woven Wire Fence ----------

Barbed Wire Fence, 4 strand ----------

Study area approximately 17,000 acres.

STATEMENT ON ANTELOPE CROSSING DEVICES

by
Larry Pate, Big Game Biologist
Wyoming Game and Fish Commission

My experience with antelope crossing devices has been limited to four types: standard cattleguard raised above the ground, standard cattleguard with the top installed flush with the ground, 4 foot by 6 foot lightweight antelope passes, and one dirt ramp.

So far I have found that the above devices should, to be effective, be placed in such a location that they will not drift full of snow or soil and are readily located by antelope. To be readily located by antelope, the structures should be placed in fence corners or on previously established antelope routes of travel.

The one dirt ramp that is in my area is a new structure and no use by antelope has been indicated either through observations of individuals or of track patterns. The dirt ramp in our study area is 12 feet wide, 30 inches high and each side is 3 feet from the fence which would necessitate a horizontal jump by an antelope of at least 6 feet. The materials for the ramp were furnished by the Bureau of Land Management and the structure was constructed by the land owner.

I have watched antelope jump the standard cattleguards with the top installed flush with the ground on two occassions: one occassion was a yearling doe in July; and the other was a buck, doe and fawn on the 24th of September. Track observations since November on soil raised standard cattleguards on the Diamond Ring Ranch, west of Casper, indicated crossings by 11 antelope, 8 of which walked across one cattleguard when it was drifted full of snow.

One doe was observed jumping a light weight antelope pass north of Casper, on July 22, 1967; however, I could not get the fawn which was with her to cross the structure. Track observations on two passes installed in a Rouse-type fence north of Casper, indicated 16 individuals jumped the passes and three walked across them when they were drifted full of sand. These observations were made during the summer and fall of 1967.

DISCUSSION

Richard DeArment, Texas: What is the disadvantage of the standard cattleguard?

Rex ZoBell, Wyoming: I don't think there is any real disadvantage to the standard cattleguard, what we're after in the antelope pass is a cheap type cattleguard. A structure that we can place out on the range because we're putting these structures in at a cost of about $45.00 and our labor costs $25.00 to $30.00. We feel that we can stick these in the fence corner location where the people won't be going too much, at least we hope they aren't going to be there; whereas, the cattleguards are placed on the roads and trails. The cattleguard versus the antelope pass, just the economics of it --you're talking of about $75.00 compared to $500.00 or upwards. I believe that is the main consideration.

Richard DeArment, Texas: In other words, cattleguards are just as effective for antelope passing?

Rex ZoBell, Wyoming: I would say if it was placed in the proper location it's as effective. If you get a lot of human use like we did in the study I presented, a lot of the time just the people themselves will keep the antelope away from the structure. We do have some cattleguards placed in Wyoming that are just way out in the boon-docks, you might say, where we hope that people aren't going to go. It's when we get a big structure like that, it is still the cost consideration. People use, that's one thing I would like to bring up on this antelope pass--this six foot width is just a little bit too wide to restrict some of these vehicles like the Ford Bronco, International Scout, etc. (some of those vehicles are just about 5'8" wide) so we feel that we're probably going to have to narrow these structures down to 5'6". Otherwise, somebody is going to try to drive through one of these things and they are going to cave in, they just aren't going to make it and we might have a court claim, or case, because somebody got hurt out there. They are light weight, they won't support a vehicle at all--a man could walk through without any trouble but with the rock hounds and the people we've got getting out on our ranges here in Wyoming in the summer, we have got to start thinking about people as well.

Ernest Wampler, Wyoming: Has BLM given any consideration on ramps rather than constructing two ramps adjacent to one another and effecting a "tank trap" situation. Would it be possible to construct these so they are offset, so that the antelope can jump down, eliminate the fence. You could tie the fence into the ramp and more or less make a jump. We use these in Jackson and have had quite good luck with them for elk. Sometime we drive them over then they get used to them and will go over without us driving them.

Rex ZoBell, Wyoming: We thought about this, and that's about as far as it got --is thinking. I've had trouble getting some of our field people even to put these ramps in. The ones we got are quite expensive, you'd have to get a backhoe out there and they cost a lot of money. I have considered the thought you presented, the Wamsutter Study we did note on our ramps down there the sheep jumped these things as well as the antelope, after they once found the darn thing they just poured over it. We forced the sheep over it up there at Wamsutter and we made them try to jump it and after they found they could jump, they jumped as well as the antelope so we started widening this jump out. One thing I have tried to get some of our district people to do, is in the construction of a new fence, generally in Wyoming they use a bulldozer to clear out the fence line. Well, I felt that when they were approaching a hill either going up or down, they could lower the blade of the bulldozer and dig a natural ramp. In a lot of these antelope movements we have noted are right near the edges of hills either

where they start up or near the top and I feel that if they'd take this dozer blade and lower it down and build a natural ramp that we'd get some movement. They could angle the blade and get about an eight foot jump and put the fence in that thing. That would give you a problem of snow accumulation in this place and they'd have to be planned pretty carefully so that the wind would clear that thing out. This is some of our future plans and we just haven't got it out in the field yet.

Doug West, South Dakota: Have the members of the panel or have any of them had any experience in considering the use of lay down panel, regular suspension fences particularly, in regard to permitting antelope movement across these panels?

Rex ZoBell, Wyoming: Idaho has some of them on BLM lands. This is primarily on cattle range, there's not enough density of antelope in this particular place to give you much evaluation on it. There is water in there and I have seen tracks going into this one particular place in Idaho that I am familiar with, but I don't know of anybody really making an evaluation on it.

Mayo Call, Utah: What do you consider to be the best spacing of the rods on the ramp?

George Bear, Colorado: Of course, on the spacing on the bars we only had one which is four inch spacing. We did have the sheep walking between us, we did have that one calf walk between them. I think we should probably reduce this to possibly three inches and again of possibly raising the height. We had set-on ties of only six inches above the ground, if you raise it up to where they would have to slip their leg down a little further between the bars they are going to be a little less reluctant to walk along. From our work, I recommend trying three inch spacing between your bars (actual space) and possibly getting your ramp up twelve inches off the ground. Of course, we had some snow problems--just like last winter I was down there and checked on it, snow was laying on the ground too. If you have it too close to the ground like six inches when it isn't blowing or anything, it just kind of piles up and you might have some problems there if you have sheep in the yard.

Pete Green, Colorado: None of the panel members have mentioned anything about the experimentation with spacing of the wires of the fencing. I wonder if you've done anything like this; and just as a comment, would like to say in the Forest Service we have established a set of specifications in trying to consider both the livestock and the wildlife species concerned. For instance, on antelope ranges where we have cattle we have the bottom wire at least 14 inches off the ground so they can go under it and if they're calves, of course, it has to be lower so we open up the middle of the fence so they can go through it with the maximum height of forty inches. Then where you have sheep, of course, you have to use woven wire fence and put it six inches off the ground. 26 inches of woven wire and barb wire one inch above this, then a space between there and the top wire so they can go through this, with a maximum of 32 inches--probably go over it if they wanted to.

Bill Crump, Wyoming: Sure Pete, I think possibly some of the conclusions that have come out of the Wamsutter Study on the spacing itself or some of the more conclusive work that has been done on this. Has anyone on the panel worked specifically with fence spacing, wire spacing, as such. I had a question in here myself, I know in working out on open range land with four wire stock fences that we had been able to get by very well with the livestock owners themselves and the BLM has gone along well with us on our recommendation for a sixteen inch bottom wire to facilitate movement. You actually do not need this much but it certainly enhances their movement

through the fence. Along our state highway systems where we use the four strand fence we go with the standard 12, 12, 12, 12 spacing on the four strands of barbed wire. In most cases we have irregularities in the surface so we end up with much more than the 12 inch spacing out half way through the span or at some point of the span so that it does permit antelope movement. It's quite common to see the antelope when they are not being rushed go under a 14 inch fence without difficulty. We have had no trouble with the livestock owners in a 16 inch fence, amazingly enough, to my knowledge.

Richard Kerr, New Mexico: I just want to say that in New Mexico BLM we have a standard spec on all antelope ranges--barb wire of 16 inches off the ground and usually a 42 inch high fence with the top two bars spread 12 inches apart, but we've even put smooth wire on the bottom in some cases, on the sixteen inch off the ground and as far as I know we haven't had any trouble at all and nobody has complained about it. I think that we prefer to see the antelope go over or under the fences as try to go through them.

Rex ZoBell, Wyoming: I can give you some additional comments on that, Wyoming has probably done more work then anyone else on this wire spacing, particularly after Wamsutter but my personal opinion that antelope either want to go under that fence or over it. That's why I think we generally prefer to try to get them to cross these structures rather than try to get them to jump through it. Where we've had them jumping through these fences we've noted the injury problem particularly to the young of the year. While the antelope are pretty good jumpers, they jump like a horse, they don't get tangled up in that fence like a deer will because their legs stick straight out behind them when they jump, they don't tuck them up like a deer--they're better jumpers in that respect but they don't seem to know that they can jump too well. So we have not favored this thing, trying to get them to jump through the fence too much. We tried a lot of this different spacing at Wamsutter and we have some of it in our field fences. Generally we want them to go under that fence or go use the antelope pass or the cattleguard. We have on some of our sheep type fences where we have net wire, we have a problem with the sheep operators particularly with lambs. This 16 inch, or 14 inch, spacing is too high and the lambs will go underneath that fence. We have stuck them in places with specifications of an eight inch spacing on the post. With our topography, we feel with an eight inch spacing on the post that we will get these little gaps between the posts that will give us 10 or 12 or 14 inch spacing. I think some of this that Larry Pate will show you this afternoon where we have an eight inch spacing that we have some movement in places where antelope have established routes, and they are going under this fence. Where we have this type of spacing we have a cooperative livestock operator, a good operator, and we haven't had complaints. If we get that fence up too high then these sheep will go underneath it.

Bill Crump, Wyoming: One other thing Pete, I think you planned a course of the Rouse recommendation, made many years ago, and they were designed with a space at the top of 12 inch spacing to permit movement by jumping through. The analysis of this type of fence in practice in the field and at Wamsutter rendered the fence virtually antelope tight, in the studies that were conducted at Wamsutter Spillet concluded the fence as virtually antelope tight except for those who attempted to jump over.

George Bear, Colorado: In regard to fence height particularly on this net wire--as stated in the paper, we had a 32 inch fence that we evaluated. You really feel that in range conditions you need something higher than 32 inches to contain livestock and yet permit antelope movement very well. I would like to point it out too, in the paper, I feel that a fence that

antelope can cross anywhere is far better than having one with just a few scattered devices along the way. Do you feel that we need something 42 to 44 inches high to contain the livestock?

Rex ZoBell, Wyoming: I'll take the first crack at this and pass it over to Dick if it gets too hot for me. I'll agree with you, I think that a 32 inch fence is plenty high to contain most livestock particularly if you have good range. There are pressure points around water or where you've got jamming up of livestock that you may have to have a higher fence. I would like to point out that probably 20 years ago here in Wyoming that if you talked about a fence under 45 inches, why they would probably run you out of the country. Today, we are gradually coming down--I know that since I've been in Wyoming and working in Montana that fences have come down, seems like the further south you go the higher these fences get. I don't know, they must run out of feed or something and you get more pressure on them. Montana fences aren't nearly as formidable as Wyoming fences, some of those fences Dick has down there, I don't know what they would do. It's a matter of education I would say, our Wamsutter study indicated the lower type fences would hold livestock particularly sheep and we have had complaints sometime from livestock operators and we have kind of a general reluctance on livestock operators part to go to these lower fences but we're trying a lot of 30 inch fences and 32's. Just a lot of range fences are being build under 36 inches here in Wyoming. I would say it's a matter of time, matter of education and I think in time we will get them down there but I do think that low fence with the structure would help facilitate them.

Richard Kerr, New Mexico: I'll just comment on the big fences that Rex commented on--we have some very tall open barbed wire fence combinations and some of these are constructed not to just keep sheep in but to supposedly, to my understanding, to keep coyotes out and this is going to cause us some problems. They call them 'wolf type' fences and so this is going to cause a little problem, we're starting to build smaller fences so we hope that it works out alright.

George Bear, Colorado: Overall jumping span of your antelope passes--five foot and six foot, yet they seem to emphasize the six foot. Seems like to me, unless you have evidence to prove that five foot doesn't contain the livestock you're better off going to five because you have the young animals and they tend to cross something a little bit smaller than they would the larger one. Is there any reason you emphasize the six foot rather than the five?

Rex ZoBell, Wyoming: On this one particular study probably the reason we went to six foot is because we had the cows that were working the five foot jump and when we made the six, we stopped them. But we feel that the side bracing had more effect at stopping the livestock movement then the actual distance of jump. At four feet we did notice livestock jumping that before, we tried some with the four feet at Wamsutter and they just weren't satisfactory at all so we had to go to a longer jump. I'd say somewhere between five and six feet, they seem to be able to jump that quite successfully, at least the ones we noticed in the fall of the year when they went over, then the whole herd went. But we do feel that if you get them too narrow, particularly with some of these wilder range type livestock that they can jump across them and with horses I know, I was raised on an Indian reservation in Montana, a horse can jump pretty well when he wants to so generally we stuck to the six foot widths.

Walt Snyder, New Mexico: What is the youngest fawn you've seen using your antelope pass structure?

Larry Pate, Wyoming: The youngest I saw was in September, it was September 24th, so that would probably be 3½ months. And this was on a cattleguard

underneath the cattleguard on the road.

George Bear, Colorado: In this regard, fawns jumping, I had them approximately four months old crossing passes but on the 32-inch fence they started picking up in September, seemed about the earliest ones I noticed going across the 32-inch fence. Then they started picking up a little bit. Of course, that's one thing I would like to see worked on a little bit, figuring out just when you are going to really get the majority of your fawns going across these fences. If you put them on areas that are going to be critical summering areas where fawns are going to have to cross say two or three months old, if you're going to get less than half of them such as I found on this fencing study crossing, well, you're going to have problems.

Alan Morton, Wyoming: Am I to understand that some of these woven wire fences have been raised up eight inches above the ground?

Larry Pate, Wyoming: Not in our particular area, they usually put these woven wires right flush on the ground then add the wires above. What Rex was referring to when he said eight inches above the ground, was a barbed wire on a sheep fence on a post.

Rex ZoBell, Wyoming: We haven't raised any of the older ones, but on new construction we have placed this specification on there, to put it eight inches on the post. If they were really going to re-build this fence, they would tear it down, put it back up again then we could get them on this eight inch spacing. (This would be with woven wire.)

Buck Compton, Montana: This may sound like an academic question but I think I will direct it primarily to Wyoming since they seem to be doing a great deal of work on these fences. How much do you know about the movements between or through fences, the various types of spacings, heights, etc. The basic reason why the antelope are moving?

Bill Crump, Wyoming: Wyoming like New Mexico has certain areas in the state in which movement is not critical, we have water and feed in these areas particularly the northeast corner of the state. It's the area of greater precipitation in the state, it's our higher plains areas that do have a lot of vegetation and good water supplies throughout and in these areas movement has not become critical and it is mostly fenced up. It is a great sheep raising area, sheep and cattle both. We have exact opposite in some of the central and particularly the south-central part of our state where we have our more arid areas, movement is often as much as 30, 40, 50 miles in some areas of actual movement where it's required. Many of the areas, the summer ranges for antelope are under two or three foot or more of snow in the winter time, in these areas movement is critical. This is what we're interested in on providing this movement.

Larry Pate, Wyoming: The movement in the Diamond Ring Study that I will discuss this afternoon is primarily a movement out of high snow country which they occupy in the summer to a lower altitude in the winter and this area here is strictly going over to pasture management system for sheep. This is an altitudinal movement of approximately 1900 feet over a distance of probably 15 miles at the most. Other areas of the state as Bill pointed out, it's the lack of moisture in July and August that they have to move toward water. This particular area that I'm interested in here, water is no problem.

Bill Crump, Wyoming: I might point out that there are a number of people in the audience that could well be on the panel but you can't get all of us up here but there are quite a number of people who work quite intensively with antelope movements and antelope management in specific areas and I am certain that any of our Wyoming people would be glad to discuss this with you.

Abe Cochran, Wyoming: The possibility of making some smaller passes for fawns, like 18 inches wide and maybe a jump of 3½ feet placed adjacent to the larger passes, or would that be an unfavorable aspect in the movement of sheep?

George Bear, Colorado: Well, the fact that we tried 3 to 3½ feet actual jump and the sheep went across these quite readily, so I don't think that you really contain your sheep at that height. You're going to have to find something just a little bit larger to contain your sheep.

Bill Crump, Wyoming: In New Mexico, maybe Walt Snyder could also help me on this, what type of reception do you get from the landowners on deeded lands in asking them to co-operate with this type of movement where movement is necessary. I'd like to see what type of reception you get from landowners in that area?

Richard Kerr, New Mexico: Of course, we on the most of our work area, Tres Piedras, is a public land and a lot of state lands so I really haven't worked with them and can't make a comment about it.

Walt Snyder, New Mexico: In this respect, with the BLM or where the landowner has got considerable amount of federal or state land then we do have somewhat of a lever. But in the areas of essentially private lands, we don't have. Now the cattle operator we normally don't have this problem. The sheep operator or normally smaller areas have gone to strictly fencing and these are the areas we're really concerned about, because we don't have much of an antelope herd in this type of an area. There are some minor exceptions, currently our antelope stocking policy is if we stock animals in any area, particularly in sheep fencing then it has to be a pasture of at least ten sections and we feel that gives a little better chance of success rather than in a smaller pasture, but we're hopeful if we can say make the economics of antelope hunting more attractive then maybe we can get something like this on the large areas of sheep use on private land.

Bill Crump, Wyoming: One of the things that we've noticed under intensive fencing programs in some cases is intensified use of the land by domestic livestock. Have you run into this problem in Colorado, as I understand, under herding conditions apparently you wouldn't be able to keep antelope or sheep in some of these areas we count on for antelope range. We have seen it in several locations and just wondered what you had run into in Colorado.

George Bear, Colorado: Well, in this area in Moffat County where we did our study, there was kind of a spring-fall use for a couple of months. It's kind of a hold over area, before going to summer ranges and coming back down in the winter time. This here, once they got it fenced in these pastures which are roughly two miles by three miles, kind of went this year to an all around year round grazing. There has been sheep in there all year round until the snow started getting pretty deep this fall, so it looks like it's kind of increasing the sheep in the sense they were there more often. I don't know whether it increased the AUM's but the sheep were there all year round and before they were there just short period times.

Darwin Creek, Wyoming: Has anyone had any experience crossing antelope over or under the Interstate Highways, either an overpass or an underpass--has anyone seen any, or had any experience, or done any work on it?

Marvin Hockley, Wyoming: I intended to cover this, or a part of this, tomorrow at my program but since it has come up, I will tell you what we have done. We have studied Interstate 90, which goes from the town of Buffalo to Powder River; it's approximately 35 to 38 miles in length, for three years. We have run this road weekly, checking the underpasses and along the fence lines themselves to see if there has been a movement through the fences or under the underpasses. In only one instance have we ever found or suspected that there might have been antelope movement under one underpass and this is in three years. The type of years they were--the first year was a severe winter, we had antelope piled up against the net wire fences; the second was a real light winter where we didn't get much of them; the third was a moderate winter. Now in July, 1967, there was an authentic case where three antelope

were found in the Interstate right-of-way and this is the only instance that I know of along this stretch of highway that antelope have actually been noted to pass over or through the underpass (30'-35' wide by 150' in length).

Rex ZoBell, Wyoming: Our Rawlins district people have noted some use of these structures on Interstate 80, which is U. S. 30. The places they noted the use there had to be a dirt floor and the antelope had to have a good view through the thing, they won't go through all of them and there are several of them out there that were placed for machinery pass purposes or to pass sheep underneath. They noted use, I believe it was two summers ago, out there when they went between the highway and the railroad--the antelope were attracted to green forage out there; this area is used for trailing of sheep in the spring and in the fall, and in the summer there's no livestock use out there and there was quite a few antelope that went under these structures. At two particular passes they have noted that they did go through but how many antelope got out there in this place, we don't know for sure but there was quite a number of antelope that were in that area.

Bill Crump, Wyoming - Summarization: I think that it's rather obvious that we do have mutual problems in the states that are represented here on movements of antelope. I think it's rather significant that New Mexico after the many years it has been fenced is still concerned about the movement of antelope in these areas. Apparently the off-set in the corner location is somewhat depending on locality or maybe at least in the degree of evaluation offers the most promise on fence passing devices of the antelope pass or cattleguard type. Also, the five to six foot length of the jump appears to offer the most success in these areas. Those cattleguards and antelope passes installed along straight fence lines without the benefit of herding occur along a corner or an off-set as you would immediately run into as the antelope moved down the line are not used as much apparently. I think these things are significant. Apparently we are just beginning to learn a little bit about actually what will move antelope, we certainly are not conclusive on these things, it's rather obvious in the percentage of animals that are getting through these fences at least by these devices. There's no question in my mind in view of discussions with various land management agencies that the deferred type pasture systems are becoming more and more popular on public lands in the State of Wyoming, I'm certain you are running into the same thing in your own states and we will be seeing more fences. I would urge caution, particularly in areas where antelope movement is still necessary--let's go into it a little bit slowly, let's not jump in and put the cart before the horse again and find out in many cases just what these will move through because in many cases the antelope are exremely valuable assets to the state, we have already heard our Commissioner point out the income to this state purely on license sale alone, this was not at all considering the money that is brought into the State of Wyoming beyond the license sale--it is rather interesting. The average amount of money spent by each antelope hunter in the State of Wyoming is around $170.00. If you multiply that times the number of licenses that the 20 year figure he gave you of some eight million dollars to the state, this is purely on license income and I think that this would be very significant in the State of Wyoming, and I am sure it would be significant in many of your surrounding states. I think it is about time to eat, I might mention one more thing, these people are going to be available, many of our people in the state that have worked quite a bit with antelope--Jack Newman, Bill Hepworth, Darwin Creek, Jim Straley, Chuck Sundstrom, feel free to contact any of these people in Wyoming from our state department and they will be glad to visit with you on what they have run into in specific cases around the state.

WATER CONSUMPTION BY PRONGHORN ANTELOPE AND DISTRIBUTION RELATED TO WATER IN WYOMING'S RED DESERT

by

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ABSTRACT

Measurements were made during 1967 of water consumption by 25 to 35 pronghorn antelope in a study pasture near Wamsutter, Wyoming. Daily water consumption rates per antelope varied from 0.09 gallons per day in May to 1.19 gallons per day in August. Total monthly precipitation, evaporation, succulent vegetation, nursing does, average temperature and average maximum temperature had marked effects on the average daily water consumption rates. A close relationship was observed between antelope distribution and water locations. Ninety-five per cent of 12,465 antelope censused by air were within a three- to four-mile radius of a water source. Occasionally, adult males were found over 6 miles from any apparent source of water.

INTRODUCTION

To determine water requirements of pronghorn antelope (Antilocapra americana spp. americana, Ord), measurements were made of water consumption by antelope in a two-square mile study pasture. This study pasture is located in the Red Desert area of south central Wyoming, 6.5 miles north of Wamsutter. The study pasture is typical Red Desert antelope habitat consisting of rolling hills with a uniform sagebrush (Artemisia tridentata ssp. tridentata) community six to 12 inches high. On some sites within the pasture, such as ravine bottom and on some slopes, big sagebrush reaches heights of three feet. Other predominant species interspersed with sagebrush are Douglas rabbitbrush, Hood's plox, Nuttal saltbush, winterfat, thick-spike wheatgrass, needleandthread, Indian ricegrass, Sandberg bluegrass and plains pricklypear.

In Colorado, it was reported that some antelope herds live and die without ever taking a drink of water (Hoover, et al., 1958). However, in Wyoming, it was found that antelope killed themselves trying to get through antelope-proof fences in an endeavor to reach water on an adjacent range (Baker, 1967). Benson (1956) considered the advent of water development in Saskatchewan to be associated with the spread of antelope there. In Oregon (Anonymous, 1961) it was felt that there is adequate range for many more antelope, but few places for them to drink in late summer. In Texas, droughts brought about a reduction in vitality of antelope which resulted in decreased fertility (Jones, 1949). Working in Utah, Beale (1966) found that from July 1 to August 15, 35 to 45 antelope consumed from 11.6 to 17.4 gallons daily.

In an effort to add to the data already gathered, the following study was conducted to determine the daily water consumption requirements of antelope in Wyoming's Red Desert area.

METHODS

On April 11, 1967, 27 antelope were in the study pasture, which contained no

available water. A water source was then supplied in a trough in the amount of 110 gallons.

Water consumption was determined by measuring the amount of water required to refill this trough to a constant level (110 gallons) as indicated by a marker. Evaporation loss was corrected by filling another trough one-tenth as large as the trough used by antelope. This smaller trough was protected by a screen. The amount of water lost by evaporation was determined by filling the smaller trough to the same level as the larger trough and then multiplying by 10. Care was taken to see that both troughs contained the same water depth and surface exposure. Both troughs were covered over three-fourths of their surfaces to reduce evaporation. Precipitation was neglected since it would be expected to apply equally to both troughs. The average daily consumption was obtained by dividing the number of gallons used by the number of antelope using the water.

No attempt was made to show whether or not females required more water than males.

Weather data was obtained from records of the U. S. Weather Bureau. "Average temperatures" and "total monthly precipitation" refer to the averages and totals for the respective month in question. "Total evaporation" was measured in the standard Weather Bureau-type pan of four-foot diameter. This evaporation refers to the total inches of water which evaporated from this pan during the entire month in question.

RESULTS AND DISCUSSIONS

April-May-June

The water consumption study began April 11, 1967, and continued through October 10, 1967. Table 1 presents a summary of the data collected during the study.

The total number of antelope in the pasture varied somewhat during the study due to an increase of 11 fawns in early June and a loss of two adults and one fawn by predation during the summer, and one adult taken by a hunter.

The data collected during April indicates a daily consumption rate of 0.19 gallons (approximately 1 1/2 pints) per antelope. In May and June, water consumption decreased to one-half (0.09 gallons). This can be accounted for by the availability of other free water resulting from precipitation. Also, during May and June, succulent vegetation became readily available to antelope.

Weather records indicate that total precipitation in May was three times as great as April. In June, total precipitation was over four times as great as April. The rain showers during this period provided additional water sources such as puddles in road ruts and natural collections in washes.

A total of 11 fawns were born during early June. The probable increase in water consumption by the nursing does could not be detected due to the aforementioned reasons.

July

The daily water requirements per antelope increased sharply in July. Weather

Table 1. Summary of daily water consumption by pronghorn antelope in the Wamsutter Study Pasture, April 1967 to October 1967.

Study Period	Number of Antelope in Study Pasture		Number of Antelope Using Water	Average Daily Consumption Per Antelope in Gallons	Monthly Average Temperature and Average Maximum Temperature	Total Monthly Precipitation by Inches	Total Evaporation
	Adults	Fawns					
April 11-30	27(10)+	--	27	.19	38.3 (53.7)†	.51	No Data Available
May 1-15	27(10)	--	27	.10	47.9 (63.1)	1.61	7.81
May 16-31	27(10)	--	27	.09	56.0 (69.9)	2.31	8.00
June 1-15	27(10)	11	27	.07	66.3 (83.7)	.60	11.64
June 16-30	25(10)**	10**	25	.12	65.8 (83.3)	.03	11.29
July 1-15	25(10)	10	25	.59	55.5 (70.1)	.95	7.25
July 16-31	25(10)	10	25	.98	46.0 (61.2)	1.08	.87§
August 1-15	25(10)	10	30*	1.12			
August 16-31	25(10)	10	30	1.12			
September 1-15	25(10)	10	30	1.10			
September 16-30	24(9)**	10	29	.90			
October 1-4	24(9)	10	29	.65			
October 5-10	24(9)	10	29	.19			

+ Number of adults in parenthesis indicates males.
† Temperature in parenthesis indicates the average maximum temperature recorded during study period.
§ Total evaporation for the first 10 days of October.
* Fawn antelope were drinking water by this time. However, it was felt that two fawns consumed the amount of water which one adult consumed.
** Predation during this period accounted for this loss.

records show a correspondingly sharp decrease in total monthly precipitation. The evaporation increased from 8.00 to 11.64 inches, an increase in evaporation rate of over 31 per cent from June.

The average temperature in July increased by 10 degrees from June, and the average maximum temperature increased by almost 14 degrees. The availability of succulent vegetation correspondingly decreased in July. These factors, in addition to the does that were nursing fawns, caused the daily water consumption per antelope to increase to almost 1 gallon (0.98 gallon) per day by the end of July.

August

During August, water consumption was greatest, averaging 1.12 gallons per day per animal for the entire month. Average temperature and average maximum temperature decreased by only one-half degree from the July weather records. However, total precipitation for the month was only 0.03 inches, which was the lowest recorded during the study. This factor, together with an evaporation of 11.29 inches, created an extremely dry situation.

Fawn antelope were observed drinking water by this time. However, it was felt that it would take two fawns to consume the same amount of water as one adult. For this reason, the number of antelope using water was increased to 30 rather than 35.

September

Water consumption gradually decreased in September. This decrease was not great during the first two weeks of the month due to the lack of precipitation. By the last two weeks of September, rain storms moved into the area and daily water consumption decreased to 0.9 gallons per day per antelope. A total of 0.95 inches of precipitation was recorded for the month. In addition, evaporation decreased from 11.29 inches in August to 7.25 inches in September for a reduction of approximately 36 per cent in evaporation rate. The average temperature for September was 10 degrees less than the August average, and the average maximum temperature was 13 degrees less.

October

During the first 10 days of October, daily water consumption decreased greatly. By October 10, water consumption was 0.19 gallons, the same as in April. Total precipitation for the entire month was 1.08 inches and evaporation rate for the October 1 to 10 period was only 0.87 inches. Some freezing temperatures were recorded during this period which would account for the decrease in evaporation rate.

Water and Antelope Distribution

As water consumption rose at Wamsutter during the early part of July, 1967, the distribution of antelope on the South Ferris-Seminoe Mountain area and Red Desert changed accordingly. Water was a critical environmental factor from early July until the beginning of October. In some areas where it was common to see antelope in June, by July they became rare.

The Red Desert antelope census began the last week of July and while conducting this census, 95 percent of the antelope were observed within three to four

miles of water. Some areas on the desert contained most of the water and it was these areas which seemed to dictate the distribution of antelope. Occasional buck antelope were observed up to seven miles from any apparent water supply. Figures 1 and 2 present a comparison of the antelope distribution in relation to water distribution.

On the Red Desert, an estimated 90 per cent of the available water was found along the northern and eastern portion - Pickett Lake, south slopes of Crooks and Green Mountains and along the Lost Soldier Divide area. Of the 9,174 antelope counted on the desert, 7,733 or approximately 85 per cent were found in the above areas.

In the South Ferris-Seminoe Mountain area, a total of 3,291 antelope were counted. Of this number, 2,334 antelope or 71 per cent were counted in areas where water was abundant and 954 antelope or 29 per cent were counted in areas where water was relatively scarce.

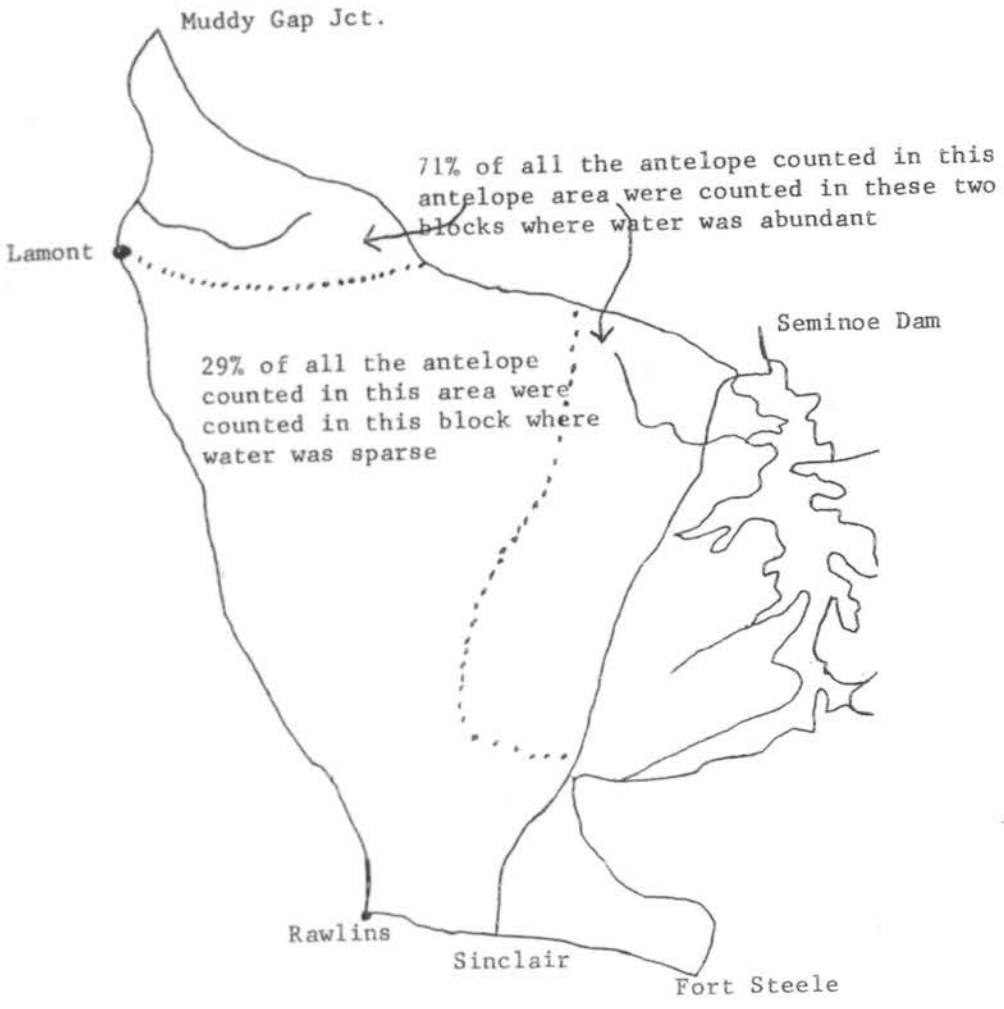

Figure 1. Antelope Distribution and Water Distribution in South Ferris-Seminoe Mountain Antelope Area, August 1967.

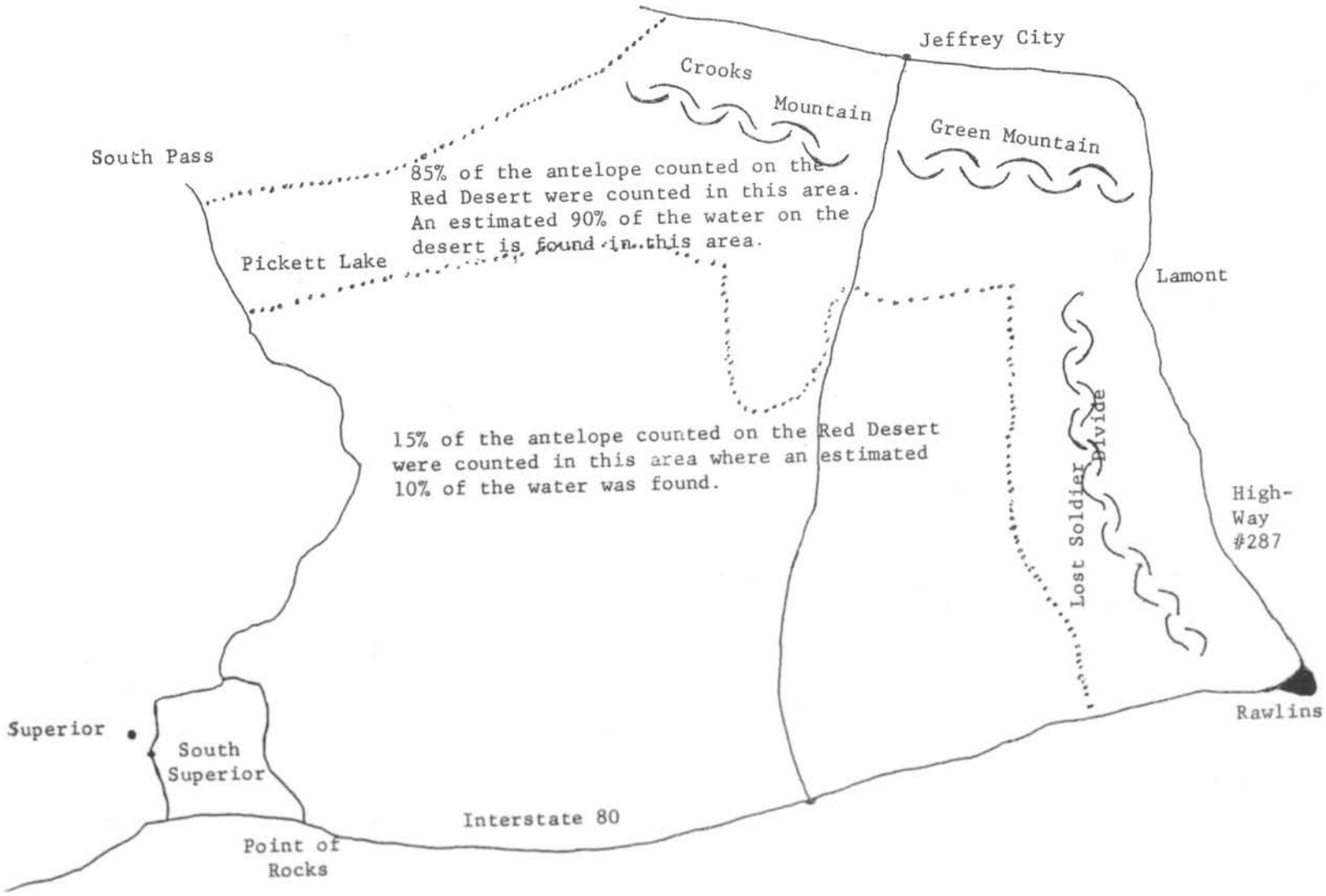

Figure 2. Antelope Distribution and Water Distribution in the Red Desert Antelope Area, August 1967.

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DISCUSSION

George Bear, Colorado: On the distribution of your water, say your guzzlers, what do you figure is the maximum distance an antelope will travel?

Charles Sundstrom, Wyoming: While I was conducting this study, I felt that during August, 95% of the antelope would be found within three to four miles of a water hole. Occasionally you'd find a lone buck as much as six, maybe even seven miles from a water hole, but for the most part three to four miles from a water hole.

Mac Black, Wyoming: During August did you find out what time they drink water during the day?

Charles Sundstrom, Wyoming: I found that while we were counting we would most generally see these antelope about 9:00 o'clock in the morning, 8:30-9:30 DMST or about that time. The antelope were up moving about and pretty close to water.

Mac Black, Wyoming: Do they water once a day?

Charles Sundstrom, Wyoming: In the Wamsutter pasture I've seen them water all day long, but on the desert it appears to me that early in the morning around 9:00 o'clock and also late in the afternoon, roughly 4:00 o'clock.

George Bear, Colorado: I might add in there too, some of the work down there they have been noticed about 9:00 o'clock until about 1:00. Some nights of bright moon light they seemed like they would come in around ten to twelve o'clock--looked like they were watering about twice a day on warm days.

Dick Kerr, New Mexico: What is the type of water developments or water control as far as water being available as desired by the antelope?

Charles Sundstrom: On the desert most of these waters are in the form of, well in the Pickett Lake Area they're natural lakes and many of the other areas are reservoirs that have been built by ranchers. In one area there's a spring that's been developed and the water comes out and fills a metal trough and I've seen antelope drinking out of this. Although I had a literature reference that indicated, and I believe it was Einerson's Book, that antelope wouldn't drink out of metal troughes but I found out that they did. That's what they were drinking out of in the Wamsutter pasture.

Kerry Constan, Montana: I was wondering if by some chance you may have had a control area where you had a bunch of antelope that had no access to any free water at all, considering that possibly maybe they didn't need water if it wasn't offered to them.

Charles Sundstrom, Wyoming: We didn't have a control area as such, the only information I had on that was the work that's been done in Colorado where they felt that they have some antelope herds that never do drink water. But it was obvious on the desert that water was a real important factor through July, August and September.

Don Beale, Utah: In placing watering devices on the desert ranges, out on the open range, is there any indication that the antelope are reluctant to use these devices?

Charles Sundstrom, Wyoming: No, we have put some guzzlers in over there north of Rock Springs and Jim June, I was out with Jim a couple of times on these guzzlers and we found where antelope have actually crossed the fence (it's only a 30 inch high fence) and were using the water. In one of these guzzlers they had put in one of these antelope passes in like we saw on the slides this morning and the antelope were jumping that pass to get into the water. Now I don't know how many antelope were involved in this, maybe just one or two antelope that will jump fences or cross these cattleguards. That's the only information we have so far but we want to find out just what effect these guzzlers will have and we're going to do that this summer.

ANTELOPE HERD POPULATION DYNAMICS VERSUS DISEASES IN THE TEXAS PANHANDLE[1]

by
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Texas Parks and Wildlife Department

ABSTRACT

In 1964 a 58,000 acre ranch was selected as an experimental area in order to concentrate research efforts. The ranch had a history of leptospirosis in its cattle and the antelope fawn production was much lower than that of the surrounding areas, despite more favorable habitat.

The antelope population trends varied from a low of 81 animals in 1958 to a high of 271 in 1965. There were 171 in 1967. Fawn production ranged from 22 percent in 1965 to 14 percent in 1967 while the surrounding areas ranged from 51 percent to 44 percent during the same period.

Serological and other tests for leptospirosis, brucellosis, infectious bovine rhinotracheitis (I.B.R.), and bovine virus diarrhea (B.V.D.) were made. Positive reactors for leptospirosis I.B.R. and B.V.D. were found. No positive reactors were found for brucellosis.

INTRODUCTION

During the last five years there has been increased concern over reproduction in antelope herds, located in the heart of the Texas Panhandle range in Hartley County. A 58,000 acre ranch near Channing was particularly hard hit by this poor reproduction. In 1966 and 1967 the reproduction was 10 percent and 14 percent respectively. This ranch, known as the H. C. (Hartley County) ranch for this paper, was selected as a study area in 1964. Studies to determine the cause of this poor reproduction were initiated three years ago.

METHODS AND PROCEDURES

Reproduction studies (ground census) have been made throughout the summers of 1965, 1966, and 1967 in conjunction with the July aerial census.

Harvest management by regulating the sex to be killed was tried. Does were killed along with bucks for the first time.

Weather and reproduction were compared to determine whether or not there was a correlation. The weather year used was July 1 to June 30.

Disease studies were carried out through necropsies, kidney examination, serology, blood slides, and ground census for sick animals.

1. This report is a contribution from Federal Aid in Wildlife Restoration Program. Texas Pittman-Robertson Project W-45-R, Jobs 2 and 10.

RESULTS

Reproduction in the H. C. ranch herd was good in past years. A 100 percent fawn crop (34 does - 34 fawns) occurred in 1958 (Table 1). Since then it has been 51 percent, 74 percent and 56 percent (2 years). However since 1963 the production has decreased to 44 percent and as low as 10 percent (Figure 1). The herd was varied in population from a low of 81 animals in 1958 to a high of 271 in 1965 (Table 1). The combined fawn production in the surrounding antelope ranges varied from the H. C. ranch by not having the earlier highs or the recent lows. The combined fawn production trend in the two local neighboring ranches was somewhat similar but still wasn't as drastic.

Summer ground census indicated no abnormal amount of fawn predation by eagles, coyotes, or bobcats. It appears the fawns just weren't being dropped.

Harvesting 30 does in 1963 and 51 does in 1965 didn't seem to have any apparent effect on the next years fawn production. In 1964 there was a 44 percent fawn crop compared to a 31 percent the previous year (Table 1). In 1966 there was a 10 percent fawn crop compared to 22 percent the previous year.

Weather and reproduction were compared by using the Dalhart U.S. Weather Bureau's records whose station is located 20 miles north of the H. C. ranch. The annual rainfall (July 1 to June 30) from 1959 through 1967 was compared with the reproduction for those years on the H. C. ranch. There appears to be a correlation through 1963 then a drastic separation the following years (Figure 2). If the correlation in the previous years is reliable then one could assume that factors other than weather were effecting the reproduction during the last five years.

Diseases that cause abortion in cattle were suspected of influencing antelope reproduction especially since the cattle and horses were having abortion problems on the H. C. ranch. In 1960 the local veterinarian found 50 aborted calves out of 1200 cows. This same year 5 out of ten mares died and one colt was born dead. His diagnosis was leptospirosis which was based on necropsy and serology examinations. Tests for brucellosis, leptospirosis, infectious bovine rhinotracheitus (I.B.R.), and bovine virus diarrhea (B.V.D.) were conducted by serological and kidney examination. Necropsies were also conducted. No brucellosis was found out of a total of 178 animals tested (Table 2). Leptospirosis was found in 51 out of 190 animals tested by serological analysis using both the macroscopic rapid plate and the agglutination lysis tests. Bovine antigen was used in all cases. Kidneys were taken and examined along with blood serum in 1964 but no leptospirosis was found despite the positive reactors in the serological examinations. IBR tests were made in 1965 and 1966 and one out of 17 were positive. BVD tests were made in 1966 and 2 out of 5 animals tested were positive.

There is serious question about the accuracy of a one-shot serological test especially where bovine antigen is used and where complimentary tests were negative. However despite the lack of sure fire tests all indications lead one to believe that abortive diseases that were introduced by cattle have influenced antelope reproduction on the H. C. ranch.

Table 1: Antelope Reproduction Data H. C. Ranch

Date	Bucks	Does	Fawns	Total	Harvest		H.C. Doe/Fawn	Neighbors Doe/Fawn	Doe/Fawn
					Bucks	Does			
1958	13	34	34	81	9	0	1/1.00	1/0.70	1/0.59
1959	26	57	29	112	0	0	1/0.51	1/0.40	1/0.32
1960	67	43	32	162	45	0	1/0.74	1/0.21	1/0.51
1961	31	68	38	137	20	0	1/0.56	1/0.90	1/0.63
1962	54	100	56	210	20	0	1/0.56	1/0.51	1/0.51
1963	58	133	41	232	20	30	1/0.31	1/0.44	1/0.37
1964	61	124	54	239	20	0	1/0.44	1/0.49	1/0.42
1965	85	152	34	271	30	51	1/0.22	1/0.55	1/0.51
1966	52	80	8	140	25	0	1/0.10	1/0.84	1/0.42
1967	36	119	17	172	15	0	1/0.14	1/0.27	1/0.34

Table 2: Abortive Disease Tests on H. C. Ranch

Year	Brucellosis		Leptospirosis		I.B.R.		B.V.D.	
	Samples	Positive	Samples	Positive	Samples	Positive	Samples	Positive
1960	--	--	17	9	--	--	--	--
1961	16	0	15	1	--	--	--	--
1962	14	0	13	6	--	--	--	--
1963	47	0	47	20	--	--	--	--
1964	14	0	14	3	--	--	--	--
1965	62	0	59	12	12	1	--	--
1966	25	0	25	0	5	0	5	2
TOTAL	178	0	190	51	17	1	5	2

Figure 1: Antelope Reproduction in the Texas Panhandle

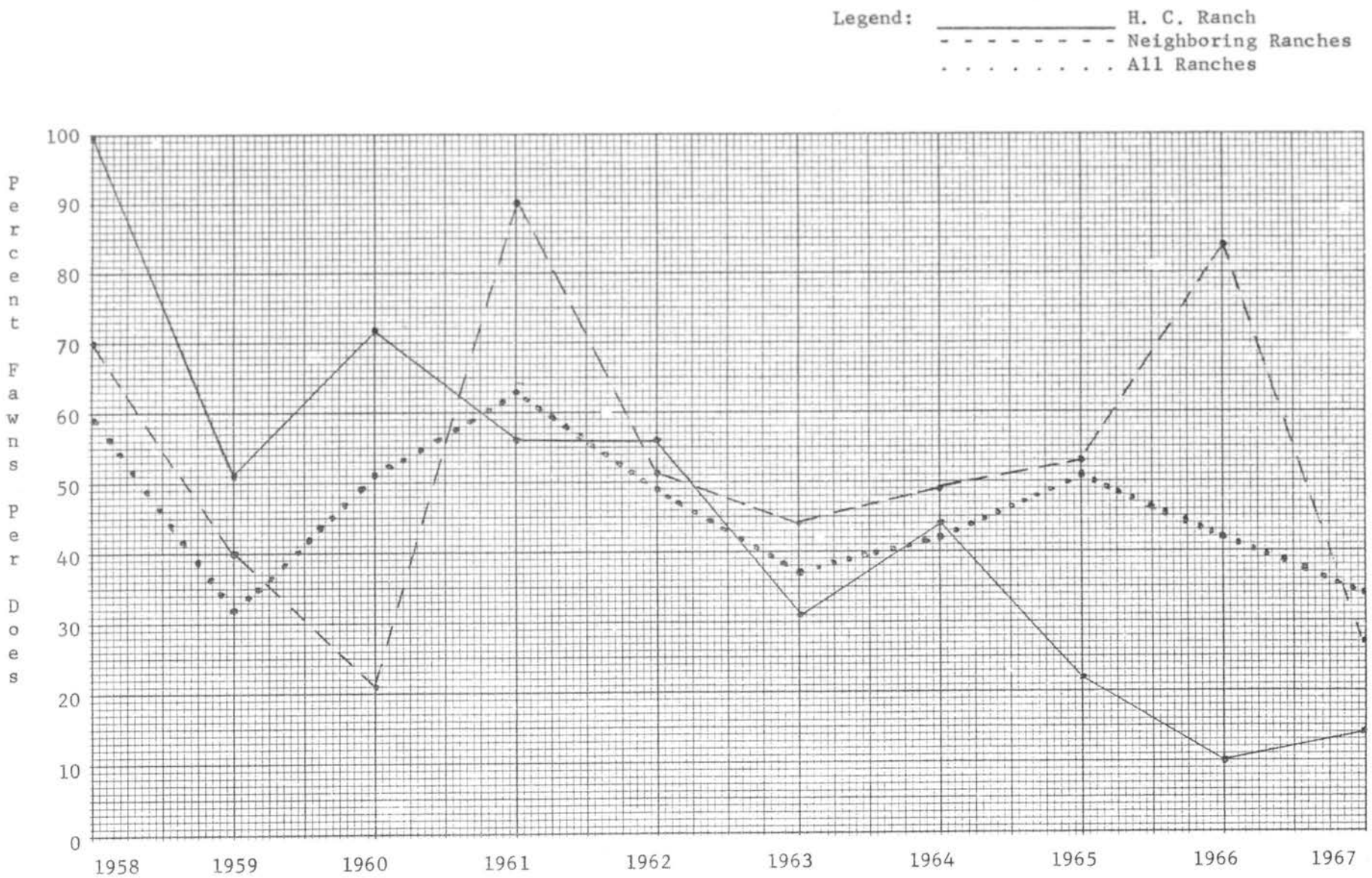
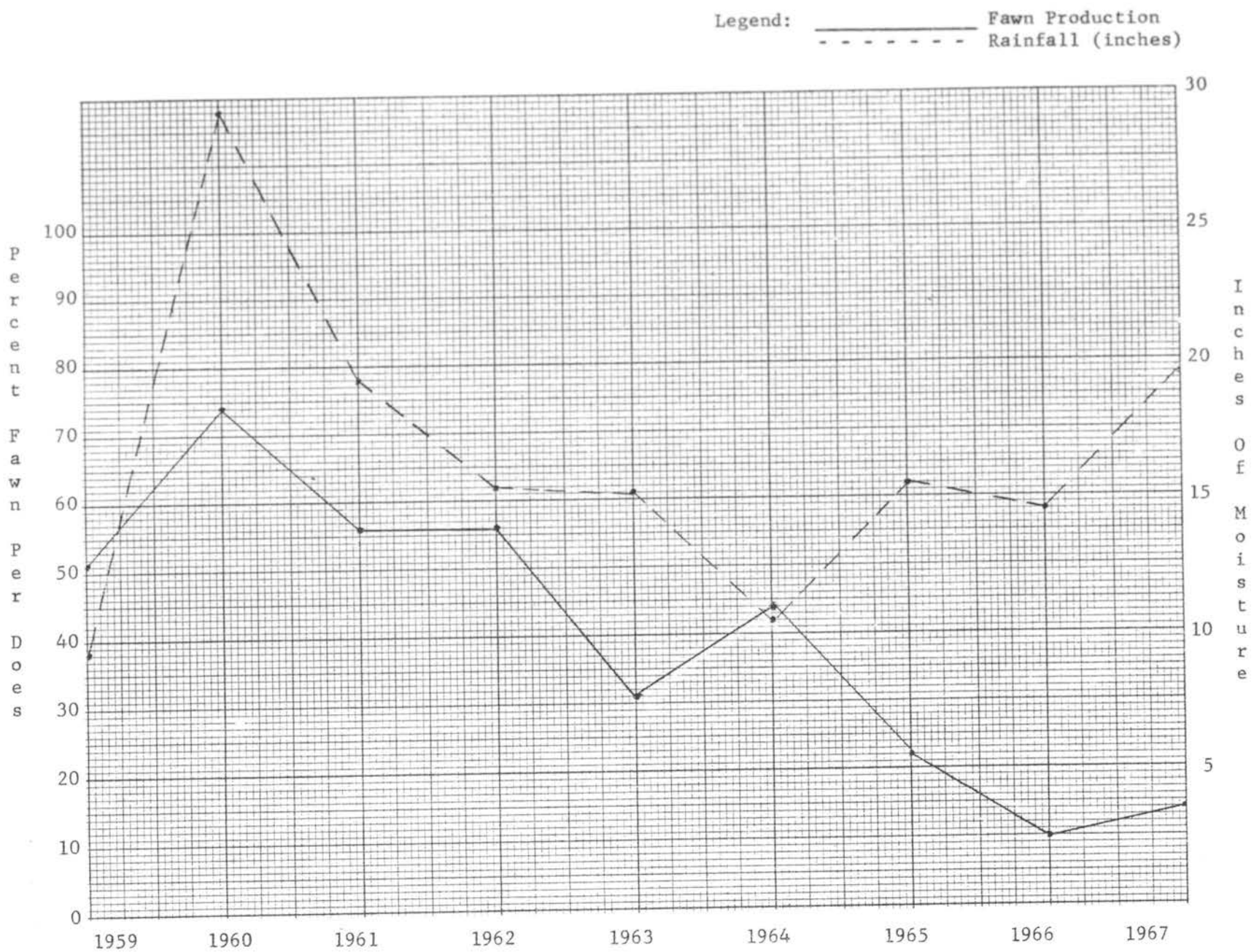


Figure 2: Comparison of Rainfall and Fawn Production



Bill Hepworth, Wyoming: Have you checked for vibriosis?

Richard DeArment, Texas: We started out to, but when we had all the swabs and the slides, everything, we could not get anybody to test it at the time. I have still got the slides, we tried to test for vibriosis and trichomoniasis too, but we could never get the job done as far as getting cooperation. We are very limited on funds and we're limited as to what we could do with what we had at the time. The slides, I didn't know where to send them.

Walt Snyder, New Mexico: In the habitat in this area, what is this, tight lands or sand hills?

Richard DeArment, Texas: It's a mixture of both, we've got sand hills it is Canadian River Break Country, it's broken by a tributary of the Canadian River on the north and the Canadian River on the south. You have the break country with your mixed grasses, little blue stem predominating and you have some silver blue and side oats grama, blue grama and prairie grama. Then we've got our flats up on top, short grass flats. You'll find in the dry seasons or extended periods of dry weather they go back into the sand hills where there's quite a few more weed and forbs.

Walt Snyder, New Mexico: On the rest of your panhandle antelope herd is this essentially plains type or tight land?

Richard DeArment, Texas: It's essentially the same, they get little pots of tight land flats plus the surrounding sand hill margins that they get back into that has sagebrush, you got the sand sage artemisia filafolia and all the associated knit grasses that go with this sand and land.

DIAMOND RING ANTELOPE AND FENCING STUDIES

by
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Bureau of Land Management, Casper, Wyoming
and
Larry Pate, Big Game Biologist
Wyoming Game and Fish Commission

ABSTRACT

Illegal fencing activities on public lands in an area of high antelope density by Diamond Ring Ranch, Incorporated, provoked a controversy which boiled into the national limelight in 1965.

The controversy centers on the issue of whether or not multiple use objectives for public lands can be met through intensive fencing for livestock pasture management. Specifically, this relates to the effects of heavy fencing patterns upon antelope and their seasonal and daily movement requirements.

During May, 1967, the Wyoming Game and Fish Commission and the Bureau of Land Management initiated a field level investigation to determine the effects of fencing upon antelope in the Diamond Ring Ranch area. This paper describes the area and reviews the study methods.

INTRODUCTION

During the fall of 1965, illegal fencing actions by Diamond Ring Ranch, Inc., on public land within the Casper BLM District surged to national prominence through controversy provoked between conservation organizations, livestock groups, and governmental land and resource management agencies.

Although this paper and study focuses on the Diamond Ring Ranch, the problems of sheep-tight fencing on public lands has wide application throughout the State of Wyoming. Rising costs met in herding operations coupled with increasing range utilization through pasture management systems are resulting in an increasing amount of sheep-tight fencing.

In response to Diamond Ring illegal fencing the Casper BLM District Manager issued a decision in July, 1966, requiring modification and removal of some of the illegal fencing. Diamond Ring Ranch appealed this decision and a Department of Interior Decision was issued in February, 1967, modifying the district manager's decision in part and supporting the balance of the decision.

The Diamond Ring decision contains the following general provisions: All installed cattleguards must be properly maintained and passable to vehicular traffic; changes in fences may be required if the need is demonstrated; and gates must be left open when pastures are not being utilized by livestock. Specific provisions called for the removal of one fence, the construction of two fences subject to rigid specifications, the installation of 16 antelope passes or cattleguards at designated sites, and removing the top wire from two fences or installing three additional antelope passes or cattleguards.

Diamond Ring Ranch accepted the Departmental decision and selected the various

options resulting in the installation of 19 cattleguards, plus complying with all other provisions. Following this acceptance fences were authorized by permit which required the decision modifications. Currently all modifications, except the installation of two cattleguards, have been completed. Installation of these two remaining modifications, delayed by unfavorable weather conditions, will be completed in April, 1968.

Obligations of the decision make further studies essential in this area in order to determine the effectiveness and proper locations of these modifications. The area, supporting a high density antelope population coupled with a heavy fencing pattern, lends itself well to a study of antelope and fencing problems.

During the winter of 1967, the BLM - responsible for habitat management, and the Wyoming Game and Fish Commission - responsible for wildlife management, initiated, at field level, a cooperative study of antelope and antelope habitat problems on the Diamond Ring Ranch.

DESCRIPTION OF STUDY AREA

The study area, which conforms to the Wyoming Game and Fish Commission Poison Spider antelope harvest unit, is located west of Casper and has an approximate surface area of 1,000 square miles. That portion of the Diamond Ring Ranch lying within the study unit occupies 214 square miles. This 214 square miles includes the best antelope range within the entire study area.

Fragmented land ownership patterns result in an intermingling of state, federal, and deeded lands. Public lands are within a Section 15 BLM district and the Bureau exerts no control on class or numbers of livestock, or on the time and season of use by livestock. Fifty-four per cent of the Diamond Ring is state and public lands and the remaining 46% is deeded.

This 214 square miles is divided into 12 major pastures varying in size from 4 to 28 sections. These pastures are enclosed by sheep-tight fences which include both woven and barbed wire. This pasture system has been accomplished through the construction of 194 miles of fencing.

Lands within the study area are used primarily for livestock grazing with sheep being the major stock animal. Other land uses include oil production and an increasing potential for uranium production. Outdoor recreational uses of the area are highlighted by the antelope harvest, a moderate deer and sagegrouse harvest and an increasing number of sightseers, rock hounds, and artifact hunters.

The study area is a high northern short-grass plains and is characterized by wind, low annual precipitation and seasonal temperature extremes. Altitudes vary from 5,550 feet to 7,400 feet above sea level.

Big sagebrush plant communities form the dominant vegetative type for the area. About 700 square miles of the range constitutes prime antelope habitat. Antelope densities in the prime range vary from 7 to 10 animals per square mile.

OBJECTIVES

Determine and define factors influencing antelope population trends within the study area.

METHODS

1. Determine population and population trends through aerial trend counts.

2. Determine seasonal habitat use patterns through direct observations and observations of marked individuals.

3. Determine the effects of different fence types and antelope pass types through direct observation, dispersal patterns of marked animals, and observation of track patterns.

4. Determine and define mortality factors with special reference to fence-caused mortality.

5. Environmental analysis with special reference to weather, snow depth, and range condition.

CONCLUSION

This study is in an embryonic stage and findings are only fragmentary and inconclusive at the current time. In addition to the above-described data gathering processes major effort is also being expended in devising and refining techniques in order to accelerate findings.

DISCUSSION

Bob Brown, Wyoming: What's been found out about the antelope piling up in sheep tight fences during blizzards?

Larry Pate, Wyoming: Well, I just started in February as you know and we haven't found any shoved up against fences. We have found sheep on the Diamond Ring, there's two or three pastures out there that do have some corners that come together and find sheep carcassess but we haven't found any antelope carcasses, Bob.

Jack Newman, Wyoming: About these plastic tags or plastic patches that you're using under the ear tags, do you notice any chewing of these streamers off by other antelope?

Larry Pate, Wyoming: No, Jack, they don't stick out, they don't hang down from the ear--just clipped on and a tag clamped on top of it. With a 25 power spotting scope I can see it at about 350 to 400 yards. This next year we're going to get flourescent colors.

George Bear, Colorado: Have you had any indication that these streamers cause abandonment? We had to cut the streamers off after a few days so the doe would take the fawn back.

Larry Pate, Wyoming: I think we got into this last year because we were real concerned with it, basically because of what we had heard; but we didn't get any that were real fresh. We discussed this back and forth between some of us, how long after the fawn was born did you...?

George Bear, Colorado: These were young animals, about a day old.

Larry Pate, Wyoming: Did you handle the fawns too, measuring and weighing them?

George Bear, Colorado: No, I put the ear tags on and handled them enough to get alfalfa from under and released them.

Larry Pate, Wyoming: Well this is all we did and we were real concerned with it, but the first three fawns that we tagged were small fawns and the next day we snuck right back up on them again because we saw the doe lying down and we were in an area where we couldn't find too many fawns, and we slipped up on them to retag them but they were already tagged. The day after we tagged them we found three marked fawns nursing.

Don Beale, Utah: We found that about 40 per cent of them abandoned and this is with handling with rubber gloves and taking as much precautions as possible. Whether it's an odor involved or a visual thing???

Larry Pate, Wyoming: Talking to other people that have done it I think it's a period there that they have to become, the maternal instinct has to get greater and after a certain time I don't believe you're going to bother them. But if you get in there before that doe actually realizes that it is her fawn, and really becomes attached to it, I think you will cause a mortality there.

Ken Diem, Wyoming: I was just wondering at this point you mentioned here, I think I have a very good bearing on it, but in some herds you might have a relatively very young composition age class wise, if your does are in the lower maturity stages you might not have a very good maternal instinct, you have the same thing in cattle or any other livestock operation in which the calving, or lambing, is not very successful because of abandonment without any interference. And I suspect you might be including this mortality where part of this mortality is merely abandonment because of the lack of fawn and mother that you could associate with inexperience.

Larry Pate, Wyoming: This is very possible; however, we compared this with the same number of animals non-tagged and so forth, comparable group.

John Crawford, Wyoming: Results have shown that this particular year we didn't seem to get into that abandonment problem, we got a fair number of resightings, and as Larry mentioned, some resightings right after tagging and it didn't seem too great a problem as far as we know.

Larry Pate, Wyoming: Even with twins, we expected this more that they would abandon one and not the other; but, we have found the twins together (one tagged and the other untagged).

Jack What was the total percentage of resightings?

Larry Pate, Wyoming: We tagged 39 fawns and throughout the summer and early fall, I haven't gathered all the information in from the personnel BLM, but I've found 48 fawns. These are some repeats, like there's two or three out there anytime you want them you can go out and see them.

Fred Yeaman, Wyoming: I believe because of the interest shown in this area the people would like to go through the area, perhaps we could arrange a short field trip.

Allen Morton, Wyoming: Is this area that you mentioned you had a transfer of antelope because of relative difference?

Larry Pate, Wyoming: Yes sir.

Allen Morton, Wyoming: How much trouble do you have with fences between upper and lower altitudes as the grazing patterns, in other words, do sheep do the same thing--go down lower in the winter months.

Larry Pate, Wyoming: The sheep in the summer time do graze heavier than they do in the winter because in the winter they are caking them every day when the weather is cold. They've got men out there caking their sheep all the time.

George Bear, Colorado: From your spraying there with that nyanzol dye, about how many animals out of the herd did you get marked like that, also, about how many gallons did you throw at one drop?

Larry Pate, Wyoming: We put four loads into the big pasture and that was about 20 gallons per load in the plane, and we got a total of 15 animals marked.

George Bear, Colorado: Would this carry over until spring?

Larry Pate, Wyoming: Until May when they shed. Chuck, how many did you get in that bunch?

Charles Sundstrom, Wyoming: We were working on the Red Desert around 9,000 antelope total, we were spraying the fawns which numbered about 2,000. And this past fall we sprayed about 40 or 50 antelope in that area. The problem with spraying, is the pilot comes in on top of the antelope when the antelope are running in a line, they can dodge from one way to the other and you can miss them completely. We made, in the Pickett Lake area, one direct hit, then on the other load the antelope ran one way so we got a bunch of sagebrush sprayed. Now on one bunch we got 15 to 20. It sure works, we're involving several different colored dyes. We have a red dye, a black dye and this year we had a passionate pink which was just unbelievable and you can see the pink from a long ways off except that it washes off, you've got to really stay with antelope a couple days or until the dye leaves. This nyanzol dye works the best, it stays longer. This year we have a green dye that we're going to try.

Question: These dyes haven't had any effect at all?

Charles Sundstrom, Wyoming: No mortality whatsoever that we've been able to determine. As you can see in the pictures, we sprayed in October when there was no snow on the ground and some of the pictures were taken in December.

Question: What do you figure your overall cost for marking per animal?

Charles Sundstrom, Wyoming: With this method it averaged out right around $50.00 a load; that includes the pilot, gas, dye, etc.

LIVESTOCK PASTURES AND ANTELOPE

by
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Wyoming Game and Fish Commission

We in Wyoming are naturally proud to have a large antelope herd.

Historically, the area which is now Wyoming abounded with antelope, but like the passenger pigeon, wolf, buffalo and grizzly bear, they were destined to suffer from civilized man's encroachment. Within a period of about 50 years, antelope numbers dropped from hundreds of thousands to mere thousands. State Game Warden, D. C. Knowlin, estimated less than 5,000 head in 1904.

We can point at many factors contributing to the big antelope decline in the late 1800's; these would include unlimited or over-use of the range by livestock, market hunting, indiscriminate slaughter, and predation. These, plus disease and hard winters, were effective in depressing the herds.

But we were able to overcome this crisis. After the bottom fell out of the antelope population, everyone became concerned. Ranchers, legislators, sportsmen and game managers, through cooperative action, paved the way in saving and increasing this remnant herd. During the ensuing years, peak harvests occurred in 1952 and 1962 with 41,000 and 37,500 animals being taken respectively. Following each of these peaks our herds have decreased. In 1956, our harvest was 23,000 and 1966 - 23,900. No harvest information is available for 1967, but it will be below the 1966 figure because 1,425 less permits were available. I hope now our antelope population is stable or increasing. Too often, we have not recognized an adverse condition until considerable damage has occurred. Other times, we recognize the problem, but because of pressures or lack of coordinated efforts, very little is achieved. Man's encroachment upon pristine wildlife was progress. We all enjoy the results of progress and cannot deny it's importance. Let's just hope we are capable of meeting future progress in such a way and degree as to retain our wildlife resource.

The problems facing us today are just as real and basic as those overlooked during the late 1800's. Antelope populations, then as now, are dependent upon habitat conditions. How the range is managed will reflect upon future antelope numbers.

One form of progress occurs in range management. Innumerable good studies have been carried out to guide the way in producing more agricultural crops from an acre of soil. Range-use practices have been devised which result in more meat production than was even dreamed of before. Livestock pastures and rotation have contributed considerably to this better production.

The fenced pasture system of range management has been gaining in popularity the past several years. Stockmen can visualize easier and better distribution of livestock. They can realize greater forage production, thus more profit; certainly profit is the result strived for. Federal land management agencies also would like to achieve greatest production from the land. Pastures give them more control of range use. No doubt, they can see a bright light ahead where, through this system, over-used ranges can be improved. Improvement can probably occur without a need of reducing a permittee's livestock animal unit privileges. This can be very important to the land managing agencies who are

subjected to pressures just as we game managers are.

A big question facing us today is how this modern land-use practice will affect wildlife. Can we continue to use the wildlife habitat intensively and extensively without adverse effect? We hope so, but in the meantime, let's not jump off the deep end.

There are several real problems I can visualize with fenced pastures and antelope management. In order to be effective, a pasture must be fenced. Depending upon the class of livestock, the fence will vary from barbed wire to woven wire. In the case of woven wire fences, how will the interference of movement affect our antelope herds?

Some parts of Wyoming, such as the northeast, have been fenced into pastures for many years. Fences range from cattle-type to woven wire for sheep on pastures up to about 2,000 acres in size. As a rule, each pasture contains all the requirements, such as food and water, necessary to sustain antelope. In other cases, antelope are able to move between pastures as needed. Movement through the fences is generally accomplished by crawling under at depressions and some by jumping. The pasture system of range management has not proven detrimental to antelope in this area.

Other antelope herds in Wyoming migrate considerable distances between summer and winter ranges. Their survival depends upon freedom of movement because of feed and weather conditions. An area set up as a pasture system would, by necessity, have fences across these movement patterns. We hope a structure can be devised that will allow unrestricted antelope movement through fences and yet hold sheep. Some structures appear quite promising, but we cannot assume they are a cure-all.

Some pasture-use systems result in one pasture of a series being heavily used one out of three or more years. Livestock can be moved from pasture to pasture and maintained on favorable forage. This is not the case with wild animals such as antelope. If pasture fences stop antelope movement, then we can assume their numbers will be governed by feed or habitat conditions at the lowest level of a pasture. Again, free movement of the antelope would be necessary to sustain a suitable population.

We have carried out enough antelope food studies to know antelope and livestock are very compatible upon the range. There is some overlap in their diets, but with moderate range use the two are compatible. Grazing by buffalo in pristine times tended to shift a plant community in the direction of forbs and browse. Without the buffalo, antelope habitat would have been much less desirable. Likewise, antelope use of increaser plants tended to shift plant communities toward the grasses for the benefit of buffalo. Cattle and antelope have a similar relationship today so long as range use is proper. A recent sheep and antelope grazing study by our department showed a minimum of competition on a sagebrush-grassland area with light to moderate range use.

What happens when a series of pastures are grazed by both sheep and cattle? Dual use is an accepted and profitable technique of the livestock industry. A given acreage of land can usually support more livestock under a dual-use system than by single use. It can be accomplished without harming the range. We can be sure, range grazed to an extreme by both sheep and cattle will be very marginal antelope habitat. An error in range management could be made by believing a particular range has a carrying capacity for antelope and livestock

which is completely independent of the other. Intensity of range use will determine compatibility of livestock and antelope.

There are many acres of antelope winter range that are only lightly grazed by livestock because of the lack of water. Some of these areas experience large concentrations of antelope in the winter. With the advent of pastures, also comes water development and uniform grazing. These areas previously used mostly by antelope could become prime livestock range. Will there still be sufficient forage to maintain the antelope under this more complete use of ranges by livestock?

We have some indication that losses through predation may be an important factor in antelope production and survival. Antelope confined within small pastures by fences could suffer considerably more predation than those with free movement unless predator numbers are properly controlled.

Fenced pastures present some related management problems concerned with the hunter and administration of correct harvest. Maybe these are not so obvious as "food", "movement" and "water" factors but nevertheless, must be considered.

Some hunters have voiced dissatisfaction over hunting within small pastures. They can make an easier kill but, to most of them, the hunt is more enjoyable than the kill. And certainly, those used to wide open space traveling will object to opening a gate every mile or so.

If pasture fences prove to be barriers to antelope, then we face the problem of regulating harvest per pasture. In northeast Wyoming, where pastures occur, the area is privately owned. Here we have a unique situation in that a trespass fee is commonly charged for hunting. Many land owners are concerned over how many animals are harvested and exert their own harvest control. I am more concerned with areas of public lands where hunters do not have such close supervision. Let's hope antelope are not fenced in so we have to issue permits on a pasture hunt area.

The picture is not all gloomy, though. Antelope, have in the past, and can in the future, benefit from water development. There are considerable acres of arid range in Wyoming that could support antelope if there was water available. With pastures, usually comes water development. Also, over-use of the range by livestock is detrimental to antelope. A pasture system gives more control and if properly executed, could benefit wildlife.

In summing up, I believe wildlife managers will find neither all good or all bad with the pasture system of range management. We will be most pleased if over-use is controlled and food supplies increase for wildlife. We are very concerned over the fences necessary to operate such a system. We wonder if more or less antelope habitat will result through water development and intensive land use as the system will bring.

I hope through proper official recognition of wildlife values, by land management agencies or individual landowners, the antelope retain a suitable home.

FENCING FOR LIVESTOCK MANAGEMENT

by
Dr. Morton May, Professor, Range Management
University of Wyoming

To begin with I should say that talking from the standpoint of a rancher or public domain administrator, I am neither, so I am in a very fine position here to sit on the fence and shoot in both directions.

I think it might be well if we go back somewhat and look at fencing first of all realizing there is no such thing as a "standard fence". We have wire fences of many kinds from the smooth wire which is used in some areas, the woven wire and the barbed wire, of course. In addition there are wood fences (not too much on our antelope ranges), swing fences or suspension fences supported approximately 100 to 150 feet by poles and non achored stays between allowing for quite a lot of movement. In range work we use the electric fence in some areas and if you get into the southern part of the antelope range down in Mexico in the states of Chihuahua and Coahuila you will find that there are adobe fences or rock fences that are about five feet high with no gaps in them for miles. Also in this area will be found living fences which are usually cactus or heavily spined plants that are planted in fence lines and they will completely restrict passage of livestock or antelope and probably rattlesnakes, humans or anything else. Then we have drift fences, snow fences, game proof fences and some of the special fences like the wolf-proof fence mentioned this morning. If you start digging into fence design you will even find some fences that are designed to let livestock pass and stop game animals. There is one that I can think of which is made out of eight or nine inch logs placed about three to four feet off the ground in a mosaic pattern to keep hippos out of livestock waterholes in Africa.

To look at fencing from the standpoint of the rancher and, again, keeping pretty much to the basics, one of the big factors of fencing is livestock distribution, more uniform utilization. Also, the rancher and the land manager regardless of their area or type of operation will find that fences are a beneficial feature for easier handling of livestock, for protection to some overgrazed or rundown areas or for protection to areas that have been seeded or treated. One of the major functions of fencing is to control animal trespass and straying or to segregate different kinds or classes of livestock. Anytime you think in terms of a ranching operation these factors are a must. Fencing can increase production. In some areas they have increased the carrying capacity to 25% through fencing and more uniform utilization without going into a special grazing system. Fencing is also desirable from the land managers point of view to eliminate or reduce livestock handling, herders and etc.

The benefits and problems of fencing have been with us for many years and we will probably have an increased amount of fencing in the near future. Perhaps we should stop for just a moment and see some of the reasons for the increase of fencing. First, we have been subjected to or privileged with a number of fine roads and highways in this state as well as others, and these highways have been fenced quite tightly in most areas to keep animals off the highway. This highway fencing demand will increase. Secondly, when we consider the world population increase, the human pressure will result in more intensive agriculture. This affects range management and the ranchers and the impact will result in increased amounts of fencing. Thirdly is the increase in

agricultural labor costs. The fact that you cannot go out and hire a sheepherder or a cowhand the way you used to is one reason why we are getting more fences, simply to cut down on the man hours required. The fourth increase factor may be related to the multiple land use concept accepted by the federal agencies. I think that we all respect the fact that we have many different natural resource uses on the land, but these are usually segregated uses within an area and additional fences are required to divide recreation areas, watershed areas and etc. from the other land uses. This also adds to the increased amount of fencing. Other reasons for increased fencing may include the type of machinery that is being developed such as fence builders and post drivers. Last but not least, increased fencing is a result of the grazing systems being employed in many areas.

Most of you are well aware of the rotation and the deferred rotation systems of grazing that are being accepted and used. There are many reasons for this from the standpoint of range management. I won't tell you that I believe a hundred percent in the rotation grazing systems because I don't. But any time you go into a rotation system you have several things that must be done. First of all, fencing to split a range area into two or more rotation units, normally the division is into four or five units. This cuts an area into considerably smaller blocks. Along with the splitting of land into smaller units is water development. The additional water may be very desirable from the standpoint of antelope production but it can cause some additional problems. For example the Red Desert of Wyoming had normally been restricted to sheep grazing in the winter, now as water is being developed there is a constant increase in cattle numbers or dual use of this area. This shift in kind of livestock changes the type of fence needed. You can no longer depend on a very low fence to control cattle as well as sheep so water development may cause problems as well as beneficial advantages under these circumstances. The principle of rotation and deferred rotation systems could have another impact on antelope production, strictly from the standpoint of compatibility. If the animals are compatible and you have areas that are deferred to livestock use there are very few people going through the deferred pastures to bother the antelope and other native fauna. One thing I think we quite often forget is that when you go into a controlled grazing system like those being used by the BLM, the Forest Service and many private operators, the ideal set-up for a rotation system is to have a homogenius piece of ground. Something that is not too diverse from the standpoint of vegetation types. This is needed because the animals starting in the spring one year will start in a different unit in the spring the next year and if there is a large range in elevation they will eventually have to start out on the top of the mountain one spring and the bottom the next. Therefore it is desirable to fence homogenius units and as soon as you do this you are fencing areas that are almost designed to cut down on the habitat available of the animal. You are confining them (if the fences do confine them) to a more restricted habitat. Now I might go a step further here and say if you were to ideally fence from a range management standpoint you would divide each major portion of land, fence it in according to its potential so that you would not be overgrazing an area that produces very little and undergrazing a highly productive area. If intensity of use in our range operations keep developing toward maximum production this is something you might keep in mind, further restricting the habitat available to the animals and basically putting them into pasture, each pasture with a different soil type or at least each unit with a different potential or carrying capacity.

I'm not a rancher, but I often work with ranchers and I would like to give you my opinion of their feelings toward fencing. First of all most of the ranchers

I work with feel that the antelope as well as our other game animals are important. I am not saying that all but most of them would like to see these animals considered perpetuated and taken care of in a range operation. To the rancher, however, fencing is a real necessity. He cannot go back to a nomadic grazing so he must fence and he will increase his fencing in the next few years. As far as having a rancher change fence style of existing fences or put in different type of antelope crossings as we have seen in the talks this morning, I think that it is almost out of the question. They would probably do it on new construction or in cooperation with a Federal agency but I think it is safe to say most of them would not tear out their existing fence and change style. Also in my opinion, a rancher by tradition has the tendency to over-fence an area. I think that this is one of the keys when we talk about types of fence that antelope can penetrate and hold livestock. Basically we should start from the beginning and determine the minimal fencing requirements to hold our livestock. There are many ranchers in the sheep business that will admit that they can use a fence constructed with five or six strands of barbed wire and under normal range condition hold their sheep. This would be cheaper than the webbed wire fencing they are now using. In many other countries, where they have both sheep and cattle (New Zealand and Australia for example) have gone to combinations of web wire and smooth wire with satisfactory results. This type of construction has merit and should be investigated further.

As far as an overall approach to the antelope-fencing problem I am not sure where to go. My feeling is very simple, this I am certain that we will get increased fencing and I think that we have to solve it by approaching the problem from all available possibilities. First of all, fence design changes are possible and practical but I am certain that is not the whole solution. Secondly, any crossings, cattleguard or jump crossings should be used where possible. I am quite certain in my own mind that we should look into the habitat requirements of antelope, the possibility of managing within a pasture unit, whether this is a smaller or large unit. This might not be the total or ideal solution but I am sure that we are going to have smaller fenced areas and we should at least look ahead at the management of antelope within these areas. The total habitat requirements for antelope are not known but if water is the limiting factor or forage or shelter, perhaps we should go a little further and look at the habitat improvements that can be made within fenced pastures. The problem is complicated and the answer will not be simple. There is not any one answer so we should try everything to work on all aspects of the total problem.

COYOTE PREDATION AS A FACTOR IN MANAGEMENT OF ANTELOPE IN FENCED PASTURES

by
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Being a Texan by transplant, I would like to exercise one of the prerogatives associated with such an affiliation, namely changing the subject. I would like to discuss aspects of coyote predation in general, using illustrations from research on white-tailed deer and extrapolating to antelope management where applicable. The data presented are a preliminary compilation of researches by Marshal White, Purdue University; Bob Cook, University of Wisconsin; Bill Samuel, University of Wisconsin; W. C. Glazener, Welder Wildlife Foundation and myself between 1960 through 1966.

The 7,800-acre Welder Wildife Refuge on the Texas Gulf Coast comprised the study area. Although a herd of 1,200 to 1,600 deer (one for every 5½ acres) live on the area, range abuse was not evident. An estimated 20 to 30 coyotes were present.

The initial step in understanding relationships between coyotes and deer was made through studies of coyote feeding patterns. More than 3,200 coyote scats were collected and analyzed between 1960 and 1962. It was soon apparent that coyotes are highly adaptive, with their diet quickly reflecting changes in the availability of a wide variety of foods. Fruit comprised a high percentage of the diet for short periods during the year (Figure 1). From early April through late May, coyotes consumed large quantities of dewberries, lotebush, and agarita. In mid-July prickly pear tunas and persimmons made up 30 to 40 percent of the diet, with prickly pear persisting through late September. Insects made significant contributions to the foods eaten in early June, amounting to 10 percent, and became increasingly important by September, when they constituted 40 percent of the diet. Insects were no longer important in the diet after mid-December. Rodents and lagomorphs constituted up to 70 percent of the diet early in the study but became less important when their numbers declined. During some periods they composed less than 10 percent of the foods taken, but averaged about 25 percent during the latter part of the study. The main species involved were cottontail rabbits, cotton rats, and packrats. Our primary interest, of course, was determining the distribution and amount of deer eaten. About 15 percent of the diet was composed of deer in later winter and early spring when rodents were plentiful. In early June the occurrence of deer skyrocketed to over 75 percent of the diet and then declined sharply to about 25 percent by mid-August. The following winter, deer constituted up to 50 percent of the diet at a time when rodents were scarce. The tremendous increase during the fawning period revealed a particular vulnerability at that time, although we were also interested in reasons for the increased utilization during late winter.

In order to interpret the significance of coyote feeding patterns in proper perspective, we also studied the productivity and population dynamics of the deer. It was determined that gross productivity of adult does (i.e. over 1 year of age) was good, with the average number of corpora lutea being 169 per 100 breeding does (Table 1). The number of fetuses per 100 does varied from 143 to 187 with an average over the six-year period of 163. Fetal mortality was negligible. Breeding among females less than one year old, was minimal

and constituted less than five percent of the total productivity of the herd. Net productivity (Table 2), as determined during herd inventories of January 1, revealed a different picture. Doe-fawn ratios at that time indicated a variation from 13 to 72 fawns per 100 does in the population. Making adjustments for the unproductive yearlings, we calculated that fawn survival ranged from 13 to 54 percent and averaged 34 percent. The variation from year to year was considerable and will be discussed later.

The indication of high fawn mortality led us to further studies of fawn survival, primarily through use of tagged animals. Fawns were captured while very young and individually marked with recognizable colored streamers (Knowlton, et al, 1964). Over the period of 1961 through 1966 more than 600 fawns were captured and marked. Minimum longevity of the tagged fawns, based upon estimated age at tagging plus the interval during which they were known to be alíve, indicated a drastic loss during the first few days of life. Over 90 percent of the mortality occurred during the first 3 weeks of life (Figure 2). Another estimate of the time of mortality was derived from finding remains of fawns in the field. Carcasses of 174 fawns were located and examined between 1963 to 1965. Ages of the fawns at the time of death were assigned according to length of long bones, state of tooth eruption, and other characteristics, and again indicated that the majority had died before reaching 3 weeks of age (Figure 3). This must be recognized as a biased sample, since frequently little or no evidence remains when a fawn has been killed by a large predator. Personal observations of fawns killed by coyotes have revealed that fawns may be totally consumed, leaving little more than bloodspots on the grass.

Through use of radio telemetry it was possible to gather more insight into fawn mortality. Over a 3-year period more than 120 fawns were equipped with radio transmitters and visual inspections made almost daily to determine their physical condition and fate. Mortality rates for radio-collared fawns approximated that for fawns in general. It was further determined that predation was potentially involved in about 80 percent of the mortality that occurred, with coyotes primarily indicated. Through the use of radio telemetry we were able to relate the high incidence of fawn hair found in coyote scats and the high mortality rate for very young fawns. Coyotes apparently were involved in 75-80 percent of the fawn mortality.

Extrapolations from age ratio regressions of adult deer, based upon tooth wear patterns, permitted construction of a population model and calculations of the population turnover rate and the number of fawns of each sex needed to survive through 6 months of age to sustain the population level. With a known adult sex ratio of 35-40 males per 100 females, the average number of fawns of each sex needed to survive until January 1 to maintain the herd was calculated at 17 females and 11 males per 100 adults in the model. This would equate with an average of 39 fawns per 100 does at the time of inventory. From Table 2 it is apparent that these minimum requirements were met. In fact, during the period of study, the herd increased from 1,150 to over 1,600 animals and then declined to about 1,350 animals.

Other aspects also deserve consideration. A close relationship was noted between gross herd productivity (i.e. the number of fetuses per 100 does) and the amount of precipitation in the previous calendar year (Figure 4). Presumably the gross productivity of the herd is influenced by rainfall through its effect upon vegetation and range conditions. It was also noted that for 5 of the 6 years, the percentage of fawns surviving to 6 months of age appeared to be related to the amount of precipitation in the January-June period of that

year (Figure 5). In other words, the amount of rainfall during the period of gestation had important implications for the subsequent survival of the fawns. It should also be pointed out that the data for 1966, the year that seemed to deviate from this pattern, were not comparable to the data collected in previous years, since none of the principal investigators were resident on the area at the time and the data available resulted from an opportune venture rather than a systematic collection of information. We now find ourselves in the position of trying to explain high mortality of fawns, principally through the mechanism of predation when the survival of fawns is markedly influenced by precipitation during a preceding 6-month period.

Our current hypothesis of the situation follows. Parturition dates for deer on this area commonly occurs during a period when no palatable fruits are available as buffer foods for the predators. When precipitation has been above normal, two significant changes occur in relation to the breeding season that subsequently affect fawning patterns (Figure 6). One is an advance in the peak conception dates and the other is a greater synchrony in breeding. When rainfall has been abundant, fawns are born earlier, with larger percentages dropped during the early portions of the season when dewberries, lotebush and agarita, all highly palatable to coyotes, are fruiting. Not only have the coyotes been conditioned to feeding on fruit at that time, but the larger number of fawns born in a brief period "floods the market", and the coyotes apparently do not take full advantage of the situation. Following less favorable rainfall conditions, the main fawning period is delayed to a time when buffer foods are less readily available, and the peak is distributed over a much broader period. Under these conditions, more fawns are vulnerable for a longer period. During extended periods of dry weather, an environmental synergism against deer productivity exists; there is a lower gross productivity; a delay in conception and parturition so that fawning periods do not coincide with periods of fruit availability; less synchrony in parturition, making fawns vulnerable over a longer period of time; a drastic reduction in buffer foods for predators and vegetation for fawn concealment; and does are in poorer physical condition and presumably less able to care for the young fawns on a nutritional basis. Hence the population dynamics of this herd centers on a high neonatal mortality of fawns, with survival closely correlated with range conditions and weather patterns preceding their birth. Predation is the primary mechanism through which these losses are accomplished, but since the deer have maintained their numbers and actually increased in density despite these losses, we must conclude that coyotes are utilizing a surplus in the herd. In the absence of hunting, this particular herd appears to be stabilized by a predation syndrome.

Some parallels can be drawn between the population dynamics of this deer herd and antelope populations. Gross reproductive rates of antelope compare favorably with those of the deer herd under study, with a high percentage of twinning but little reproductive success realized from animals less than one year of age. In the Trans-Pecos Region of Texas, in the absence of predators, net antelope fawn production also appears to be closely related to rainfall (Hailey, et al, 1964). The vulnerability of the animals themselves is another consideration. Adult antelope are typically smaller than deer, and from size alone would be more vulnerable to coyotes. I believe antelope are also more stereo-typed in terms of behavior and are more vulnerable because they have a more limited scope of response to attack. Admittedly, doe antelope frequently challenge and drive coyotes from the vicinity of their fawns, but maternal behavior is a poor basis for determining general vulnerability to larger carnivores. In addition, on most antelope ranges buffer foods (primarily rodents and fruits) are present in much smaller quantities than on the area we were

studying. Under these circumstances I would anticipate coyote predation to have a greater impact than we observed on the deer herd discussed above.

Udy (1953) in Utah and Arrington and Edwards (1951) in Arizona concluded that there were significant increases in antelope populations in areas where coyote control had been practiced. I did not receive a copy of Wyoming's recorded antelope harvest (Yoakum, 1968) until this morning, but comparisons between predator control techniques and antelope harvests for the state are interesting. In the 1920's the primary techniques for controlling coyotes were steel traps and strychnine baits. In the late 1930's the Humane Coyote Getter was developed and experimentally tested. Between 1940 and 1942, with emphasis upon the latter date, there was an extensive switch from steel traps to the new device. Antelope harvest figures for this period show that the harvest rose from 2,362 in 1939 to 6,000 animals in 1942. One year later the harvest exceeded 14,500 animals. During 1945-46 thallium sulphate was used as a poisoning technique for coyotes along with experimental use of compound 1080. By 1948 thallium sulphate was dropped from the list of toxicants used for coyote control and emphasis was placed on the use of 1080, subsequently recognized as one of the more effective techniques for suppressing coyote populations. During 1945-49 the recorded antelope harvest in Wyoming varied from 9,100 to 17,000 with an average for the 5 year period of about 12,000 animals. In the succeeding 3 years, and coincident with the extensive use of 1080, the recorded antelope harvest rose to over 41,000 animals. Sociological, economic, and political considerations, of course, were involved, and cause-and-effect relationships are elusive, but I do not think we should ignore the possible significance of predator control in relation to these harvest figures.

Touching lightly on the relationship of fenced pastures to possible coyote-antelope relationships, I think it is reasonable to assume that fences would facilitate the capture of antelope by coyotes. Coyotes have an uncanny ability to learn and will take advantage of fences. I also suspect that the smaller the fenced areas the more advantageous it would be for the predator. On the other hand, construction of suitable fences can facilitate coyote control measures. Although it is doubtful that a "coyote-proof" fence exists, movements of coyotes between areas can be minimized by suitable fences. It is also a safe deduction that any device constructed to permit passage of antelope will also be an open gate for coyotes. Most fencing on antelope ranges is done in relation to the livestock industry. Where this is done for the management of sheep ranges, we can probably discount the need for any additional protection of antelope, since coyote numbers presumably have already been reduced to accomodate the needs of the livestock industry.

I personally feel that predators can exert significant effects upon the population levels of large game animals. In areas of <u>intensive</u> game management, serious thought should be given to the effects of predators. However, the words "intensive management" carry with them an implication of full harvest. If we do not intend to fully utilize the crop that is available, I see no reason to deny it to the carnivores.

TABLE 1: Gross Reproductivity per 100 Adult Does

Year	n	Number of Corpora Lutea	Number of Fetuses
1961	--	---	165
1962	33	167	164
1963	46	150	143
1964	20	160	150
1965	30	197	187
1966	15	187	173
Average		169	163

TABLE 2: Net Productivity per 100 Does

Year	Number Fawns (January 1)*	Percent Fawn Survival thru 6 Months**
1961	51	41
1962	26	21
1963	13	13
1964	48	40
1965	72	54
1966	50	38
Average	42	34

* Based on classification of over 500 individuals.
** Adjusted for the non-productive yearling age class.

FIGURE 1: Feeding patterns of coyotes on the Welder Wildlife Refuge

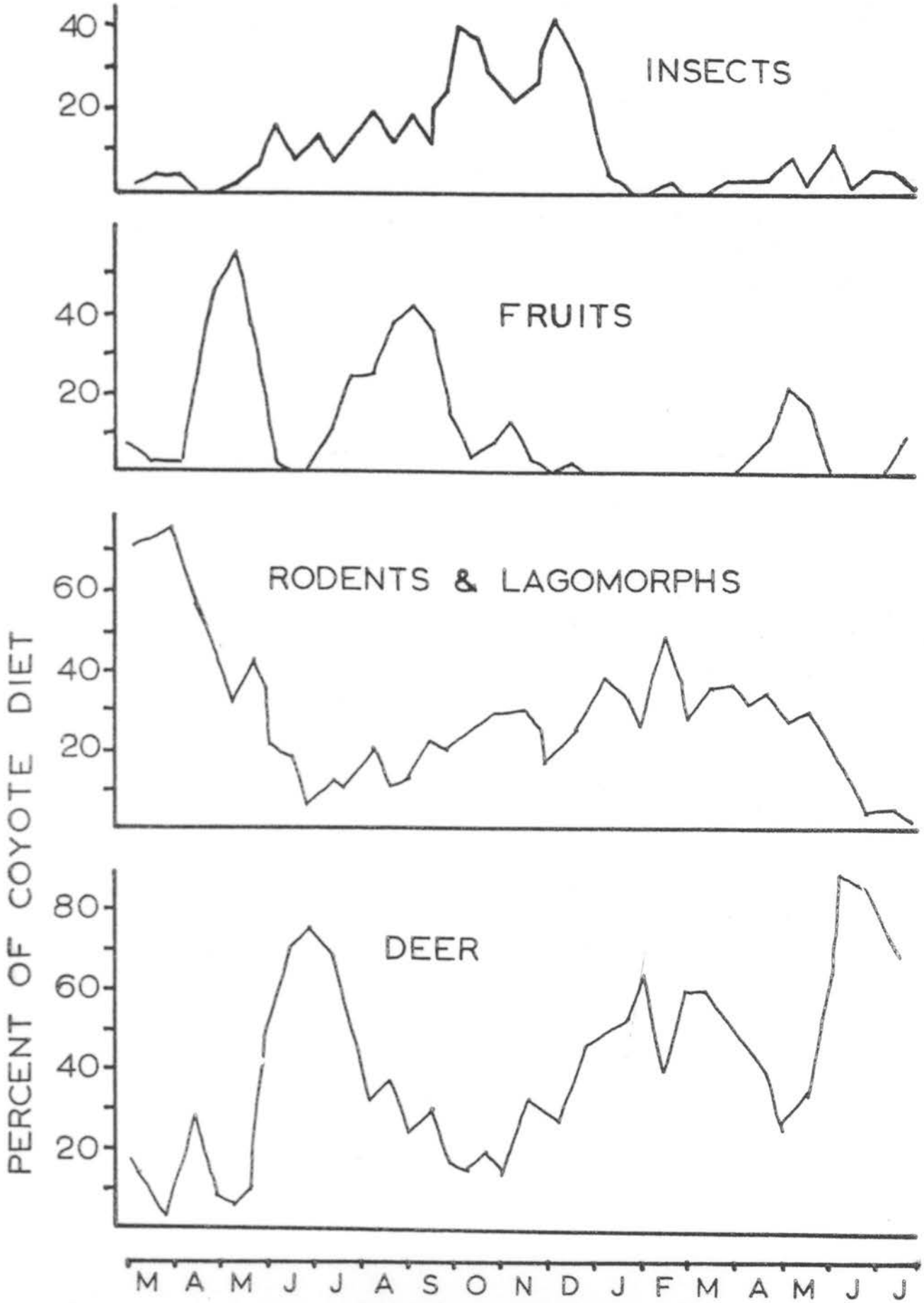


FIGURE 2: Minimum longevity of 128 tagged deer fawns

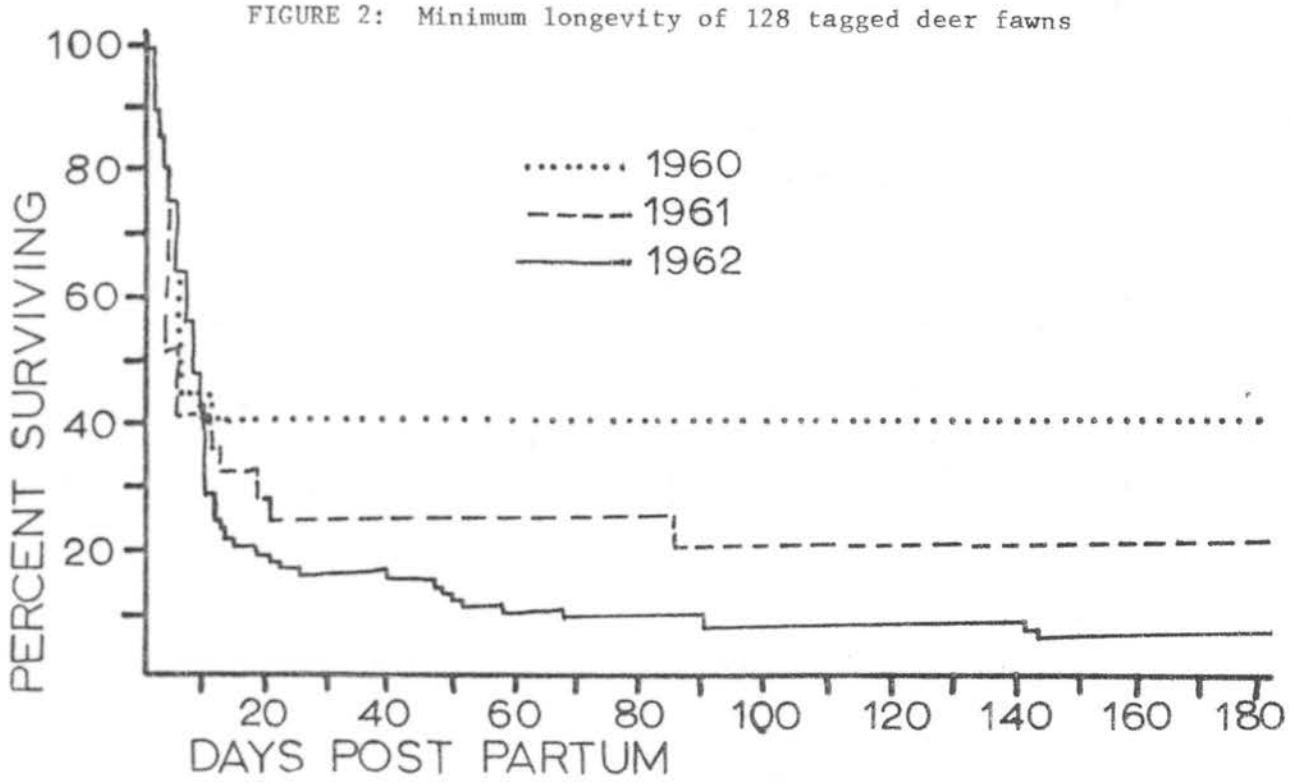


FIGURE 3: Age at death of 174 fawns found dead

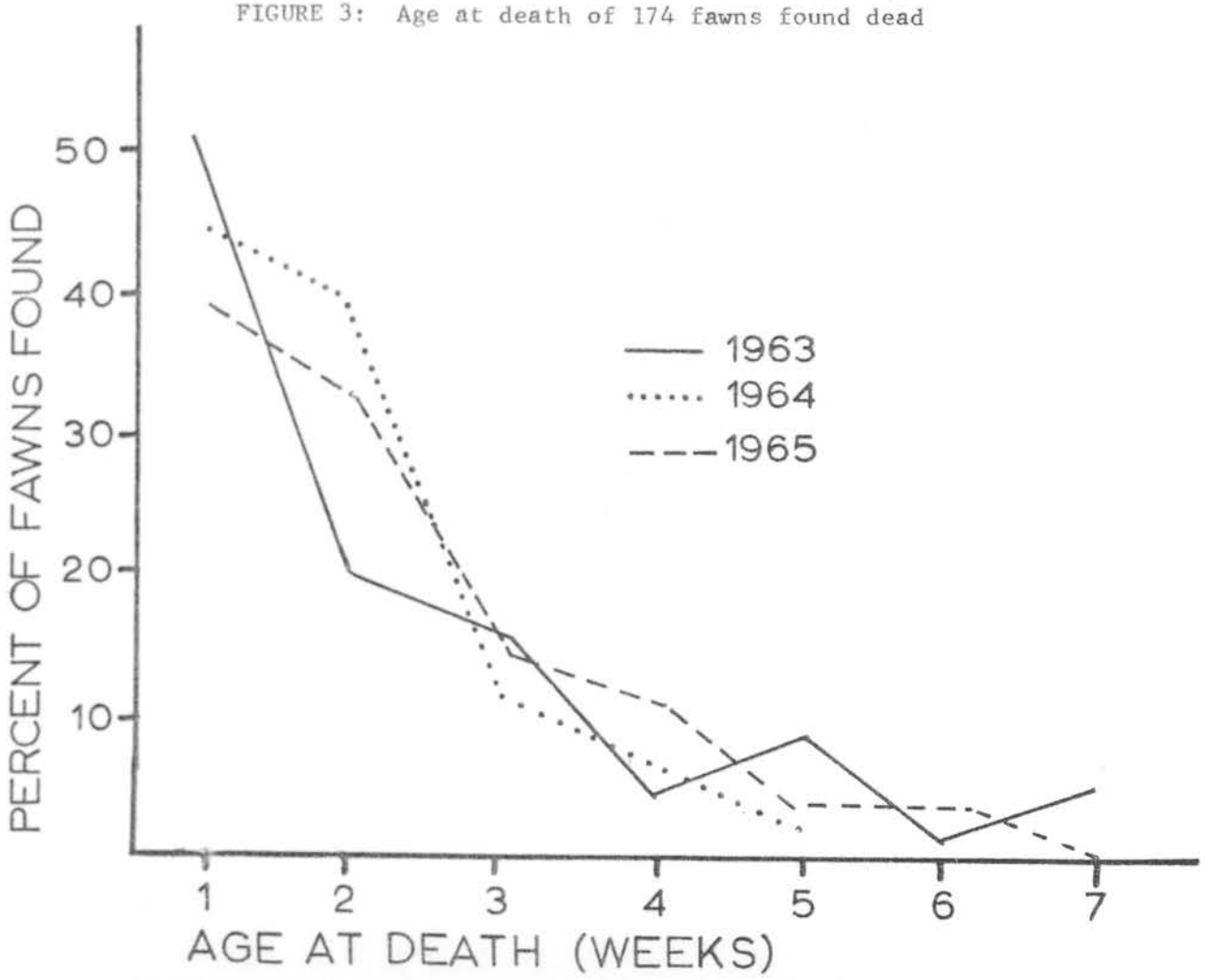


FIGURE 4: Comparison of gross productivity and annual precipitation

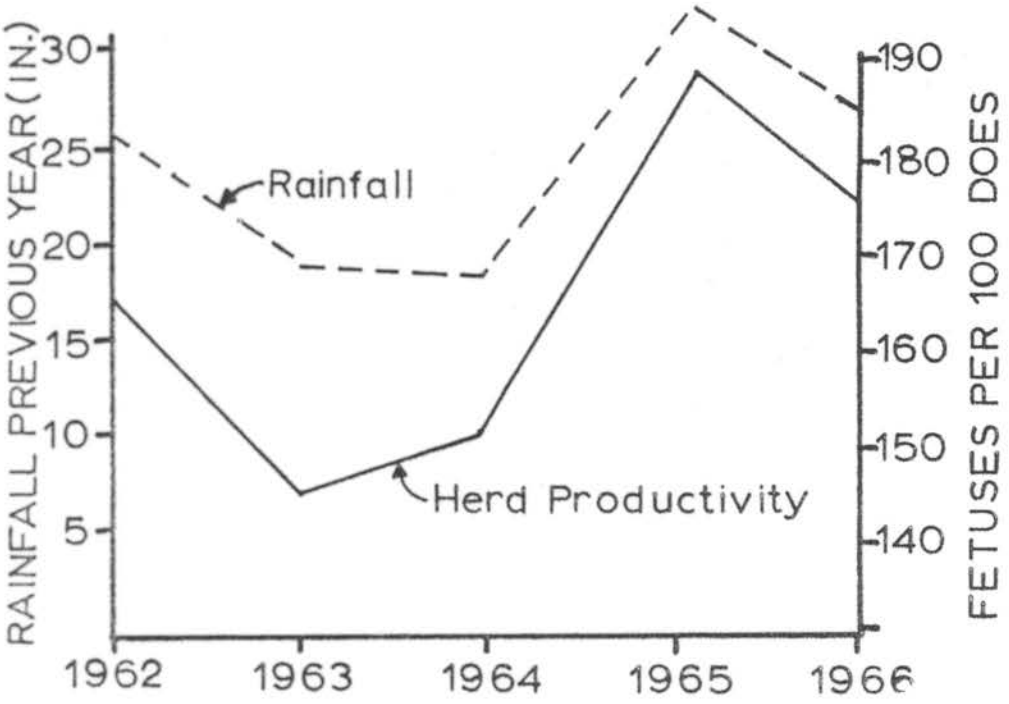


FIGURE 5: Comparison of percentage fawn surivval and rainfall during gestation

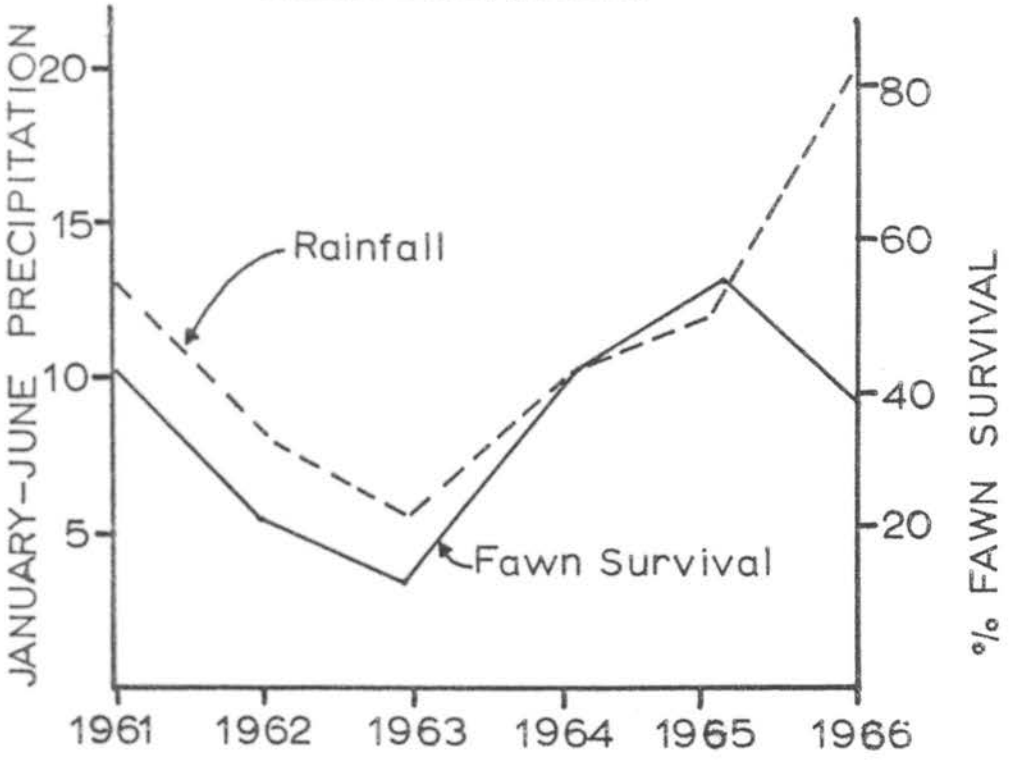
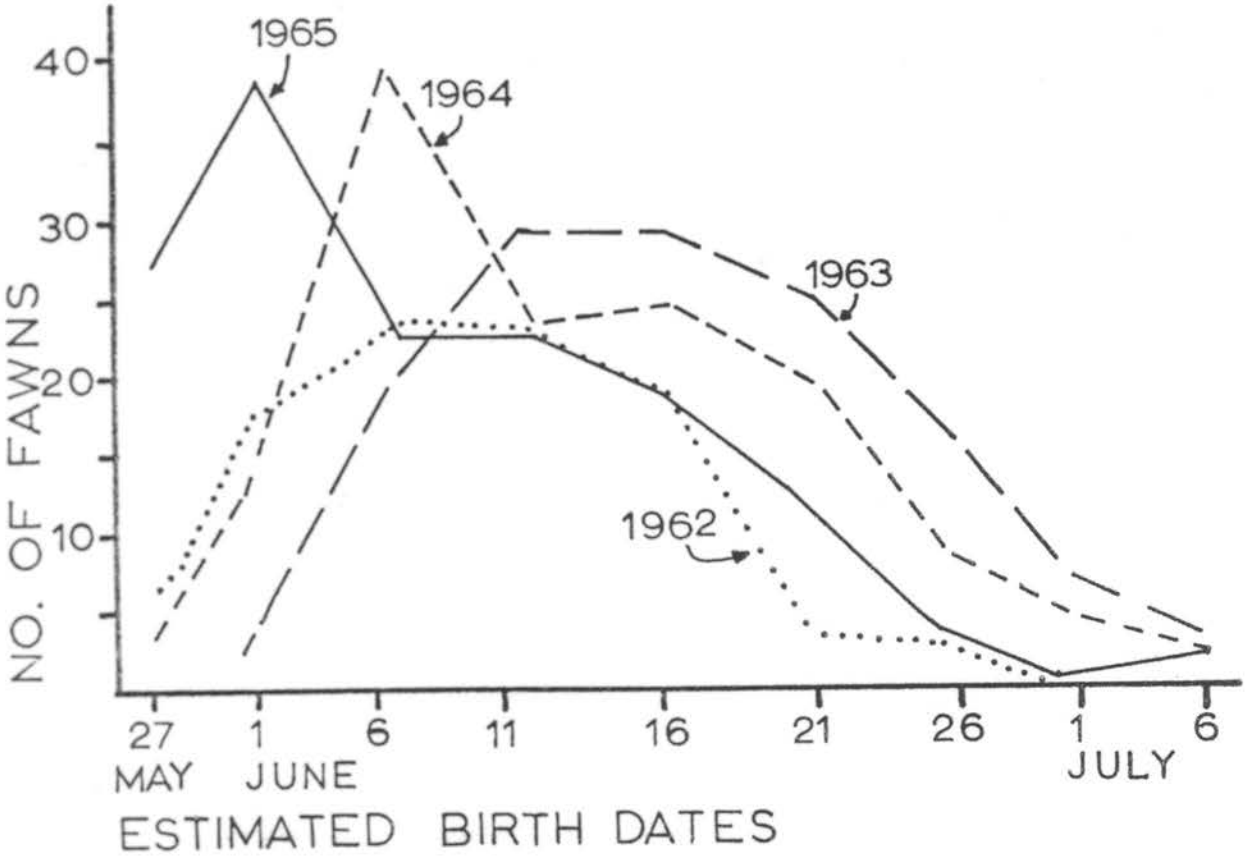


FIGURE 6: Deer fawning patterns on the Welder Wildlife Refuge



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SPECIALIZED GRAZING SYSTEMS AND THE PUBLIC INTEREST

by
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As I sat here this morning and this afternoon many of the things I had planned to say have already been said. Consequently, I am going to throw some things out here which are more in the form of questions rather than answers and I would certainly hope they will promote some discussion. When we talk about grazing systems that have evolved since the late 1800's, we talk about rotation, deferred grazing, and fencing and these are nothing new. Generally, specialized grazing systems evolved to rehabilitate deteriorated range conditions and in those grazing systems fencing played a major role.

Harold Heady, 1961, wrote an excellent review of the various grazing systems and much of what I am going to comment on here is based on his review. We can use 1961 because not much has developed since then, at least nothing that refutes or changes the situation described by Heady. Heady stated that the use of specialized grazing systems emphasized: (1) vegetative improvement and control; (2) livestock handling; and (3) more livestock products. Heady further states that as such the principle use of specialized grazing systems is the improvement of deteriorated range. Heady's discussion raises one important point which we all too frequently dismiss because it's a very difficult question to answer and because there's very little data to evaluate. Heady asks, "If we are talking about deteriorated ranges, are they the bulk of the ranges we are dealing with, if not, then what about the grazing system that maintains an excellent range and yields the greatest net return from that excellent range?" Of all the papers you've read about grazing systems, can you recall one that discusses this point?

With reference to the role of fencing control in special grazing systems, there is a need to re-examine this management technique. Generally fences are used to control animal distribution, to regulate animal stocking or numbers and to regulate forage use. Unfortunately these functions of fencing are usually considered from the viewpoint of each special interest without a proper functional evaluation with respect to the entire environmental unit of which cattle, sheep, antelope, and people are a part. From the viewpoint of the grazer, generally the forage, the animals and the grazer form the simplified ecosystem or environmental system under consideration regarding the implementation of grazing systems and fencing. Unfortunately, management of grazing resources is not that simple. The simple grazing ecosystem includes other activities of man and other environmental components, i.e., antelope, coyotes, petroleum resources, water resources, recreational resources, road construction, vegetation spraying, camping facilities, urban development, etc. In our attempts to study these grazing ecosystems, generally we are attempting to solve management problems through such studies as fencing influences on animals and grazing vegetation improvement. I ask you, how much longer can we continue studying only one or two facets of the complicated grazing environment, without the simultaneous involvement of all the related environmental factors? How much longer will the general public tolerate this unscientific procedure?

Public support in any resource management program is imperative. It is gained only slowly and usually with considerable hard work. In contrast, public support can be lost very quickly and in most cases because of some unnecessary or

irrelevant action. The problem of public access and fencing on public lands is such a case in point. Also, these access problems have created game harvesting problems. Fence lines have cut off entirely and needlessly, in too many instances, useful, long established public roads. In other circumstances, where gates have been established they have been too few and far between. In too many instances gates have been located in inappropriate places with respect to useful horse or vehicle use, or with respect to areas that are all season travel route, free of drifting snow or with good drainage during snow melt and in rainy seasons.

You may have the feeling that these problems are elementary and their importance is being over emphasized. This is not the case. After a man has travelled 15 or 30 miles on a road only to be confronted by a fence with no gate or a gate in a hollow mudhole, he has two alternatives: (1) return the way he came or (2) cut the fence. Gentlemen, you and I know wire cutters are very commonly a part of Wyoming back road travelers these days. As resource managers condoning poor fencing practices, you make a violator out of a man who has been using that public trail for maybe as long as 20 years. In addition, you make the grazer unhappy because you create a situation for mixing his stock with the next allotment. In fencing layout, these problems would never need to arise if you give proper consideration for the total use of the area, i.e., the rock hunter, antelope hunters, fisherman, and ordinary travelers, typical of the ranchers that use those short cut roads in seasonal periods. In Wyoming's open spaces and sparse population these are important considerations which can be so easily accomodated in sound, long range planning.

The problem of fencing restricting game harvests, is in my mind, even more serious than the public access. Even with limited data, it is evident that it is a definite problem with Wyoming's antelope harvests. Those antelope nearest accessible roads and larger human population centers have been absorbing the greater hunter pressure and greater antelope harvests. The Laramie Peak-Shirley Basin Unit is one example. Prior to 1961 the majority of the hunting pressure was south of the Laramie River. In 1961 two units were formed, one south and one north of the Laramie River. These two units replaced the former single unit in an attempt to get better and more uniform hunter distribution. It now appears, from information supplied to me, that the northern area will have to be further sub-divided into two units to force more uniform hunter distribution. Generally, the causes for this inequitable hunter distribution and disproportionate antelope harvest can be tied directly to the influence of fences and limited roads on uniform hunter access to all parts of the original hunting unit.

One response to this problem is that these isolated and lightly hunted units provide antelope stock to repopulate these other subunit areas. Information on a variety of circumstances indicate this is a rather serious risk with some very serious implications. The Jackson Hole elk herd had several subunit populations which were nearly exterminated by uncontrolled hunting pressure. In Yellowstone National Park during the recent elk reductions, some subunit populations were nearly or entirely eliminated by trapping and shooting. The elk inhabiting the higher more remote country escaped. In these circumstances, the natural evolution involved for establishment of a local herd may have taken centuries or thousands of years, yet man has been responsible for their extinction in one or several hunting seasons. This same situation appears to be developing with various antelope populations in Wyoming. In addition, if any elk did survive, they continued to survive in the future because they became so conditioned to man and his hunting efforts that they learned just what to do to

escape him.

With problems such as these and many more yet unrecognized problems, how long can we avoid radically redesigning land use programs to give proper consideration to every aspect of land use ecology? How can we consider implementing specialized grazing systems without involving every related environmental factor? How can we attack complex problems without resorting to discrete, refined and imaginative measures of analysis? We can no longer be a "horse and buggy smithy" in an age requiring guided missile technology and sophisticated people management.

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Richard DeArment, Texas: Did you allege that coyotes would have a greater influence on a mortality of antelope than deer because of the buffer species, fear resulting from the antelope?

Fred Knowlton, Texas: My personal belief is that in areas where antelope exists there are fewer buffer species particularly in the quantities that I was talking of in relation to the deer data that I presented. I also think that coyote is capable of being much more effective on the antelope because of the, I consider the antelope to be the more stereo-typed animal and I think we can predict a little more about what he is going to do. He's sort of programmed, more completely I think than what deer normally are.

Richard DeArment, Texas: Well the Welder situation that sounded familiar was a unique situation and, of course, when you get used to that type of buffer speciesyou assume that when you get up in the prairie that you don't have the buffer species. Now we've got plenty of them up there in the line of fruit, we've got all kinds of fruit and we can match you fruit for fruit. And another thing, of course, you don't realize in the prairie you have plenty of jack rabbits, rats and mice; there are plenty of buffer species. And that the situations are different, and as far as antelope being stereotype for coyotes, there's all kinds of records of antelope handling and warding off coyotes so I would be inclined to disagree with that assumption.

Fred Knowlton, Texas: At least I think that the records show that antelope have responded to a much greater extent then deer in relation to predator control, if we can accept the records that have been passed down to us from well even as late as the last century.

Richard DeArment, Texas: In our panhandle area we have had ten-eighty control right in our antelope ranges that had no noticeable effect on the increase on rabbits and rats. I mean that we had coyote control of ten-eighty, both in our deer range and our antelope range.

Fred Knowlton, Texas: I don't suppose that this is going to answer all the questions, all I was trying to do was, I think that we can actually raise more intelligent questions from the data we got than we've received so far and this is one of the topics that the further you pursue it, it's like a piece of gristle, it just keeps getting bigger and bigger and bigger and pretty soon you wish you had quit.

Ken Diem, Wyoming: I would like to support the gentleman from Texas on his comment about whether or not antelope are more susceptible, because it took centuries for this beast to survive in the very anatomical devices that it has suggests that it's pretty well adapted despite the coyote plus we have a problem here, the conclusions that you're drawing from the total antelope numbers, predator control, etc. These are the types of problems we have had here before. When you look at one set of data that extends over many, many years and draw conclusions without looking at the entire ecosystem and the environmental factors that went along with this you're flirting with the same kind of problem that some of the people came up with a number of years ago with regards to the number of Baptist ministers in Wisconsin. They were directly correlated in their increase with the production of beer. Now what does this mean?

Fred Knowlton, Texas: I think that there's one thing we should remember. The fate of any population is dependent on the fate of the juvenile portion of the population. And I made very little reference at all to the fate of adults in the deer herd, I think that it would be the same thing with the antelope, as you indicated in the panhandle herd that it's the fate of the young and something has happened to the reproduction. . . . . .

Bill Hepworth, Wyoming: I would just like to comment rather than take a stand on either side. It is obvious what the results of some of our studies point to. But as far as antelope in the desert are concerned there is very definitely a correlation between fawn losses and coyotes, and there very definitely is an indication that food supply deteriorates and when their other food supply of buffer species deteriorates there seems to be more predation on antelope. Now admittedly, we have jackrabbits and ground squirrels--ground squirrels are in hibernation in the winter time and quite frequently the jackrabbit population fluctuates. And at the times we have seen our lowest fawn crop are also at the times when the jackrabbit population has been at its low ebb. This could point out perhaps a correlation between predation and avaiability of other species. As far as available checks on mortality in the field at the present time with the exception of highway mortality, approximately 50% of the mortality to all these classes of antelope resulted from predation. I'm not saying this is all coyotes because we also have bobcat, feral dogs and we also have eagles, but there seems to be a very significant number of animals being taken and this seems to correlate very well with available food supply in other species. Maybe this is academic but nevertheless we don't have the fruits here that you have in Texas.

Question: I've been given to understand that occasionally an antelope will take an animal that's been weakened, in your study down there could you determine whether these fawns were taken after being weakened because of birth defects or parasitism prior to being taken by the coyote?

Fred Knowlton, Texas: Trying to determine the condition of a fawn after a coyote has gotten a hold of it, is something a little bit beyond our present technology. We have, there were two people from the University of Wisconsin who were running this parasite and disease study on the fawns, now these are subsequent studies--sort of a continuation. There seems to be little evidence of disease as such, there may be one or two parasites which may cause some mortality at the six or seven week mark, but this is after the drastic reduction has already occurred. Where you want to draw the line as far as disease, do you want to consider the possibility of malnutrition maybe this isn't the right word to use when you're talking about an early post partem animal but one point that I didn't bring up in my earlier presentation was in the differential mortality between the male and the female fawns which is apparent and which the unbalanced sex ratio in the adult is the result of. We have speculated that it is the result of poor nutrient requirements possibly through lactation in the does and that male fawns requiring or having higher metabolic rates may be susceptible to, if I can use the term hunger a little bit earlier, in affect go in search for its mother. We've observed them out there wandering around in the middle of the day bleating, and that's about as good as a death warrant where you have coyotes in the number that we have. Now we were dealing with about two coyotes per square mile or per section, this is an estimate, this is not the most dense populations that we have, but this a fair coyote population.

Ken Diem, Wyoming: The one point I had that I think we need to put into this picture very seriously is that we're all looking for one easy shotgun solution and it just isn't there. I don't care how hard you try, how many of you play craps, how many of you have seen a guy just sit in there and just whip you to fair thee well? I can remember a man who had a mind that worked just like a calculator, he used to play bridge for a nickel a point, he had a mind that knew where the dice were going to fall before the guy threw them, because he looked at all thirteen possibilities. When we look at predation, when we look at rainfall, when we look at domestic livestock, when we look at fences--we're looking at four, as yet, undefined possiblities that are affecting antelope production. Mr. Knowlton used a diagram on the

board and it would be rather interesting to me to run that through the statistical test, the correlation; if you recall the survival of fawns and rainfall. In the last year there was as much difference in opposite direction with the rainfall going up and the fawn production going down as there was between the highest peak and all the other curves. Now this raises some question in my mind as to the correlation. It looks good for the first three, but the last one just kills you deader than a doornail. It may not have an influence but the point is, that there are other things that obviously operate here. The one thing that people have yet to mention here is the influence of man in his harvest--what is the relationship between our harvest program and predator loss? What's the influence of the availability of all food sources and the predator population? People talk about predators being few in number, I sometimes wonder, because after having watched in the past two years (three years) this elk operation in Yellowstone--man can condition an animal to unbelievable capabilities to avoid him. If you don't think this is true, you've heard about the helicopter being such an efficient trapping device. Those elk have become so conditioned out there, that they're practically ineffective as far as rounding up animals. Animals dive under the nearest tree and sneak literally around the tree, with the helicopter on the opposite side, just go around and around and as long as they got that tree there they know that they're safe. Predator control, hunter harvest, all have conditioned animals in the same way. I think that frequently we give too little credit to the animals survival, it wouldn't have been here for as long as it's been without some brains. There are a multitude of things involved here and we have to consider them beyond the old cliche, the predator, the cowman, fences, and hunters. There are other things gentlemen, that make that antelope tick and it's about time that we found out what they were.

John Newman, Wyoming: In looking over my summary sheet here, I see that the panel has been very efficient in pointing out the various factors and the host of problems that we can expect to deal with in this question and I want to thank the panel members at this time for doing what I consider an excellent job on a rather knotty subject. I also wonder if it would be proper to charge the next meeting of this session to come up with some of the answers.

TEN YEARS OF ANTELOPE MANAGEMENT IN THE GILLETTE AREA OF WYOMING

by
Marvin Hockley, Big Game Biologist
Wyoming Game and Fish Commission

In the northeast corner of Wyoming is to be found some of the state's best antelope habitat and one of the most productive herds (aerial census of 1967 found 12,154 antelope) in Wyoming. This area is made up of rolling plains, intermittently broken by hills and rough eroded gullies, which are covered with sagebrush, forbs, and grass species. In the northern half, small timbered areas (yellow pine) which are widely dispersed are common and typical of the landscape.

The Gillette area is approximately 3,042,840 acres in size, of which 80 per cent is privately owned, the rest being made up of federal (12.6 percent) and state owned (6.6 percent) land.

The climate is characterized by abrupt and often extreme variations in both temperature and precipitation. The average temperature is 45 degrees, although temperatures of 54 degrees below to 110 degrees above zero have been recorded. The annual precipitation is about 14 inches which generally comes in the form of snow. Bad winter storms, especially late ones, occasionally cause some loss in livestock and antelope. Severe thunderstorms are common during the summer period.

The main industry in this country is cattle and sheep ranching, although some farming is also done. In the past two years the oil industry has increased its activities considerably and certainly will have some effect on our future antelope population. The land use patterns, such as multiple livestock use and the large amount of deeded land, has created some unique problems and interesting facets in the management of the antelope for this area.

It has become common practice for landowners in this area to charge a trespass fee for the privilege of hunting. This practice which has been going on for the past ten years has stopped many of the resident sportsmen from hunting in this area. The vacuum left by the residents was quickly filled by the non-resident hunter who is quite willing in most cases to pay the fee (from $10.00 to as much as $150.00, depending on the amount of services required). Each individual landowner charges whatever fee he likes and allows or controls the number of hunters who will hunt on his property. The landowner looks on the hunting as a second source of income and makes it a lucrative business. In this way he essentially controls the harvest on his land and can also dictate what sex a hunter can shoot while hunting on his property.

The antelope in this area have for many years been subjected to livestock fences and although the fences are of some hinderence to the normal movement of antelope, the herds do not seem to have suffered greatly because of them. Antelope for the most part have adapted themselves to fences by crawling under, through, or jumping them. The fences in this area for the most part encompass large acreages of range, which provides ample forage and the numerous stock reservoirs provide ample water which does much to reduce the necessity of antelope movements. Most of the movements are local, with the exception of movements which are the result of severe weather conditions which force the antelope

to move to other areas. To determine what effects the Interstate Highway Systems might have on migrations, we set up a study along Interstate 90 from the town of Gillette to the Powder River (approximately 36 miles). For three consecutive years the road right-of-way and underpasses were checked for antelope movements. Although these were checked weekly during the winter months, only once was there a suspected movement of antelope through an underpass. We have, however, one authentic report of three antelope being inside the Interstate right-of-way in July of 1967, so some movement has occurred.

Antelope herd composition studies which have been conducted in this area (Table 1) for the past 13 years have shown a consistently high reproductive success year after year. An average of 100 fawns per 100 does is common. One year (1966) the fawn-doe ratio reached an all time high of 130 fawns per 100 does.

A comparison of the fawn-doe ratios and precipitation data since 1955 shows a high degree of correlation between the two sets of data except for the year 1966 when the fawn-doe ratio increased to its highest level (graph). The precipitation data was taken from six weather stations which are distributed throughout the area. All have approximately the same elevation (average elevation 4,400 feet) and are located in the area of dense antelope populations. The difference of elevation from the highest station to the lowest station is 1,300 feet.

This herd is being subjected to hunting seasons which in the past ten years have averaged in length to around 23 days. During this ten year period 50,503 either sex permits have been issued or 5,050 permits per year. The total harvest for the ten year period has been 46,824 antelope of which 74 percent have been bucks, 21 percent does and five percent fawns. The nine year hunter success has varied from a low of 93 percent to a high of 98 percent, with an average of 95 percent for the nine year period.

To check on the intensity of our management, we have conducted several age studies in this area, the most recent one, during the last hunting season in 1967. A sample of 340 antelope were aged by using the lower jaw dentition. This sample was collected at the locker plants in the town of Gillette. In the sample, the bucks represented 86 percent, does 11 percent and fawns three percent. The buck percentage is felt to be somewhat higher than the true percentage figure. It is interesting to note that the largest number of antelope (Table 2) harvest came from the 1½ year old age group in the buck segment of the herd, yet it is not considered to be extremely high. In 1964 for instance we found that 46 percent of this age group (bucks) was represented in the harvest. In the doe segment of the herd, 49 percent of the does were taken in the four plus year old age group and indicated that the does have a better chance of reaching this age group than the bucks under our present management. In the yearling class we find the does made up 24 percent of the harvest. For both sexes we found that only three percent of the harvest was made up of fawns. The yearling group made up 35 percent which was the largest age group found, followed by the four plus age group which made up the second largest group with 29 percent.

The conclusions which can be drawn from the age study and the rest of the data presented here is that this herd has been able to maintain its own under intensive management. The number of permits, perhaps could be slightly increased. However, we feel that this herd is being subjected very close to the maximum harvest allowable without permanent damage being done to the herd.

Certainly in light of the rapid changing land use patterns, the increase in oil activity and the interest which is being shown in the development of open pit coal deposits, we are going to be hard pressed to maintain the antelope population at the present level.

Table 1: Gillette Antelope Management Area Herd Composition Studies

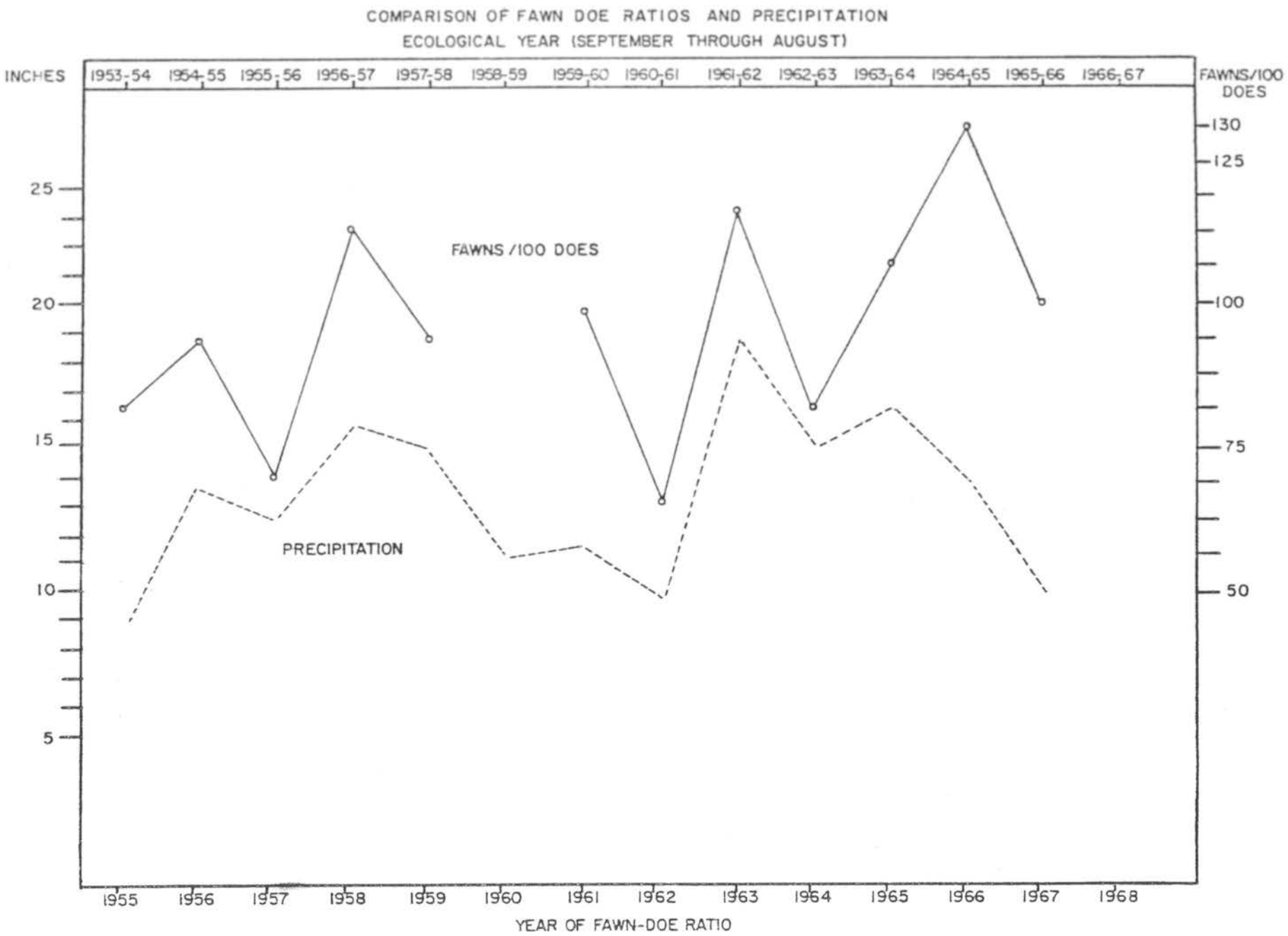
Year	Total Number Classified	Ratios		
		Buck/100 Doe/Fawn		Fawn/100 Adult
1957	415	37	71	52
1958	591	49	117	78
1959	1,579	63	98	60
1960				
1961	813	57	105	67
1962	2,134	42	71	50
1963	1,629	34	120	89
1964	4,374	44	83	57
1965	1,267	35	110	82
1966	922	33	130	100
1967	2,082	43	98	68

A 13 Year Average is 100 Fawns per 100 Does

Table 2: Antelope Age Study in the Gillette Antelope Management Area Harvest for 1967

Age	Bucks		Does		Both Sexes	
	Number	Percent	Number	Percent	Number	Percent
Fawn	-	-	-	-	*12	3%
1½ Years	110	38%	9	24%	119	35%
2½ Years	43	15%	3	8%	46	14%
3½ Years	57	19%	7	19%	64	19%
4 Years Plus	81	28%	18	49%	99	29%
TOTAL	291		37		340	

*Fawns were not classified as to sex.


COMPARISON OF FAWN DOE RATIOS AND PRECIPITATION
ECOLOGICAL YEAR (SEPTEMBER THROUGH AUGUST)
INCHES
1953-54 1954-55 1955-56 1956-57 1957-58 1958-59 1959-60 1960-61 1961-62 1962-63 1963-64 1964-65 1965-66 1966-67
FAWNS/100 DOES
25
20
15
10
5
130
125
100
75
50
FAWNS /100 DOES
PRECIPITATION
1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968
YEAR OF FAWN-DOE RATIO

HUNTER HARVEST AND POPULATION TREND OF A SMALL HERD OF ANTELOPE LOCATED IN MOFFAT COUNTY, COLORADO*

by
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ABSTRACT

A herd of antelope located in the sandhills immediately south of Maybell, Moffat County, Colorado, has been under study since 1963. The area is approximately five miles by six miles in size and is enclosed by a sheep-tight fence. Hunter check stations were maintained near the study area during the hunting seasons to obtain information on the age structure and sex of the harvest. Aerial counts were conducted annually to determine population size and herd structure. Hunting permits were of a "specified permit" type (designating the sex of the animal that could be killed) from 1963 through 1966. In 1967 all permits were of the "either sex" type.

The herd declined rapidly under a heavy harvest of 42-48% and increased with a light harvest, approximately 20%. It would appear that a harvest level somewhere between 40% and 20% might have maintained a stable population. The buck-to-doe ratio's increased under the restricted harvest of the buck segment of the herd. The mean age of the does in the harvest and fawn:doe ratios showed a somewhat similar trend to the population curve; declining and inclining as the population decreased and increased.

INTRODUCTION

A herd of antelope located in the sandhills immediately south of Maybell, Moffat County, Colorado, had been under study since 1963. The area is characterized by a shrub overstory consisting primarily of bitterbrush (Purshia tridentata), silver sage (Artemisia cana), and rabbitbrush (Chrysothamnus sp). Cacti (Opuntia sp.) and cheatgrass (Bromus tectorum) are the major understory species, intermingled with a variety of forbs. The area is approximately five miles by six miles in size and is enclosed by a sheep-tight fence. The fence is constructed of net and barbed wires to a height of approximately forty-six inches; and appeared to effectively prevent antelope movement into or out of the area.

METHODS

Hunter check stations were maintained at the study area during the hunting seasons to obtain information on the age structure and sex of the harvest. Hunters were required to check in and out the main gate to the pasture, so a check station was set up at this entrance. The age of each animal was determined by the tooth erruption and wear technique. Information on the number and location of dead or wounded antelope was obtained from the hunters to aid in the wounding loss surveys.

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*This paper is a contribution from the Federal Aid Project W-40-R (Antelope Investigations), Colorado Game, Fish and Parks Department.

The area was thoroughly searched on foot, by vehicle, and by the use of an airplane following the season to determine the wounding loss on the study area. Dead antelope were most easily seen on the aerial surveys during mid-day when the sun was directly overhead; shining directly down between the shrubs and illuminating the white portions of the animal.

Aerial counts were made on the area to determine population trend, sex ratios, and fawn ratios. The entire area was flown in one-half mile wide strips at an altitude of 100-300 feet. Counts were made in late winter and early spring to obtain information on the herd size and buck:doe ratios. Counts were made again in late August to obtain fawn:doe ratios for the herd.

RESULTS AND DISCUSSION

The hunting permits for the area were of a "specified permit" type (designating the sex of the animal that could be killed) from 1963 through 1966. In 1967 all permits were of the "either sex" type. The numbers of permits issued varied throughout the study period. In 1963 and 1964 there were 250 permits (50 bucks - 200 doe) issued (Table 1). This was reduced to 100 permits in 1965 and 1966: 25 buck - 75 doe and 50 buck - 50 doe, respectively. Then 60 permits were issued in 1967. The hunter succes was very high (over 90 percent) for all years except 1965, when the success was low due to a heavy snowfall in the area during the hunting season.

The aerial counts indicated a rapid decline in the population from 1963 to the period following the 1965 hunting season, then the population started increasing (Figure 1). The fawn:doe ratio increased from 75:100 in 1963 to 91:100 in 1964; decreased to 54:100 in 1965; then started increasing to 71:100 and 90:100 in 1966 and 1967 (significantly different at the 95% confidence level). Fawn: adult ratios showed a trend more closely resembling the population trend; decreasing from 55:100 in 1963 to 43:100 in 1964, and 35:100 in 1965. These ratios then started upward in 1966 and 1967, 47:100 and 59:100, respectively. The buck:doe ratios showed a slight upward trend under the restrictive buck permits during the period from 1964 through 1967; 32:100, 40:100, 43:100, and 40:100 respectively. However, these ratios were not significantly different at the 95% confidence level.

Table 1: Hunter success on the study area.

Year	Permits Issued			Number Harvested	Percent Success
	Buck	Doe	Total		
1963	50	200	250	243	97%
1964	50	200	250	229	92%
1965	25	75	100	60	60%
1966	50	50	100	92	92%
1967	Either-Sex		60	57	95%

The mean age of the does harvested followed a pattern similar to the population

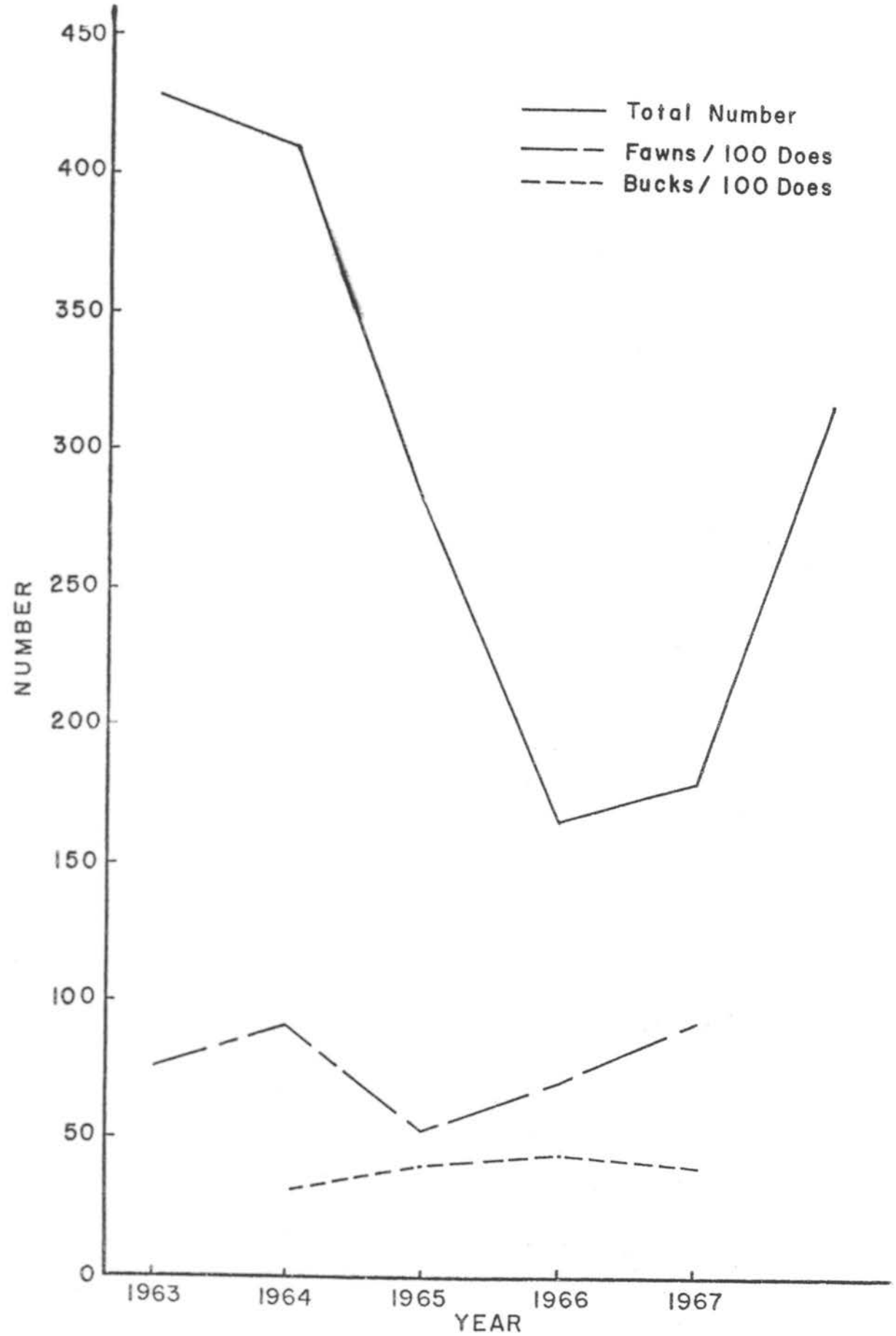

Figure 1: Total number and ratios obtained on the aerial antelope surveys

trend. The mean age decreased from 2.3 years in 1963 to 1.2 years in 1965, then increased to 214 years in 1966, and down to 2.0 years in 1967 "either sex" season (Table 2). The fawn age-class was low in the 1963 harvest, increased and remained high until 1967, when it decreased again (Figure 2). The low percentage of fawns in the harvest occurred when the fawn:adult ratios were high, also when the population was high in 1963 and rapidly increasing in 1967. Therefore, hunters were likely biased in selecting larger animals when the population was high, and were less selective during the population low. Yearling and adult (two years and older) portions of the harvest were alternately high and low: the adult class being high in the harvest when the yearling class was low; and the reverse being true, also. It would stand to reason that the adult portion of the population would be low following a year when the yearling harvest was heavy, and the adult portion of the population would increase following a year when the yearling harvest was light; because of the yearling recruitment into the adult class the following year.

There didn't appear to be any relationship between the percentage of yearlings or adults in the harvest and the population trend. However, graphs obtained by plotting the number of yearlings and adults in the harvest, rather than using percentages, more closely resembled the population curve. Sample sizes for doe segment in the various age classes during the last three years were quite small; for example: the numbers in the yearling class were 10, 5 and 6. Thus, the age structure based on these small samples may be misleading.

The mean age of the bucks decreased then gradually increased upward until 1966. In 1967, when the either sex permits were issued, the mean age dropped again. Hunters were noticably biased in selecting their bucks. When large bucks were fairly numerous in the herds and easily found the hunters put forth more effort in obtaining animals with large horns. Therefore, the buck harvest is less apt to reflect the age structure of the population than the doe segment of the harvest.

An estimate of the preseason population was derived from the total counts and the fawn ratio counts. For example: 428 animals were counted in the spring of 1963; then a ratio of 55 fawns per 100 adults was obtained on the flight in August; by multiplying 55% times 428 adults there was estimated to be 235 fawns; 428 adults plus 235 fawns equals 663 animals (Table 3). The hunter harvest was combined with the known wounding loss for 1963 to obtain an overall harvest of 282 animals. Then a percent harvest figure was obtained by dividing the harvest by the estimated population number. The percent of harvest in 1963 through 1967 was 42%, 48%, 17%, 40%, and 21%, respectively. In relating the percent harvest to the population trend, we see that the population decreased slightly with a 42% harvest, then sharply declined following a 48% harvest the next year. Then there was a slight increase with a 17% and 40% harvest. The population increased sharply following the 21% harvest in 1967. It would appear that a harvest level somewhere between 40% and 20% might have maintained a stable population.

Table 2: Age of the antelope checked at the Hunter Check Stations

Age Class (years)	Bucks		Does		Total	
	Number	Percent	Number	Percent	Number	Percent
1963						
Fawn	5	10	26	19	31	17
1	16	33	54	40	70	38
2	12	25	13	10	25	14
3	8	16	18	13	26	14
4	6	12	20	15	26	14
5+	2	4	4	3	6	3
Total	49		135		184	
Mean Age	2.5		2.3		2.3	
1964						
Fawn	23	32	41	35	64	34
1	14	19	27	23	41	22
2	21	29	20	17	41	22
3	11	15	15	13	26	14
4	4	6	7	6	11	6
5+	0	-	8	7	8	4
Total	73		118		191	
Mean Age	1.9		2.0		2.0	
1965						
Fawn	4	24	8	33	12	29
1	3	18	10	42	13	32
2	5	29	4	17	9	22
3	1	6	1	4	2	5
4	4	24	0	-	4	10
5+	0	-	1	4	1	2
Total	17		24		41	
Mean Age	2.4		1.2		1.6	
1966						
Fawn	6	12	13	38	19	23
1	7	14	5	15	12	14
2	13	26	4	12	17	20
3	8	16	4	12	12	14
4	9	18	3	9	12	14
5+	7	14	5	15	12	14
Total	50		34		84	
Mean Age	3.1		2.4		2.8	
1967						
Fawn	6	18	5	26	11	21
1	13	39	6	32	19	37
2	5	15	4	21	9	17
3	3	9	2	11	5	10
4	3	9	1	5	4	8
5+	3	9	1	5	4	8
Total	33		19		52	
Mean Age	2.3		2.0		2.2	

Figure 2: Percentage of fawns, yearlings, and adults occurring in the harvest

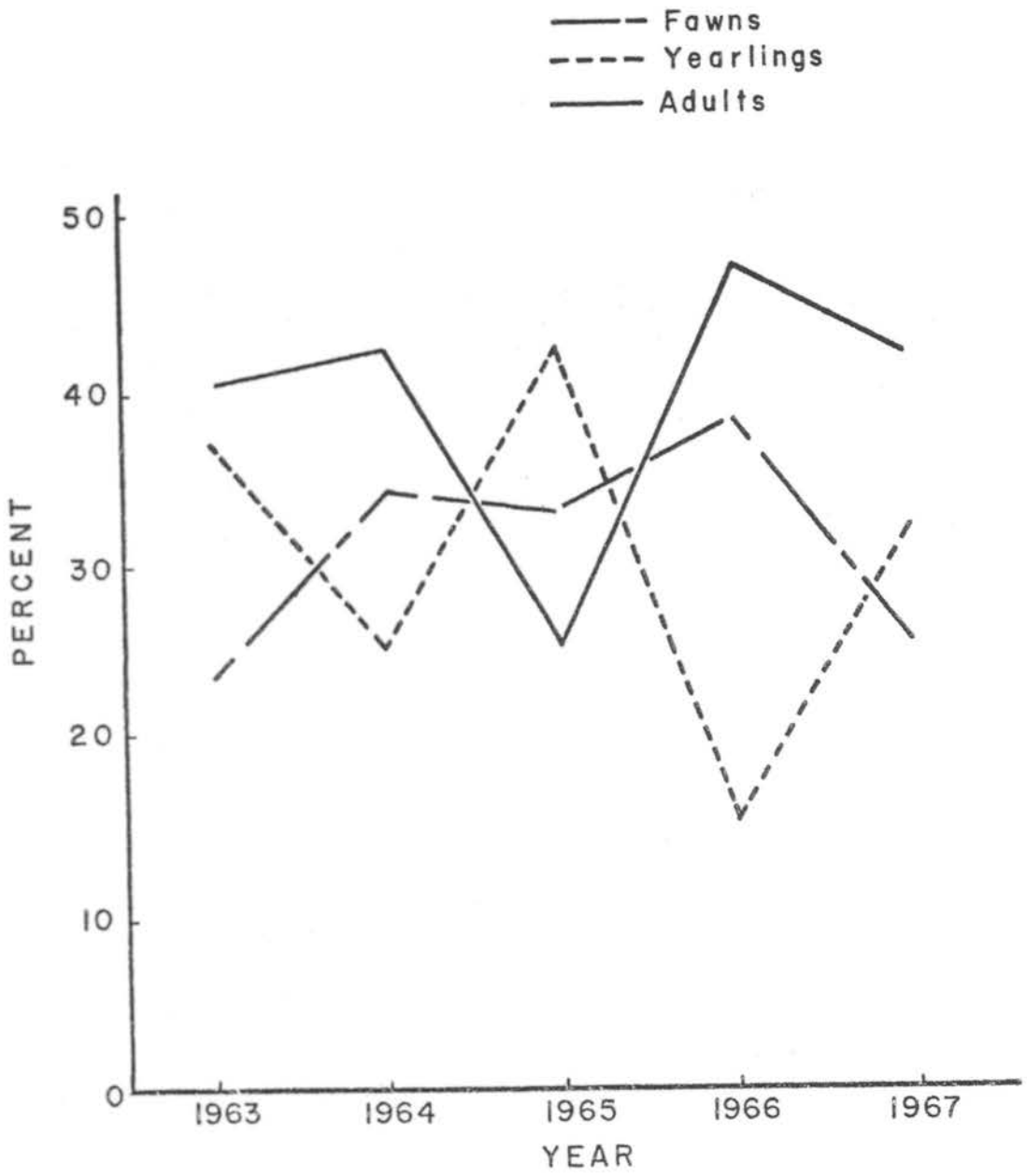

Table 3: Hunter harvest on the study area

Hunting Season		Bucks	Does	Fawns	Total
1963	Harvest	54	138	51	243
	Wounding Loss	9	3	27	39
	Total	63	141	78	282
	Estimated preseason population: 428 ad + 235 fawns = 663				
	Percent of population harvested: 42%				
1964	Harvest	59	92	78	229
	Wounding Loss	21	15	15	51
	Total	80	107	93	280
	Estimated preseason population: 410 ad + 176 fawns = 586				
	Percent of population harvested: 48%				
1965	Harvest	19	24	17	60
	Wounding Loss	1	2	0	3
	Total	20	26	17	63
	Estimated preseason population: 280 ad + 98 fawns = 378				
	Percent of population harvested: 17%				
1966	Harvest	49	22	21	92
	Wounding Loss	1	3	0	4
	Total	50	25	21	96
	Estimated preseason population: 165 ad + 78 fawns = 243				
	Percent of population harvested: 40%				
1967	Harvest	24	13	20	57
	Wounding Loss	0	1	1	2
	Total	24	14	21	59
	Estimated preseason population: 178 ad + 105 fawns = 283				
	Percent of population harvested: 21%				

A REVIEW OF HARVEST AND POPULATION CHANGES IN THE BIG PINEY - MUDDY CREEK AREA

by
James H. Straley, Big Game Biologist
Wyoming Game and Fish Commission

This antelope herd occupies an area in Sublette County and is in the northwestern most limits on antelope habitat within the state. The area is in the vicinity of the Great Fur Rendezvous and is abundant with early accounts of great numbers of antelope. In 1811 antelope were reported by W. P. Hunt in the Jackson Hole area, some of which undoubtedly used the same migration routes as are used today; coming up the Green River and down the Gros Ventre River into the valley. From this time on all accounts indicate a decrease in numbers of antelope. In 1913 only 150 antelope were reported in the Upper Green River area and by 1917 less than 40 were reported. (Forest Service File). In the 1930's there was evidently a low within the state, as less than 5,000 were harvested each year between 1927 and 1940. (Creek, 1967). Records indicate that in 1929 antelope were practically eliminated west of the Green River. (Sundstrom, 1967).

It is not known for sure if any antelope existed west of the Green River in Sublette County but on December 7, 1941, about 14 head were transplanted north of Big Piney in the Bench Corral area, (Roberts, personal communications). Whether or not this initial transplant was responsible or if natural movement into the area occurred, by 1956 some 308 antelope were counted in the Piney Area. This was essentially the beginning of the management of the Big Piney antelope herd.

Census:

Table I shows the census information for this area and the month of the count. Severe winter conditions cause movement out of the area during some years and the time of the year the census is made affects the total number of animals counted. As an example, in April of 1965 some 450 antelope were counted and in July of the same year only 178 remained in the same area. More and more antelope continue to move to higher elevations and into the fringe areas of the forest, and to the north of the Piney hunting unit an entirely new hunting area was established in 1967 to obtain a harvest on a large number of antelope that had recently moved into the area to summer. This movement to the west side of the Green River would certainly affect any census information for the Piney Unit.

Herd Composition:

Table II shows pre-season herd composition for the Piney area from 1958 thru 1967. It is interesting to note the first two years listed as they were classifications on an unhunted herd. The fawns/100 does has varied from a high of 110 to a low of 30. In 1965, after the year when only 30 fawns/100 does were evident, 12 female antelope were collected, six each during January and May. All 12 females were pregnant and had a total of 23 fetuses. The only female that did not have twins was a 9½ year old animal. This same spring, at the peak of the drop, of 17 does with fawns, 9 had singles and 8 had twins. In

early July of 1966 there were 100 fawns/100 does but by the time of the usual preseason classifications in late August this ratio had dropped to 70 fawns/ 100 does. In all of the investigations we have never found any conclusive proof of why the fawn crop varies from year to year.

Although they have comprised about 70 percent of the total legal harvest the buck ratio has remained fairly static. The wide range in the buck ratio during 1966 and 1967 is probably due to migration and movement, but in 1966, when few bucks were evidently available, more than twice the number of females were field checked than in a year (1967) when a high buck ratio is indicated.

Hunter Harvest:

In 1959 the first antelope season was held in the Piney area with 25 permits issued. Table III shows the total number harvested and a breakdown by bucks, does and fawns. The years of 1959, 1960, 1966 and 1967 show actual hunter field checks. All other figures are from the antelope harvest reports. This table also shows the number of permits for each year. The nine years indicate 678 antelope harvested on a total of 735 permits.

In 1961 a special attempt was made to determine hunter loss. A total of six animals considered hunter loss were found in the harvest of 67 antelope so the figure of 10 percent was again substantiated for hunter loss.

Age Information:

Table IV shows the past seven years age composition of the harvest. This information was derived from hunter field checks that varied from 20 to 50 percent of the total harvest. Incisor replacement was used for aging. The average for the seven years is shown and compares to statewide averages of 13 percent fawns, 27 percent yearlings, 23 percent two, 11 percent three and 26 percent over three (Creek, 1967).

Bias Checks:

With the total harvest being obtained through sample questionnaires and the high percentage of animals that can be field checked comparisons have been made to check on the reliability of the questionnaire. Table V shows this information for two years. The information from 1965 shows a close correlation but in 1966 there were widespread differences. As was mentioned previously 1966 had a low buck ratio in the herd and not as many bucks were field checked as in other years and this may have resulted in some bias reporting by hunters. Most years have shown a correlation similar to the 1965 information.

Conclusions:

Migration and distribution changes have probably had more influence than all other factors in the Piney antelope herd. Although it has been shown that total numbers have increased the original hunting area of 1960 has been extended to include more area and to the north an entirely new area was opened to hunting to better distribute pressure west of the Green River. The Pinedale area to the east side of the Green River has had 1,000 permits in past

years but now has been reduced to 500 and further cuts are anticipated.

As with many population shifts or changes it is difficult to find causes. Several factors that could have influenced this are changes in the habitat the past ten years. Activity in the forms of opening new ground and sagebrush spraying have altered many acres. Of some 900,000 acres of public land in Sublette County more than 100,000 acres of sagebrush have been sprayed in addition to another 50,000 acres of private land. More and more antelope are being found in the fringe areas of the forest and at elevations of 9,000 feet.

The management of the Piney antelope herd has changed until information is not very comparable. As in most big game populations things do not remain static for any length of time and the work of gathering information has to be continued to keep up with these changes.

TABLE I: Census Information - Piney Area

	Date							
	December 1941	October 1956	October 1959	October 1962	April 1963	April 1965	July 1966	June 1967
Number	14	308	395	377	511	450	623	602

TABLE II: Herd Composition - Piney Area

Year	Bucks/100 Does	Fawns/100 Does
1958	78	89
1959	75	88
1960	72	88
1961	75	110
1962	80	65
1963	70	67
1964	78	30
1965	85	76
1966	40	70
1967	100	82

TABLE III: Harvest and Permit Numbers - Piney Area

Year	Number Bucks	Number Does	Number Fawns	Total Harvest	Number Permits
1958	0	0	0	0	0
1959	*16	5	0	21	25
1960	*47	10	3	54	60
1961	52	14	1	67	75
1962	54	15	2	71	75
1963	83	8	5	96	100
1964	72	15	4	91	100
1965	69	22	9	100	100
1966	*22	7	1	88	100
1967	*21	3	2	90 est.	100
TOTAL				678	735

* Actual Hunter Field Checks

TABLE IV: Age Information - Percent Total Harvest - Piney Area

Age	1961	1962	1963	1964	1965	1966	1967	Averages	State Wide
Fawn	6	4	6	7	9	3	8	6	13
Yearling	20	21	19	30	17	23	14	20	27
Two	14	16	19	20	17	31	11	18	23
Three	12	13	5	0	24	3	38	13	11
Three	50	46	51	43	33	40	29	42	26

TABLE V: Comparison Between Hunter Field Checks and Statistical Analysis - Piney Area

	Percent Bucks	Percent Does	Percent Fawns
1965			
Hunter Field Checks	69	22	9
Questionnaires	73	20	6
Difference	4	2	3
1966			
Hunter Field Checks	73	29	3
Questionnaire	86	10	5
Difference	13	19	2

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Bill Crump, Wyoming: In following that age group through as you did on your harvest, apparently you didn't have a 30 fawn per 100 does. You must have missed in some way or the other, it wouldn't have been possible to show enough in the harvest in the percentages they did. When were you running your doe/fawn count, was that an August doe/fawn count?

James Straley, Wyoming: Bill's question had to do with this 30 fawns per 100 does, we ran these in August. Of course, the first time I went out there, you're always busy doing something else--there comes a week you do your antelope composition. When I found the 30 fawns per 100 does then a week later Bill Hepworth and a few other people went out there with me; we checked and re-checked, and double checked, and the funny thing about it is that this area here is the only area that we had 30 fawns. The Pinedale area right across the river, we've probably had migration into this Big Piney area from there was not affected this way and neither was the beginning of the antelope that started to move into here. This seemed to be restricted to this one small area. I'm just saying again like most everyone else has said on their paper that we just can't come and find one thing. Bill examined all of these antelope, we could find no evidence of disease and like I say, we almost had to discount predators and they show up in the harvest. So, I don't know.

Dewey Henderson, Wyoming: Jim, don't you have a movement across the Green River, would this have any bearing on it?

James Straley, Wyoming: Probably I suspect, of course, you know we talk about this low fawn crop and I don't think we were actually harvesting this particular herd at this particular time to the point where our age structure defined this well. I think that from the figures we saw, I'm quite sure we've had continued migration into this area because it's actually built up too fast. And here again, this original hunting area had to be extended because of some (I was just going to ignore this but I might as well mention this Jack) 900,000 acres, there's been about 100,000acres sprayed of public land and 50,000 acres of private land. We're talking about just this upper end of Sublette County, as I mentioned a habitat manipulation, the fences in the area that were constructed during this time were just a four strand wire fence. However, I do believe that they had an effect but I don't know, I just can't put my finger on any just one thing and say that this has been the cause or this is the effect or anything conclusive like that.

Question: Do you have much of a stomach load or stomach worms with antelope in that area?

Bill Hepworth, Wyoming: On the antelope that we checked during this low mortality period there were very few parasites we found. I don't think that parasites were our problem.

James Straley, Wyoming: Actually, when I say we collected these females--we collected everything and on the weighed carcasses we actually had some of the heaviest animals and as far as the body condition, they were in excellent condition. Even the January and the May samples, both, that is the carcasses were very heavy.

W. J. Allred, New Mexico: Just a point for the record, the Green River in this area marks the west boundary of the Little Colorado Desert. In 1929 the season the Game Department had there virtually wiped out the antelope west of the Green River and this transplant made in 1941 was actually made a little south of LaBarge and the antelope moved north to the Big Piney area.

James Straley, Wyoming: I stand corrected on that. This area, you might be

interested Mr. Allred, between LaBarge and Big Piney, we've had 40 head in there for the past ten years. They just stay 40 head, so thank you for that information. I have your report that you presented at the North American Wildlife Conference in 1942 and it doesn't say definitely, and I wish it did. I wish that I would have gotten more information from Ken Roberts, he was the one that actually drove the truck that day I guess and I don't know just how many were actually moved. But this was the first trapping and transplanting operation in the State of Wyoming.

SUMMER RANGE HABITS OF THE PRONGHORN ANTELOPE IN CENTRAL MONTANA WITH SPECIAL REFERENCE TO PROPOSED SAGEBRUSH CONTROL STUDY PLOTS

by
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My study, conducted during the summers of 1966 and 1967, is part of a 10-year project initiated in 1965 by the Montana Fish and Game Department (Federal Aid W-105-R), in cooperation with the Bureau of Land Management, in central Montana. The purpose of this project is to study the short and long-range effects on wildlife of ecological changes resulting from sagebrush eradication. The objective of my project was to obtain quantitative data on range use, food habits and home ranges of the pronghorn antelope in summer on and adjacent to sagebrush control study plots prior to the control of sagebrush. These data will be available for comparison with those collected after the control of sagebrush.

The study area, including the four sagebrush control study plots, comprised approximately 84,000 acres. Fifty-eight percent of this was private land and 42 percent public land. The latter is administered largely by the Bureau of Land Management. Rangeland predominates. Cropland comprised only 2 percent of the total area. The physiography of the area was characterized by undulating and sharply rolling upland plains, gravel capped benches, shale slopes and bottomlands. The climate is semiarid with an average annual precipitation of 12.57 inches and a temperature of 45.4 degrees.

The vegetation of the study area is included in the mixed grass prairie association (Oosting, 1958). Floral composition of the vegetation was determined by a modification of the technique of Daubenmire (1959). Two by five decimeter plots were systematically placed within a relatively homogeneous and undisturbed portion of each vegetation stand. The canopy coverage and frequency of occurrence of each taxon occurring within each plot were visually estimated.

Vegetation types described in this manner, and the portion of the study area that each covered, included the sagebrush-grassland type -- 59 percent; the greasewood-sagebrush type -- 22 percent; the grassland type -- 7 percent; the greasewood type -- 6 percent; and the shale slope type -- 2 percent. Other vegetation types not measured and described quantitatively included the cropland type comprising 2 percent of the area and the abandoned meadow and timber types each comprising 1 percent.

Characteristics of the pronghorn population on the study area were determined by recording all antelope observed during each of 27 trips over a 50-mile vehicle route and during each of five aerial censuses. A total of 5,588 individual antelope observations were classified by sex and age. Data from ground counts gave lower female:male ratios and higher fawn:female ratios than did those from aerial counts. The ratios obtained in 1967 were lower than the 1966 ratios for each of the census methods. Ground counts indicated 262 females:100 males and 84 fawns:100 females in 1966 and 190 and 71, respectively, in 1967. Aerial counts conducted by Bayless (1967) indicated 309 females:100 males and 74 fawns:100 females in the summer of 1966. Aerial counts conducted by the author in the summer of 1967 indicated 241 females:100 males and 57 fawns:100 females.

Use of vegetation types was determined by recording the type on which each of 5,742 individual antelope was first observed. The data were tabulated by successive 2-week periods throughout the summers to show changes, if any, in use of certain types (Table I).

TABLE I. PERCENTAGE DISTRIBUTION OF 5,742 OBSERVATIONS OF INDIVIDUAL ANTELOPE BY SUCCESSIVE 2-WEEK PERIODS ON THE SAGEBRUSH-GRASSLAND TYPE AS COMPARED TO THE COMBINATION OF TYPES DURING THE SUMMERS OF 1966 AND 1967.

Time Interval	Vegetation Types: Sagebrush-Grassland	Vegetation Types: Shale Slope-Greasewood-Grease-Sage-Cropland Combination	Total Antelope
June 1-15			
1966	99	--	73
1967	--	--	--
June 16-30			
1966	87	8	278
1967	77	22	738
July 1-15			
1966	51	47	242
1967	69	25	731
July 16-31			
1966	50	50	236
1967	63	37	643
Aug. 1-15			
1966	32	61	218
1967	56	42	980
Aug. 16-31			
1966	28	72	251
1967	52	48	977
Sept. 1-15			
1966	7	93	96
1967	57	41	299
AVERAGE			
1966	51	47	
1967	62	36	

During both summers a trend in the intensity of use of certain vegetation types was apparent. In general, there was a progressive decline in use of the sagebrush-grassland vegetation type and a corresponding increase in total use of the shale slope, greasewood, greasewood-sagebrush and cropland vegetation types combined. The greasewood, greasewood-sagebrush and cropland types occurred on mesic sites located in depressions or along creek bottoms. On these sites, as well as on the shale slope type, succulent vegetation persisted longer than on the dry uplands where the sagebrush-grassland type occurred.

The magnitude of change in use of these vegetation types between successive

periods in general and between early and late summer was far greater in 1966 than in 1967. A possible explanation is that during the first 2 months of the summer of 1966 rainfall was 65 percent below normal (85 percent-June; 19 percent-July); while during the same period in 1967 rainfall was 42 percent above normal (51 percent-June; 21 percent-July). As a result, in 1966, much of the succulent vegetation on the upland sagebrush-grassland vegetation type became desiccated early in the summer possibly resulting in the antelope shifting early to the more mesic sites where succulent vegetation persisted. In 1967 succulent vegetation persisted through a greater part of the summer possibly resulting in the antelope remaining on the sagebrush-grassland vegetation type longer and in greater numbers than in 1966. These trends within years and differences between years seem to indicate that the antelope may have preferred the sagebrush-grassland vegetation type and moved onto the other more restricted types in large numbers only when the succulent vegetation on the former became desiccated.

Despite these differences in intensities of intra- and inter-summer use, the sagebrush-grassland vegetation type still averaged 50 percent or more of the total use both summers.

Additional information on range use was gained by estimating the density of sagebrush at each of 2,980 individual antelope observation sites within the sagebrush-grassland vegetation type. The basis for these estimates was provided by a 100-foot line intercept measurement of big sagebrush (Artemisia tridentata) at each of 38 sites in the sagebrush-grassland vegetation type (Table II).

TABLE II. CHARACTERISTICS OF EACH OF FOUR SAGEBRUSH DENSITY CLASSES AS DETERMINED BY LINE INTERCEPT MEASUREMENTS OF BIG SAGEBRUSH AT EACH OF 38 SITES IN THE SAGEBRUSH-GRASSLAND VEGETATION TYPE.

Density Classes	Average Percentage Line Intercept of Big Sagebrush Per 100 Feet of Line	Average Number of Plants Per 100 Feet of Line	Average Distance Between Plants
Rare	2	--	--
Scattered	2-5	6	11.8
Common	6-25	20	5.1
Dense	25+	41	1.5

For both summers at least 90 percent of these antelope were observed on areas where densities of big sagebrush were estimated to be scattered or common.

Antelope food habits were evaluated in 1966 by the examination of 34 feeding sites and in 1967 by the examination of 28 feeding sites and analysis of the contents of 12 rumens. A total of 9,111 instances of use were recorded. A bite from a leaf or twig for shrubs, a stem or bunch of stems for grasses and a leaf or stem for forbs was considered as one instance of use. Rumen samples

were analyzed according to the method of Cole (1956) and others. Each plant species used was expressed as a percent of the diet for each feeding site or rumen sample. These percentages were totaled and averaged using the aggregate percentage method (Martin, et al. 1946).

The difference between the percent of the diet for each plant and its abundance in the plant community (expressed as percent canopy coverage) was determined at each of 48 feeding sites. The average of these differences for each species was tested statistically where sample size permitted using a two-tailed t-test at the 5 percent level of significance. The hypothesis tested was: there is no significant difference between the percent of the diet constituted by an individual species and its abundance in the plant community.

Forbs, the most important forage class, comprised 86 percent and 97 percent, shrubs 14 percent and 3 percent, and grasses a trace of the total use at feeding sites in 1966 and 1967, respectively. In 1967 these forage classes averaged 85 percent, 14 percent and 1 percent, respectively, of the total identifiable material in 12 rumen samples.

Five forbs constituted 71 percent in 1966 and 62 percent in 1967 of the total use at feeding sites and averaged 35 percent by volume of identifiable material in rumen samples. These included fringed sagewort (Artemisia frigida), longleaf sagebrush (Artemisia longifolia), three-leafed milkvetch (Astragalua gilviflorus), alfalfa (Medicago sativa) and yellow sweetclover (Melilotus officinalis). The latter four were the only species to yield a significant positive t-value one or both years, indicating a significantly higher proportion in the diet than in the plant community.

It may also be of interest to note that Artemisia species, including silver sagebrush (Artemisia cana), big sagebrush, longleaf sagebrush and fringed sagewort, constituted 28 percent and 14 percent of the total use at feeding sites in 1966 and 1967, respectively, and averaged 10 percent by volume of identifiable material in rumen samples.

Characteristics of summer home ranges were determined by successive observations of 19 individually marked or otherwise recognizable antelope from June 17 to September 11, 1967.

All observations of an individual antelope were plotted on graph paper. The distances between successive locations were determined. A line was drawn around the outside points of observations designating the perimeter of its home range. The area of each home range was then calculated with the aid of a Polar Planimeter.

Territorial males (7) occurring alone or with females and fawns moved the shortest distance between successive observations (average 0.75 miles) and had the smallesthome ranges (average 1.54 square miles). Males (8) associated with male herds moved the greatest distance between successive observations (average 2.12 miles) and had the largest home ranges (average 6.43 square miles). Females (4) associated with other females and fawns or with females, fawns and a single male were intermediate with respect to these measurements (average 1.06 miles and 4.46 square miles, respectively). For females distances were 59 percent greater between successive observations when they were not accompanied by a territorial male.

The average size of home ranges of territorial males was 121 percent larger on

the sage brush-grassland vegetation type than on the greasewood vegetation type (sample size 3 and 3). The home range of one male located primarily on the greasewood-sagebrush vegetation type was 219 percent larger than the average on the latter type.

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FOOD HABITS, RANGE USE AND HOME RANGE OF PRONGHORN ANTELOPE IN CENTRAL MONTANA DURING WINTER

by
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ABSTRACT

A study of the food habits, range use, and home range of pronghorn antelope with emphasis on the winter period was conducted in 1966-67 on a 171,712 acre area in north-central Montana. The physiography and vegetation of the area was described. Characteristics of the antelope population were evaluated from results of five aerial censuses in summer. There were 309 females per 100 males and 74 fawns per 100 females. Distribution of antelope and use of vegetation types was evaluated. The sagebrush-grassland type received most of the use, both in summer and winter. Most of the antelope observations in winter were in vegetation types where sagebrush was common. The average group size for antelope in winter was 23.5, with groups being largest when snow covered the ground. The average group size in summer was 9.4. Winter food habits were determined from the examination of 28 feeding sites and analysis of the contents of each of 18 rumen samples. The winter diet of antelope, determined by examination of feeding sites, consisted of 93 percent shrubs, 6 percent forbs, and a minor amount of grass. Big sagebrush (Artemisia tridentata) provided the bulk of the antelope food. It was also the only plant present in significantly higher proportions in the diet than in the plant community. Three dead fawns were found on the study area. The apparent cause of death was malnutrition. Their rumen contents did not vary significantly from those of other antelope collected during the winter. Poor body condition of antelope and fawn mortality were possibly related to quality of sagebrush in the diet. Winter home range size was determined for each of 16 individually marked antelope. Each of three was equipped with a radio transmitter. Marked antelope were located daily when possible. A total of 579 individual observations of marked antelope was recorded from December 10 through March 23. Eight of the marked antelope "shifted" their home range at least once in winter. A yearling female had a home range size of 5574.4 acres and a yearling male, 4160.0 acres. Six adult females had an average home range size of 2841.4 acres; three fawn females, 2417.1 acres; and five fawn males, 1579.5 acres. Fawn females had the most variable home range size. Adult females used a larger area on the sagebrush-grassland vegetation type than on the greasewood-sagebrush type. Both fawn males and females showed the opposite.

INTRODUCTION

The study I am here reporting was conducted in partial fulfillment of the requirements for a Master of Science Degree in Fish and Wildlife Management at Montana State University, Boseman, Montana. During the study, I was supported by the Montana Department of Fish and Game under Federal Aid Project W-98-R-6.

The study was prompted due to a lack of information about antelope habits during the winter. Some of you may be familiar with the studies by Glen Cole (1956), Cole and Wilkins (1958), and Martinka (1967). All of these are studies of Montana pronghorns, but none contain detailed winter information. Cole's study was conducted on the same study area as the one I am here reporting.

The principal objectives of the present study, conducted during the summer of 1966 and winter of 1966-67, were to obtain quantitative data on winter food and range use habits of pronghorns. The summer period was largely devoted to an analysis of the vegetation of the study area. Radio tracking equipment was used during the winter and greatly aided the study of habitat relationship and behavior.

STUDY AREA

The study area, located in central Montana near Lewistown, covered about 171,712 acres. The principal economy of the area is stock raising, integrated with grain, alfalfa and forage production. Privately owned lands constitute 67.3 percent of the area; publicly owned lands, 32.7 percent.

The characteristic physiographic features of the area are sharply rolling upland plains, shale slopes and bottomlands (Cole, 1956). The soils have developed over cretaceous shales of the Colorado formation (Andrews et al., 1944). Upland soils range from heavy clays to shaly clay loams. Shale slopes have soils ranging from fine shale loams to coarse shale gravels. Bottomlands have soils with thin loamy surface horizons, barren spots of salt impregnated soils, and clay soils with dense saline-alkaline subsoils.

The average annual precipitation on the east edge of the study area is 12.57 inches. The mean average annual temperature is 45.4° F. Temperature extremes during the study were 105° F. in July, 1966, and minus 13° F. in March, 1967.

The vegetation of the study area was sampled and mapped using the method of Daubenmire (1959), whereby 2x5 dm plots were systematically placed within a relatively homogeneous and undisturbed portion of each vegetation stand. The following vegetation types were recognized: sagebrush-grassland, grassland, shale slope, greasewood, greasewood-sagebrush, cropland, abandoned meadow, and woodland. The sagebrush-grassland type, recognized by the dominant aspect of big sagebrush (Artemisia tridentata), occupied the major portion of the study area, 51.3 percent or 85,696 acres. Detailed information on the composition, occurrence and distribution of vegetation types is omitted here in the interest of time and space limitations.

PRONGHORN POPULATION CHARACTERISTICS

Six aerial censuses were conducted (Table I). A standard technique employed by the Montana Department of Fish and Game was used. As you can see from the results of these six censuses, quite a discrepancy exists in the figures. This would seem to indicate that even with a highly observable animal such as antelope, aerial censuses give at best only a rough approximation of total numbers.

In 1962, a census of the same area by the Montana Department of Fish and Game disclosed a population of 1171 antelope and a fawn/doe ratio of 90/100. During my study, the best aerial census accounted for 529 antelope. The average fawn/doe ratio for the first four censuses was 74/100. The population decreased approximately 55 percent over a four-year period.

TABLE I. RESULTS OF SIX AERIAL CENSUSES MADE ON THE YELLOW WATER TRIANGLE STUDY AREA DURING THE SUMMER OF 1966 AND WINTER OF 1966-67.

	Pronghorns Classified						
	Adults						
Date	Does	Bucks	Does or Bucks	Fawns	Total	Does/ 100 Bucks	Fawns/ 100 Does
6/27-28/66	207	54	32	135	428	383	65
7/11/66	246	89	13	181	529	276	74
8/3-4/66	227	78	9	210	524	291	93
8/12/66	209	67	37	131	444	312	63
9/9/66	---	--	--	---	380	---	--
2/9/67	---	--	--	---	441	---	--

DISTRIBUTION AND USE OF VEGETATION TYPES

Winter

During the winter, 9345 observations of individual antelope were recorded. The sagebrush-grassland vegetation type received most of the antelope use regardless of month (Table II) or weather conditions. During each month, 62 percent or more of the observations were in this type, and for the entire winter, 71 percent. All sagebrush types combined (sagebrush-grassland and greasewood-sagebrush) provided 89 percent of the total antelope observations for the winter period.

The density of sagebrush at each observation site recorded from the ground was determined (Table III). Density values were based on the canopy coverage and number of sagebrush plants intercepted along line transects. Most of the antelope observations were in vegetation types where sagebrush density was estimated as "common" -- that is, 21 to 40 plants intercepted per 200 feet of line transect, or about a 10 to 24 percent density based on canopy coverage.

TABLE II. PERCENTAGE DISTRIBUTION BY MONTH OF 9345 OBSERVATIONS OF INDIVIDUAL ANTELOPE ON THE YELLOW WATER TRIANGLE STUDY AREA OF FIVE VEGETATION TYPES IN WINTER, 1966-67.

Month	Sagebrush-grassland	Grassland	Greasewood	Greasewood-sagebrush	Cropland	Total Number Antelope
Dec.	67	4	10	13	6	1810
Jan.	86	4	5	3	2	2682
Feb.	62	6	-	31	-	3204
Mar.	70	7	-	23	-	1649
AVERAGE	71	5	4	18	2	

TABLE III. PERCENTAGE DISTRIBUTION BY MONTH OF 8904 OBSERVATIONS OF INDIVIDUAL ANTELOPE IN RELATION TO SAGEBRUSH DENSITY IN WINTER, 1966-67.

	Sagebrush Density[1]				
Month	Rare	Scattered	Common	Dense	Total Number Antelope
Dec.	9	29	50	12	1810
Jan.	7	28	53	12	2682
Feb.	7	38	45	10	2763
Mar.	7	17	48	28	1649
AVERAGE	7.5	28.0	49.0	15.5	

1/ Sagebrush densities were assigned on the basis of the number of plants intercepted/200 feet of line as follows:

0-8 Plants = Rare (0-4% Canopy Coverage)
9-20 Plants = Scattered (5-9% Canopy Coverage)
21-40 Plants = Common (10-24% Canopy Coverage)
41+ = Dense (25%+ Canopy Coverage)

Two or more antelope together were considered to represent a group. The average group size in winter was 23.5. Three groups observed in December and January on the cropland vegetation type were largest, followed by those on the greasewood and greasewood-sagebrush types. Group size increased steadily from approximately 20 when the ground was dry to about 31 when snow covered the ground. Groups were also slightly larger with warmer temperatures.

Summer

During summer, the sagebrush-grassland type received most of the antelope use, but intensities of use were much less than for winter (Table IV). Use of this type steadily decreased through the summer, until in September, the grassland and cropland types each received greater use than did sagebrush-grassland. Cole (1956) reported similar findings.

The average group size in summer was 9.4. Groups were largest on the cropland vegetation type, but only eight percent of the total groups were seen here. Most of the groups observed were in sagebrush-grassland where the average group size was 8.2. Female-fawn groups, bachelor herds, and territorial males, as described by Cole (1956), were observed.

TABLE IV. PERCENTAGE DISTRIBUTION BY MONTH OF 2305 OBSERVATIONS OF INDIVIDUAL ANTELOPE ON SEVEN VEGETATION TYPES IN SUMMER, 1966, AS DETERMINED BY FIVE AERIAL CENSUSES.

Vegetation Type	Month				Average
	June	July	August	September	
Sagebrush-grassland	53	50	44	16	41
Grassland	24	24	31	45	31
Shale Slope	2	-	-	-	tr
Greasewood	5	2	1	1	2
Greasewood-sagebrush	9	6	16	17	12
Cropland	6	17	8	22	13
Abandoned meadow	2	-	-	-	tr
Total Number Antelope	428	529	968	380	

WINTER FOOD HABITS

Food habits were determined by two methods: a rumen sample from each of 18 antelope collected on the study area was examined using the aggregate percent method (Martin, et al., 1946), and feeding site examinations were conducted immediately following use by feeding antelope. At feeding sites, each bite on a plant was recorded as one instance of use (Knowlton, 1960). Daubenmire canopy coverage plots and line transects were conducted at feeding sites.

Shrubs were the most important forage class in the antelope diet during winter, averaging 93 percent of the total use at feeding sites (Table V), and 78 percent by volume of the identifiable material in rumens (Table VI). Big sagebrush was the most important shrub, averaging 78 percent of the total instances of use at feeding sites, and 45 percent by volume of the total identifiable material in rumens. It was the only plant which gave a significant positive value in a statistical analysis, indicating it occurred in higher proportions in the diet than in the plant community. This led to the conclusion that antelope actually selected big sagebrush when feeding.

Forbs were the next most important forage class. They averaged 6 percent of the diet on feeding sites and 19 percent by volume of the identifiable material in rumens. Fringed sagewort (Artemisia frigida) and prickley pear cactus (Opuntia polycantha) were the important forbs in rumens.

Grass was unimportant, but was eaten by antelope during green-up periods in warm weather. In the April rumen sample, grass, a large part of which was green, formed 22 percent by volume of the total identifiable material.

TABLE V. WINTER FOOD HABITS OF ANTELOPE BY MONTH AS INDICATED BY 13,758 INSTANCES OF PLANT USE AT 28 FEEDING SITES ON THE YELLOW WATER TRIANGLE STUDY AREA.

Taxa 1/	January		February		March	
	Number Instances of Use	% of Diet	Number Instances of Use	% of Diet	Number Instances of Use	% of Diet
SHRUBS:						
Artemisia cana	910	19	257	4	367	11
Artemisia trindentata	4309	76	3378	79	3096	78
Chrysothamnus nauseosus	-	-	129	3	254	5
Symphoricarpos occidentalis	-	-	-	-	95	3
TOTAL SHRUBS	5266	96	3795	87	3852	97
FORBS:						
Artemisia frigida	7	tr	332	11	94	3
Aster canescens	214	2	-	-	-	-
TOTAL FORBS	289	3	339	11	94	3
GRASSES:						
Poa compressa	-	-	80	2	-	-
TOTAL GRASSES	43	tr	80	2	-	-

1/ Only those species which comprised one percent or more of the diet for at least one month are included.

During the winter, two dead fawns were found in February and one in March. The gelatinous condition of the marrow in the femur bones indicated malnutrition (Cheatum, 1949). Little or no subcutaneous fat was visible on antelope collected for rumen samples. The amount of fat inside the body cavities of antelope was observed to grow progressively less with each collection through the winter. Measurements at feeding sites indicated that 13 percent of the sagebrush plants were decadent (25 percent or more of the crown was dead). At permanent transect sites, 34 percent of the sagebrush plants were "severely clumped", 72 percent were "mature", 26 percent were "decadent", and only 2 percent were "young" plants.

Martinka, in his study of antelope mortality in northern Montana during a severe winter, suggested that malnutrition was related to a lack of sufficient quantities of shrubby sagebrush in the diet. I concluded that the poor quality of sagebrush on my study area may have been a factor leading to mortality. The relatively low fawn/doe ratios, poor antelope body condition, and a 55 percent decrease in the antelope population on the study area over a four-year period may also be indicative.

WINTER HOME RANGE

Nineteen antelope were trapped and banded in December, 1966, on the study area. All were fitted with neckbands, and all were individually recognizable. Three of these were equipped with two-stage crystal controlled transmitters mounted on a one-eighth inch thick leather collar. Receivers were the double conversion

TABLE VI. FREQUENCY OF OCCURRENCE AND VOLUME PERCENTAGES OF PLANT TAXA AND FORAGE CLASSES AMONG 18 ANTELOPE RUMEN SAMPLES COLLECTED OVER A FIVE-MONTH PERIOD IN WINTER, 1966-67.

Taxa[1]	Month					
	December	January	February	March	April	Unknown[2]
	(3)[3]	(2)	(3)	(6)	(1)	(3)
SHRUBS:						
Artemisia cana	33/3[4]	50/T		17/T		
Artemisia tridentata	100/50	100/57	100/47	100/38	100/22	100/54
Atriplex spp.	67/T	100/3	33/T	17/T		33/T
Chrysothamnus nauseosus	67/7	50/21	33/9	67/3	100/9	
Unidentified shrubs	100/12	100/10	100/15	100/23	100/47	100/33
TOTAL SHRUBS	100/73	100/92	100/71	100/64	100/78	100/87
FORBS:						
Artemisia frigida	67/14	50/T	67/15	83/5		67/1
Aster canescens		50/3				
Leptodactylon pungens	67/4			17/T		67/4
Opuntia polycantha	100/5	100/3	67/7	100/19		100/T
Oxytropis spp.						33/1
Unidentified forbs	100/4	100/T	100/6	100/8		100/4
TOTAL FORBS	100/27	100/7	100/28	100/33		100/11
GRASS AND GRASS-LIKE PLANTS	100/1	100/1	67/T	100/2	100/22	67/1

1/ Only those taxa which comprised one percent or more of the volume for at least one month are included.
2/ Includes three rumen samples from fawns found dead on the study are in February and March.
3/ Number of rumen samples in parenthesis
4/ Percent frequency/aggregate percent of total volume. T indicates values less than one percent.

crystal-controlled superheterodyne type.

Banded and radioed antelope were located daily when possible. The transmitter signals, under optimum conditions, were heard from as far away as 7 miles. A total of 579 locations of individually marked antelope was recorded from December 9 through March 23. The number of relocations of individual antelope varied between 4 and 58.

Locations of marked antelope were recorded in one-tenth of a mile intervals (example - Figure 1). To estimate home range size, a line was drawn around the outside points of observation for each individual antelope. The area enclosed was calculated with the aid of a Polar Planimeter.

Data for three antelope were too incomplete for consideration. Eight of the 16 for which home ranges were calculated each "shifted" their home range; one shifting twice and the other seven, once. A home range "shift" was defined as a movement from one area of activity to another with no subsequent return.

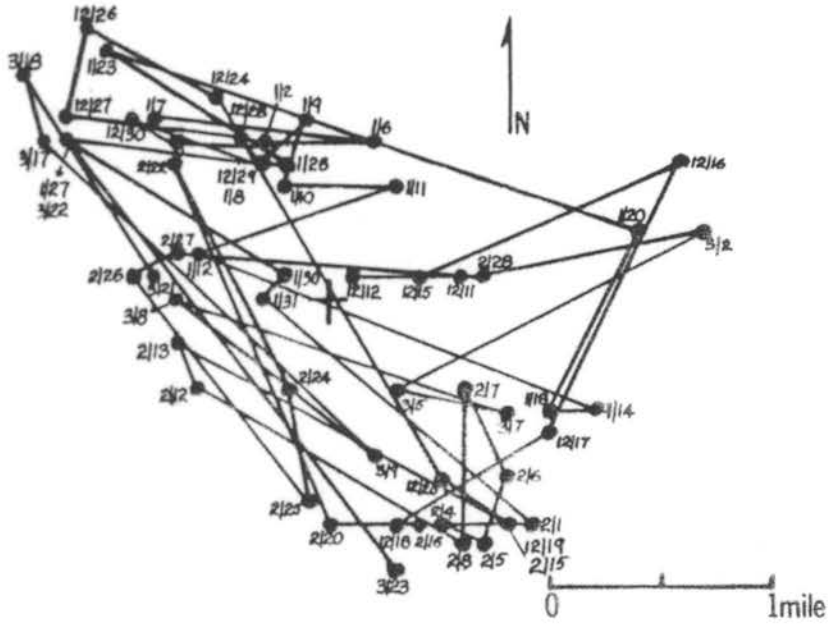
A yearling female had the largest home range of all sex and age groups, followed by a yearling male, adult females, fawn females and fawn males (Table VII). No adult males were trapped during the study.

TABLE VII. AVERAGE WINTER HOME RANGE SIZE FOR EACH OF FIVE SEX AND AGE GROUPS OF INDIVIDUALLY MARKED ANTELOPE ON THE YELLOW WATER TRIANGLE STUDY AREA IN WINTER, 1966-67.

Sex and Age Group	Number of Antelope	Average Home Range Size (acres)	Range
Adult Females	6	2841.4	1250.1 - 3840.0
Yearling Females	1	5574.4	-
Fawn Females	3	2417.1	915.2 - 4691.2
Yearling Males	1	4160.0	-
Fawn Males	5	1579.5	723.2 - 2668.8

Fawn females had the most variable home range sizes, followed by adult females and fawn males, respectively. Adult females used a larger area on the sagebrush-grassland vegetation type than on the greasewood-sagebrush type, but fawns used a larger area on the greasewood-sagebrush type.

FIGURE 1. Individual Locations of a Radioed Adult Female by Day and Month.



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Richard Kerr, New Mexico: You said that you had a 13 percent of your sagebrush decadent?

Steve Bayless, Montana: Yes.

Richard Kerr, New Mexico: Would you say that this was sagebrush range used to capacity?

Steve Bayless, Montana: Well, this is one of those things I'm sure that is a real complex thing, you can't pin it down to any one specific thing but we did have 1100 antelope in this area (280 square mile area) in 1962. I don't know if that was too many at that time or not. The sagebrush is low in vigor, we do have drought problems there occasionally just like any place else so it is an important factor related to some other areas I have seen.

ECOLOGICAL EFFECTS OF CHEMICAL AND MECHANICAL SAGEBRUSH CONTROL

by
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Montana Fish and Game Department

OBJECTIVES: To assist the Montana Fish and Game Department, the Bureau of Land Management, and other land managers in planning sound, multiple-use management of sagebrush-grass ranges by determination of basic facts concerning effects of sage brush control on plant and animal ecologies.

SCOPE: This is a broad-base study emphasizing team approaches to certain phases. Individual studies include: sage grouse, antelope, livestock, song birds, small mammals, insects, and western wheatgrass. The project is financed jointly by the Montana Fish and Game Department and the Bureau of Land Management.

Our investigations on antelope are being extended to cover year around studies. Harold Wentland will study antelope food habits, range use, and home range for four months during spring.

A student is expected to continue the study during summer. He will be concerned with post-treatment studies inside a 1200-acre pasture that will be sprayed this spring. Antelope will be confined to this pasture for the next four years. He will also be studying reactions of antelope to post-treatment vegetational conditions on mechanical treatments of interseeding and contour-furrowing.

We have displayed a picture series on the antelope trapping done this past winter. This is the second year of antelope trapping, neck marking and radio telemetry equipment. We have displayed samples of the marking collars and radio telemetry equipment.

The new radios seem to have a slightly shorter transmitting range than the ones last year which transmitted up to 7 miles and consistently transmitted 4 miles or more. The new ones, however, are supposed to have a longer battery life. They should last for a year, instead of six months.

We have started using telemetry from an airplane to speed up locations and reduce the chore-tending aspects of telemetry.

Our studies will emphasize home ranges, group interactions (to help show population boundaries) food and feeding habits, behavior, and much emphasis on vegetation requirements. Part of the study has an indirect approach--where we measure what antelope use and compare it with the vegetational composition before and after treatment.

Height measurements were incorporated into our range survey to calculate a "cover index", which is height class times (x) canopy coverage. We expect this additional dimension to help show differences in before and after surveys. It might also show differences between cover needs and food needs.

George Bear, Colorado: Do your transmitters give out a pulsating signal or a steady signal?

Duane Pyrah, Montana: The transmitters we used last year gave a steady signal, except for one. And this year's all have pulsating signals because this was their way to increase battery life--it also makes them a little more difficult to find this way.

Question: Can you identify specific antelope by these signals?

Duane Pyrah, Montana: These radio transmitters are crystal control, each animal is on a different frequency.

Question: Do you put them on fawns or adults?

Duane Pyrah, Montana: These are all on adults, nothing younger than yearling.

Walt Snyder, New Mexico: What is the unit cost for each transmitter?

Duane Pyrah, Montana: $70.00

Question: What was the approximate cost of your receiver and transmitter?

Duane Pyrah, Montana: $595.00

Question: How many channels?

Duane Pyrah, Montana: It has 12 channels, it has a selector just like a television set.

Jack Welch, Wyoming: How did you trap these antelope with the collars on?

Duane Pyrah, Montana: We just herd them into traps with helicopters.

Question: When your battery gave out on your transmitter, how did you recover the transmitter?

Duane Pyrah, Montana: We collected the antelope last year, but we feel that we got our monies worth out before the battery went dead so it's not a problem.

Ken Johnson, Nebraska: Why isn't this area open to public hunting?

Duane Pyrah, Montana: It is an area that is open to public hunting.

Allen Morton, Wyoming: Did you say that you had to spray sagebrush?

Duane Pyrah, Montana: Our sagebrush treatments will be applied to the area that you saw the map of this spring. All the work we've done so far is all free sprayed work.

Question: What frequency range is your transmitter?

Duane Pyrah, Montana: After the decimal point, I don't know--151.

Dewey Henderson, Wyoming: What kind of a fence do you have on this range?

Duane Pyrah, Montana: Right now it's only a 32-inch fence and our study is not completely outlined yet. We had the 32-inch fence and we're anxious to see the reaction of the antelope to the fence. I left the gates open and when they went into this sagebrush area during hard winter conditions, I went around and closed the gates and they've been in there for over a month. So far they haven't jumped out. Our intention is to increase the height of this fence to 48 inches.

SUMMARIZATION - SELECTION OF NEXT MEETING PLACE - ADJOURNMENT

John Newman, Wyoming: Well, Gentlemen, that about winds it up, we've got a few odds and ends here to tie in, or try and tie in. As you all know, this Antelope States Workshop was set up originally under the Western Association of Game and Fish Commissioners. They also participate in workshops on mountain sheep, sage grouse and elk, the antelope workshop has been changed and the name has been changed somewhat to include some of those states who aren't members of the Western Association. The antelope workshop alternates with the elk workshop and this is the third such meeting of this group, and in summarizing, I would say that we had a very successful meeting.

I would at this time consider discussion from the floor on whether we should have another meeting in two years, and if so where this meeting should be held.

George Bear, Colorado: Well I feel that we should continue on a biennial basis for a while. I know that Nebraska showed some interest in holding the meeting, you might ask them.

Karl Menzel, Nebraska: Suggested that the attendance of this meeting showed a general interest of the group in having a meeting and he has offered the State of Nebraska to host the Workshop in 1970.

John Newman, Wyoming: For the record I think we have 98 registered delegates to this workshop.

Gentlemen, I guess that this concludes this session of the Antelope States Workshop and once more I want to thank the many people who have taken part in this; most particularly I want to thank Bill Hepworth, who has done a great deal of work on the program and Don Miller who has done yeoman duty up here.

Mayo Call, Utah: What time and where are the people meeting who are going on the tour?

Fred Yeaman, Wyoming: Meet at 1:00 P.M.

John Newman, Wyoming: Right now it looks like five--Doug West, South Dakota; Lyle Peterson, South Dakota; Rex ZoBell, Jim Yoakum and Richard Kerr of the Bureau of Land Management. Anyone who wants to get on this tour contact Fred Yeaman in this room right after the meeting.

Bill Hepworth, Wyoming: Just one thing Jack, I would like the group to show appreciation to you for the work you've done on this program.

(APPLAUSE)