PROCEEDINGS
OF THE
SIXTH
ANTELOPE STATES WORKSHOP

SALT LAKE CITY, UTAH
FEBRUARY 19-21, 1974

P R O C E E D I N G S

o f t h e

SIXTH

A N T E L O P E S T A T E S W O R K S H O P

Salt Lake City, Utah

February 19-21, 1974

Chairman
Donald M. Beale

C O N T E N T S

I N T R O D U C T I O N

The Utah Division of Wildlife Resources hosted the Sixth Antelope States Workshop in Salt Lake City, Utah on February 19-21, 1974.

Fifty-two individuals attended the workshop. They represented ten western states, two Canadian Provinces and seven Federal Agencies and Universities.

The first meeting of the "Antelope States Workshop" was held in Sante Fe, New Mexico in 1965 to exchange ideas and to obtain a realization of common problems in pronghorn antelope management and research. This meeting was thought to be very successful and a second meeting was planned for Denver, Colorado in 1966. From this date on, the workshop has been held on a biennial basis.

Each year, the Antelope States Workshop has held greater interest and representation. In 1972, the group voted to affiliate with the Western Association of State Game and Fish Commissioners in hopes that this would better enable them to accomplish their objectives. Requirements for affiliation with the Western Association have been completed.

The goal of the Workshop is to provide information relative to and encourage the perpetuation of sustainable wild stocks of pronghorn antelope as an ecological, aesthetic and recreational natural resource on western rangelands, both public and private, at their most productive levels consistent with other proper land use.

The state of Idaho has agreed to host the Workshop in 1976.

P R I O R W O R K S H O P S

Year	Place	Chairman
1965	Sante Fe, New Mexico	William S. Huey
1966	Denver, Colorado	George D. Bear
1968	Casper, Wyoming	John L. Newman
1970	Scottsbluff, Nebraska	Karl Menzel
1972	Billings, Montana	H. O. Compton

ANTELOPE STATES WORKSHOP REGISTRATION

Name	Affiliation	Mailing Address
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Norm Bowden	Utah Wildlife Resources	1596 West North Temple Salt Lake City, Utah 84116
John Logan	Utah Wildlife Resources	1596 West North Temple Salt Lake City, Utah 84116
Rodney John	Utah Wildlife Resources	1596 West North Temple Salt Lake City, Utah 84116
Paul Shields	Forest Service	Ogden, Utah

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THE SIXTH BIENNIAL ANTELOPE STATES WORKSHOP

Auditorium - Utah State Division of Wildlife Resources

1596 West North Temple

Salt Lake City, Utah

February 19-20-21, 1974

SIXTH BIENNIAL ANTELOPE STATES WORKSHOP

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1596 West North Temple
Salt Lake City, Utah

TUESDAY, FEBRUARY 19

6:00 PM	Early registration and social hour (Holiday Inn, 1659 West North Temple)

WEDNESDAY, FEBRUARY 20

8:00 AM	Registration
9:00 AM	Call to order, Donald Beale, Workshop Chairman
9:15 AM	Welcome Address - Director John E. Phelps
9:30 AM	State Reports
10:00 AM	Coffee Break
10:30 AM	State Reports (continued)
11:30 AM	Habitat Requirements for Pronghorn Antelope - Jim Yoakum, Bureau of Land Management Reno, Nevada
12:00 NOON	Lunch
1:30 P.M.	Importance, Utilization and Quality of *Artemisia cana* on Pronghorn Winter Ranges in Alberta - Morley W. Barrett, Fish and Wildlife Division, Lethbridge, Alberta, Canada
2:00 P.M.	Use of Trained Pronghorns to Measure Natural Forage Consumption - Charles C. Schwartz, Iowa Conservation Commission Chariton, Iowa
2:30 PM	Feeding Pronghorn Antelope on Artificial Diets With Different Levels of Protein - Authur D. Smith, Utah State University Logan, Utah
3:00 PM.	Coffee Break

3:30 PM — Plant Availability Versus Utilization by Pronghorn Antelope -
ElRoy Taylor, Wyoming Game and Fish Department
Rawlins, Wyoming

4:00 PM — The Importance of Drinking Water to Pronghorn Antelope Does and Fawns on Desert Range Lands -
Donald M. Beale, Division of Wildlife Resources
Cedar City, Utah
Ralph Holmgren, Intermountain Forest and Range Experiment Station
Provo, Utah

4:30 PM — The Success or Non-success of Pronghorn Antelope Transplants in Utah As Related to Vegetation Types -
Jim Bates, Division of Wildlife Resources
Price, Utah

7:00 PM — Dinner

THURSDAY, FEBRUARY 21

8:00 AM — Antelope Fawn Bedding Cover Selection in Central Montana -
Duane Pyrah, Montana Department of Fish and Game
Lewistown, Montana

8:30 AM — Analysis of Sampling Procedures Used for Antelope Classification Counts -
Harvey S. Donoho, Colorado Division of Wildlife
Dale L. Wills, Roosevelt National Forest
Colorado

9:00 AM — A Study of the Great Divide Antelope Herd, Moffat County, Colorado -
Claude E. White, Division of Wildlife
Grand Junction, Colorado

9:30 AM — Format for Kansas' First Antelope Season -
Kent Montei, Forestry Fish and Game Commission
Hays, Kansas

10:00 AM — Coffee Break

10:30 AM — Energy Development in Wyoming's Powder River Basin and It's Possible Effects on Wildlife -
Raymond D. Mapston, Bureau of Land Management
Casper, Wyoming

11:00 AM — The Impact of Severe Winter and Fences on Antelope Mortality in South Central Wyoming -
Charles Oakley and Phillip Riddle
Wyoming Game and Fish Commission
(presented by John Newman, Laramie, Wyoming)

11:30 AM — Report on Development of Standards by the Federal Task Force Regarding Livestock Fencing on Pronghorn Antelope Range -
John E. Crawford, Bureau of Land Management
Denver, Colorado

12:00 NOON — Lunch

1:30 PM — Open Discussions on Problems Which Arise With Multiple Use Management on Pronghorn Antelope Range.

A. Problems, in addition to winter mortality, which result from fencing pronghorn range.

B. Problems caused by water developments, primarily for livestock, such as piping springs from their natural source to lower elevations.

C. Problems caused by off-road vehicle use of pronghorn range, particularly fawning grounds.

3:00 PM — Business Meeting

A. Report on Rules and Bylaws Committee
Allan Boss, Richfield, Utah

B. Report from Fence Committee
Donald Beale, Cedar City, Utah

C. New Business

D. Selection of Host State for 1976

ADJOURN

S T A T E R E P O R T S

REPORT OF ANTELOPE MANAGEMENT ACTIVITIES IN ARIZONA

Paul Webb

The long term status of antelope in Arizona has been slightly down. Residential development and other land uses have eliminated many areas of good quality habitat. Annual fluctuation caused by winter losses and drought have been experienced. However, we have been able to manage available populations to a hunter success of 50 to 60 percent by manipulation of antelope hunting permits.

A three-day season is held annually about the third weekend in September. Harvests are determined by a questionnaire mailed to 100 percent of the hunters. Response rate from the first and only mailing is usually about 80 percent. A second mailing brings the response up to 90 percent.

Hunting is done by permit only. A successful applicant cannot apply for another permit for five years. Time limitations were three years but were changed in 1973. The number of authorized permits have varied from 835 to 1,416 since 1959. During this same period of time the number of antelope harvested ranged from 369 to 844.

Antelope populations are closely monitored each year, mostly by June aerial surveys. There has been some question whether past surveys were providing true sex and age ratios in some parts of the state. Surveys may be tried in August in these areas in an attempt to obtain better information.

Arizona is initiating planning programs under the species management plan concept. Antelope has been chosen as the first game species to have a written plan. Hopefully, this plan will serve as a model for succeeding species plans. Included under the plan are such broad categories as:

Inventory
Management Practices
Development Possibilities
Uses
Research Needs

In writing the proposed plan (which is still subject to review and modification), considerable effort went into scanning literature and analyzing past management practices.

Several items of interest emerged from this. A scatter diagram was plotted showing the relationship of the number of antelope permits authorized to the number harvested from 1949 to 1973. Analysis of these data indicate there is a linear relationship of harvest with permit numbers. This also indicated that conservative hunts have been held in the past and that recommendations for the number of permits have taken into account population fluctuations.

The above effort also showed that, historically, antelope occurred in every grassland throughout Arizona. Some of this potential habitat has been irretrievably lost through use; either by livestock or by encroachment. However, there are still areas of good habitat where antelope were historically in abundance. There still remains the problems of land ownership and current land use conflicts before attempts can be made to reestablish antelope in these areas.

There are three subspecies of pronghorn recognized in Arizona--Antilocapra americana americana, mexicana and sonoriensis. Concern for population of the first two subspecies is not as pressing as for the last. Therefore, investigations are continuing on the Sonoran pronghorn, considered by some an endangered species. The major portion of this subspecies' habitat is in Sonora, Mexico, but includes a small area of the hot, dry desert in southwestern Arizona (see attached map). There is a drift of pronghorns occurring between the two countries.

The objective of this special study is to determine population numbers, sex and age composition, seasonal distribution and to recommend specific studies regarding life history and habitat requirements of pronghorn.

At the present time, there are probably no more than 100 Sonoran pronghorn in Arizona and no more than 500 in Mexico. Although the present population in Arizona apparently has not changed a great deal in the past 40 years, the population in Mexico has fluctuated from 600 in 1922 to 1,000 in 1957. The survival of the Arizona population is dependent upon a stable and lasting population in Mexico. A serious threat to the Mexican population is severe competition from cattle grazing. The Sonoran pronghorn has been completely protected in Mexico and Arizona since 1922.

Future plans for studies on the Sonoran pronghorn include determination of food habits and spring aerial surveys.

Coincidental to antelope management plans, plans are also underway to initiate research in the next fiscal year on the factors influencing fawn survival. Some factors that will be considered are predation and nutritional requirements.

Antelope Range

ARIZ. GAME & FISH DEPT.
Game Management Division

ANTELOPE IN COLORADO

by

Gary T. Myers
Big Game Supervisor
Colorado Division of Wildlife

Best estimates indicate that Colorado has about 36,000 antelope which occupy close to 35,000 square miles of habitat prior to the annual hunting season which opens for three days on the fourth Saturday in September. In 1973, 16,744 people applied for 4,910 antelope licenses which were issued by public drawing with 50% of the licenses in each area reserved for applicants who had never before had an antelope license. The regular antelope license cost residents $10.00 and nonresidents $50.00. Other than a higher license fee, nonresident antelope hunters are treated the same as resident antelope hunters. The September 22-24, 1973 season was either sex in 53 areas and bucks only in six areas. The bag limit was one antelope. A November 3-6 season for one antelope of either sex was held in three other areas in an effort to get along with landowners who usually ship cattle in late September. Preliminary estimates indicate that 4,570 hunters harvested 3,350 antelope for 73.3% success in these seasons which provided 6,692 days of recreation.

A statewide archery antelope hunt was also held November 3-30, 1973 for one antelope of either sex. Anyone who wished to participate in the archery hunt could do so by purchasing an archery antelope license, $10.00 for residents and $25.00 for nonresidents. Harvest statistics for the 1973 archery hunt are not yet available, but in 1972, 106 archers bagged 8 antelope for 7.5% success. The archery antelope season provided 492 days of recreation, or 61.5 days of recreation for each animal harvested. The average hunter spent 4.6 days hunting.

Colorado has established a management goal of increasing antelope populations and meeting sport hunting demand. With 16,000 people wanting to hunt antelope, and only 35,000 antelope in the state, this is indeed a challenge. In order to accomplish this objective, herds must be maintained at optimum levels. Herd composition must be such that maximum annual surpluses are produced which are acceptable to the hunting public.

None of this can be accomplished without a refined management system; so an effort is being made to improve the accuracy of data used to estimate population size, production and mortality. Management biologist are working with Dr. Jack Gross, Acting Leader, Colorado Cooperative Wildlife Research Unit, Colorado State University who has developed computerized population models for all major antelope herds in the state. The modeling system generates alternative ways of obtaining management goals and can provide information in forms appropriate to decision makers' needs. Although still experimental, this system, will be demonstrated at the forthcoming North American Wildlife and Natural Resources Conference. Hopefully, the system will be in use by managers and administrators by 1976.

There are no active Federal Aid research projects in Colorado; so I have nothing else to report.

1974 NEW MEXICO ANTELOPE SUMMARY

By Jack Herring - New Mexico Department of Game and Fish

In 1972 the New Mexico legislature revised the policy which applies to the setting up of antelope hunts. The old law allowed approximately 70 percent of the permits applying to private land to be issued to the public. The new policy allows all of the permits issued for 100 percent private land to go to the landowner. No agreement is signed, although an authorization is filled out for record purposes, and the landowner has complete control of the permits.

Hunts on mixed status lands are handled similar to the way they were in the past. An agreement is signed with the landowner and he receives a percentage of the licenses based on the amount of private land he owns or controls, with the rest of the licenses going to the public. Public licenses are allocated through a drawing.

The landowners have been very receptive to the new system and some very large ranches that have not been hunted for several years hunted during the 1973 season. There was approximately a 33 percent increase in the total number of licenses issued over 1972. However, public licenses decreased from 1,716 to 1,213.

Landowners are beginning to realize the added income from selling trespass rights on their private property for hunting. This, and the decreased number of public licenses, has caused some public dissension. The Department of Game and Fish feels, however, that the new system will create an incentive for proper management of antelope on private land and result in a considerable increase in hunting, as well as an increase in public hunting from the 1972 level within three or four years.

1974 New Mexico Antelope Summary

Antelope surveys are made by fixed-wing aircraft and are flown 33 percent or 100 percent. Fawn crop surveys are flown in mid-July and population surveys are made in May.

Antelope hunters number under 1,900 statewide and less than 1,200 antelope were harvested. Hunter success was 63 percent statewide.

An unlimited bow-only hunt is held in one area in the north central part of the state with the number of hunters projected to 170 and taking a projected harvest of 5 to 9 antelope for a hunter success of 5.4 percent.

Another bow hunt was held in the southeast part of New Mexico with 39 projected hunters taking 1 to 3 antelope for a hunter success of 5.3 percent.

Random card surveys are run on all antelope hunts by antelope hunt unit.

ANTELOPE PROJECTS IN SOUTH DAKOTA, 1973

by
Lee J. Vanderbush
South Dakota Department of Game, Fish and Parks

INTRODUCTION

The aerial spring antelope survey was conducted between May 12 and July 10, 1973. The July population was 33,128 antelope for western South Dakota, 231 for eastern South Dakota, a total of 33,359 in the South Dakota Hunting Units. This information forms a basis for recommending hunting season unit boundaries and numbers of antelope to be harvested.

This report also summarizes the 1973 archery antelope and firearms hunter report card data.

The hunting season is the most important tool for management of antelope. Ultimate objectives of an antelope hunting season are to keep the population well distributed within the landowner tolerance levels and the carrying capacity of range, and to provide recreational opportunity through hunting. Hunting units are based on a flexible zone and quota system which allows local populations to be increased, stabilized or reduced independently of each other. This system has been in effect in South Dakota since 1941.

OBJECTIVES

The objectives of this study are:

(1) to determine the total number of antelope in South Dakota within 10 percent of the true population.

(2) to form a basis for recommending hunting season units and the number of animals to be harvested within the units.

(3) to determine the sex ratio of adult antelope by management units.

(4) to determine reproduction within the herd.

(5) to determine hunter success, and

(6) to obtain information on hunter characteristics and habits.

POPULATIONS

Procedures

All hunting units in South Dakota with the exception of units 6 and 14 were surveyed by Conservation Officers. Five aircraft and sixteen Conservation Officers were used on the survey. The low level flights were made with airplanes of at least 115 horsepower at speeds not to exceed 75 miles per hour. The survey began after spring green-up and was completed in mid-July.

Censused areas were blocked into working units using boundaries delineated by roads, section lines, major streams, or other identifiable landmarks, and were generally smaller than 400 square miles in size.

The census consisted of a 33-1/3 percent coverage of each unit based upon a one-half mile belt spaced at 1-1/2 miles between centerlines. Because of low density populations in eastern South Dakota, Unit 20 received 100 percent coverage by flying two half-mile wide belts in each mile and only a doe:young ratio was flown in Units 17, 18, 19 and 21. Sufficient altitude was maintained to allow observation of all terrain within the one-half mile wide transects. Flight periods did not exceed three hours in duration without a rest stop.

All adult antelope were recorded and identified by sex or classified as unknown. A later reproductive check flight was made to

establish the doe:young ratio. This was accomplished by observing a minimum of 10 percent of the does in each unit and recording the number of youn. Computation of adult population figures and doe:young ratios results in the July antelope population.

Findings

The calculated July, 1972 antelope population for western South Dakota was 33,128, a decrease of 1,766 antelope over July, 1972. The adult breeding population increased by 760 antelope from 1972. The population increased in five of the West River Hunting Units and decreased slightly in eleven units.

The doe:young ratio was 100:84. This was lower than the doe:young ratio of 100:102 in 1972. This low doe:young ratio made up for decrease in total antelope population.

HARVEST

Procedures

Hunter report cards were provided each licensee as a part of his antelope license. These cards were to be returned to the Rapid City Regional Office of the Game, Fish and Parks by mail. The cards were sorted into separate categories according to seasons and hunting units. The following information was obtained: Reported success, projected success, sex of harvested animals and man-days spent hunting.

Reported success is calculated from hunter report cards. Projected success and projected kill are claculated by the following method: Non-reporting hunters have been determined to be 80 percent as successful as reporting hunters (as a result of a hunter follow-up study in 1972). On this basis, kill by non-reporters is calculated

and added to the kill by reporters, giving total projected kill figures. Projected total kill figures are divided into license sales to determine projected success percentages.

Findings

In the West River antelope units, 7,771 licenses were sold for the rifle season. The voluntary hunter report card return was 77 percent with a reported hunter success of 92 percent.

1,590 hunters failed to return their report cards. Projected kill and projected percent success was calculated using data obtained in 1972. It has been determined that non-reporters are 80 percent as successful as reporters. In 1973 a projected harvest of 6,831 antelope and projected success of 88 percent was obtained. Of the total harvest 65.6 percent of harvested antelope were bucks.

For the East River firearm season, all 100 licenses were sold. 87 percent of the East River hunters returned their cards. Reported hunter success was 91 percent.

Projected kill and projected success was determined to be 87 antelope for an 87 percent success. 55-1/2 percent of the total harvest was bucks.

423 resident archery antelope licenses and 33 non-resident archery antelope licenses were sold in 1973. 63 percent of all antelope archers returned their hunting report cards. From these reports a 19 percent reported success was tabulated. A total of 54 antelope were taken by archers.

Some Problems Associated with Chasing Pronghorns

Gordon A. Chalmers: Regarding the question, "What is wrong with "sportsmen" chasing antelope for sheer pleasure?", Morley Barrett and I have had an opportunity to provide a partial answer, we think. It has been our experience with drive trapping adult pronghorns during very warm weather and also with over zealous individuals trapping kids, that these animals can and do go down and die. Post mortem examination often reveals hemorrhage in the muscles, especially those muscles of the hind limbs, but also those in other areas of the body; edema and some pallor of these normally dark muscles is also seen. Microscopically, there is evidence of hemorrhage, edema and degeneration of numerous muscle fibres. This degeneration bears resemblance to what is known as white muscle disease (Nutritional Myopathy) in domestic lambs and calves. Morley has mentioned previously that there are indications of deficient as well as toxic levels of selenium in *A. cana* in our area and since there is an association between selenium-Vitamin E deficiency and white muscle disease, perhaps some of the muscular changes seen in Pronghorns are related to this. In our view, these changes are indicative enough of stress, exhaustion, myopathy, or whatever you might want to call it, to indicate negative reasons for the kind of harassment that goes with chasing these animals for so-called pleasure.

Morley W. Barrett: In the past 3 years we have observed stress-induced mortality of pronghorns caused by drive trapping. In 1971, we experimented with our trapping schedule by conducting two or three drives each month from September through December, inclusive. Pronghorn mortality was markedly increased during warm weather drives. Of 27 pronghorns trapped prior to October 10, 1971 we lost nine animals to no other apparent cause than stress. By conducting identical drive trap operations in the colder weather of late November and December we have virtually eliminated direct stress losses. In early December of 1972 and 1973, we corralled 275 pronghorns without any sign of stress-induced mortality; the temperature range was -24 ^{o}F to +30 ^{o}F.

Gordon Chalmers has mentioned necropsy findings regarding the early mortalities. Some of the clinical observations include the following: 1) many animals were unable to stand and fell in lateral or sternal recumbancy; 2) animals were almost completely oblivious to human approach; 3) most animals had limited or no motor abilities; 4) some animals shook uncontrolably; and 5) the onset of clinical signs of stress were not evident in some animals for over an hour after the drive. Three of the nine animals were actually tagged and released only to find that they died within approximately 2 hours and one half mile from the trapsite. Since virtually all pronghorn hunting seasons are held in warm weather we suspect that continued active pursuit by sportsmen may induce difficulties similar to what has been observed in warm weather drive trapping. We should also caution that sub lethal effects of stress may be highly significant to pronghorns; such effects are unknown at this time.

G E N E R A L P A P E R S

PRONGHORN HABITAT REQUIREMENTS FOR SAGEBRUSH-GRASSLANDS

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

Abstract: Habitat requirements for the American pronghorn antelope in a sagebrush-grassland biome are:

ABIOTIC: Physiography: Large, wide open, low rolling rangelands with no major physical barriers.
Climate: Average precipitation 8-15", snow level no higher than 15"; temperature no problem.
Soils: Not a limiting characteristic.
Water: Desirable to have available within 3 to 5 mile radius; consume 1/4 to 1 gallon daily, especially during the summer.

BIOTIC: Vegetation: Most important habitat factor for antelope: high density ranges average 50% vegetation production, 50% non-vegetation--of which 40-60% is grass, 10-30% forbs, and 5-10% browse; height no higher than 24"--prefer around 15"; use a variety of ecological communities--steppes, grasslands, meadows, weed patches, dry lake beds, recent wild burns, etc. Succulence is extremely important and creates a preferred forage; dietary preferences are not limited but include practically every plant species with a high preference for the more succulent; availability (often only browse on some winter ranges today) is extremely important for winter survival.
Animal: Tolerant of other wild ungulates. Predation a factor but not limiting for most ranges. Man's uses of the land has the greatest effect on habitat--can be beneficial or detrimental depending on how he manipulates water and vegetation.

SUMMARY: The above requirements must be available in the right combinations. Too much or too little of any one may become the major factor limiting pronghorn production or survival.

INTRODUCTION

The American pronghorn antelope (Antilocapra americana) ranges from northern Mexico, through the western United States and up into southern Canada (Einarsen 1948). This is the pronghorn's range as it has been historically; today, however, both the inhabited range and the herd population has been greatly reduced during the last century (Yoakum 1968).

Studies of the pronghorn and its habitat were commenced in 1952 and have been continued (Yoakum 1957, 1962, 1972). Indications are that the sagebrush-grassland community is inhabited today by approximately one-third of the pronghorn population (Yoakum 1972). Consequently, the objectives of this paper are to (1) record factors affecting antelope range relationships, and (2) document the habitat requirements of the American pronghorn.

The author wishes to acknowledge the assistance of many workers in collecting field data, and especially for evaluating vegetative community transects. Students in big game classes at Humboldt State College, Arcata, California, and Colorado State University, Fort Collins, Colorado collected data for many range transects. Then, too, the author discussed the techniques of vegetative transects with various State and Federal agency personnel, resulting in the collection of additional information for inclusion in this report.

THE ANTELOPE POPULATION

During the mid 1960's, various State wildlife agencies were contacted for information pertaining to antelope abundance and distribution (Yoakum 1968). The data obtained was plotted on a vegetative community map (Yoakum 1972). By combining the findings from antelope distribution and abundance data with the vegetative community delineation, it was possible to estimate numbers of pronghorn inhabiting the sagebrush-grassland range for the various States (see Table 1).

Table 1. Estimated number of antelope inhabiting the sagebrush-grassland community.

State	Estimated Number of Antelope 1/	Notations Regarding Population Status During Early 1970's
Washington	120	
Oregon	8,950	Herds increasing lightly. 2/
California	2,690	Herds increasing lightly. 2/
Idaho	4,700	
Nevada	3,500	Herds increasing lightly. 2/
Montana	15,300	
Wyoming	65,200	Herds increased, then decreased. 3/
Colorado	3,150	
Utah	200	
TOTAL	103,810	

1/ Yoakum (1972).
2/ Reported at Interstate Antelope Conference 1974.
3/ Sundstrom et al 1973.

THE SAGEBRUSH-GRASSLAND COMMUNITY

The community was defined by Kuchler (1964) and is delineated in Figure 1. The number of antelope in the community, by State, is listed in Table 1.

In order to obtain more detailed information on the vegetative community characteristics, a study was initiated based on the following procedures:

Step 1. Complete an antelope-habitat relation form described in this report under "Observations of Antelope-Range Relationships."

Step 2. For random selected areas, complete a series (generally 3 to 10) of vegetative transects using a modification of the step-point method. A total of 100 readings per transect were taken.

Data was classified as vegetative (grass, forbs, browse) or non-vegetative (bare ground, rock, litter). Frequency of hits was then calculated into percentages. Additional notes of vegetation composition, utilization by animals, or photos were taken.

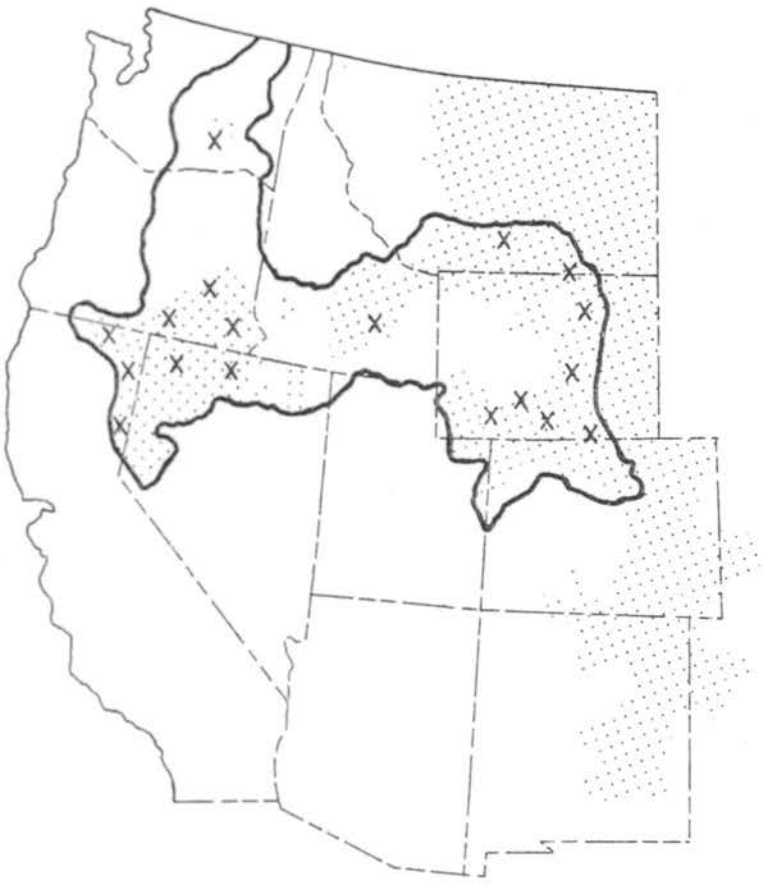
Findings from these range transects are tabulated in Table 2. The locations for the study sites are spotted on Figure 1.

Table 2. Findings for 60 study sites in 6 States having sagebrush-grasslands inhabited by pronghorns.

State	Study Sites		% Vegetation			% Total Hits	
	No. Transects	No. Readings	Grass	Forbs	Browse	Total Veg.	Non-Veg.
Washington	2	2,000	10	14	14	38	62
Oregon	37	14,400	14	5	22	41	59
California	5	3,600	16	7	31	54	46
Nevada	5	2,500	10	10	21	41	59
Montana	2	500	21	6	21	48	52
Wyoming	9	4,900	37	11	9	57	43
Total	60	27,900					
Average			18	9	19	46	54

OBSERVATIONS OF ANTELOPE-RANGE RELATIONSHIPS

When antelope were seen on the range, a form was completed listing the following data: number, sex, and age ratios; date; time; location; elevation; weather conditions; soil type; vegetative community, height of vegetation; proximity to water; and any other worthwhile notes such as dual use by livestock, types of fences; any habitat manipulation practices, etc. Table 3 provides a compilation of much of the pertinent findings summarized to date.



LEGEND

Sagebrush-grassland community

Range currently inhabited by pronghorns

X Vegetative study sites

Figure 1. Delineation of current antelope distribution to the sagebrush-grassland community and notation of vegetative study sites.

Table 3. Summary of data collected and an analysis of the characteristics of sagebrush-grassland ranges inhabited by pronghorns.

State	Number Observations	Antelope Seen	Average Elevation	Average Vegetation Height	% Range Dually Used With Livestock	Average Approximate Distance to Nearest Water
California	47	482	4,500	18"	100	4 miles
Idaho	1	5	5,000	12"	100	1/2 mile
Montana	6	45	4,500	16"	100	2 miles
Nevada	51	303	4,500	16"	100	5 miles
Oregon	449	3,200	4,500	16"	100	3 miles
Wyoming	120	1,580	5,000	15"	100	2 miles
Total	674	5,615				
Average			4,500	16"	100	3 miles

ANTELOPE REQUIREMENTS FOR HABITAT

Based on an analysis of the findings of this study and a review of published reports, the habitat requirements for pronghorns are classified into two categories: abiotic (non-living) and biotic (living). A description of these requirements is as follows:

Abiotic

1. Land Area

   A. Physiography. Antelope have for centuries, and still do, use land form typified by low rolling, wide open, expansive terrain. Some small herds occupy ranges with sparse stands of ponderosa pine (Pinus ponderosa) or juniper (Juniperus sp.), although these are few and such sites generally have low understory vegetation thereby permitting visibility and rapid mobility.

   Frequently the question is asked--what size land area is needed by antelope? The answer is that the size of the area is dependent upon a particular range having all of the approximate habitat requirements in sufficient quality and quantity for all seasons of the year and for every year.

   Examples of how ranges can vary in possessing all of these requirements can be realized by comparing three different ranges all on or within sight of Hart Mountain in south-central Oregon.

   (1) The first example is an area with a diameter of five miles in Warner Valley. The site has sufficient forage and water year round. Snow depth rarely, if ever, exceeds six inches. This situation results in a resident herd.

(2) The second example is the nearby Drakes Flat tableland--an area 15 miles so in length. Food and water is abundant all year. Antelope use the higher elevations (80% or more) all year depending on the snow depth. As soon a snow depths recede, the herds move to higher elevations where preferred plants are more available. This situation results in the seasonal movement of the herd.

(3) The third example is the Hart Mountain area where the differentiation of summer and winter ranges is pronounced. The degree of traveling is related to the amount of snow, i.e. the deeper the snow, the further the herds travel seeking lower elevations with less snow. In a sense these travels are not true migrations such as the caribou (Rangifer artius) since the antelope movements differ each year, but are related to annual snow depths.

B. Natural Barriers. Natural barriers affect antelope movements and, therefore, the occupancy of habitat. Such natural barriers may be: large bodies of water; large rivers; an abrupt escarpment or mountain ridge; heavy, thick, high brush or trees; deep canyons; and others. Einarsen (1948) cited examples of such barriers when he referred to two cases (one being the Columbia River and the other a heavily forested area) where pronghorns did not occupy or reestablish on nearby favorable ranges.

C. Elevation. Pronghorns inhabit ranges from sea level to 11,000 feet. Only a few antelope occupy ranges at sea level in Mexico. Likewise, small herds use the alpine meadows in Oregon and Wyoming. By far, the greatest densities occur on rangelands between 4 to 6,000 feet above sea level.

2. Climate

A. Precipitation. The highest antelope densities appear to be on habitat receiving precipitation averaging 10 to 15 inches per year. When antelope have been transferred to areas of higher precipitation, production and/or survival decline. Antelope do live in areas of less precipitation, but densities are likewise less.

B. Snow. Most antelope ranges receive some snow. However when snowfalls exceed 10" to 12", antelope frequently have a hard time obtaining the necessary quality and quantity of forage. Prolonged seasons of deep snows are especially harmful to antelope when combined with factors such as: (1) low quantities of forage, (2) excessive wind increasing chill factors, and (3) obstacles to free movement (fences, roads, etc.) to lands with less snow.

C. Temperatures. Temperatures appear not to be a major problem. The antelope is adaptive to the hot deserts or alpine plateaus.

3. Soils. The American pronghorn inhabits lands of various soil classifications, i.e. sandy, clay, basalt etc. Soils appear to be not a major criteria relative to antelope distribution or abundance. However, soils combined with 10" to 15" rainfall produce vegetation both in quality and quantity which becomes the major factor in antelope density.

4. Water. Antelope range from dry semi-arid lands to lush alpine meadows with an abundance of water. Extensive ranges producing and maintaining high antelope densities have water available every three to five miles. Small numbers of animals can be found further than five miles from water; however, studies in Wyoming (Sundstrom 1968) disclosed that 95% of over 12,000 pronghorns were within a three to four mile radius of water.

   Antelope use water obtained from springs, streams, lakes, water catchments, or metal troughs, as well as snow. Pronghorns use water or snow year long. When succulent forage is available, one quarter gallon of water per day seems sufficient. During dry summers, one gallon to a gallon and a half a day may be needed (Sundstrom 1968).

Biotic

1. Vegetation. Quality and quantity of vegetation appears to be the major factor affecting antelope densities. The following characteristics of the sagebrush-grassland community are for preferred ranges:

   A. Ground Cover. Ground cover averages 50% living vegetation and 50% non-living vegetation (bare ground, rocks, litter, etc.).

   B. Composition. Generally, the composition of living vegetation is 40-60% grass, 10-30% forbs, and 5-10% browse.

   C. Variety. Within the vegetative community, there is a large variety of plants. This often averages 5-10 species of grass, 20-40 species of forbs, and 5-10 species of browse.

   D. Succulence. Succulent plants are sought after. Dietary studies have disclosed that during wet springs or summers which produce an abundance of succulent forbs, pronghorns utilize more forbs. Antelope will move from dry ranges to such places as intermittent lake beds to seek succulent vegetation.

   E. Range Types. Open rangelands having a variety of vegetative types (meadows, weed patches, etc.) are more desirable than monotypic stands of vegetation. Antelope seek areas of recent wild fires for foraging. Such areas provide new green grass sprouts and an abundance of succulent forbs.

F. Height. Wherever antelope range, a quick glance at the vegetation discloses that it is low in height--averaging 15". Rangelands with vegetation over 24" become less preferred and those over 30" are infrequently used. Antelope will seek higher vegetation sometimes for forage, i.e. saltbrushes, and may pass through the higher brushy areas while traveling to or from more preferred ranges; however, their total yearlong use of 30" or higher vegetal areas is minimal. There may be a factor here of less visibility, or decreased mobility, which are paramount to the antelope's survival.

G. Wildlife.

(1) Other Ungulates. Pronghorns historically grazed with herds of buffalo, elk and deer. There appears to be little problem of tolerance or competition when forage is abundant.

(2) Predators. Coyotes and bobcats do prey on antelope, especially the fawns; however, predation is rarely a limiting factor where herds are abundant.

H. Man. The effect of man on pronghorns today can be stated as follows:

(1) Species Management. Today's advanced scientific wildlife management practices have increased herds over 1,000 percent during the past 40 to 50 years. Effective control of hunting and large scale trapping, transplanting, and herd re-establishments to historic ranges have been major benefiting ventures. Less than 5% of the herds in North America are in areas of uncontrolled hunting, and these herds continue to decrease in numbers.

(2) Habitat Management. What man does to the rangelands affects the welfare of pronghorns more than any other factor. His range management practices including forage manipulation, fence or highway construction, and the development of waters which all affect the antelope's ability to survive. If these practices are accomplished with consideration of the antelope's habitat requirements, then all is well. If these requirements are ignored, then the land can no longer provide the needed forage, water, and space for reproduction and survival.

Summary. Table 4 is a checklist of habitat characteristics and pronghorn requirements for a grassland-sagebrush community maintaining high antelope densities. It cannot be emphasized too strongly that optimum habitat is directly related to the right combination of all identified requirements. Too little or too much of any one requirement may become the major factor limiting antelope production or survival. Optimum habitat requires the right combination of abiotic and biotic factors.

Table 4. Checklist of pronghorn habitat requirements for sagebrush-grassland ranges maintaining high antelope densities.

HABITAT CHARACTERISTICS	ANTELOPE REQUIREMENT 1/
ABIOTIC	
1. Physiography	Large expanse area (10 miles minimum) - low rolling terrain - no major physical barriers (large rivers, mountain ranges, etc.)
2. Climate - precipitation - snow depth - temperature	10-15" Not over 10-15" for prolonged periods Not a factor--populations in hot deserts to alpine meadows
3. Soils	Not a determining factor except to soil-site relationships in which some sites do not grow the right vegetation
4. Water	Desirable to have one quarter to one gallon per day for every day of year, particularly warm seasons. Water distribution every 3 to 4 miles
BIOTIC	
1. Vegetation	Ground cover--most ranges have around 50% vegetation: 50% non-vegetation Composition: 40-60% Grass 10-30% Forbs 5-10% Browse Variety: Grass - 5 to 10 species Forbs - 20 to 40 species Browse - 5 to 10 species Succulence: The more available year round the better in all plant species Communities: Variety and diversity important (meadows, intermittent lake beds, wild fire burns, etc.) Height: No higher than 24"; preferably from 12-24"
2. Animal	Big game: Tolerable of all species Predators: Affect antelope to some extent, but rarely a limiting factor Man: Can or cannot be problem based on two major factors: - Effective enforcement of indiscriminate year long killing - Methods and practices of habitat or range management (maintaining or improving vegetation, waters, fences, etc.)

1/ These requirements must be available in the right combinations. Too much or too little of any one may become the major factor limiting antelope production or survival.

LITERATURE CITED

Einarsen, A. S. 1948. The pronghorn antelope and its management. Wildl. Managt. Institute, Wash., D. C. 235 p.

Kuchler, A. W. 1964. Potential natural vegetation of the conterminous United States. American Geographical Society, N. Y. Special Pub. No. 36, 116 p. plus separate map.

Sundstrom, C. 1968. Water consumption by pronghorn antelope and distribution related to water in Wyoming's Red Desert. Antelope States Workshop Proc. 3:39-46.

_____, W. G. Hepworth, and K. L. Diem. 1973. Abundance, distribution and food habits of the pronghorn. Wyoming Game and Fish Com., Cheyenne. Bull. No. 12. 61 p.

Yoakum, J. 1957. Factors affecting mortality of pronghorn antelope in Oregon. M.S. thesis, Ore. State College, Corvallis, Ore. 112 p.

_____. 1962. The interstate antelope range, its research and management needs. Inter. Antelope Confer. Trans. 13:52-58.

_____. 1968. A review of the distribution and abundance of American pronghorn antelope. Antelope States Workshop Proc. 3:4-14.

_____. 1972. Antelope-vegetative relationships. Antelope States Workshop Proc. 5:171-177.

IMPORTANCE, UTILIZATION AND QUALITY OF *Artemisia cana* ON PRONGHORN WINTER RANGES IN ALBERTA [a]

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Abstract: Observations on the distribution of pronghorns (*Antilocapra americana* Ord) in Alberta during the winters of 1971-72 and 1972-73 indicated that more than 60 percent of all animals sighted were on silver sage (*Artemisia cana*) vegetation complexes. Food habitat studies in Alberta have also revealed a high utilization of *A. cana* during fall and winter. Permanent browse transects established on all major winter ranges in 1971 have revealed the mean utilization on *A. cana* over the past two winters was 25 percent. Discussion is presented concerning the degree of utilization of browse in relation to season, sagebrush growth and animal numbers. Preliminary data from experiments designed to help interpret browse utilization data suggests that pronghorn densities on winter ranges in Alberta should not exceed 15 pronghorn days per acre and that the mean intake of *A. cana* per day per pronghorn during winter was approximately 2.45 pounds per day. Proximate analysis of *A. cana* samples collected during the past two winters revealed a mean protein, calcium, phosphorus, calcium to phosphorus ratio, and fiber content of 7.64, 0.75, 0.16, 5.05 and 38.8 percent respectively. The sulphur and selenium content of a limited number of sage samples is presented.

[a] Presented at the sixth biennial Antelope States Workshop, Salt Lake City, Utah, February, 1974.

Variation in some of the above determinations is discussed with respect to year, month, winter range and snow accumulation. Data from *in vitro* analysis of *A. cana* is also presented. All conclusions and recommendations reached in this paper are tentative since all aspects of the study are continuing.

INTRODUCTION

The abundance and distribution of pronghorns *(Antilocapra americana)* in North America is largely a function of the capability of local environments to support them. Undoubtedly the most essential but perhaps least understood aspect of their environment is the suitability of the habitat. Habitat becomes even more critical in Alberta and Saskatchewan where pronghorns exist on the northern-most fringe of their range.

Mitchell and Smoliak (1971) reported on the food habits and some range characteristics of pronghorns in Alberta and found that silver sage *(Artemisia cana)* was present in 88 percent and composed 38 percent of the total volume of rumens collected during winter. Similarly, Barrett (unpublished data) observed that silver sage had a frequency index and a mean weight content of 100 percent and 85 percent, respectively, and 11 rumens collected from pronghorns on southern Alberta winter ranges. In Saskatchewan, Dirschl (1963) observed that 85 percent of the winter diet of pronghorns in the Cypress area of Saskatchewan bordering Alberta, was composed of silver sage. Similarly in Montana, Bayless (1969) and Cole (1956) reported that sagebrush, primarily big sage *(A. tridentata)* was the plant type most heavily utilized by pronghorns during winter.

Since sagebrush is unequivocally the most important plant species to wintering pronghorns in their northern ranges. The purpose of this study was to investigate some of the vital characteristics of *A. cana* and some of the relationships between sagebrush and pronghorns. The conclusions reached in this paper are tentative since all aspects of this program are continuing.

Thanks are extended to E. Bruns, L. Gudmundson and G. Wood for assistance in reading vegetation transects and gathering sagebrush samples for analysis. The assistance of J. Martin and L. Massey of the Provincial Soil and Feed Testing Laboratory in Edmonton is appreciated.

METHODS AND MATERIALS

Study Area

This investigation was carried out in the southeast portion of Alberta and encompasses all of the major pronghorn wintering areas (Fig. 1). Mitchell and Smoliak (1971) have described two representative portions of this area in detail. Most activities reported in this paper have resulted from investigations conducted within individual pronghorn winter ranges. Pronghorn enclosures referred to during this paper were located beside transect 4, winter range F, on Sage Creek (Fig. 1).

Pronghorn Distribution

When travelling within the pronghorn range in Alberta, project personnel recorded the number of animals observed and the habitat type on which they were seen. Classification of sage density was done subjectively in most cases but personnel were required to test their judgement regularly by measuring sage densities.

Sage Transects

Permanent browse transects using silver sage as the key species were established in all recognized pronghorn winter ranges (Fig. 1). Individual transect sites were selected on the basis of previous use by pronghorns, aspect, and proximity to an access route. Each transect consisted of 25 tagged stems each of which was located on a different plant; selected on the basis of the nearest neighbour method. Browse use on the transects were recorded during October and April in 1971-72 and 1972-73 according to the method of Cole (1963). All leaders less than one half inch long were disregarded when reading transects. The length of all leaders was recorded for every fifth tagged stem at each transect reading. The maximum height of each marked plant was also recorded at every reading. The number of sage plants intercepted and the length of the intercept was recorded for two randomly selected 200 foot straight lines transects at each reading of the permanent transects.

Enclosure studies

Two adjacent 10 acre enclosures (A and B) were established on the pronghorn winter range on Sage Creek. The enclosures A and B were stocked with a total of 2 and 3 pronghorns respectively, in late November and early December of 1971. These animals received no supplementary food or shelter and were completely dependent on the native grass prairie-medium sage vegetative type for survival over winter.

In 1972 the partition between Pen A & B was removed to form one 20 acre enclosure (C). Four aduit pronghorns were placed in Pen C on December 7, 1972, and all remained there until April of 1973. One animal was

removed in April but the remaining three remained in Pen C until released in June 1973. As in 1971-72, no supplements were provided.

Two permanent sage transects, the same as previously described were established within the 20 acre enclosure complex and were read in October and April of both years. The enclosure studies had several applications but in keeping with the context of this paper data will be discussed only as they pertain to the utilization of sagebrush.

In August of 1971 and 1972 the annual forage production was determined by clipping 10 randomly selected 1 m plots per each 10 acres of enclosure. Clipping was done in enclosures A and B in 1971 and in enclosure C in 1972. Clipped material was separated into grasses, forbes and browse and overdried browse was further subdivided into species. Each class of forage was overdried to determine annual production.

Forage Analysis

Samples of silver sage were collected at regular intervals from plants located near all permanent browse transects established on pronghorn winter ranges. There were three sampling periods during the 1971-72 winter and five sampling periods during the 1972-73 winter (Fig. 3). Each sample was obtained by collecting vegetative leaders and some seed heads from a number of different plants. Sagebrush samples were collected in a manner which was intended to simulate pronghorn browsing habits. Only plant material produced in the latest growing season was collected. Plant material was stored in unsealed paper bags until analyzed. During both winters some samples were collected from sagebrush above snow and a duplicate sample from sagebrush below the snow.

Forage analysis were conducted by the Agricultural Soil and Feed Testing Laboratory of the Province of Alberta. Protein (nitrogen x 6-25, macro kjeldahl), selenium (fluorometric method), and moisture determinations were conducted by the respective methods outlined by the association of official analytical chemists (Horwitz 1970). Calcium and phosphorus content in forage was determined by the method outlined by Roach (1965) while the sulphur determinations followed the procedure of Carson et al. (1971). Fiber determinations were conducted using the acid detergent fiber technique outlined by Goering and Van Soest. The technique used for the *in vitro* digestion of forage was that outlined by Troelsen (1970) and employing sheep inoculum. All data presented in this report is expressed on a dry weight basis.

RESULTS

Pronghorn Distribution

The vast majority of pronghorns wintering in Alberta can be found in or very near a native grass prairie-sagebrush vegetation type. So specific are the known pronghorn winter ranges in Alberta that they occupy less than one percent of the total short grass prairie area of the province. The major pronghorn winter ranges in Alberta are shown in Figure 1. The borders of each winter range were determined by plotting the distribution of suitable winter range vegetation types and the known winter distribution of pronghorns. The distribution of pronghorns in relation to a variety of habitat types is presented in Table 1. Over 60 percent of all animals were observed on a sagebrush vegetation type.

Similarly, most pronghorns observed on native grass prairie were in close proximity to sage areas.

Permanent Sage Transects

The majority of pronghorn winter ranges were not over-browsed by pronghorns from 1971 to 1973 (Table 2). Only one range had more than 50 percent of its leaders utilized in both winters and the average leader use reading for all transects over the two winters was 25 percent. Mean browse utilization was reasonably consistent over the two winters and averaged 27.5 percent in 1971-72 and 23.0 percent in 1972-73.

The amount of annual growth per leader varied dramatically between winter ranges and between years. Some winter ranges had relatively high growth in both years and undoubtedly reflects superior soil and moisture conditions. Most areas had a lower production of sagebrush in the 1971 growing season (mean = 5.9 cm per leader) as compared to the 1972 growing season (mean = 7.7 cm per leader). Despite the increased production and decrease proportion of leaders used in 1972-73, there was no decrease in the proportion of annual growth utilized (mean 1971-72, 17.5 percent as compared to 1972-73, 18.7 percent). The proportion of annual growth utilized (based on length not weight) appeared to be a true measure of actual browse utilization. There did not always appear to be a direct correlation between the number of leaders clipped and the proportion of annual growth utilized over winter.

Sagebrush characteristics vary widely throughout Alberta but the following parameters are based on data obtained from the 35 permanent

transects located throughout the province over the two year period. The mean height of individual sagebrush plants in the month of October was 14.6 inches. The mean number of sagebrush plants intercepted per 200 foot transect was 18.2 while the linear intercept per 200 foot transect was 11 feet or 5.5 percent.

Enclosure Studies

During the 1971-72 winter all five pronghorns retained in Pens A and B eventually perished. Death was attributed to a combination of starvation and exposure which were aggravated by the accumulation of 6 to 12 inches of snow. Pronghorns survived for a mean of 53 and 54 days in Pens A and B respectively. The 268 pronghorn days per acre resulted in a mean utilization on sagebrush of 53 percent of the leaders and 41 percent of the total length of the annual sage growth.

In the 1972-73 winter all four pronghorns survived the entire winter in Pen C and all but one were eventually released. The mean number of pronghorn days per acre between reading the sage transects was 24. This intensity of stocking resulted in a mean leader use of 93 percent and a utilization of 84 percent (based on length) of all annual sagebrush growth.

The number of pronghorn days per acre in both years has been plotted against the percentage of *A. cana* leaders utilized in Figure 2. This figure should be useful in interpretating the number of relative number of pronghorn days in a given winter range by examining the leader use on permanent transects. Based on observations during the 1971-72 and 1972-73 winter, the maximum over-winter stocking rate should not exceed 15 pronghorn days per acre. This would appear to be all that an Alberta winter

range can stand in terms of sage utilization on a sustained basis without causing a high decadence rate on sage. Stocking rates of 15 pronghorn days per acre or less do not guarantee over-winter survival of pronghorns in severe winters. Based on a 120 day winter in Alberta and a 15 pronghorn day per acre stocking rate we should not exceed 80 antelope per square mile in wintering areas. It should be emphasized here that these suggested maximum stocking rates are tentative and are based on very preliminary data.

The extremely heavy browsing in Pen C in 1972-73 provided stark evidence regarding the dangers of over-utilization of sagebrush. Examination of the transects in Pen C in October of 1973 revealed that 20 percent of the plants which had tagged stems showed no signs of current years growth. An additional 48 percent of the plants showed no measurable growth on the tagged stems. Only 32 percent of the tagged stems had any measurable new growth and their production was markedly reduced. The mean leader length in terms of annual growth in the fall was a mere 1.3 cm in 1973 as compared to a 4.8 and 4.3 in 1971 and 1972 respectively. It should be noted that the utilization of sage continued in Pen C after the transects were read in April of 1973. Three pronghorns were maintained in Pen C for approximately another 60 days and therefore the fall 1973 sage production reflects continuous pronghorn browsing from Dec. 7, 1972 until June 15, 1973.

Average forage production from 1971 and 1972 in the wintering areas monitored was 73.5 pounds of browse, 65.9 pounds of forbes, and 437.8 pounds of grass per acre, respectively. Essentially all the browse production represented *A. cana*. Based on the enclosure studies, a stocking

rate of approximately 15 pronghorn days per acre resulted in a mean utilization of approximately 50 percent of the annual sagebrush growth. Using the 1971 and 1972 mean sagebrush production of 73.5 pounds per acre, the consumption of sage per antelope in the enclosures was 2.45 pounds per day. Confirmation as to whether 50 percent utilization of leader length results in a similar utilization of leader weight is required.

Forage Analysis

The mean protein content of sagebrush per sampling period is presented in Figure 3. Protein content was lower in the 1971-72 winter samples than in 1972-73. The higher protein levels in 1972-73 seemed to be a reflection of a short, warm, open winter during which some growth periods may have occurred for sagebrush. Similarly, in April of 1973 sage in some transects showed considerable new growth whereas in 1972 most sagebrush plants were still held by winter's grip. The mean winter protein level in all sagebrush samples collected over the two years was 7.64 percent.

Mean calcium content of all sagebrush samples collected over the two year period was 0.75 percent. Monthly variations over the two winters are expressed in Figure 4. Calcium content of sagebrush was higher in the 1972-73 winter. Unlike other nutrients measured, the calcium content decreased in late winter and early spring.

The phosphorus content of sagebrush in relation to time of collection is presented in Figure 5. Phosphorus content was notably higher in the 1972-73 samples. The mean phosphorus content of all samples collected over the two winters was 0.16 percent.

The calcium to phosphorus ratios for each collection period are presented in Figure 6. The overall ratio based on all samples over the two winters was 5.05. Calcium to phosphorus ratios were not appreciably different between the two years.

Mean fiber content for each sagebrush collection period is presented in Figure 7. Fiber content was higher at all sampling periods in 1971-72 as compared to 1972-73. The mean fiber content of all samples analyzed over the two winters was 38.8 percent.

Sagebrush samples collected from different winter ranges had correspondingly different nutrient contents. Variations in protein content between winter ranges for the two year period are presented in Figure 8, while similar variations for calcium and phosphorus are presented in Figure 9. Some winter ranges had consistently higher levels of protein each year; similar observations were observed for calcium and phosphorus. With respect to protein, sagebrush from winter ranges in the extreme southwest portion of the province had characteristically higher protein levels. A somewhat converse arrangement was observed for calcium where the highest readings were for sagebrush collected in the northern and western winter ranges. While phosphorus content of sagebrush varied considerably between ranges, there were no large, general, geographic areas that had consistently high or low readings.

Seventeen sagebrush samples collected in the winter of 1971-72 had a mean sulphur content of 0.17 ± 0.04 ($\bar{x} \pm 1$ S.D.) percent and a mean selenium content of 982 ± 872.7 ($\bar{x} \pm 1$ S.D.) parts per billion. The

sulphur content from sample to sample was relatively consistent but the selenium content was highly variable (range 40 to 5520 ppb). By comparison two grass samples collected during the winter had a mean sulphur and selenium content of .09 percent and 680 ppb, respectively.

Thirty-two sagebrush samples examined had an *in vitro* digestibility of 43.7 $\pm$ 4.3 percent ($\bar{x} \pm 1$ S.D.). *In vitro* digestibility was positively correlated with protein content (r = .64) using natural numbers in a simple linear regression. By comparison, two grass samples collected in the winter had a mean *in vitro* digestibility of only 35.9 percent.

The nutrient content of sagebrush increased dramatically when samples were collected below snow (Table 3). The increase was most notable in the 1971-72 winter when there was a much greater snow accumulation. Possibly the most significant nutrient change from a pronghorn standpoint lies in the overall 28.4 percent higher levels of protein in the two years.

DISCUSSION

There can be little doubt that the pronghorn in Alberta is highly dependent on sagebrush during the winter. Similarly, pronghorns throughout much of its northern range are similarly dependent during fall and winter on woody browse and in most cases on some species of *Artemisia* (Bayless 1969 and 1971, Cole 1956, Dirschl 1963, Martinka 1967, Mitchell and Smoliak 1971, and Pyle 1972).

Most winter ranges in Alberta were not over-utilized in 1971 to 1973. A few areas however, were approaching the maximum allowable leader use of approximately 60 percent and one area exceeded this level. Pyle

(1972) reported that moderate to severe hedging resulted from 51 to 59 percent leader use of sagebrush in a chronically over-utilized Saskatchewan pronghorn winter range. Alberta ranges should be watched closely to observe the degree of use during a more severe winter. The proportion of annual growth utilized should be analyzed critically when more data is available to determine if it is a better indication of pronghorn use than the percent of leaders clipped.

The enclosure experiments dramatically indicated the degree to which different weather conditions effect pronghorn winter survival. In 1971-72, all pronghorns died before the sagebrush was heavily over-utilized but in 1972-73 all animals lived despite very severe browsing. The winter of 1971-72 was much more severe than the 1972-73 winter. We felt that pronghorns in the enclosure were under much more extreme conditions of exposure and stress than free ranging animals and consequently the mortality in 1971-72 within the enclosure cannot be used as a measure of natural mortality.

The suggested maximum stocking rate of 15 pronghorn days should be viewed as a very preliminary figure, and care should be taken in extrapolation this value to other geographic areas. It was shown dramatically that severe use of sagebrush on a periodic basis can exact a very heavy toll on subsequent sagebrush production and hence carrying capacity. The mean utilization of 2.45 pounds of sagebrush per day per pronghorn is likewise a very tentative value and is based partially on the assumption that leaders of equal length are of equal weight. Wesley et al (1973) suggest that a moderately active pronghorn in winter would consume approximately 2.6 pounds of native vegetation per day. They also allowed that

the consumption would increase in very cold weather. Beale and Smith (1969) reported that captive pronghorn kids on a ration consisting of free choice of big sagebrush plus 200 grams of pellets per day resulted in an average of 2.65 pounds of food ingested per animal per day.

Protein levels in sagebrush characteristically decrease from spring and reach their lowest levels in winter (Clarke and Tisdale 1945, Dirschl 1963, and Smoliak and Bezeau 1966). Based on nutrient content, however, sagebrush still provides a much higher winter protein diet than native grasses (Barrett, unpublished data) in the same area. Generally, browse is reported to provide a higher winter content of protein, phosphorus and carotene than grass (Cook and Harris 1968). The overall sagebrush protein content of 7.6 percent found in this study is probably adequate for wintering pronghorns.

The National Research Council Committee (1970) listed some of the dietary requirements for wintering mature, pregnant beef cattle as 5.9 percent protein, 0.16 percent calcium and 0.16 percent phosphorus. If pronghorn requirements are at all similar to those of beef cattle then there should be no general deficiency in protein, calcium or phosphorus. However, given winter ranges do not meet the phosphorus requirements for beef cattle and some come close to not meeting the protein requirements. Calcium does not appear to be deficient in any winter range but it's high levels may interfere with phosphorus metabolism. Calcium to phosphorus ratios should ideally fall between 1 to 2 and 2 to 1 (Dietz 1965). The high calcium to phosphorus ratios and the overall marginal phosphorus content of Alberta sagebrush may well be an important factor

to pronghorns. If as Dietz (1965) suggested, low phosphorus is a contributing factor in causing poor deer fawn production and survival then the low productively of Alberta's pronghorns should be investigated along these lines.

The mean fiber content of sagebrush was predictably high but not necessarily detrimental to pronghorns. Nagy (1969) reported that white-tailed deer can handle a high fiber diet if it is presented in a suitable form and if the other nutrients are adequate. However, the mean *in vitro* digestibility of sagebrush was high in comparison to what has been reported for native grasses collected in the water in the same area of Alberta (Smoliak and Bezeau 1966).

The selenium content of sagebrush was extremely variable and ranged from near deficient to potentially toxic levels. Massey and Martin (1972) reported that any level below 100 ppb selenium could be considered potentially deficient and levels above 5000 ppb are potentially toxic to livestock; sagebrush selenium concentrations exceeded those limits at both ends of the scale. Myopathy characteristic of selenium deficiency has been observed in a limited number of Alberta pronghorns (Chalmers and Barrett, unpbulished data) but no direct connection to selenium levels was possible.

The sulphur content of sagebrush was extremely low ($\bar{x}$ = 0.17%) in comparison to the expected range in most plant species in southern Alberta of .25 to .40 percent (Walker 1972). Sulphur is known to interfere with the uptake of selenium by plants under certain conditions (Hurd-Karrer 1938) but due to the reduced sulphur levels in sagebrush such interference would not be expected.

The higher nutrient content of sage collected below the snow may provide a form of nutritional compensation for animals during adverse conditions. It is difficult however, to interpret the relative net energy return to the animal in utilizing sage below snow; additional energy must be expended to travel in such areas and to obtain sagebrush below the snow and it may be presumed that they were selecting for higher quality forage. It is most probable that sagebrush covered with snow has a higher nutrient content because it is not exposed to intensive curing and therefore, nutrient content of below snow samples more closely resemble the pre-snow fall levels. The below snow sagebrush has a higher moisture content and a seemingly greater palatability for pronghorns. While snow in great quantities is devastating to pronghorns, we don't know as yet whether a limited amount of snow is beneficial to them on winter ranges.

LITERATURE CITED

1. BAYLESS, S. R. 1969. Winter food habits, range use, and home range of antelope in Montana. J. Wildl. Mgmt. 33: 538-551.

2. _____. 1971. Relationships between big game and sagebrush. Presented at Northwest Section, Wildlife Society, Annual Meeting, Bozeman, Montana. 14 pp. mimeo.

3. BEALE, D. M. and A. D. Smith. 1969. Big game - livestock relationships study. Antelope nutrition study. Job progress report, State of Utah, Proj. No. W-105-R-5, Job No. A-4n. 12 pp. mimeo.

4. BRUNS, E. H. 1969. A preliminary study of behavioural adaptations of wintering pronghorn antelopes. M. Sc. Thesis, University of Calgary, Calgary, Alberta, Canada. 60 pp.

5. CARSON, J. A., J. M. Crepin, and P. Nemunis - siugzdinis. 1972 A sulfate - sulfur method used to delineate the sulfur status of soils. Can. J. Soil Sci. 52: 278-281.

6. CLARKE, S. E. and E. W. Tisdale. 1945. The chemical composition of native forage plants of southern Alberta and Saskatchewan in relation to grazing practices. Canada Dept. of Agric., public No. 769, Tech. Bull. No. 54: 60 pp.

7. COLE, G. F. 1956. The pronghorn antelope, its range use and food habits in central Montana with special reference to alfalfa. Montana State College Agric. Exp. Station, Bozeman, Montana. Tech. Bull. No. 516: 62 pp.

8. _____. 1963. Range survey guide. U. S. Dept. of Interior, National Park Serv. 20 pp.

9. COOK, C. W. and L. E. Harris. 1968. Nutritive value of seasonal ranges. Utah State Univ. Agric. Exp. Station, Bull. No. 472: 55.

10. DIETZ, D. R. 1965. Deer nutrition research in range management. Proc. Thirtieth North American Wildlife Conference. p 274-285.

11. DIRSCHL, H. J. 1963. Food habits of the pronghorn in Saskatchewan. J. Wildl. Mgmt. 21: 81-93.

12. GOERING, H. K. and P. J. Van Soest. A rapid method for the determination of fiber and lignin using detergent. U. S. Dept. of Agric. Handbook No. 379.

13. HORWITZ, W. 1970. Ed. Official methods of analysis of the association of official analytical chemists. 11th Edit., Assoc. of Official Analytical Chemists, Benjamin Franklin Station, Washington, D. C. 1015 pp.

14. HURD-KARRER, A. M. 1938. Relation of sulphate to selenium absorption by plants. Amer. J. Botany 25: 666-675.

15. MARTINKA, C. J. 1967. Mortality of northern Montana pronghorns in a severe winter. J. Wildl. Mgmt. 31: 159-164.

16. MASSEY, D. L. and P. J. Martin. 1972. Selenium soil-plant-animal relationship. Alberta Dept. Agric. Information Bull. 4pp. mimeo.

17. MITCHELL, G. J. and S. Smoliak. 1971. Pronghorn antelope range characteristics and food habits in Alberta. J. Wildl. Mgmt. 35: 238-250.

18. NAGY, J. G. 1969. Effects of quality on food intake in deer. Thirty-fourth North American Wildlife Conference: 146-154.

19. NATIONAL RESEARCH COUNCIL (U.S.A.) 1970. Nutrient requirements of beef cattle. Nat. Acad. Sci., Washington, D. C.

20. PYLE, W. H. 1972. Range vegetation characteristics, fall and winter habitat utilization, food habits and behaviour of pronghorn antelope on the Piapot winter range, Piapot, Saskatchewan. M. Sc. Thesis. Univ. of Saskatchewan, Regina, Saskatchewan, Canada. 200 pp.

21. ROACH, A. G. 1965. Application of technicon auto analyzer equipment to the routine determination of calcium and phosphorus in animal feed stuffs. Proceedings of Technicon Fifth International Symposium. London, England: 137-141.

22. SMOLIAK, S. and L. M. Bezeau. 1967. Chemical composition and *in vitro* digestibility of range forage plants of the *Stipa* - *Bouteloua* prairie. Can. J. Plant Sci. 47: 161-167.

23. TROELSEN, J. E. 1970. Outline of procedure for *in vitro* digestion of forage samples. Can. Dept. of Agric: 21 pp. mimeo.

24. WALKER, D. R. 1972. Personal communication memo, Jan. 27, 1972 to G. A. Chalmers, Vet. Services Branch, Lethbridge, Alberta, Canada.

25. WESLEY, D. E., K. L. Knox, and J. G. Nagy. 1970. Energy metabolism of pronghorn antelopes. J. Wildl. Mgmt. 37: 563-573.

Table 1. Winter pronghorn distribution in relationship to habitat types in Alberta. Data for 1971-1972 and 1972-1973 winters.

Habitat Type	Pronghorns Observed	
	Percent	Total
Native Grass Prairie (N.G.P.)	23.4	4,310
N.G.P. - light *A. cana* *	14.6	2,696
N.G.P. - medium *A. cana* *	32.2	5,947
N.G.P. - dense *A. cana* *	14.9	2,740
Dry lakes and sloughs	7.6	1,415
Stubble	5.6	1,035
Summer fallow	1.4	263
Tame grass	0.3	44
Total	100	18,450

* Light <10, medium 10-25, and dense >25 plants per 200 foot intercept.

Table 2. Fall to spring use of *A. cana* on permanent browse transects. Each transect consists of 25 tagged plants.

Winter Range	1971 - 72			1972 - 73		
	No. of Transects	Leader Use Over Winter (%)	Annual Growth Utilized (%)	No. of Transects	Leader Use Over Winter (%)	Annual Growth Utilized (%)
A. Red Deer River (M)	2	28	25	3	27	18
B. South Empress	2	1	5	2	1	0
C. S. Saskatchewan River	2	27	9	3	12	7
D. Walsh Flats (M)	4	58	42	6	58	39
E. Lodge Creek (M)	2	10	7	4	33	16
F. Sage Creek (M)	4	18	15	4	19	35
G. Manyberries Creek	2	14	7	2	2	0
H. Canal Creek	2	41	13	2	3	0
I. Milk River (M)	2	55	36	3	25	12
J. Milk River Ridge	-	-	-	1	59	61
K. Grand Forks (M)	-	-	-	2	19	21
L. Lake Newell (M)	2	23	16	3	18	15
Q. Enclosure	2	53	41	2	93	84

M - Winter range annually supports 200 or more antelope.

Table 3. Comparison of nutrient content of *A. cana* collected above and below the snow.

	Percent Increase Below Snow		
Nutrient	1971-72 [a] (n=10 pairs)	1972-73 [b] (n=7 pairs)	Overall
Protein	38.0	18.2	28.4
Calcium	23.7	2.3	13.8
Phosphorus	35.7	5.6	12.5
Calcium/phos. ratio	0.58	3.7	2.0
Fiber	18.6	1.3	11.8
Sulphur (n=4 prs)	22.2		
Selenium (n=4 prs)	42.2		

a "Normal" winter, 6 - 12 inches of snow cover.

b Very open winter, little snow cover.

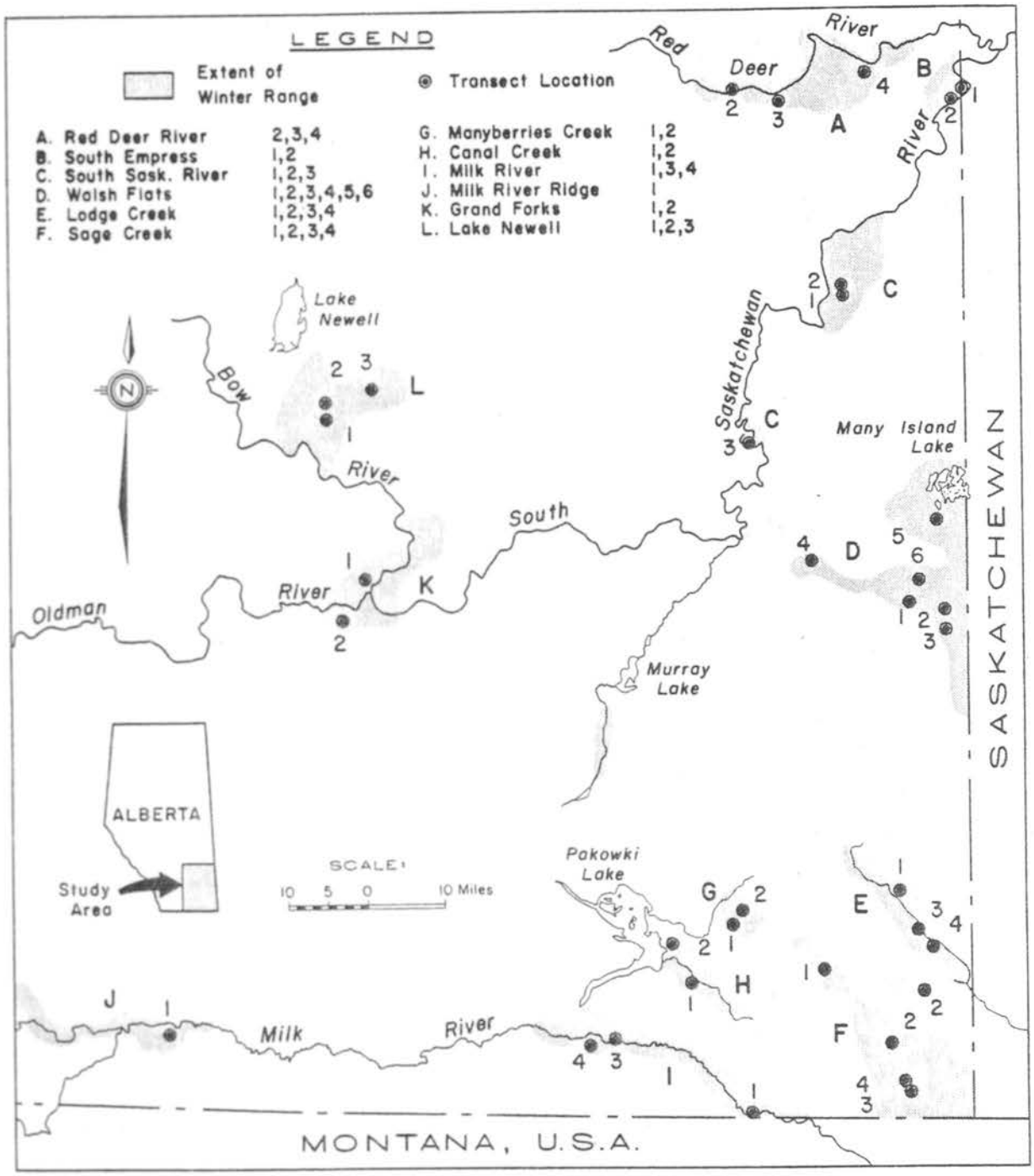

Figure 1. Known pronghorn winter ranges and location of permanent browse utilization transects in Alberta.

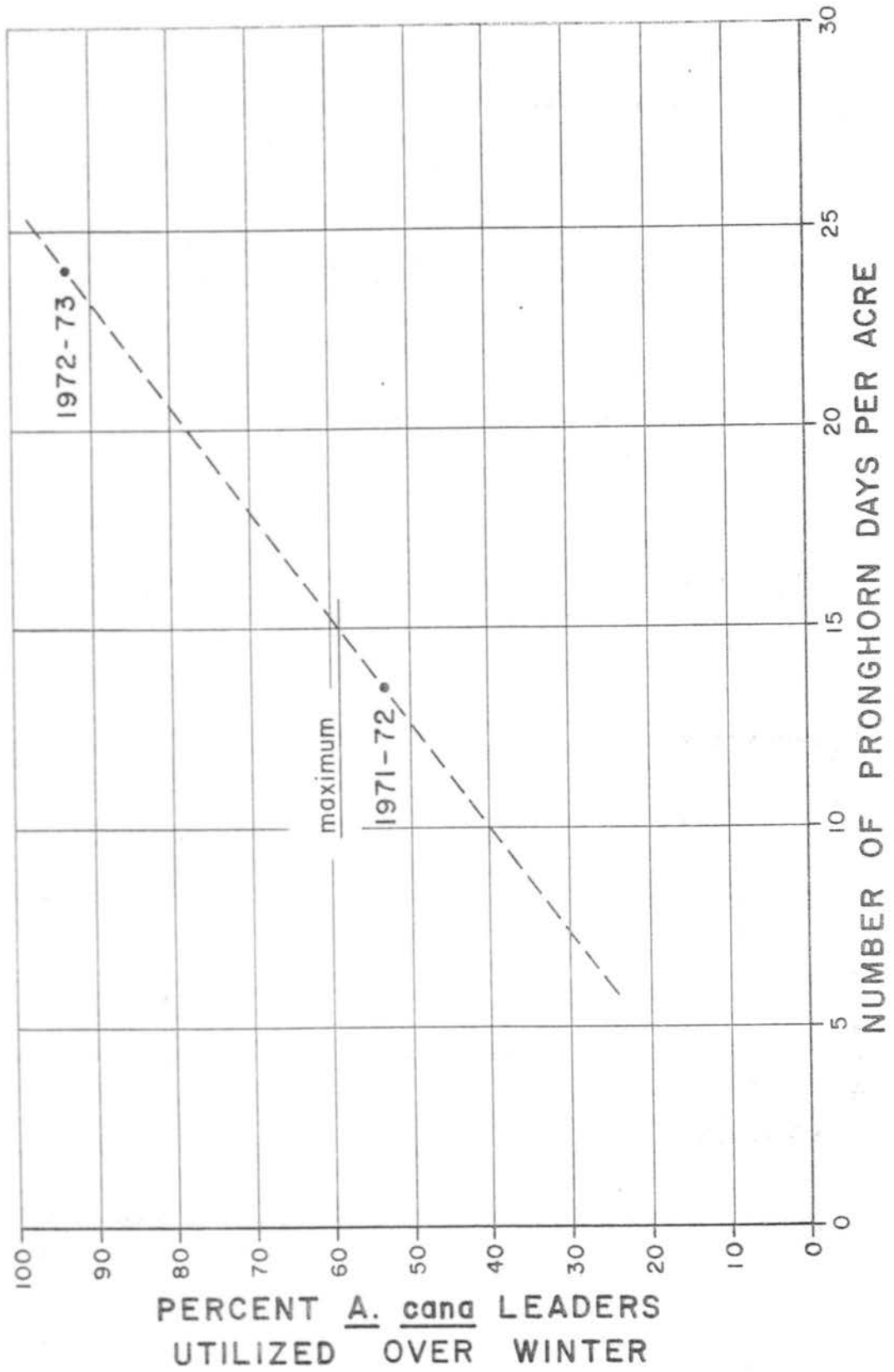

Figure 2. Relationship between pronghorn densities and utilization of browse as determined by enclosure studies.

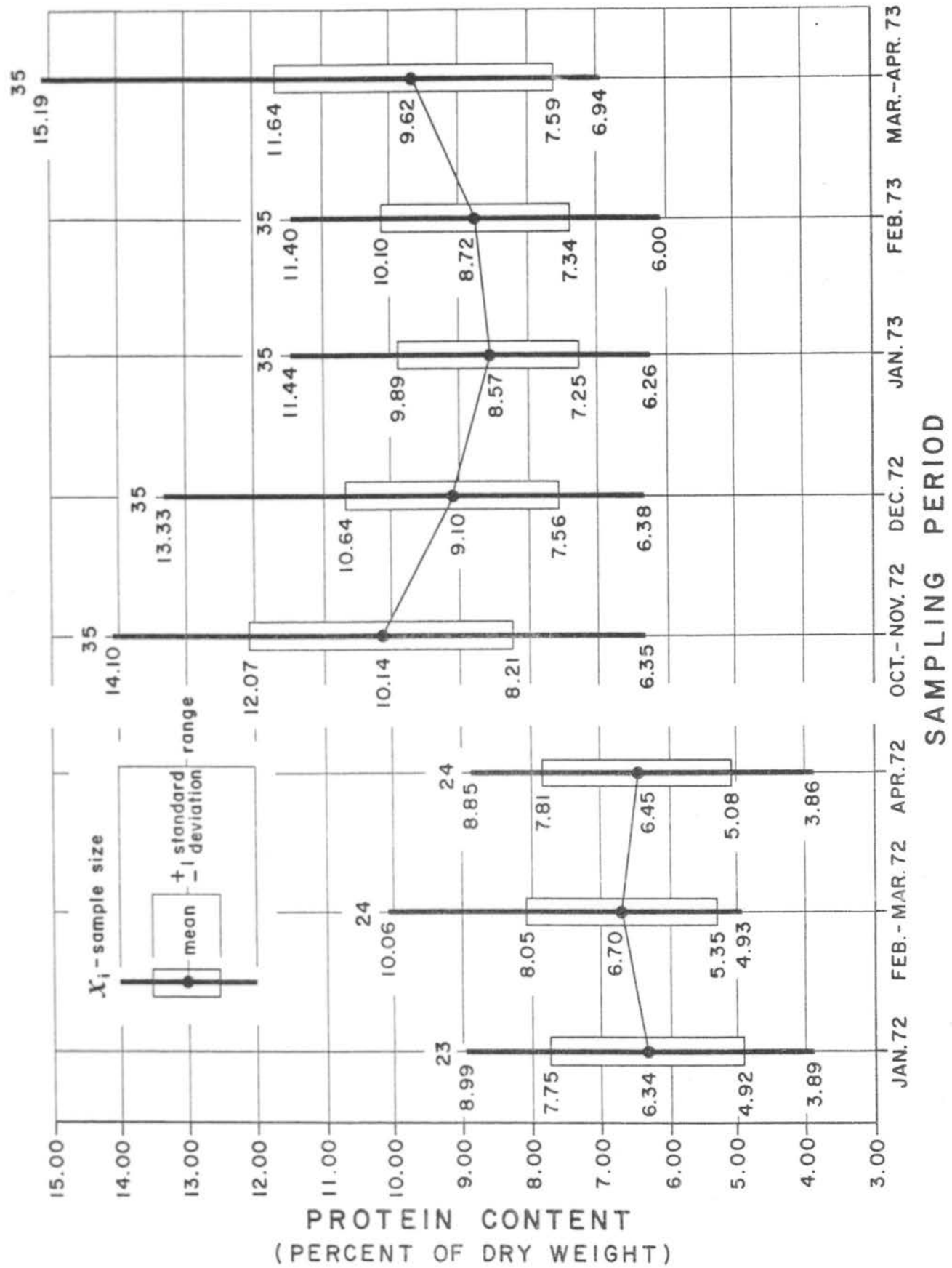

Figure 3. Seasonal variation in protein content of Artemisia cana collected from all pronghorn winter ranges in Alberta.

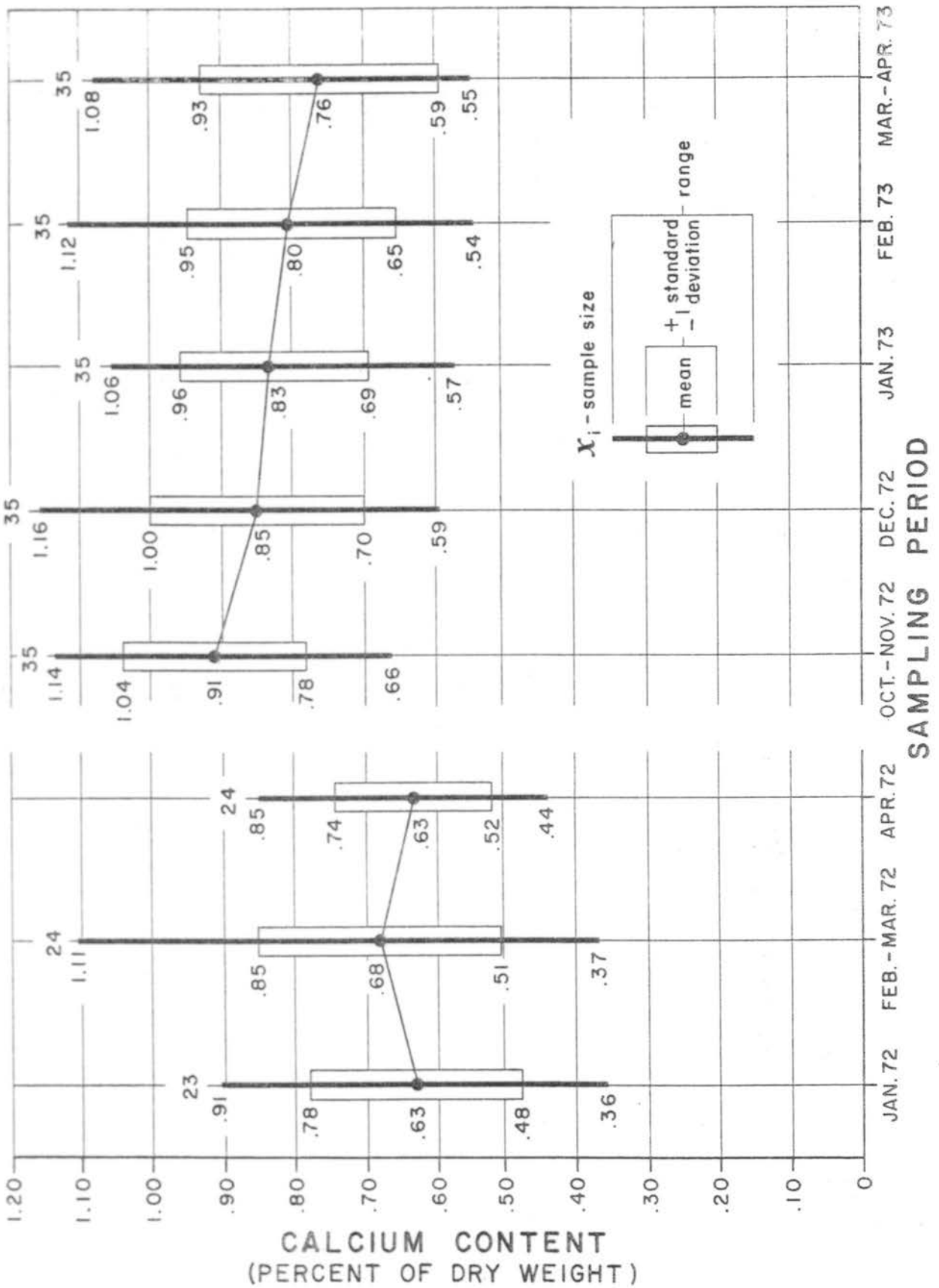

Figure 4. Seasonal variation in calcium content of Artemisia cana collected from all pronghorn winter ranges in Alberta.

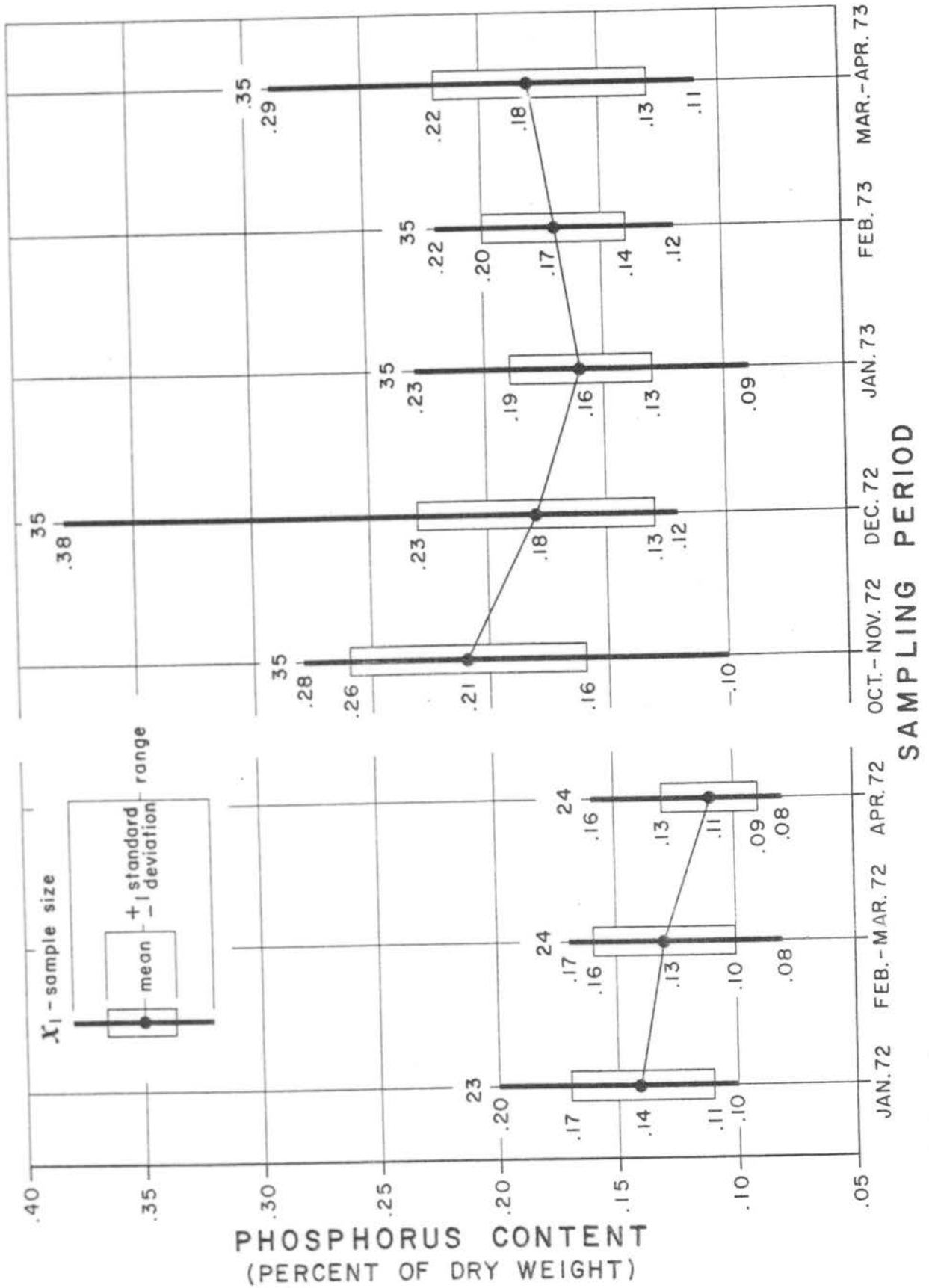

Figure 5. Seasonal variation in phosphorus content of Artemisia cana collected from all pronghorn winter ranges in Alberta.

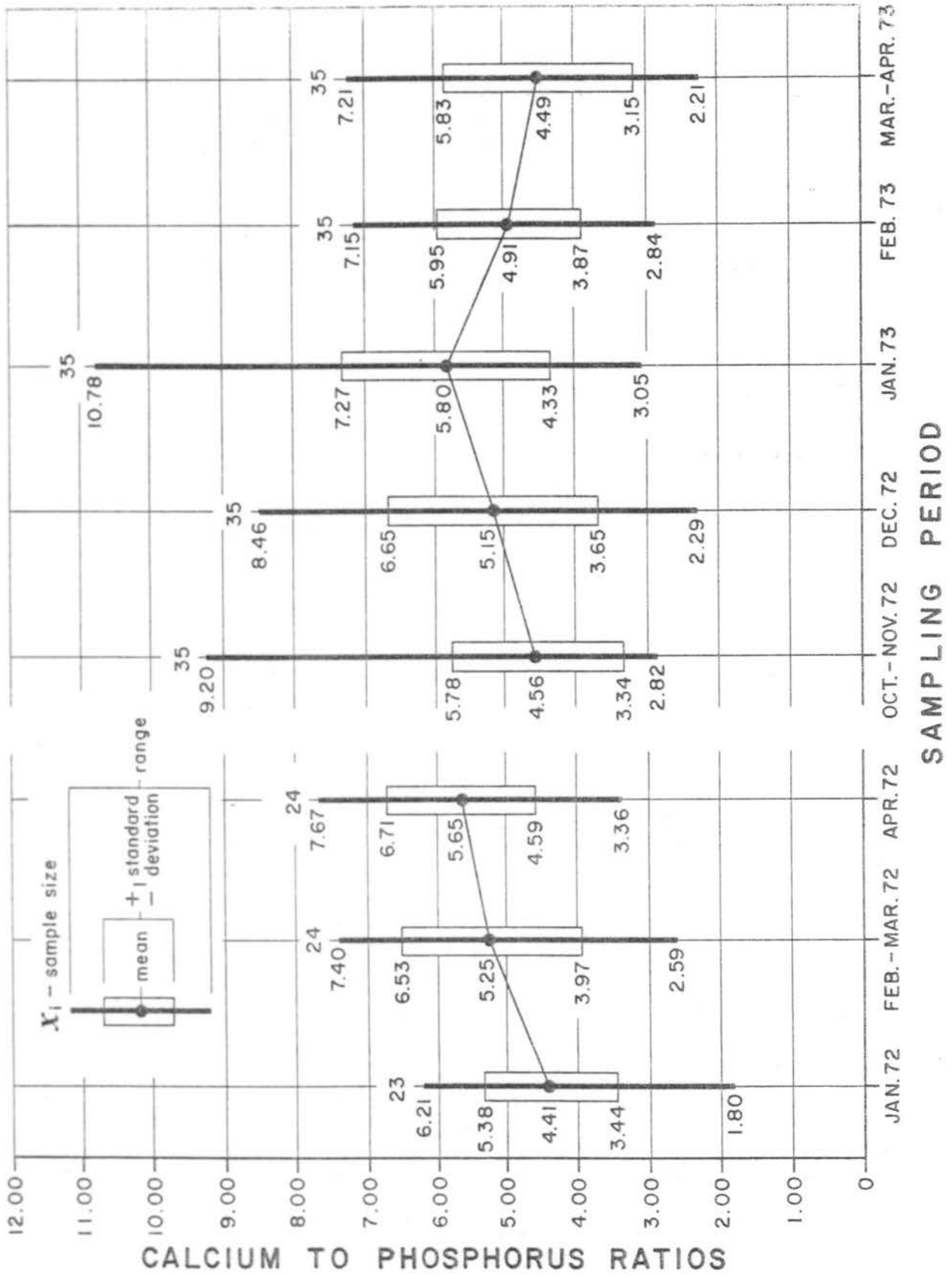

Figure 6. Seasonal variations in calcium/phosphorus ratios in Artemisia cana collected from all pronghorn winter ranges in Alberta.

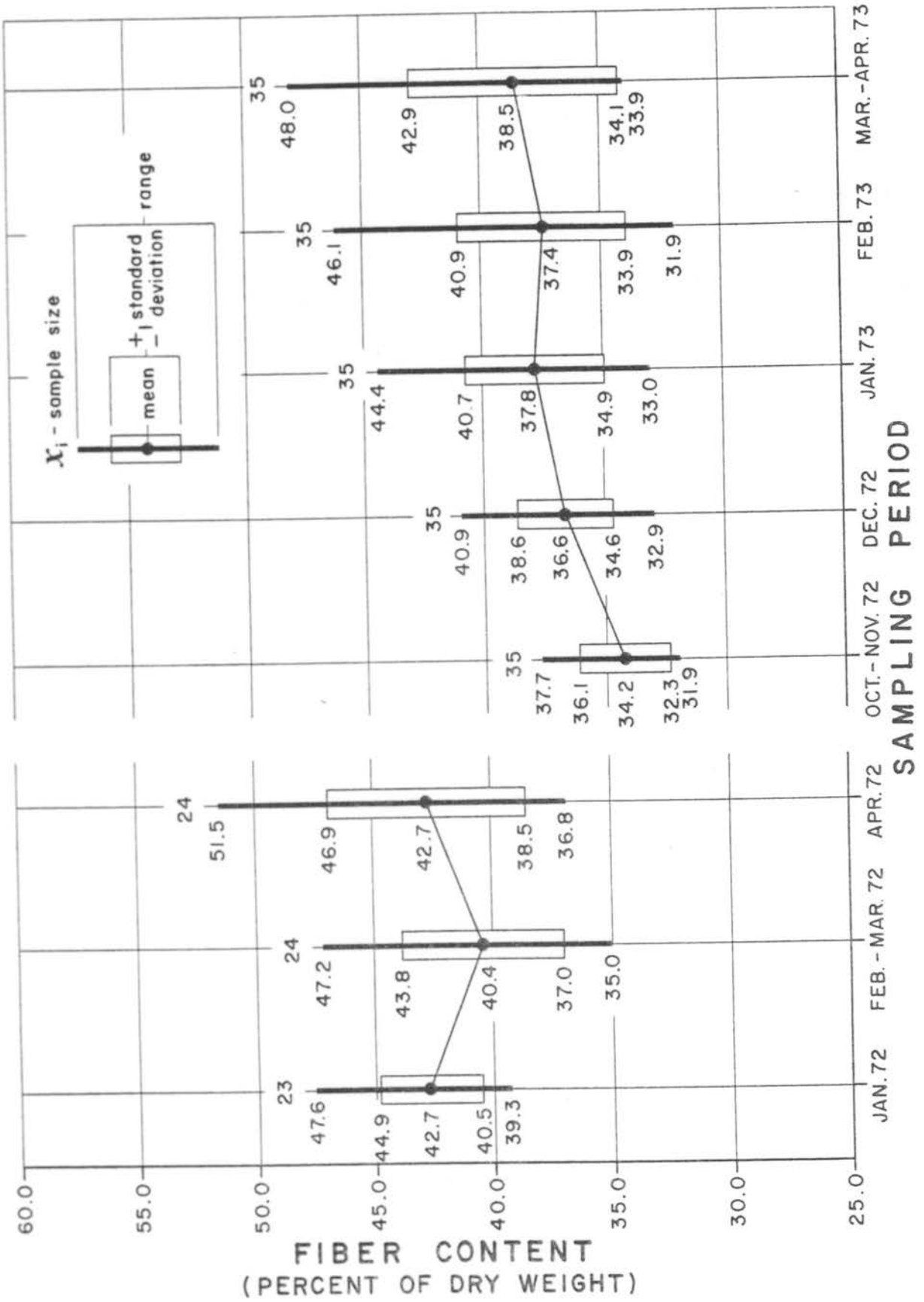

Figure 7. Seasonal variations in fiber content of Artemisia cana collected from all pronghorn winter ranges in Alberta.

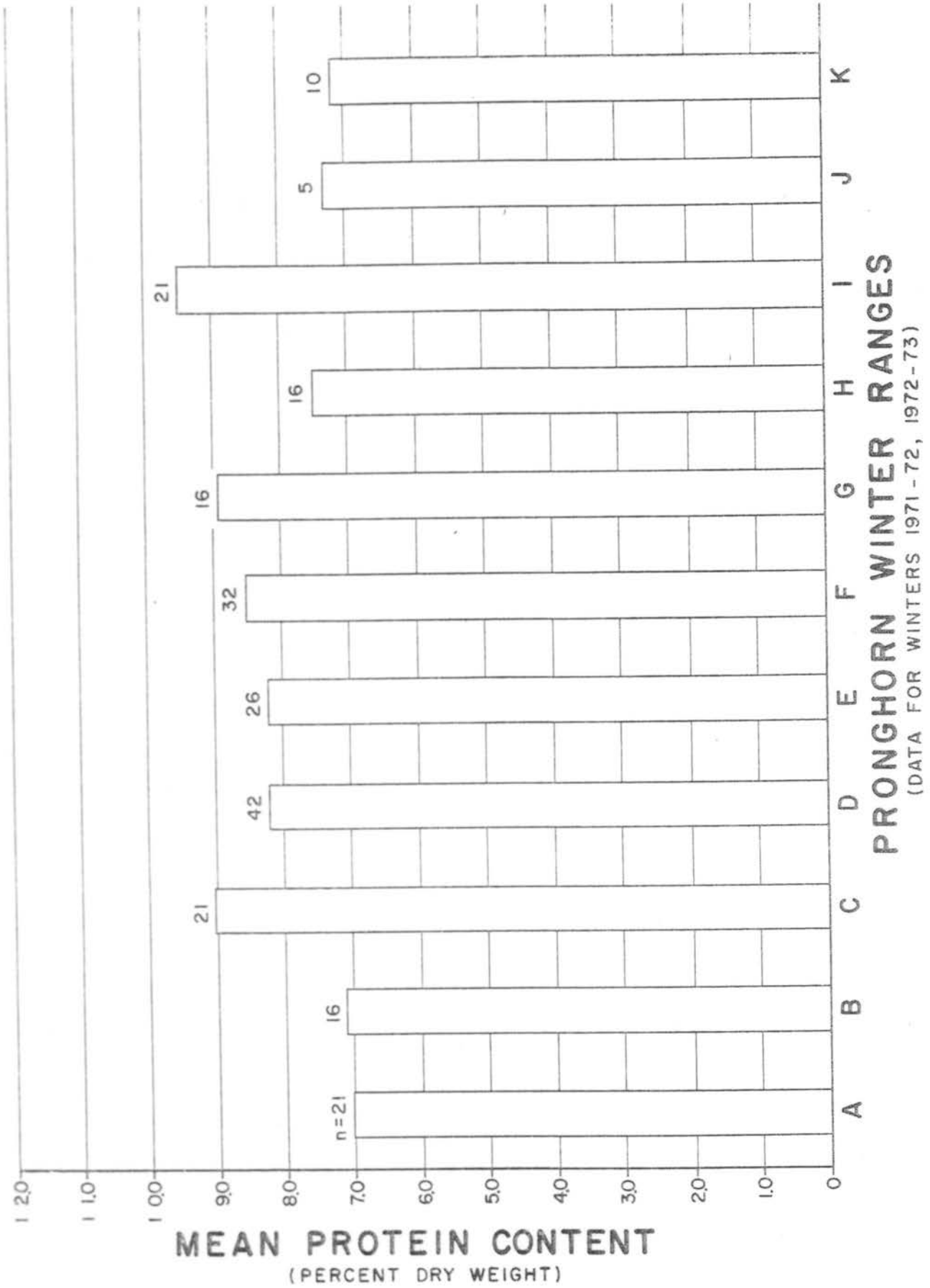

Figure 8. Variations in protein content of Artemisia cana between different winter ranges. Letters correspond to the winter ranges as outlined in Fig. 1.

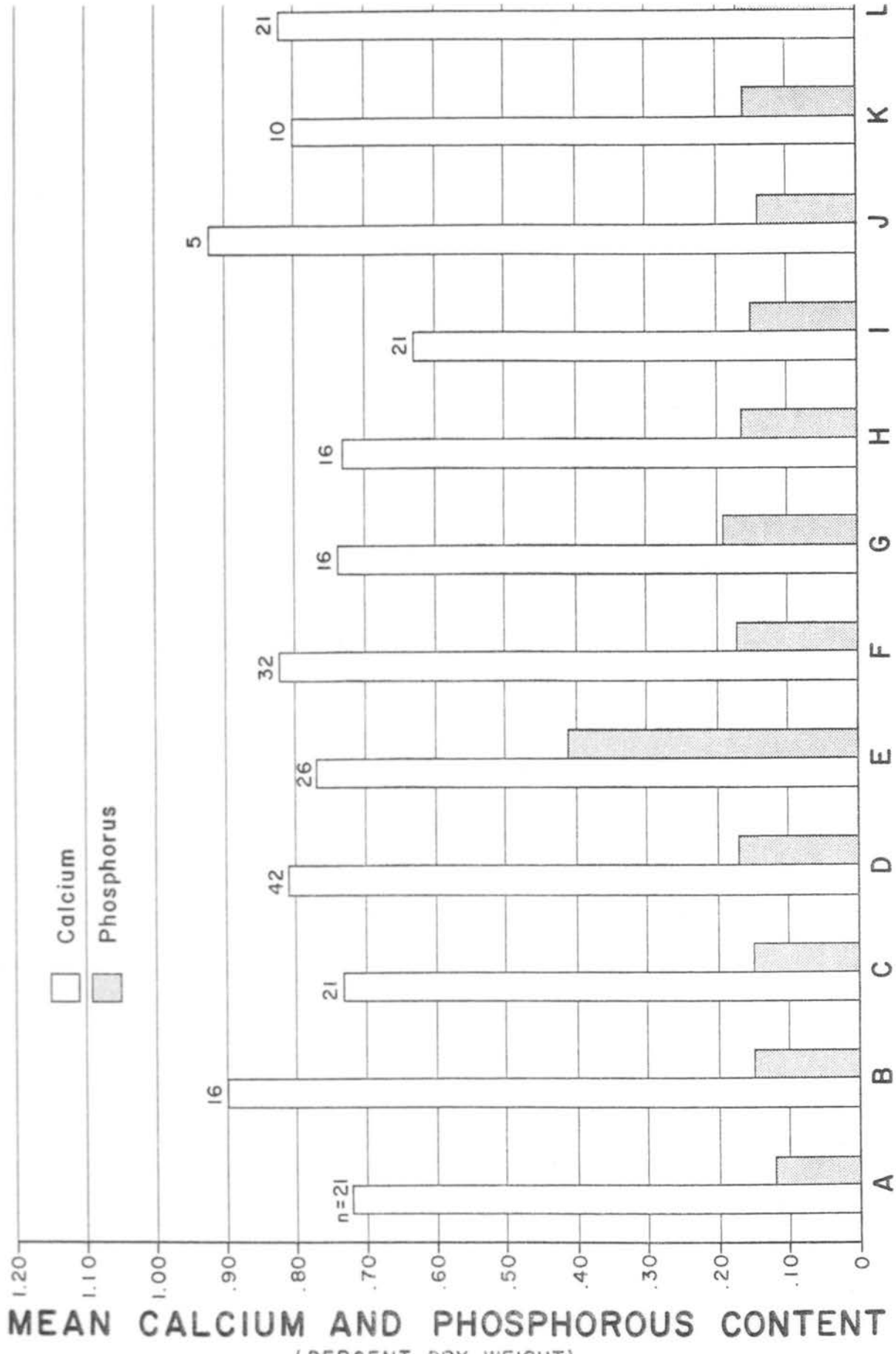

Figure 9. Variations in calcium and phosphorus content of Artemisia cana between different winter ranges. Letters correspond to the winter ranges as outlined in Fig. 1.

Pyrah: Have you been able to correlate any variations of production of and or fawn survival with the variations in nutrients?

Barrett: We have suspicions because we characteristically report a lower fawn doe ratio than are reported south of us. For instance, last year our survey of overall fawns per 100 does was 45. That's pretty darn low. We have large areas which are even lower than that. In the extreme southeast corner of the province, ratios were less than thirty fawns per 100 does last year. Now, we have not at this point in time, been able to associate nor have I tried every possible route to associate this with a particular mineral deficiency. We have run this stuff so far, and I think that's something we'll have to do, is see where it fits in.

Smith: How do you account for the difference in nutrient quality above and below snow level?

Barrett: I could say I'm a management biologist like Jim Yokem. Maybe in a year I'll be able to have an answer for you. I have a couple of hunches. I don't believe that the levels increased below snow, I believe the levels maintain themselves better below snow. They more aptly reflect fall levels--it's like putting in an ice box. Secondarily, and perhaps more importantly, I believe that they received more protection from wind and general weathering below snow, therefore, the leaf to stem ratio is greater below the snow. I am supposing that leaves have higher protein values and so on, than stems; therefore, with a greater leaf to stem ratio you would expect to have higher nutrient levels. We are analysing differential parts of plants now to see if that, in fact, does exist.

Urness: Do you contemplate fertilizing some stands to determine if you can, (one), get better protein levels in the plants; (secondly), whether the antelope prefer these plants? You are talking about a level of protein just about minimal, 7 percent.

Barrett: Yes, I think that's a good suggestion and we will be doing that. We have fertilizer on hand now and we have a six hundred acre enclosure with pronghorns, which is for this type of work. Incidently, we use small enclosures for this stocking rate stuff. We are trying to prove it out now over six hundred acre enclosures which is more realistic....but that would be an excellent possibility to check affects of fertilizer. We're doing that on elk ranges now.

Title: Use of trained pronghorn to measure natural forage consumption

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One of the most important tasks of game biologists is to provide adequate food containing all the nutrient and energy requirements for wild animals. Because nutrients must come from natural vegetation, habitat manipulations constitute an important phase of wildlife management. An important task, however, before we can improve natural vegetation for a particular animal species, is to accumulate knowledge on food habits of the animal. We must know which plants are available during different seasons, which plants and plant parts are selected by the animal and the nutritive and energy content of ingested foods.

The importance of gathering information on food habits of wild animals has been recognized long ago. For ruminants basically four methods have been used:

(1) Exclosures

(2) Fecal content analysis

(3) Observation of wild animals from a distance

(4) Killing the animal and analyzing the rumen contents for recognizable plant fragments

Although all of these methods supply some sound information they also have several disadvantages and limitations. Excluding animals from an area can be used successfully only when enough animal pressure is present and when only the studied animal species is grazing the area surrounding the exclosure. Fecal

content analysis (Martin and Korschgen, 1963) can give us information on some major plant species eaten but the method is subject to serious problems when food items (plants) are quantified. When observing animals from a distance (Smith et al., 1959; Rippert, 1960) misidentification of the food item can occur frequently especially if the animal is foraging in mixed vegetation where plants of many different sizes and species occur. The practice of walking in after the observation period and closely examining the grazed area for eaten vegetation can be misleading when grazed plants are completely eaten. To obtain reliable data on rumen content analysis, many animals must be collected throughout the year. This practice many times is not feasible particularly if the studied species is rare. Also, rumen content analysis has been shown to favor plants or plant parts which are digested or passed through the rumen slowly. In addition, neither method supplies accurate information on the nutritive value of the food.

The use of tame and trained animals overcomes the difficulties and limitations of the above methods and opens up many possible avenues to study wild animals. Within the framework of the International Biological Program, Shortgrass Biome Study (Pawnee Site, Colo., U. S. A.) we have used trained pronghorn antelope (Antilocapra americana) for a variety of tasks. We have invetigated metabolic rates of growing and adult pronghorn, critical temperatures, and social and grazing behaviors including food habits. Since the animals are completely at east with humans, they can be followed and observed without the slightest disturbance and distraction. All plant and plant parts eaten can be identified, their relative proportion in the diet calculated and the similar plant parts collected shortly after the observation period. Thus, data can be obtained on chemical contents of the diet. Special requirements related to age and sex can also be investigated. About the only disadvantage of the method is the high cost of training and caring for animals and acquiring dependable and knowledgeable personnel.

One of the major prerequisites for use of this method is that the animals must be completely tame, trained, and dependable. Our training program started with animals less than three days old. We tryed to collect pronghorn fawns only after they had nursed their wild dam several times. This hopefully enabled fawns to acquire some natural resistance to certain infectious diseases from antibodies present in the dam's colostrum. Fawns were bottle fed four times a day for the first month and less frequently thereafter. After a few days of feeding and acclimatization animals were bottle fed in a vehicle suited to transport them to the field.

When a few weeks old and imprinted to the presence of humans, animals were regularly transported to the field. Upon release, young pronghorn ran and played for approximately 30 minutes and then regathered in the proximity of their caretaker for feeding. After a few hours of exercise and feeding the caretaker slowly lead the animals back to the vehicle where they were bottle fed milk at the early ages and concentrate food later. When older our animals receive an ad libitum diet of concentrate and alfalfa hay. Bottle feeding was continued as long as animals continued to take milk; around five or six months of age the milk often served as a source of reassurance more than as actual nourishment.

There is considerable variation in temperament of pronghorn antelope and not all of them are equally suited for later trials. For this reason, we started with 12-14 animals. Due to losses including fatal illnesses, injuries and accidents, only 6-8 of these animals were usable for experiments as adults.

In preparation for actual dietary studies, we investigated several methods. One method involved transporting two animals daily to predetermined release points in a 400 ha. area. We observed these animals grazing in the morning and in evening for two hours, then transported them back to their permanent quarters.

The advantage of this method is that animals can be transported to any suitable area, and their reactions to different plant communities can be studied. The major disadvantage is that only very dependable animals can be used. A second method invetigated was to keep animals in a sheltered small enclosure overnight and release them during the day in a fence enclosed area (300 ha.). We found that if animals are adequately imprinted to the presence of humans there is no problem walking with or observing them while grazing from a close distance even if they are continuously in the field.

In preliminary trials our data indicated that antelope graze intensively for 1.5 hours in the morning and in the afternoon. We divided each 1.5 hr. into two equal observation periods. In a predetermined manner, two observers collected data for the first 45 minutes on two animals, then switched to a second set of animals for the second 45 minute period. The same procedure with new animal sets was followed in the afternoon (Table 1). In this manner, each animal pair was observed at different times during a trial period. The two observers equipped with portable tape recorders recorded plant species and plant parts eaten, plus number of bites consumed. A bite consisted of each discrete removal of a plant or plant part. After each grazing period adequate "bites" were collected by the observers from the same area where animals were grazing. These "bites" simulating the actual intake of animals were combined and their dry weight determined. These hand plucked samples can be used to estimate intake by wieght and to determine the nutritive content of the diet.

Obviously when using tame animals to obtain food habits data, two main questions must be answered before one can rely on the collected data. Since tame animals must often receive some additional concentrate food, especially during winter, and/or they must be enclosed for safety reasons overnight, it is necessary to evaluate these added variables on food selection. In addition, and ultimately the most important question, was to determine how closely diets

of tame animals compare with those of their wild counterpart.

To investigate the first question we divided nine animals in three groups during summer when many plants were available. Group 1 stayed in the diet pasture day and night. Group 2 and Group 3 were led back to the corral in the evening and spent the night there. Group 2 received no additional food while Group 3 received ad libitum concentrate. For three consecutive days randomly chosen animals were observed in the morning for 30 minute intervals and their food habits recorded.

Statistical analysis of data indicated that there were no significant differences ($P < 0.05$) between plant species preferences for pronghorn grazing freely for 24 hours (Group 1) and those restricted only to daytime grazing (Group 2). Data also indicated a non-significant difference ($P < 0.05$) between animals on ad libitum feed (Group 3) and those receiving no concentrate (Group 2). An effect of ad libitum feeding, however, on animal behavior was noticeable. Animals receiving concentrate were more playful, grazed considerably less and were harder to manage and observe. The total number of bites taken during the day was considerably less for animals on the concentrate diet than for those not receiving supplement (Table 2). Number of bites recorded per day were less in the free grazing group than in those enclosed overnight. Upon release the latter group grazed more intensively than those animals which were kept on the pasture for 24 hours. Our data indicate that when necessary, animals could be closed in overnight and that some supplemental food could be given to them greatly influencing their dietary preferences. From the standpoint of data collection ad libitum feeding is not desirable and supplemental feeding, if necessary, must be kept at a very low level.

To compare the diet of tame animals with that of their wild counterparts we collected fecal samples from our animals and from different wild antelope

herds grazing on the short grass prairie close to our study area. Remains of plant species in fecal contents were identified using the microtechnique method of identification (Baumgartner and Martin, 1938; Sparks and Malacheck, 1968; Hansen et al., 1971). One should realize that this method will not give reliable quantitative data on dietary intake but positive identification of many plant fragments of the same species in the feces suggests that the plants were consumed and that they probably constitute an important portion of the diet.

Results indicated considerable variation among individual animals from different herds. Some of the plants, e.g., fringed sagewort (Artemisia frigida), blue grama (Bouteloua gracilis), and scarlet globmalow (Spaeralcae coccinea) which seasonally occurred as every day food items in the diet of the tame animals occurred with high frequency in the fecal samples of wild animals. All of the plant species which were known to occur in the diet of tame animals showed up in the feces of wild animals but not necessarily in the same proportions. It seems that individual day by day preferences for certain plant species, availability and relative abundance of a species, and the abundance of other seasonally preferred species at a given locality are more important in determining the diet of the individual pronghorn (or group of pronghorns) than tame or wild status.

Results of our studies indicate that pronghorns will consume, depending on the season, 30-70 plant species during their feeding activity at the Pawnee Site. The proportion of these plants in the diet varied according to season and phenological stages of the plants (Table 3). For example, blue grama (Bouteloua gracilis) and fringed sagewort (Artemisia frigida) are consumed during late winter or early spring. Scarlet globemallow (Sphaeralcea coccinea) and greenthread (Thelesperma filifolium) which grow throughout the summer were

important during this season. Toward late summer when most plants were at an advanced phenological stage, besides scarlet globemallow and blue grama, Russian thistle (Salsola kali), an actively growing forb, was consumed in large quantities. Shrubs and shrublike species gained importance throughout fall and winter, although the abundance of these species at the Pawnee Site was generally low (Figure 1).

Our results indicate that pronghorn antelope prefer a variety of plant species throughout the year. Their selection depends mainly on the phenological stage of the species. Large variations exist in the amount of a plant eaten by individual animals at a given time. Daily, seasonal and yearly variations in plant preferences do exist using the same pasture and the same animals.

In conclusion we feel that tame animals can provide reliable data on the feeding behavior of wild animals. Besides pronghorn we have been using mule deer (Odocoileus hemionus) for several years for the same purposes and found this species equally suited for field studies. We believe therefore, that other wild animals could be studied with this method. The bite count method is well suited and accurate for animals which select their bites carefully and which take only one plant species at a time. Accuracy of the method will suffer in case of animals, e.g., cattle, which consume occasionally more than one species for a bite.

There are many extrinsic and intrinsic factors which will influence food selection and especially composition of plants in the diet of an animal at a given time and location. Such factors are individual animal variation in plant preference, plant abundance, availability and combination of plant species. Environmental factors such as seasonal moisture distribution, temperature changes, etc., could influence seasonal preferences from one year to another. For these reasons seasonal plant preferences should be replicated over the years and factors influencing plant preferences carefully studied.

LITERATURE CITED

Baumgartner, L. L. and A. C. Martin. 1939. Plant histology as an aid in squirrel food-habit studies. J. Wildl. Mgmt. 3:266.

Hansen, R. M., A. S. Moir and S. R. Woodmansee. 1971. Drawnings of tissues of plants found in herbivore diets and in the litter of grasslands. Tech. Rept. No. 70. Int. Biol. Progr. Grassland Biome. Fort Collins, Colo.

Martin, A. C. and L. J. Korschgen. 1963. Food habits procedures. In: Wildlife investigational techniques. The Wildl. Soc., Washington, D. C. pp. 320-333.

Reppert, J. N. 1960. Forage preferences and grazing habits of cattle at the Eastern Colorado Range Station. J. Range Mgmt. 13:58.

Smith, E. F., V. A. Young, L. A. Holland and H. C. Freyer. 1959. A comparison of two grass sampling methods for digestibility trials conducted on pasture. J. Range Mgmt. 12:306.

Sparks, D. R. and J. C. Malacheck. 1968. Estimation percentage dry weight in diets using a microscopic technique. J. Range Mgmt. 21:264.

Table 1. Animal observation sequence for dietary studies with pronghorn.

	Day			
	1	2	3	4
Morning				
1st period	Set A	Set D	Set C	Set B
2nd period	Set B	Set A	Set D	Set C
Afternoon				
1st period	Set C	Set B	Set A	Set D
2nd period	Set D	Set C	Set B	Set A

Table 2. Effects of different feeding and handling of antelope on forage intake.

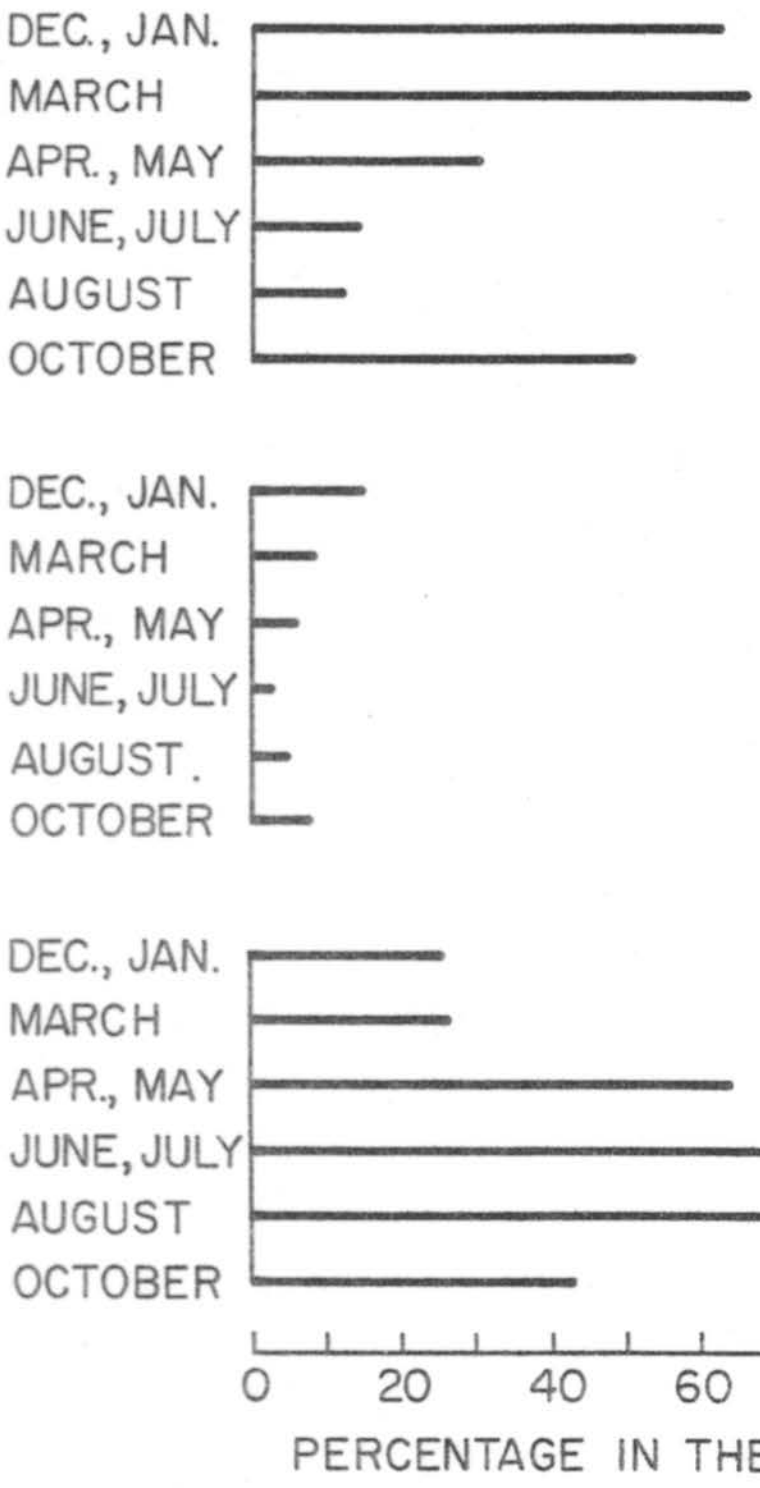
	Average number of bites per animal per day		
Treatment:	24 hr. grazing	Daytime grazing	Daytime grazing plus *ad libitum* concentrate
Average number of bites	1,150	1,610	986

Table 3. Plant species consumed by pronghorn and constituting seasonally over 10 percent of total bites.

Winter (Oct., Nov., Dec., Jan., Feb.)	Spring (March, April)	Summer (May, June, July)	Late Summer (August, Sept.)
Artemisia frigida (Fringed sagewort)	Agropyron smithii (Western wheatgrass)	Bouteloua gracilis (Blue grama)	Bouteloua gracilis (Blue grama)
Bouteloua gracilis (Blue grama)	Artemisia frigida (Fringed sagewort)	Erigonum effusum (Spreading wild buckwheat)	Salsola kali (Tumbling Russian thistle)
Bromus tectorum (Cheatgrass brome)	Bouteloua gracilis (Blue grama)	Plantago pursii (Wooly indianwheat)	Spaeralcea coccinea (Scarlet globemallow)
Eriogonum effusum (Spreading wild buckwheat)	Carex heliophila (Sun sedge)	Sphaeralcea coccinia (Scarlet globemallow)	Sophora sericea (Silky sophora)
Sphaeralcea coccinea (Scarlet globemallow)	Cymopterus acaulis (Stemless spreading parsley)	Thelesperma filifolium (Greenthread)	Thelesperma filifolium (Greenthread)
	Heterotheca villosa (Hairy goldaster)	Tradescantia occidentalis (Prairie speiderwort)	
	Sphaeralcea coccinea (Scarlet globemallow)		

Figure 1.

SEASONAL PERCENTAGE DISTRIBUTION OF GRASSES, SHRUBS AND FORBS IN THE DIET OF TAME ANTELOPE



MAJOR SPECIES

Grasses: Agropyron smithii, Boutelaua gracilis, Bramus tectorum, Buchloe dactyloides

Sedge: Carex cleocharis

Shrubs: Artemisia frigida, Chrysothamnus nauseosus Eriogonum effusum

Forbs: Cymopterus acaulis, Plantago pursii, Oenothera spp, Salsole kali, Sphaeralcea coccinea, Thelesperma filifolium

Smith: How do you go from observing what they eat to quantitative representation?

Schwartz: O.K. There's two ways that we look at this. We patterned our method after investigations done with deer. It is called a bite count and what we did in our field studies was to carry a portable tape recorder when following the antelope. Every time they took an individual bite of a plant species we recorded it on tape, and a bite consisted of an animal putting it's mouth over a plant or portion of it and plucking it off with it's teeth. And in most cases it was a very distinct bite. O.K., we'd observe these animals for one observation period for a day and after that time, when they're eating a certain species you can get a pretty good idea of how much they are taking with each bite. Granted, all bites are not exactly the same but they have a relative proportion. We would go out then and collect what we felt was a 100 bite estimate by weight of their consumption for each species and then we could quantitate on the total number of bites taken, plus we could quantitate on grams consumed by the bite weight estimate. This is how we did it.

Beale: How did this data you obtained from the bite count compare with information obtained from fecal analysis?

Schwartz: O.K. You mean the fecal analysis of my tame animals as opposed to the bite count analysis of my tame animals.

Beale: Yes.

Schwartz: O.K. I couldn't do this with the particular study that I was doing and quantify it because I was shifting my tame animals from a lightly grazed pasture to a heavily grazed pasture back to a lightly grazed pasture. They did not have free choice of all plant species at any one time, so if I happened to pick up a fecal group one day, I did not know whether that fecal group represented forage consumed in a lightly grazed pasture or a heavy grazed pasture. I couldn't quatify, so I don't know, but in other studies that we did we would take pure samples of individual species and grind them. We would then take known weighed amounts of each species and mix them in different proportions in a vial, send them to a lab for analysis and see what they came up with and use this as a quality control. There were instances, and it was not uncommon to have instances, where their percentage of what was in our sample was not what we had weighed into it. There were instances where they would have species occurring in our fecal samples that did not occur in the pasture we were grazing.

Beale: And how did they compare there?

Schwartz: They were not statistically different. The variations between different samples from wild animals was great. In other words, if I collect 15 fecal groups and just take one species like blue gramma, the variation and the percent of blue gramma that occurs in those 15 fecal groups is much greater than between those 15 fecal groups than it is between my wild and tame antelope.

Durfee: I was wondering during the winter months, December and January, what was the snow conditions?

Schwartz: In the area that I was working in, there is very little winter snowfall. During the two winters that I worked, let me put it that way, there was very little winter snowfall, there was about 6 inches of snow on the ground, our animals in all cases but one ate plant species that were sticking out of the snow. We had one animal that would go around and paw the snow, dig down and eat plants near the ground, but all the rest of the animals just went along and just nipped plants species that were sticking up out of the snow. The snow lasted two days and it was gone, so we don't have the snow problem in this area for long periods of time like they do in Canada.

Zobell: Have you tried them on any sagebrush or other brush species at all--the trained antelope?

Schwartz: The only sagebrush species that occur was Artimesia frigida, fringe sage, which is really not a true brush species--it's more of a fleshy type sage. They did consume it; they did not consume large quantities. Our antelope did not consume large quantities of brush at all. Now we had a difference, we had a diet pasture that was heavily grazed and most of the preferred forbs and grasses were removed from this area by cattle and sheep grazing; in this area we had higher use of browse by our antelope and I suspect that it's a fact that their preferred plants weren't there, they had to eat something so they had to eat browse, but we did not take them to a sagebrush community and graze them.

Barrett: Could you mention what you found in consumption per antelope per day and if you were able to monitor changes in diet?

Schwartz: I don't have consumption by animal by day, in other words, I have just estimates of the botanical composition of the diet total. Dietary intake or partitioning of energy through the animals was another project which was done by David Wesley and I think it's published in the Journal of Wildlife Management. Wesley was on the same project, used the same animals as a matter of fact, he just partitioned energy flow through these animals, but it was not wild foods. It was commercially prepared rations, but it's the best we had.

Yoakum: Was your study during the four seasons of the year?

Schwartz: Well it was not necessarily the four seasons. We tried to select our grazing periods to correspond to changes in plant growth. In other words, we wanted to hit the dormant season during the winter, we wanted to hit the early green-up during spring, we wanted to hit the growing season during June and July and we wanted to hit the dry-up season during August and then go back to an October sampling. This is the way we set it up. Now we kind of had to fit it into when the plants started to grow and this depended on rainfall and temperature warm up and so on, but we tried to hit through all the seasons of plant phenology so that as these plants changed in chemical composition and structure and so on, we could see how our animals reacted to them.

Yoakum: I'd like to make a comment, and I'd like to call this, in particular, to Art's attention. That is that prior to this study, I believe there was only one other comprehensive study of antelope food habits on a short grassland range. This was accomplished in New Mexico and in that particular food habit study they showed that forbs was the highest used forage class on a year long basis all four seasons of the year. In general, if you took overall food habits studies on antelope, you would find few of them on a grassland community as opposed to a sagebrush-grassland situation. This is a major factor in total analyzation. I am convinced that the reason that more isn't known about antelope food habits on a grassland is that no comprehensive study has been done before and this wasn't available prior to this extensive piece of work as well as one in New Mexico, and actually, if you go back to historical data you would find that the majority of the antelope lived on the short grassland as opposed to the sagebrush grassland.

Compton: Perhaps I missed this, but do you have compositions percent on the range--I mean occurrance on the ranges.

Schwartz: Yes I do. Yes, in conjunction with this, they did estimates of the available biomass to the animals during the seasons that we sampled; they are based on kilograms per hector, or grams per meter squared, however you want to put it, and we can come up with preference or selectivity indices for individual plant species. A good example is a prickly pear (opuntia), very common and makes up a very large percentage of the biomass of the plants that occur in the short grass prairie. We had absolutely no utilization at all, the only time we got an antelope to eat it is when they found a dried pad that was black and they chewed on it and then spit it out; but they made no attempt to use it at all. On the other hand, we had species that were rare; animals would actually select for these species. One thing I might

mention on this too, quickly, is that we could tell not only what plant the animals were eating, we could get an indication of what plant part they were eating. There were certain species that during certain times of the year they preferred the leaves. During certain times of the year they preferred the flower and so on, so when we do a fecal analysis or rumen content analysis or something like this, you could tell what they were eating but you couldn't necessarily tell what part of the plant it was eating, so this is another advantage to the method.

Production and Survival of Pronghorn Antelope on Artifical Diets with Different Protein Levels. [1/]

Arthur D. Smith, Professor Emeritus
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Introduction

Although antelope are widely distributed in Utah, partly in consequence of introductions, populations and productivity are commonly low. Historical accounts indicate there were much higher populations than at present and neighboring states have experienced similar histories. In Utah, fawn production in antelope fluctuates widely from year to year.

One of the hypotheses advanced for fluctuating production and low populations is inadequate supplies of suitable forage. Another is that the forage available is inadequate nutritionally. In an attempt to establish some nutritional parameters, a herd of antelope does was confined and fed diets of known composition. Measures of the effect of the different diets were animal weights, fawn production, and survival of fawns.

Procedures

In 1969 a herd of 12 antelope does were confined to three, 4-acre paddocks, near Logan, Utah, and fed on pellets formulated from common livestock foods. The pellets were calculated to be iso-caloric, but with three levels of crude protein. The antelope used had been fed on pellets of a similar sort prior to the beginning of the experiment and were thus acclimated to pellets.

[1/] Research conducted by Utah State University, Department of Range Science and Utah State Division of Wildlife Resources and Federal Aid in Wildlife Restoration, Utah Project W-105-R, Job A4N.

Pellets contained 50 percent meadow hay, 10 percent alfalfa, 10 percent potato starch, and 5 percent dried molasses. Foods used to achieve different levels of crude protein and maintain iso-caloric diets were ground corn, soybean meal, and wheat straw. These were varied to attain the desired nutritional mix. There was 16.5 percent corn in the low-protein diet and none in the high-protein feed. Soybean meal made up 2.5 and 22.2 percent of the low and high-protein diets, respectively. Vitamin A and dicalcium phosphate were added in equal amounts to all mixes to insure adequate vitamins and minerals.

The twelve does available at the outset were divided into 3 lots of 4 animals each. Pellets were weighed and fed three times a week, and uneaten pellets were collected and weighed. Sufficient quantities were offered that food was available at all times. Water was available, and the paddocks were sterilized with simazine at the outset of the experiment and cultivated in subsequent years to eliminate vegetation, with incomplete success.

Each fall, buck antelope were introduced into the herds for about two months and then removed. At that time all animals were trapped and weighed, and fawns were removed from the doe herds and taken to smaller pens where they were continued on the same level of protein as their mothers. Any female yearlings available at the time bucks were placed with the herd were caught, weighed, and assigned to one of the three lots of does.

At fawning time the herds were monitored closely in the mornings and evenings. Fawns were caught within a few hours of birth, weighed,

the sex determined, and a numbered plastic tag affixed to their necks by means of an elastic band. This could be read with the aid of a spotting scope. Thus, daily surveillance was possible. When a particular fawn was not observed on any day, a search was made of the paddocks so that in the event of death the carcass could be examined to determine the cause.

Tests were begun in 1969 and continued until the fall of 1972, encompassing three fawn crops.

Findings

Plans were to feed three levels of protein, 7, 11 and 15 percent to represent low, medium, and high, respectively. This was modified to 8, 12 and 14 when a nutrient-balance sheet was completed. In actuality none of the pellets formulated conformed precisely to these intended levels. Mixed pellets were invariably higher in protein than chemical analyses of the separate foodstuffs indicated in most instances as shown:

	Range %	Mean %
Low protein	7.8 - 11.9	9.9
Medium protein	9.4 - 12.5	11.0
High protein	14.1 - 19.4	16.1

At the outset, preliminary tests were made to ascertain the acceptability of the pellets. All three levels of pellet were first offered to the three lots of antelope. Based on consumption in all three pens, pellets were preferred in this order, low, high and medium, although in one pen the consumption of high-protein pellets was least.

The animals in this pen ate less during this period than either of the other lots.

Following this, one level of protein was fed at a time and rations were rotated until each pen had access to each of the three protein levels for a period of 10 days. Consumption of the low-protein pellet was slightly greater than for the other two, and again the preference was low, high, and medium. Consumption was much greater during these feeding trials than in the former one, and the differences among pellets and pens was much less. The differences were not significant.

Food Consumption. Because of our inability to weigh animals at will, and other constraints, consumption data for the doe herds were computed for three periods: breeding period when bucks and, except for 1969, fawns were present; winter gestation period; and lactation period until fawns were weaned. Because of variations in fawning dates and time of introduction of bucks and removal of bucks, these periods were not of equal time intervals each year nor among lots of antelope. Broadly, however, they should represent significant biological stages that might influence pellet consumption. By calendar dates, breeding was from late September to December, gestation from December to early June, and lactation from early June until bucks were added.

The breeding season was of shortest duration; the gestation period the longest. Data were arranged so that a complete breeding cycle is represented each year, starting with the addition of replacement does and the introduction of bucks in the fall until the same events transpired a year later (Table 1).

There were some aberrations in the data. A consistent level of consumption among the lots of antelope from period to period and year to

Table 1. Mean daily pellet consumption and daily protein intake of antelope doe herds on three protein levels.

Protein Level	Breeding		Gestation		Lactation	
	Consumption	Protein intake (gms/kg/day)	Consumption	Protein intake (gms/kg/day)	Consumption	Protein intak (gms/kg/day)
Low						
1969-70	36.50	3.19	28.12	2.18	33.84	2.73
1970-71	40.24	3.37	22.09	2.17	24.24	2.45
1971-72	44.63	4.80	28.97	3.00	45.54	4.73
Mean	40.46	3.79	26.39	2.45	34.54	3.30
Medium						
1969-70	38.17	3.58	23.41	2.61	35.08	4.02
1970-71	36.33	4.26	26.87	3.15 a/		
Mean	37.25	3.92	25.14	2.88	35.08	4.02
High						
1969-70	35.68	6.02	18.03	2.64	35.32	5.79
1970-71	34.16	6.20	25.50	4.18	34.08	4.50
1971-72	50.51	7.12	26.77	3.65	31.79	4.60
Mean	40.11	6.45	23.43	3.49	33.73	4.96

a/ Switched to high protein 21 March 1971.

year was not attained. There are several reasons that may account for this. First, protein levels changed over the course of the study; the low pellets became very close to what the medium-level pellets were at the outset. Secondly, animal weights caused us some problems. Where we had considerable death loss in the high and medium pens, herd weights became somewhat uncertain. Moreover, when death was preceded by a period of ill health, food consumption was probably depressed prior to death. Thirdly, the number of fawns present during the lactation period was very unequal among the pens. It is not known when pellet consumption becomes important, but fawns were observed as though eating pellets at an early age. Because of uncertainty as to when pellet consumption took place and because fawns varied considerably in age, no effort was made to estimate their consumption. Probably, higher consumption during the breeding season was in part due to consumption by fawns, although high consumption took place in 1969 when no fawns were present. Lastly, although an attempt was made to remove vegetation from the pens it was not wholly successful. In 1971 and 1972 annual weeds re-appeared in the pasture. These were shortlived. However, a dense crop of rye grew in the high protein pasture in 1971 and again in 1972. Pellet consumption was lower during the lactation period than any other, probably due to consumption of some green feed. The food intake was so low among the animals on high protein in 1972 some data were excluded during early summer that year.

Highest consumption was observed during the breeding period, the lowest during the gestation period. The presence of fawns, which were eating pellets, partially accounted for the former, but the low consumption during the gestation period, which included the winter

months, seems remarkable. A possible explanation, and this is speculative, is that metabolic rates and, hence, food consumption is less during winter. Klein (1970) and McEwan and Wood (1966) attribute this characteristic to caribou and possibly other northern ungulates.

Consumption by Juveniles. Each fall, except in 1970 when only two survived, fawns were weaned and placed in small pens in lots of one to three and fed until the following fall when yearling females were put into the breeding herds and the males were released. Fawns born in 1972 were released in January of 1973 after only 3-1/2 months of feeding. The numbers surviving to long yearling age were small, many dying short of the full year (Table 2).

Individual animals responded differently; some did well, others poorly irrespective of diet. In consequence, there were considerable differences in pellet consumption and protein intake. In 1969-70 a male on the high protein level grew rapidly which may account for the high level of consumption and high protein intake that year. By comparison, a pen of three fawns fed high-protein pellets in the fall of 1972 consumed little more than half as much. The data for the low protein feed are much more uniform although there is a marked difference between those fed to long yearlings and those in 1972 which were fed only till about six months of age. As in the case of does, the low protein-fed lots showed less variation than did these on the high protein feed. Considering that the numbers are small and deaths and prior sickness were involved, no conclusive inference can be drawn from these data. They suggest, however, that the lower levels of protein were not greatly restrictive to growth.

Table 2. Pellet consumption of antelope fawns following weaning until release or disposition.

Year	Feeding period	High Protein			Medium Protein			Low Protein		
		Number of animals[1]	Pellet consumption (gms/kg/day)	Protein intake	Number of animals	Pellet consumption (gms/kg/day)	Protein intake	Number of animals	Pellet consumption (gms/kg/day)	Protein intake
1969-70[2]	year	2	37.23	5.81	2	39.01	4.30	2	35.59	2.85
								1	35.72	2.84
1971-72	year	1	30.75	4.07				1	27.74	2.89
		1	27.72	3.85				1	30.20	3.15
Mean yrlgs			33.23	4.88		39.01	4.30		32.97	2.92
1972-73	3-1/2 mo.	3	21.47	3.11				2	44.93	4.69
		2	40.35	5.84				2	46.17	4.82
								3	47.18	4.92
Mean fawns			29.02	4.20					46.25	4.83

[1] More than one animal occupied a pen except in 1971-72.

[2] Only two fawns survived in 1970 and they remained with the does.

Fawning Success. Deaths were more frequent among does fed higher levels of protein and additions had to be made to keep their numbers up. The original animals on the low protein level were alive at the termination of the tests in 1972, although 3 of 4 does trapped in the wild and added to the herd in 1971 died. No does survived the entire period on either medium- or high-protein pellets. One yearling doe added to the intermediate level pen in 1970 and subsequently put in the high level pen survived. Omitting one animal that died from accidental cause, of 14 does in the medium and high lots only 2 survived (Table 3).

As to fawn production, of 16 does on low protein alive at fawning time, 15 gave birth to 27 live fawns; 9 of 12 does on high protein produced 12 live fawns (Table 4).

Birth Weights of Fawns. The data indicate birth weights of fawns dropped by does on high protein pellets may have been increased over lower protein levels (Table 5). Although birth weights of the heaviest fawns born to does on high protein levels were but little greater than those born to the low diet herd, 5 (20 percent) of the 25 fawns on low protein diets were smaller than any in the high-protein herd. The average difference between these lots was 0.75 pounds. Only two fawn weights were obtained from the medium protein-level herd. Examination of the protein levels of the medium pellets showed them to be within the ranges of the low-protein pellets. Accordingly these fawns were included with those on low protein giving a differential of 0.66 lbs. in favor of the fawns on high protein. The probability is less than 70 percent that these differences are significant.

Table 3. Identification number of antelope does on diets of different protein levels showing year of introduction and death, shown by an X.

	1969	1970	1971	1972
Low protein				
	190	190	190	190
	494	494	494	494
	487	487	487	487
	444	444	444	444
			188[a]	X
			254[a]	X
			384[a]	X
			70[a]	70
Medium protein				
	492	492[b]		
	27	27	X	
	491	491	X	
	490	X		
		497[b]		
		555X		
High protein	488	X		
	489	X		
	113	X		
	359	X		
		36	X	
		201	X	
			382[a]	382
			492[b]	X
			497[b]	497
			496X[c]	
Prior to mixing pellets	104X			
	613X			
Total deaths	2	6	5	4

a/ Trapped in wild

b/ Transferred from medium to high protein in 1971

c/ Accidental death

Table 4. Fawning success among antelope does on diets of different protein levels.

	Protein Level								
	Low				Medium	High			
	1970	1971	1972	Total	1970[a]	1970	1971	1972	Total
Number of does at:									
Breeding time	4	4	8	16	4	4	6	3	13
Fawning time	4	4	8	16	4	3	6	3	12
Does parturiating	4	3	8	15	2	3	3	3	9
Percent fawning	100	75	100	93.75	50	75	50	100	69.23
Fawns born:									
Dead[b]	0	0	2	2	2	2	1	0	3
Live	8	5	14	27	2	3	4	5	12
Percent crop	200	125	175	168	50	100	67	167	100

[a] - Does on middle level of protein fed high protein after March, 1971.

[b] - Includes stillborn and foetuses of does dying in parturition.

Table 5. Birth weights of fawns born to antelope does on diets with different protein levels.

	Low Protein			Medium[a] Protein			High Protein		
		Sex	Wght/lbs.		Sex	Wght/lbs.		Sex	Wght/lbs.
1970	Twin	F	5.5	Twin	M	6.9	Single	F	8.6
	Twin	F	5.8	Twin	F	8.0			
							Twin	M	6.0
	Twin	F	6.0				Twin	F	5.5
	Twin	F	4.3						
	Twin	F	6.8						
	Twin	M	6.4						
	Twin	M	3.9						
	Twin	M	5.3						
1971	Twin	F	7.4				Twin	M	9.1
	Twin	M	6.6				Twin	F	7.25
	Twin	F	5.0				Twin	F	6.9
	Twin	M	4.9				Twin	F	6.0
	Single	F	6.25						
1972	Twin	F	6.25				Twin	M	6.06[b]
	Twin	F	6.06				Twin	M	11.94[b]
	Twin	F	6.44				Single	F	7.00
	Twin	M	8.50						
							Twin	M	5.75
	Twin	M	5.63				Twin	F	6.94
	Twin	M	5.69						
	Twin		4.50[c]						
	Twin	M	5.25						
	Twin	F	7.69						
	Twin	F	2.56[c]						
	Twin	F	8.50						
	Twin	F	5.56						
	Twin	M	5.56						
	Twin	F	5.69						
	Twin[d]	M	7.00						
Mean			6.08			7.45			6.83

[a] Does changed from medium to high protein in March 19, 1971. No does continuously on high protein diets fawned in 1971.

[b] Nine days old when caught and weight not used in computing mean.

[c] Stillborn or died in parturition--not included in mean.

[d] Sibling found dead in fence.

Growth of Fawns. Weights of fawns subsequent to birth fall into three groups (1) those that died prior to weaning time, (2) those weighed at weaning time, and (3) a post-weaning weight at about 6 months of age. In all categories except the first, where only one animal was represented on the high-protein diet, mean gains were greater for the high-protein herd. Fawns on low protein gained 0.23, 0.32 and 0.19 pounds per day at death prior to weaning, at weaning, and post-weaning, respectively. Weaning and post-weaning gains on high protein were 0.40 and 0.25 pounds daily, respectively. Gains of fawns living until weaning are shown in Fig. 1.

Growth to Yearlings. Because of deaths and injuries, only 11 animals were raised to long yearlings. Weights were taken in the fall at the time the bucks were placed in the herds. Aside from two males on high protein diets, there is no great superiority indicated by these data (Table 6).

Table 6. Weights of long-yearling antelope fed diets with different protein levels.

Low		Medium		High	
Sex	Weight, lbs.	Sex	Weight, lbs.	Sex	Weight, lbs.
F	90.8	F	91.0	M	105.3
M	89.0	M	84.8	M	104.5
F	80.8	M	63.0	F	76.5
F	66.3			F	72.0
Mean	81.7		79.6		89.6

Discussion and Summary

Because of the small numbers of animals involved and the high incidence of deaths from disease and accidents, it is difficult to draw conclusions from these data. It does seem clear that fawns born to does on higher levels of protein made better gains to weaning time than did those on low-protein diets, but this may be biased somewhat in favor of the high protein diet. Two of the twelve fawns were single births, and considerable succulent vegetation was present in 1972 in addition to the pellets which may have contributed to greater milk production among this herd. I did not attain mean weights as high as those found at the Desert Experimental Range, but all were within hours of birth a condition not always attained at the Range.

Attained weights as yearling showed less superiority for the high levels of protein than did birth weights, although the two largest animals were those on high protein. Some animals on lower protein levels made what appear to be adequate gains.

Two factors tend to make results imprecise. It was not possible to control closely the protein levels in the pellets due, presumably, to the dependence upon a commercial plant for making the pellets. Although the operation was carefully monitored and the weights of most of the ingredients were made by our own personnel, soybean and corn were supplied by machinery by the plant operator. There is no evidence that he erred in some cases, but the possibility exists. In addition, it is not possible to control protein intakes by controlling the percentage of protein in the feed when animals are fed ad libitum. Greater consumption can negate the lower percentage in the feed. This occurred in the case of the fawns in 1972 when those on low protein

consumed 15 percent more protein than did those on high-protein pellets.

There is some indication that higher levels of protein were detrimental to animal health, although in only one instance could death be feed related. Autopsy revealed the presence of Speropherous, a feed-related organism. The doe involved had been trapped in the wild and had been on the low-protein feed for only 7 months. In a somewhat similar experiment conducted for 12 years with heifers calving at 2 years of age in Oklahoma, animals survived better in a low-protein feed given as a supplement in winter than on a high protein feed (Pinney et al., 1972). Similar, though less definite results were observed in heifers calved at 3 years of age, although to 10 years, survival was considerably better in the low-protein herd.

Assuming birth weights were lowered by the low-protein feed, though the difference were not significant, one can only speculate upon the effect of this upon subsequent growth and maturity. Wardrop (1968) related birth weights of calves and lambs to subsequent gains and concluded that there was significant correlation in the case of lambs but not with calves. But even if gains are birth weight related, it is not certain what the ultimate effect is. Allden (1968) restricted the intake of Merino lambs in Australia at two periods and concluded that neither pre- or post-weaning restrictions affected the ultimate size of lambs, it only took longer. Unless smaller size can be shown to relate to survival, as for instance in greater vulnerability to predation (Beale and Smith, 1973) or other factors, smaller birth weights cannot be assumed to be detrimental.

During the summers of 1969 and 1970, an attempt was made to determine the nutritive value of forage consumed by two herds of antelope

in Utah, the Desert Experimental Range and the Awapa Plateau. Crude protein contents of diets, as estimated from utilization observations at 8, three-week periods from April to September, varied from 10 to 22 percent and averaged more than 14 percent. These do not indicate a protein deficiency of pronghorn diets on desert ranges in the Great Basin.

During the experiment, especially after the first year, it did not appear that does were milking heavily, as judged by the size of the udder. While locating fawns at the Desert Experimental Range, we found udder development a good clue to impending parturition and lactating does even at the considerable distances involved. It is possible that the close confinement at Logan may have prompted more frequent nursing and, consequently, prevented udders filling so fully, but pre-parturition observations showed a generally poor bag development. The only explanation for this is that the dry nature of the feed gave a sub-standard milk flow, although in view of the fact dairy cows produce well under dry-lot feeding the year round makes this explanation suspect.

In summary, fewer fawns were born and doe mortality was greater in the high-protein animals. Fawn weights and gains and yearling weights were lower in the low-protein animals. Under the conditions of the study and the facilities available, pronghorn proved to be poor subject animals. Disease took many animals and handling animals invariably resulted in deaths or crippling losses. Fawns were especially vulnerable to hind leg injuries.

Literature Cited

Allden, W. G. 1968. Undernutrition of the Merino sheep and its sequelae. III. The effect on lifetime productivity of growth restrictions imposed at two stages of early postnatal life in a Mediterranean environment. Austral. Jour. Agr. Res. 19:981-996.

Beale, Donald M., and Arthur D. Smith. 1973. Mortality of pronghorn antelope fawns in western Utah. Jour. Wildlife Mgt. 37:343-352.

Klein, David R. 1970. Tundra ranges of the north boreal forest. Jour. Range Mgt. 23:8-14.

McEwan, E. H., and A. J. Wood. 1970. Growth and development of the barren ground caribou, heart, girth, hind foot lengths, and body weight relationships. Can. Jour. Zoology 44:401-411.

Pinney, Don O., D. F. Stephens, and L. S. Pope. 1972. Lifetime effects of winter supplmental feed level and age at first parturition on range beef cows. Jour. Animal Sci. 34:1067-1074.

Wardrop, I. D. 1968. Birthweight, liveweight gains in early life, and subsequent gain in sheep and cattle. Austral. Jour. Agr. Res. 19:837-844.

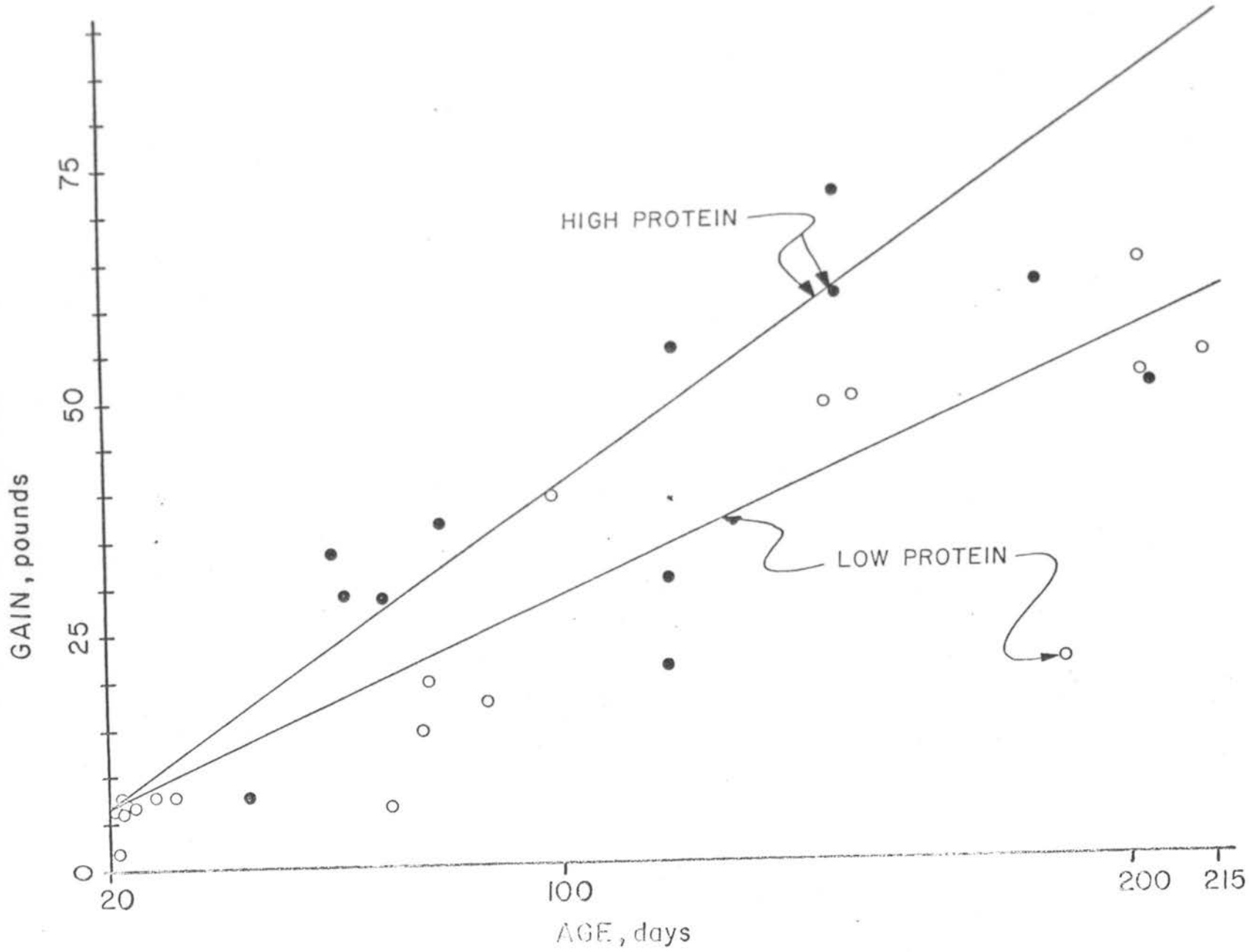

Figure 1. Gains from birth of antelope fawns on low- and high-protein diets.

Compton: I may have missed it, but did you continue on this protein regimentation diet through the fall and winter as well? Is that a year long diet?

Smith: We put them on in 1969 and continued them on it until into the fall of 1972. We were going to abandon it then and so we weaned the fawns and released the does and we continued the fawns that we had into early 1973, but they were on the same make-up of diet continuously during this whole period (any animals that survived it).

Barrett: As you would expect, you would find your April to mid-July samples to be well above your level in a normal range. Did you also analize after the curing period--say fall and winter you probably expect them to be considerably lower than your levels in the wild range.

Smith: We didn't make any collections during that winter period. Since we are not entirely, but we were thinking in terms of productivity in fawning and survival of fawns as a central part of it and we felt obliged to keep them on the same diet all the time for practical reasons and what not, that we were interested in whether or not during that fawning period, particularly, if protein was adequate.

Pyrah: I was wondering if you isolated some of the organisms that were giving you problems; were they regular livestock disease things or were they common bacteria that perhaps was giving you problems? Did you try feeding it antibiotics?

Smith: Well, no we didn't. This is in reference to antibiotics; we talked with the vets and they said that (after we had a number of deaths) there wasn't really any one thing at all--it was a broad spectrum of things. Pnuemonia was a big factor--they get pulmonary problems, but there's a lot of different organisms that occur, found in young and old, and sometimes they die. In order to count this period, it rather destroys my faith in a veterinarians analysis of why an animal dies. One of the last years we were out on the desert, a fellow got an antelope permit, so he went down the night before scouring around the desert to find a place to hunt. We were down making collections from antelope that were killed. Just about dusk, he came rushing back into the station all excited, "I got an antelope", he opened up the trunk of the car and sure, he had a dead antelope. He was out on the range at Snake Valley, which is about 30 miles away, and drove down a little road and there was an antelope lying, still alive, in the road (a little yearling buck, as I remember) so he loaded it in and brought it back; well, it died in route--a period of about half an hour. We took the animal, saved everything, took it in and froze it. We refrigerated it on the assurance from the vets that if we'd get an earlier refrigeration on

it they could do just as well on a frozen one. They went through the organs and the intestines of the animal--the whole darn thing--and it came back negative. There wasn't a thing wrong with that animal--it just laid down in the road and died. I didn't put it in this paper, but we have a list in our final report of the specific organisms found in this study and we'll get out with it in some other literature.

Pyrah: With our sage chicks, we found things like salmonella which waterfowl and others have all the time, but where it's just death on sage chicks; well, we finally treated them with terramycin and maybe that wasn't very good, but it kept them alive.

Smith: Well, there's two things which deterred us. Because of the range of things, they didn't know what to give them. The other thing is based on our experience in handling the animals. We figured we could kill just as many trying to give it to them.

Audience: Since you were concerned with production, did you consider supplementing vitamin A as well as protein?

Smith: Oh, we put vitamin A in the mix, but we didn't very it, we had a constant level of vitamin A and minerals and tried to hold the energy values at a constant level and only varied the protein. It was one thing that we suspected and were looking at. We don't think the animals milked as well on this feed as we observed them at the desert. There udders were not as big and they didn't bag up. Of course, they were in close proximity to the fawns they may have suckled more times of day after partuition, but it's a little troublesome because dairymen will keep a cow on a dry feed lot the year around without green succulent feed as long as it has adequate nutrition.

Audience: Did anyone try to detect any mechanical damage due to this feed that you had them go through? Could the wide range of bacteria affecting their digestive system have been a reaction really to mechanical damage of your diet going through?

Smith: Well, we gave this a pretty good looking over--normal necropsy and all-- to see. There was only one animal that they isolated for which they identified as a feed related organism, that they did, in fact, find some organisms bothersome with domestic livestock when they are on harvested forage, and that's the only one that had any suggestion it was tied in with what we were feeding them.

Audience: Did you ever make the three levels available to them free choice to see what the antelope would have selected?

Smith: Yes. I mentioned that briefly but passed over it. What we did before we actually started to feed, when we got

our first batch of pellets mixed, we went out first and (remember we had three section troughs) we put all three feeds to all three lots for two weeks and they ate more low protein. Then for a period of ten days, which means thirty days for any lot--ten days on low, ten on high and ten on medium--and those narrowed down pretty much based on the whole lot. The mean consumption was a little higher for low, little less for high and a little less for medium, but there was no significant difference--this lot just ate a little more than this one but a little less than the other. We concluded from this that despite the fact that from the outset they preferred the low protein diet pellet when they had all three, but given one alone, they'd eat substantially the same amount irrespective. I don't know whether you noticed in looking over these tables, but there were some periods that consumption of low popped up quite high so that they actually got more protein than those on high protein feed.

Audience: Did the low protein mean that it was high in carbohydrates?

Smith: No, the rations were icecoloric within a few points, the same estimated choloric values for the three rations, so this was maintained at a level. We got there, you see, by juggling straw. Wheat straw was juggled just a little in the low batch, but mostly it was simply transfers between corn and soybean meal--and you plugged in corn--it has no (or virtually no protein) to get the choloric value up to balance what you lost when you depressed the soybean. My last advice if you contemplate something like this, write and ask us what our set-up was and how to do it--and do it differently.

PLANT AVAILABILITY VERSUS UTILIZATION BY PRONGHORN ANTELOPE ON THE RED DESERT OF WYOMING

by

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Abstract

The relationship of vegetative availability to feeding use by pronghorn antelope revealed that selection did take place. Plant use varied with: season, stage of plant growth, associated plants, recent food habits, weather and other factors. Food habits were not significantly different among antelope on these study areas or between sexes. Selection suggested areas and plants that would serve as indicators to the degree of range use by antelope.

Background

Knowledge of food habits is essential to proper management of antelope and evaluation of antelope range. Food habits have been studied by a number of researchers in various states (summarized in Sundstrom, Hepworth and Diem 1973), but relatively little has been done regarding forage selection in relation to availability. Selection indicates which plants, of those available, are the most palatable and gives clues to the role played by each species. This knowledge is a prerequisite if ranges are to be maintained for antelope. Key species and key areas for determining antelope range use can be best determined using knowledge of antelope forage selection.

The work reported here is part of a comprehensive study entitled "Carrying Capacity for Pronghorn Antelope on Wyoming's Red Desert" which manuscript is in preparation. This work began in 1969. Two facets of that report involve food habits of the pronghorn and forage availability on Wyoming's Red Desert. This brief paper relates the two in a manner that reveals the selection that occurred as free-ranging antelope fed on natural vegetation. Forage preference and use is examined in detail. The relationship of antelope behavior to foods eaten is discussed. Possible application of this information to practical antelope management are explored.

Procedures

Three study areas were selected to determine carrying capacity for pronghorn antelope. Food habits and vegetative analyses were segments of that project. The three areas were selected by gross visual observations to represent: 1. a typical desert site, 2. a grassy site and 3. an area having more brush than considered typical. All three areas had year-round populations of antelope and were accessible during all seasons.

Antelope food habits were determined by analyzing rumen samples collected over a two year period (May 1970 through April 1972). A collection consisted of six antelope, a male and a female from each of the three study areas. Collections were made in May, June, July, August, October, December, February and April. In addition, rumen samples were taken from study area antelope killed by hunters during the September hunting seasons. Fawns were not taken. During the summer months yearling does were taken, when possible, to avoid killing nursing does and abandoning young fawns. A total of 109 rumens thus collected were analyzed. The usual collection procedure was to drive into an area until antelope were located. They were then stalked and shot in such a manner as to avoid damaging the rumen. The preferred shot was in the heart-lung area because of its relative size and the predictable results of such a shot. A 2-quart sample was taken from each rumen after its contents were well mixed. This sample was preserved in a 10 percent formalin solution. Items recorded at each collection included: weather conditions, snow cover, plant availability and the vegetative type where the animal was killed. Rumen analysis recorded plants used by percent volume (Taylor, 1971).

The compressed crown cover of each plant species was determined by a sampling technique which included use of aerial photographs and two different-sized sampling frames. The areas to be sampled were selected systematically from aerial photographs. Selected sites were then sampled with a 10-square-foot frame for brush species and a 1-square-foot frame for grasses and forbs. The number of samples required was determined using Stein's two stage sample (Steele and Torrie 1960). The percent compressed cover by species was estimated. Cover determinations were made only during the summer due to manpower limitations. Forage availability during other seasons was determined by keeping careful notes during collection, when driving monthly weather station routes and whenever changes occurred in the field. This method may not be as exact as rerunning cover samples using frames each season, but it is felt to be adequate.

Findings

Study areas were originally selected on the basis of apparent vegetative differences. Tests to compare the percent cover by species among the study areas showed there was no significant difference. The highest variable was the percent cover by grass. More grass was found in the Seminoe site (grass site) than in the Riner site (typical site) and the least amount occurred at the Lamont site (brushy site). This did not follow through into the antelope food habits as grass use was not significantly different among areas. Forb growth characteristics resulted in abundant forbs in wetter areas and practically no forbs in the drier areas. Sampling this distribution gave a high variation which may have obscured otherwise significant differences. It was concluded that there was no significant difference in forage availability among the three areas.

Ninety plant species or groups occurred in measurable amounts in the forage cover samples. Only 12 of these 90 species or groups of plants made up one percent or more on the antelope's diet (Table 1). These 12 plants were used as a basis for tests throughout this study and made up 82 percent of the year-long diet. Food habits were not significantly different among the three study areas. Other plant species occurred in low amounts both in the rumens and in the vegetative community.

The level of occurrence and variation made analyses of these species statistically impractical.

Table 1. List of "Important species utilized by antelope. Important defined as those species which made up at least one percent of the antelopes' year-long diet.

Species	Common Name	Includes
Artemisia pedatifida	Birdfoot sagewort	
A. tridentata	Basin big sagebrush	A.t. vaseyana, A.t. wyomingensis and A.t. tridentata
Atriplex gardneri	Nuttall saltbush	
Chrysothamnus sp.	Rabbitbrush	C. viscidiflorus and some C. nauseosus
Sarcobatus vermiculatus	Black greasewood	
Arenaria congesta	Ballhead sandwort	
Cirsium sp.	Thistle. sp.	Genus
Cordylanthus ramosus	Bushy birdbeak	
Mackaeranthera glabriuscula	Woody aster	
Opuntia polyacantha	Plains pricklypear	
Penstemon sp.	Penstemons	Genus
	Grass	All species

The annual diet was weighted to two months for spring (May and June) and summer (July and August), three months for fall (September, October and November) and five months for winter (December, January, February, March and April). Antelope food habits varied by season. Table 2 presents a seasonal breakdown of food habits and Fig. 1 gives food habits by collection date. While antelope food habits have been well documented, another question not as well researched is: do these changes represent the end result of selection or availability? The answer is both. If a plant is not available it cannot be selected for or against.

Each important species was tested by season to determine the differences between its availability and use (Table 2). This series of tests indicated that several significant selections were made. Student's T test was used to compare the per-

cent a species made up of the diet with the percent available in the vegetative cover. The table reveals antelope preferences. It is interesting to follow some of these species through an annual cycle.

Table 2. Significance of selection: plant composition compared with percent of antelope diet by season. (Entries are percent in rumen over percent of vegetative composition.)

Species	Season			
	Spring	Summer	Fall	Winter
Birdfoot sagewort	9.7	10.2	3.6**	0.9**
	7.4	7.9	9.2	5.9
Basin big sagebrush+	25.2*	21.6**	51.0	69.1
	35.4	37.6	44.0	78.0
Nuttall saltbush	0.6**	0.7**	9.1	12.0
	9.8	10.4	12.1	7.8
Rabbitbrush sp.+	4.8	18.9**	11.0*	8.7
	3.6	3.8	4.4	6.6
Black Greasewood	0.9**	4.4	1.3**	0.0**
	5.1	6.1	7.1	6.1
Ballhead sandwort	9.8*	T	0.0	0.0
	0.7	0.7	0.6	T
Thistle sp.+	1.7	2.3	1.0	T
	0.1	0.1	0.1	T
Bushy birdbeak	0.7	5.2	3.6	0.0
	T	T	T	T
Woody aster	0.7	8.5*	2.4	T
	0.1	0.1	0.1	T
Plains pricklypear	0.0**	4.3	7.8	0.2
	1.6	1.6	1.9	1.7
Penstemon sp.+	7.3	2.6	0.3	T
	T	T	T	T
Grass+	17.3	1.8**	4.2*	6.9
	10.9	13.6	7.3	10.3

+ = Species or subspecies lumped together because of difficulty in separating species by bits and pieces found in rumens.
* = Significant at p=.05 level.
** = Significant at p=.01 level.

Sagebrush made up 49 percent of the year-long diet. Obviously sagebrush is an important food item. The reasons for this high use included both availability and selection. Some researchers have found that sagebrush is selected for by antelope (Bayless 1968). This was not the case on the Red Desert. Table 2 shows that antelope used sagebrush in the same ratio as it was available in the fall and winter seasons. In the spring and summer it was used significantly (p=.05 and .01 respectively) less than it was available. Several factors seem to explain these results.

On the Red Desert, sagebrush made up 56 percent of the available vegetation year-

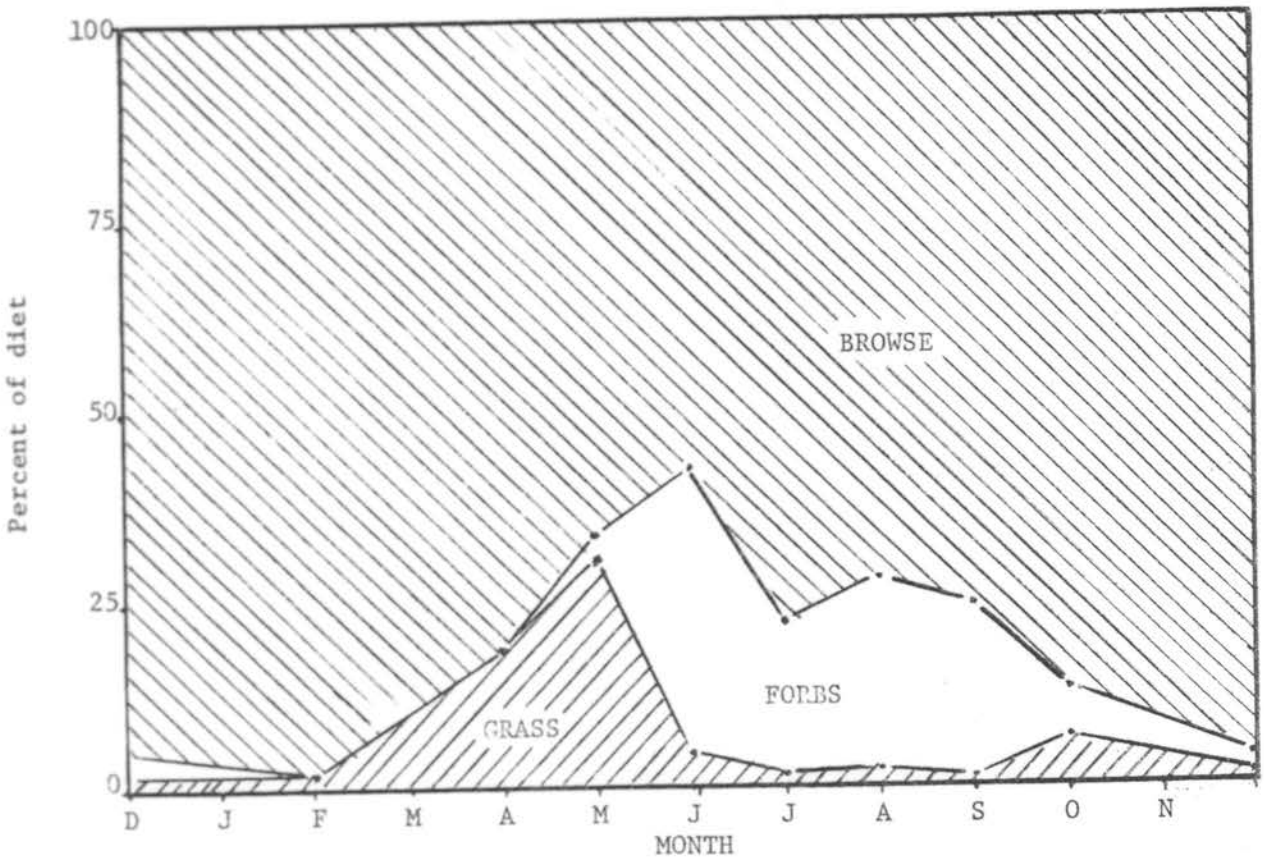

Fig. 1. Antelope food habits by forage class. Determined from rumen analyses.

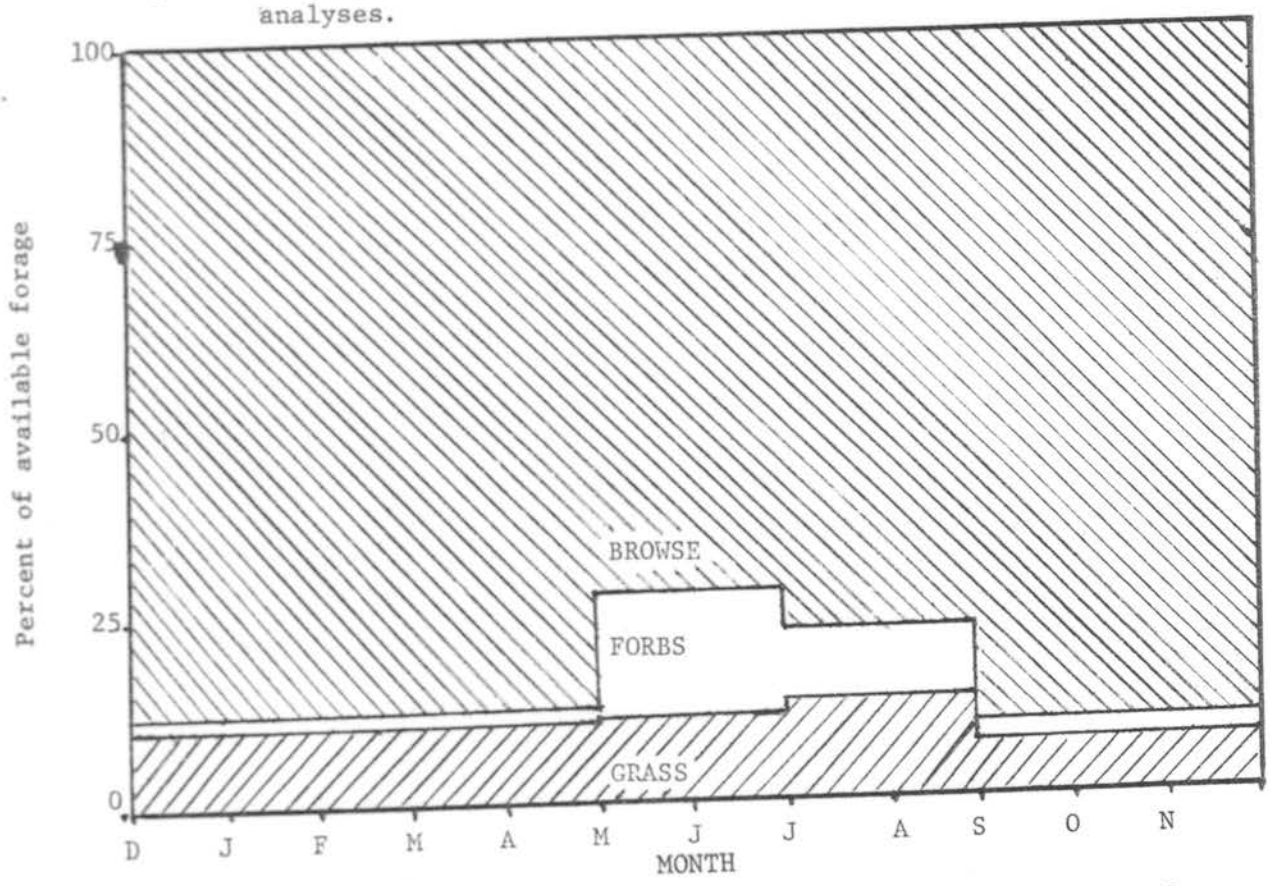

Fig. 2. Seasonal plant availability by forage class. Determined from percent forage cover.

long. Variety has been recognized as an important component of many animals' diet (Marler and Hamilton 1966). Monkeys given all they could eat of one type of food for half an hour might refuse to eat that food again for up to two days. Other foods were freely accepted during this period (Katz 1937 in Marler and Hamilton 1966). If sagebrush were utilized in the same ratio that it occurred all year, a seemingly monotonous diet would result. Following high winter use of 70 percent sagebrush, antelope selected other forage when it was available during the spring and summer. Sagebrush was still a major component of the diet during these seasons, but it did not occur in the diet in as high a percentage as it was present in the vegetative cover. There may be an optimum level or amount of sagebrush in the diet that antelope prefer. If this is true, a lower amount of sagebrush than the optimum level would result in positive selection while an abundance of the same plant would result in negative selection. If sagebrush were less abundant, qualitative evidence suggested that selection for sagebrush would have increased. This hypothesis suggested itself several times.

These hypothetical statements were suggested from observations of antelope feeding on various vegetative types. During the spring and summer, antelope foraging on a sagebrush type spent most of their time utilizing species associated with sagebrush. A small ratio of the available sagebrush plants was fed on, and the degree of use on any given plant was low. When pronghorns fed on a different vegetative type having less sagebrush, this relationship applied in reverse. Thus, in this last instance, there was more sagebrush present in the diet than in the percent cover. Single sagebrush plants growing in a grass type had a higher chance of being used than a sagebrush plant growing in a dense stand. Positive and negative selection does not indicate the importance of the species to the antelope. Positive selection for sagebrush may take place when it occurs as a scattered component and, yet it will still make up a small percent of the antelope's diet. Negative selection may take place when antelope feed in a dense sagebrush stand and still that plant may make up the majority of the diet.

Another example where antelope displayed an optimum selection for a particular plant was in the use of rabbitbrush. This plant made up only 5 percent of the vegetative cover, but 11 percent of the diet. It was eaten more in every season than it was available. In the summer this selection for rabbitbrush was significant ($p=.05$) and in the fall highly significant ($p=.01$). Selection for rabbitbrush was obvious from field observations of feeding pronghorns. There were well-beaten trails where antelope traveled some distance to feed on rabbitbrush. Antelope have been observed traveling several miles to feed on this plant. After spending some time in a rabbitbrush association these antelope were observed to reverse their travel and return in the direction from which they had come. Examination of the area revealed that the brush had been hedged by use. There were several well-used trails leading into the area. This same type of trail was observed in other rabbitbrush stands.

When feeding, antelope seemed more likely to use a particular rabbitbrush plant than a particular sagebrush plant. This resulted, to some extent, from the relative abundance of each. It is impossible to tell whether sagebrush is more or less palatable than rabbitbrush unless they are presented in equal ratios under the same conditions. I suspect that if the tables were turned and sagebrush was the more rare it would have been selected for at least as strongly as was rabbitbrush.

Greasewood use presented an interesting study. It is selected against significantly ($p=.05$) in all seasons except summer. Some reasons for this are: in the spring this warm-season plant has not produced abundant growth and in the winter it has shed its leaves and is particularly unpalatable. The difference between summer and fall use is more intriguing. During both seasons greasewood has green and succulent leaves available, but use was highest in summer. Part of this difference may be due to weather and antelope behavior. During the hot summer months antelope sometimes seek shade and greasewood is one of the most available shade sources. Also, during the summer, pronghorns water once or twice per day (Sundstrom 1968) or perhaps less often when succulent vegetation is available (Beale 1970). Water holes are typically in the lower areas and are frequently in or near the greasewood type. Thus, during the summer, antelope are associated with greasewood more than during the other seasons. In the fall the weather is cooler and wetter, shade is sought less often, and water is more available. Observations of antelope suggested that they disliked having balls of mud on their hooves or traveling over slick terrain. Both of these conditions occur when antelope use the greasewood type after rains.

Forbs are the most preferred forage class whenever they are available (Table 2). Plains pricklypear was the only forb selected against. All other forbs were selected for when green and succulent and lacking protective structures. Ballhead sandwort was selected for significantly ($p=.01$) in the spring and then was used sparingly during other seasons. A closer look at changes in the plant itself may explain this. In the spring, when rapidly growing, the sandwort leaves are soft and succulent. As maturity is approached the tips of the leaves harden and form a thick mat of prickly defense. Other physiological changes also affect use. Woody aster was selected for significantly ($p=.05$) only during the summer months even though availability changed little during spring, summer and fall. The answer is, again, found by field observation. The leaves of the plant are rough and sharp and are used relatively little. The plant puts up highly palatable flower heads in July. Antelope could be observed during this time feeding almost exclusively on flower heads for substantial periods of time. One part of a plant may be relatively unpalatable while another part is highly preferred.

Antelope are closely associated with grasslands so one might assume that, if availability dictated use, they would eat considerable grass. This is not true. Fig. 1 shows a strong peak of grass use in early spring and another smaller peak in the fall. These peaks coincide with the availability of the cool-season grasses and not with abundance of all grasses (Fig. 2). Grasses are growing and in various stages of maturity throughout the spring, summer and early fall. Grass species found in rumens were lumped because of the difficulty in identifying the species from parts and pieces. Experience gained during the analyses, however, showed that most of the grass used was Sandberg bluegrass (Poa sandbergii). The periods of high grass use coincided with availability of this species. Spring use occurred when bluegrass first began growth. This was the first green feed available in any quantity in the spring. It is tempting to speculate that any green lush growth would be greeted with enthusiasm after 5 months of browse and dried forage. As forbs became available in May and June, they were selected for. Other species of grass seemed to be consumed almost incidentally. As forbs dried out in the fall, bluegrass had some green growth (associated with fall rains) and was used to a limited extent. Even though grass was used less than the other forage classes, the data suggested that it may be important to antelope as a source of vitamins and

other nutrients needed in early spring when the antelope body condition is at a low point. Grasses served to extend the period when succulent forage was available.

Plant composition and distribution effect the foods available to antelope. Vegetative sampling was designed to accurately represent the whole plant community. Antelope feeding distribution does not sample the whole plant community equally. Pronghorns select feeding areas and return to favorable locations.

Penstemons may make up 0.01 percent of the total vegetation and be measured to within $\pm$ 0.004 percent, but if an antelope is standing in it up to his knees its availability to him is 100 percent. Some may point to these discrepencies as possible weaknesses in selection comparisons. A number of samples minimizes this effect, but it should still be recognized as a component of variation in the rumen samples. Individual animal differences were sometimes quite evident. Antelope food habits discussed here represent an average, but individual antelope preferred different foods from this average. It was assumed, for the purposes of this study, that the mobile antelope had access to all vegetative types within a study area. The fact that an antelope or a number of antelope feed repeatedly in the same type or location is a measure of selectivity.

In winter, the percent cover of a plant species may have little to do with its availability to antelope. Birdfoot sagewort made up 6 percent of the vegetative cover in the winter but antelope may be forced to spend most of their feeding time on wind swept ridges where it makes up 50 percent of the plant composition. Winds may influence foods in another way. Antelope were also observed seeking sheltered locations to avoid the wind and feeding in these areas.

Recommendations

It has been shown that antelope are selective in their feeding habits. This selectivity is influenced by antelope, plant and environmental factors. Antelope factors were: behavior, individual preferences and recent food habits history. Plant factors were: stage of growth, texture of plant, degree of succulence and protective devices. Environmental factors were: current weather, past weather, snow cover, winds and chill factor.

Antelope selectivity can be applied to management. Selection of key species and key areas as indexes to degree of range use is dependent on a knowledge of antelope food habits and is facilitated by a knowledge of food preferences. A summer key species might be rabbitbrush because it is selected for in this season. It is also easier to measure use on than many other species. A key species in the winter could be sagebrush, saltbush or rabbitbrush since they are utilized in the same ratio as they are available. Other browse species are not used to this extent. Ease of measurement could again be a deciding factor given prior knowledge of antelope wintering areas. Thus carrying capacity of a given area or seasonal range could be determined using a few key areas or species along with generally available management information such as distribution.

Antelope range improvement might possibly be dictated by selectivity studies. Improvement of winter ranges could conceivably be done by planting a palatable

browse species which would be available throughout the winter. Early spring range might be improved by introduction of an early growing forb or grass. Summer range could be improved by maintaining good stands of forbs. This type of information has been lacking in management plans and will be one of the keys to future antelope management.

Literature Cited

Bayless, S. 1968. Food habits, range use and home range of pronghorn antelope in central Montana during winter. Proc. Antelope States Workshop. 3:104-113.

Beale, D. M. and A. D. Smith. 1970. Forage use, water consumption and productivity of pronghorn antelope in western Utah. J. Wildl. Mgmt. 34(3):570-582.

Katz, D. 1937. Animals and men. Longmans, Green and Company, London. (in Marler and Hamilton 1966).

Marler, P. and W. J. Hamilton III. 1966. Mechanisms of animal behavior. John Wiley & Sons, Inc. New York.

Steel, R. G. D. and J. H. Torrie. 1960. Principles and procedures of statistics: with special reference to the biological sciences. McGraw-Hill Book Co., Inc.

Sundstrom, C. 1968. Water consumption by pronghorn antelope and distribution related to water in Wyoming's Red Desert. Proc. Antelope States Workshop. 3:39-47.

_____, W. G. Hepworth and K. L. Diem. 1973. Abundance, distribution and food habits of the pronghorn. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Taylor, E. R. 1971. Methods of forage sampling to determine food habits, forage requirements and carrying capacity for pronghorn antelope. Job Completion Report FW-3-R-18. Wyoming Game and Fish Commission, Cheyenne, Wyoming.

Smith: My first question relates to just what you just got through saying that you can improve this range if you provide it with more rabbitbrush than they've got under certain circumstances. Are they better off eating rabbitbrush? Presumably, if rabbitbrush wasn't there at all, would sagebrush be better--maybe they would eat sagebrush.

Taylor: Well, certainly if plants aren't available they can't select for or against.

Smith: Is it then an improvement producing more foliage and more nutritious foliage?

Taylor: We have't done any nutritional work on this. As far as the antelope are concerned, they would rather have more rabbitbrush. I'm not answering your question, I know.

Smith: I'll correct you on that now with your own words. They do not prefer more rabbitbrush because you just suggested that if these quantities were reversed with sage and rabbitbrush, you might have the same picture you just transferred to me. You said that.

Taylor: I said that. I think that there is an optimum mixture in here someplace that antelope would probably eat everything as it was available. In other words, take sagebrush for example, I think that sagebrush probably makes up an optimum level in any season that they would tend towards, maybe 85% available sagebrush in wintertime is above this level, so that there is negative selection if you can use that term, in a qualified sense. And if there were less sagebrush than that, then the selection would be positive. Now whether you are improving the nutritive value of the range by and large, by planting rabbitbrush, I can't tell you.

Smith: O.K. Now I have trouble with this concept--comparing utilization with availability. You carry it to a new twist--with diet and availability, but I think there is an analogy here that if you wanted, you could establish at least an equal acceptability of lamb in the diet of the American people if you use this concept--what they ate and what was available--like for example, in a couple of years it was shown that if you take production and sale of lamb per capita consumption, lamb was preferred to beef, but we usually interpret the other way--that because we eat many times more beef than we do lamb, then we prefer lamb. Now I understand that there is an error in here that markets and production tend to follow what they can sell, but still it's not unlike what is done in these contexts and that we use. I think it's faulty and only is true if you have approximately equal amounts available of all species compared.

Taylor: True--if you make these comparisons of selecting for and against. We're qualifying these by saying that in these

proportions they are selected thusly--we aren't saying that if everything were in the same proportion under the same conditions from here to Rawlins they would select things like I have said at all.

Smith: Maybe we can only talk about those that are sufficiently available that they eat what they want and reach let's say their saturation point.

Taylor: But at the same time, I think you can use a species like rabbitbrush as an indicator species, don't you?

Smith: Oh, I don't know, I'd have to answer that only with your own words. To start you said you can agree with some and disagree with some--we found some use of rabbitbrush but didn't find extensive use of it in our desert country.

Taylor: It certainly varies by areas. Of course, when you select a key species you want to select one that is important to the antelope and one you don't want to wipe out and make, say, a sacrifice species out of it too, so that might enter into it.

Audience: I'd like to find out one thing--what it's all about. You talk about rabbitbrush species. I don't think you can identify crysothamnus vicsidifuorus from c. nauseosus or even a variety in your rumen samples. I think there's a tremendous possibility for error here.

Taylor: Most all of our rabbitbrush use was c. vicsidiflorus and maybe a little bit of douglas and there was just a little bit of c. nauseosus, but it wasn't worth our while to separate it out in our samples, so if I were planting, I would certainly take those considerations.

Audience: What species of rabbitbrush were preferred most?

Taylor: Any of the rabbitbrushes were selected for, but again, if you take nauseosus by itself, it's quite rare on the desert.

Audience: What was the grass they were using on that October pick up?

Taylor: That was again sandburg bluegrass. We get a little bit of fall rain and it greens up again around the bases and the antelope are using it again. It might be real important that a grass is used that heavy in the springtime and maybe serves as a source of nutrients and vitamins that they haven't had for quite awhile. Then in the fall it might serve to prolong the green period when there is little other succulent vegetation available.

The Importance of Drinking Water to Pronghorn Antelope Does and Fawns on Desert Range Lands

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ABSTRACT

Pronghorn antelope were held in four 160-acre enclosures (5, 6, or 7 adults and 5 or 6 fawns per enclosure) on the low-shrub desert of western Utah in the summer of 1973. Water for the animals to drink was available in all enclosures except for two periods (16 days in late June and 11 or 18 days in late July), when water was withdrawn from two enclosures.

The season was better than everage for plant growth, and twigs and leaves retained their succulence for a greater part of the summer than usual. Herbage yields ranged from 250 to 610 lb./acre in the enclosures, and the production of species used by antelope constituted 20 to 68 percent of the yield.

Water consumption ranged from 0.5 to 2 gallons per adult animal per day. The amount used increased as the moisture in the feed decreased. Use was higher during hotter periods of the summer. In the enclosures having more succulence in the feed which the animals were taking, less drinking water was consumed. In the periods when they had no water to drink, the deprived animals tended to select more succulent forage as compared to what they selected at other times and to the forage selection of the

non-deprived animals in the other enclosures at the time the former were without water.

The does with fawns were most affected by lack of water to drink. A barren doe and a buck under this treatment showed less obvious response, but even their condition became poor during the waterless periods. The adult animals fell off in weight, appearing thin and dehydrated. They became less active and spent less time feeding and more time lying down. They tended to seek shade more than the watered animals did. Toward the end of the periods without water they became weak and very "tame". The udders of lactating does changed from round and firm to loose and narrow, but the fawns continued to nurse during the dry periods. There was only slight evidence of treatment effect on the fawns. They seemed to grow more slowly and appeared narrower across the body than the fawns whose dams had water available.

As the animals dehydrated the moisture content of the feces steadily decreased. At the beginning of the waterless period (and through the same period under the other treatment), fecal moisture content was 10 to 20 percent higher than forage moisture content. By the end of the period, fecal moisture was 20 to 22 percent lower than forage moisture.

When water was returned to the dry animals their recovery was dramatic. In a matter of hours, the weak, tired and "tame" animals became active, strong and "wild", and within a few days they were regaining flesh or recovering from the affects of dehydration.

COMMENTS AND QUESTIONS

Schwartz: Did you have a control to measure evaporation rates on your stock tanks?

Holmgren: Yes. The water that was added was added at the same time in a similar trough that was not used. All troughs were the same size and shape with the same amount of exposure. We deducted the amount that was lost in the control to account for rainfall and evaporation.

Schwartz: On your fecal moisture samples...did you collect only fecal samples that you saw drop by animals in the field or did you just go out and collect fecal samples?

Holmgren: We practically carried the bottle behind the antelope, except they were wild and could run fast, so we watched the antelope and as soon as we could get to that spot, we would bottle and cap the sample; therefore, the moisture content was not altered by drying prior to collection.

THE SUCCESS OR NON SUCCESS OF PRONGHORN ANTELOPE TRANSPLANTS IN UTAH AS RELATED TO VEGETATIVE TYPES

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ABSTRACT

Several recent transplants of antelope have been made in Utah the past few years. The first in 1964 on the Parker Mountain, (Wayne County) followed by reintroductions on Myton Bench, (Duchesne County) Hatch Point, (San Juan County) Icelander Wash, (Carbon County) and Clark Bench (Kane County).

In 1964, 20 pronghorn were released on the Parker Mountain with an additional 109 animals in 1965. The area contains approximately 240,000 acres of antelope habitat 7,000 - 9,000 feet in elevation with an annual precipitation of 9 - 10 inches. The vegetative community is made up of several associations which include black sage, big sage, fringed sage, bitterbrush, rabbitbrush, snake weed, and a variety of associated forbs and grasses. Bitterbrush-big sage stands exist on side slopes and washes, which collect drifting snow in winter and as a result receive higher precipitation than surrounding types. During the year 75 percent or more of the antelope feeding time falls within this type, which makes up less than 10 percent of the available range. Precipitation in the area during the six month period from April through September is most important for forb growth.

Production in the big sage-bitterbrush type by all vegetative classes of forage was greater than in the black sage-grass type.

Fawn production was low the first year, but has persisted between 80 to 150 fawns per 100 does. There's been no indication of excessive fawn mortality and the number of yearling and mature does doubled in four years.

The Myton Bench (Duchesne County) is essentially a salt desert shrub type containing about 200,000 acres on a plateau which increases in elevation from 4,700 to 7,000 feet. The vegetative community on the north portion is composed of shad scale, curley grass, with a fair amount of forbs which are dependent upon available moisture. From the central portion of the unit to the pinion-juniper belt the vegetative type is black sagebunch grass with associated forbs. Needle and thread and beardless wheat grass are associated in this type. Water is available in stock ponds and the Green River.

In January, 1971, 76 animals were released on this area and productivity has run 55 fawns per 100 does in 1971, 30 fawns per 100 does in 1972, and 32 fawns per 100 does in 1973.

Hatch Point (San Juan County) is a desert shrub type consisting mainly of sage brush and grassland associations. Elevation from 5,000 to 7,000 feet. Topography is rolling to flat, traversed with small washes, sandstone knobs, small mesa's with a pinion-juniper edge. Flat and rolling topography of

big sage and grass with sheltered valleys offer feed and cover. Big sage, fourwing, rabbitbrush and associated forbs and grass are the major forage species. Snow depth runs 8 - 10" , but doesn't stay long.

In January, 1971, 84 animals were introduced with a subsequent plant of 66 animals in 1972. Productivity ran 66 fawns/100 does in 1972, and 122 fawns/100 does in 1973.

Icelander Wash (Carbon County) is a semi-arid salt desert shrub type plateau of about 120,000 acres. Annual precipitation about 9 inches. Distribution of precipitation is important for forb distribution and growth. Frost free season about 4½ months - May through September. Elevation 6,500 - 7,600 feet. The semi-arid climate limits native vegetation to a salt desert-bunch grass association with a sparse pinion-juniper mixture and a barren soil association. Major browse species are big sage, black sage, rabbitbrush, four-wing and shad scale. The winters are mild.

Productivity ran 85 fawns/100 does in 1972 followed by 53 fawns/100 does in 1973.

Clark Bench (Kane County) runs 4,000 - 5,000 feet in elevation and contains about 54,400 acres of a southwest desert shrub type. The area consists of a sandy soil and large bench areas, which support sand sage, ephedra, four-wing and some big sage with associated forbs and grasses distributed throughout the vegetative associations. The lower country consists mainly of shad scale and a low growing perennial grass, while the bottom lands have a good distribution of ephedra and kocia. There are several permanent waters throughout the area.

In 1971, 105 animals were released in this area. Floyd Coles (Game Manager) says "it appears the transplant should be successful. Antelope have wandered, but appear to be stabilizing in the Coyote and Wahweap Creek areas."

SUMMARY:

These five recent pronghorn transplants have been made in spacious, but diverse topographical areas and vegetative types. The developing herds have not been studied long enough to draw conclusions regarding the differences in herd productivity as related to the various vegetative types in which they have been released; however, it appears those released in the sagebrush-bunch grass associations on the Parker Mountain and Hatch Point are more productive than those released in the salt desert shrub and desert shrub types.

Don Beale says six factors are important for the good antelope range that exists on the Parker Mountain and are the reasons for the success of this transplant.

1. Large acreage and room for several hundred animals.
2. The presence of smooth rolling terrain, which provides easy movement and escape.

3. A large percent of short vegetation, which also aides in easy movement and helps provide good visibility to approaching danger such as from coyotes or bobcats.

4. The considerable amount of succulent and high quality forage that is available on the big sagebrush-bitterbrush types, particularly when the other vegetation types are dry.

5. The presence of abundant watering ponds, which provide easy access for antelope at all times of the year, even during long drought periods.

6. The presence of good winter range near to adjacent summer range with adequate amounts of sagebrush and usually less than 12 inches of snow.

COMMENTS AND QUESTIONS

Barrett: When did you take the fawn-doe ratio count?

Bates: We took them in August.

Oliver: Are we to assume that all transplants are doing fairly well increasing or just increasing at differential levels.

Bates: I think that all the transplants are producing but some at a slower rate--the salt desert type does not have the productivity of the others. Some of these transplants were made in 1972--there has not been enough time lapse to really tell for sure what success or productivity they will show. Parker Mountain plant is the oldest and is doing very well. We have been harvesting animals from this area for several years. The herd has increased about 20 percent each year since the introduction.

Yoakum: Where is Parker Mountain located--near Montecello?

Bates: No. Parker mountain is near Loa. That's in Wayne County.

Yoakum: Where is that in the State?

Bates: It's in the central part of the State.

Yoakum: The one thing that I remember that you mentioned that the second year of productivity was lower than the first year. Was this true of Parker Mountain also?

Bates: No. Fawn-doe ratios have been in the range of 95 fawns to 100 does since the first year.

Yoakum: Did it drop?

Bates: No. The first year of productivity was lowest on Parker Mountain. These others were higher the first year and then the second year they went down.

Audience: Do you remember what your productivity was year before last? Last year on Parker Mountain?

Bates: Yes. 80-90 fawns per 100 does.

Audience: What was it at the highest in your report?

Bates: Over 100 - one year. It's ranged between 80-100 nearly every year in our area other than the first year after introduction.

Audience: How many years after your transplants did you have your first hunt?

Bates: On Parker Mountain the third year.

ANTELOPE FAWN BEDDING COVER SELECTION IN CENTRAL MONTANA[1]

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ABSTRACT:

A study was initiated in central Montana in 1971 to evaluate the importance of sagebrush *(Artemisia tridentata wyomingensis)* as bedding cover for very young antelope *(Antilocapra americana)* fawns. During 1972 and 1973, the vegetative cover at 85 bedding sites of antelope fawns was measured. All sites selected by antelope fawns were in vegetation types containing sagebrush and they often laid next to a sagebrush plant. Our observations indicated that sagebrush was highly desirable if not irreplaceable for good quality fawn bedding cover.

Average percentages of canopy coverage were: sagebrush 21.2, grass 32.0, forbs 13.5, and total 66.7. Average cover volume (cubic feet/100 square feet) was: sagebrush 16.1, grass 14.1, forbs 4.4, and total 34.6. Canopy coverage and cover volume of vegetation life forms, particularly sagebrush and grass, were apparently complementary and decreases in one at a site were often compensated by increases in another, thus making total cover relatively uniform.

Sagebrush/blue grama *(Artemisia tridentata/Bouteloua gracilis,* ARTR/BOGR) appeared to be the preferred vegetation type although there remain some unanswered questions regarding the degree of preference. Sagebrush/bluebunch wheatgrass *(A. tridentata/Agropyron spicatum,* ARTR/AGSP), sagebrush rhizomatous wheatgrass *(A. tridentata/A. dasystachum, A. smithii,* ARTR/AGDA, AGSM), and sagebrush/crested wheatgrass *(A. tridentata/A. desertorum,* ARTR/AGDE) were used approximately as available. Greasewood/sagebrush *(Sarcobatus vermiculatus/A. tridentata,* SAVE/ARTR) and longleaf sagebrush/rabbitbrush *(A. longifolia/Chrysothamnus nauseosus,* ARLO/CHNA) were used less than available.

Bedding sites in ARTR/BOGR and ARTR/AGSP were compared statistically. Significantly more sagebrush occurred at bedding sites in ARTR/BOGR and significantly more grass in ARTR/AGSP. Significantly less cover occurred at 1973 bedding sites than in 1972. Height class 2 grass was reduced 16.7 percent in 1973. Height class 2 sagebrush was the single most important cover constituent.

Frequency distribution of measurements indicated that apparently suitable cover characteristics for fawn bedding cover were: sagebrush 5.1 to 35 percent canopy coverage and 5.1 to 25 cu. ft. cover volume, grass 15.1 to 40 percent canopy coverage and 5.1 to 25 cu. ft. cover volume, forbs .11 to 30 percent canopy coverage and .11 to 10 cu. ft. cover volume, and total canopy coverage of 50 percent or greater and total cover volume of 15 to 50 cu. ft. The higher values might not be properly evaluated due to their rarity in the study area. Lower values could be minimal and maybe not completely satisfactory.

[1]This full report will be available later this spring and can be sent on request.

CONCLUSIONS:

1. This new method of measuring cover volume apparently works and provides quantitative data which can be compared between types, areas, and years.

2. Canopy coverage measurements alone do not reflect changes in cover.

3. Sagebrush is highly desirable if not irreplaceable as antelope fawn bedding cover in central Montana and possibly other places as well.

4. Sagebrush might be the most stable cover element for antelope fawns and does.

5. Reduced cover volume was associated with reduced fawn survival between two years; however, this has not been tested adequately.

6. Different cover types had different potential for antelope fawning cover which was associated with the food and cover values and possibly soil differences.

7. Vegetation classes are complementary to some degree and a fairly wide range of cover values appeared to be suitable; however, good quality antelope fawning cover has minimum limits of shrubs, grasses, forbs, and total cover.

Table 1. Canopy coverage of vegetation classes at antelope fawn bedding sites, 1972-73.

Vegetation Cover Class	Height Class[1]	(N) Measured 1972	(N) Measured 1973	Mean 1972	Mean 1973	Mean Ave.[2]
Sagebrush-Live	1	41	44	3.8	5.4	4.6
	2	41	44	11.5	13.4	12.4
	3	41	44	3.9	3.7	3.8
	4	41	44	.4	.2	.3
Sub-total	All	41	44	19.8[3]	22.7	21.2[3]
Sagebrush-Dead	All	41	44	2.1	2.9	2.5
Grass	1	29	44	16.5	24.9	20.7
	2	29	44	14.2	6.6	10.4
	3	29	44	1.6	.2	.9
Sub-total	All	29	44	32.3	31.6[3]	32.0
Forbs	1	29	44	11.3	11.3	11.3
	2	29	44	3.5	.7	2.1
	3	29	44	.1	0	T
Sub-total	All	29	44	14.9	12.0	13.5
TOTAL[4]	All	(41) (29)	44	67.0	66.3	66.7

[1]1 = 0-6", 2 = 6-12", 3 = 12-18", 4 = 18-24".
[2]Arithmetic average of 1972 and 1973 means.
[3]Totals that do not agree due to rounding of numbers.
[4]Total of live sagebrush, grass, and forbs - not average of transect totals.

Table 2. Cover volume[1] of vegetation classes at antelope fawn bedding sites, 1972-1973.

Vegetation Cover Class	Height Class[2]	(N) Sites Measured		Mean		
		1972	1973	1972	1973	Ave.[3]
Sagebrush	1	41	44	1.0	1.4	1.2
	2	41	44	8.6	10.2	9.4
	3	41	44	4.9	4.6	4.8
	4	41	44	1.0	.5	.8
Sub-total	All	41	44	15.5	16.7	16.1[4]
Grass	1	29	44	4.1	6.2	5.2
	2	29	44	10.7	5.1	7.9
	3	29	44	2.0	.2	1.1
Sub-total	All	29	44	16.8	11.4[4]	14.1[4]
Forbs	1	29	44	2.8	2.8	2.8
	2	29	44	2.6	.6	1.6
	3	29	44	.1	T	T
Sub-total	All	29	44	5.5	3.4	4.4
TOTAL[5]	All	29/41	44	37.8	31.5	34.6

[1]Cover volume = cubic feet/100 square feet.
[2]1 = 0-6", 2 = 6-12", 3 = 12-18", 4 = 18-24".
[3]Arithmetic average of 1972 and 1973 means.
[4]Totals that do not agree due to rounding of numbers.
[5]Total of sagebrush, grass, and forbs - not average of transect totals.

Table 3. Distribution of fawn bedding sites by habitat or cover type as related to availability.

Habitat or Cover Type	Availability[1]	1972 No.	1972 %	1973 No.	1973 %	Total No.	Total %
Artemisia tridentata/Agropyron spicatum	28	14	34	12	27	26	31
Artemisia tridentata/Agropyron rhizomatous	8	6	15	1	2	7	8
Artemisia tridentata/Bouteloua gracilis	13	16	39	24	55	40	47
Artemisia tridentata/Agropyron desertorum	3	0	0	3	7	3	4
Sarcobatus vermiculatus/Artemisia tridentata	14	3	7	4	9	7	8
Artemisia longifolia/Chrysothamnus nauseosus	12	2	5	0	0	2	2
TOTALS	78[1]	41	100	44	100	85	100

[1]Percent of 136,252 acres considered primary antelope habitat; other types account for the remaining 22 percent.

Table 4. Statistical comparison of average canopy coverage of vegetation classes at antelope fawn bedding sites between sagebrush/ bluebunch wheatgrass (ARTR/AGSP) and sagebrush/blue grama (ARTR/BOGR) vegetation types.

		VEGETATION CLASSES									
		SAGE			GRASS			FORBS		TOTAL	
Veg. Type	Year	N[1]	$\bar{X}$	Sig.[2]	N[1]	$\bar{X}$	Sig.[2]	$\bar{X}$	Sig.[2]	$\bar{X}$	Sig.[2]
ARTR/AGSP	1972	14	17.5	A E G	14	32.5	A E G	15.0	A E* G	65.3	A E G
	1973	12	19.0	A F H	12	30.4	A F H	12.2	A F H	61.6	A F H
	72-73	26	18.2	C*	26	31.5	C	13.7	C	63.6	C
ARTR/BOGR	1972	16	24.2	B E H	4	28.2	B E H	5.4	B E* H	59.3	B E H
	1973	24	24.4	B F G	24	31.5	B F G	11.6	B F G	67.6	B F G
	72-73	40	24.4	C*	28	31.0	C	10.7	C	66.4	C
BOTH TYPES	1972	30	21.1	D	18	31.5	D	12.9	D	63.9	D
	1973	36	22.6	D	36	31.1	D	11.8	D	65.6	D
	72-73	66	21.9		54	31.3		12.2		65.0	

1 Number of fawn bedding sites measured.

2 Significance of differences between paired means - letters refer to pairs tested. Example: ARTR/AGSP (1972) was compared to ARTR/AGSP (1973) A-A, ARTR/BOGR (1972) E-E, and ARTR/BOGR (1973) G-G. Of these, none were significantly different.

* Significance at .95 level.

Table 5. Statistical comparison of average cover volumes of vegetation classes at antelope fawn bedding sites between sagebrush/bluebunch wheatgrass (ARTR/AGSP) and sagebrush/blue grama (ARTR/BOGR) vegetation types.

		VEGETATION CLASSES									
		SAGE			GRASS			FORBS		TOTAL	
Veg. Type	Year	N[1]	$\bar{X}$	Sig.[2]	N[1]	$\bar{X}$	Sig.[2]	$\bar{X}$	Sig[2]	$\bar{X}$	Sig.[2]
ARTR/AGSP				A			A		A*		A*
	1972	14	13.6	E	14	19.3	E	6.0	E*	39.2	E
				G			G*		G*		G*
				A			A		A*		A*
	1973	12	13.3	F	12	13.8	F*	3.3	F	30.5	F
				H			H		H		H
	72-73	26	13.5	C*	26	16.7	C*	4.8	C*	35.2	C
ARTR/BOGR				B			B*		B		B
	1972	16	19.4	E	4	14.0	E	1.4	E*	36.5	E
				H			H		H		H
				B			B*		B		B
	1973	24	18.0	F	24	9.2	F*	3.0	F	30.1	F
				G			G*		G*		G*
	72-73	40	18.6	C*	28	9.8	C*	2.8	C*	31.0	C
BOTH TYPES	1972	30	16.7	D	18	18.1	D*	5.0	D*	38.6	D*
	1973	36	16.4	D	36	10.7	D*	3.1	D*	30.3	D*
	72-73	66	16.6		54	13.2		3.8		33.0	

1 Number of fawn bedding sites measured.

2 Significance of differences between paired means - letters refer to pairs tested. Example: ARTR/AGSP (1972) was compared to ARTR/AGSP (1973) A-A, ARTR/BOGR (1972) E-E, and ARTR/BOGR (1973) G-G. Of these A-A and G-G were significantly different.

* Significance at .95 level.

Table 6. Percent frequency distribution of fawn bedding sites by classes of canopy coverage and cover volume.

	1972				1973				Average			
	Sage	Grass	Forbs	Total	Sage	Grass	Forbs	Total	Sage	Grass	Forbs	Total
CANOPY COVERAGE (Percent)												
0 - .1	0	0	0	0	0	0	0	0	0	0	0	0
.11 - 5	2	0	10	0	2	0	20	0	2	0	16	0
5.1 - 10	10	3	31	0	11	0	30	0	11	1	30	0
10.1 - 15	22	3	10	0	16	2	18	0	19	3	15	0
15.1 - 20	24	7	17	0	18	20	16	0	21	15	16	0
20.1 - 25	12	17	14	0	9	9	7	0	11	12	10	0
25.1 - 30	15	14	14	0	11	14	7	0	13	14	10	0
30.1 - 35	10	17	3	4	25	18	2	2	18	18	3	3
35.1 - 40	2	7		4	5	16		0	4	12		2
40.1 - 45	2	10		4		7		0	1	8		2
45.1 - 50		14		7		2		2		7		4
50.1 - 55		7		14		11		16	1	10		15
55.1 - 60+				68				80				74
COVER VOLUME (Cu. Ft./100 Sq. Ft.)												
0 - .1	0	0	0	0	0	0	0	0	0	0	0	0
.11 - 5	7	3	52	0	11	50	84	0	9	3	71	0
5.1 - 10	29	21	34	0	14	23	14	0	21	38	23	0
10.1 - 15	22	34	14	3	23	20	2	2	22	27	5	2
15.1 - 20	12	17		7	14	5		7	13	19	1	7
20.1 - 25	20	7		10	27			14	24	5		12
25.1 - 30	5	7		7	5			16	5	3		12
30.1 - 35	2	7		21	5			32	4	3		26
35.1 - 40		3		10	2			18	1	1		14
40.1 - 45				21				5				13
45.1 - 50	2			14				7	1			10
50.1 - 55				0								0
55.1 - 60+				3								2

COMMENTS AND QUESTIONS

Beale: On the West Desert of Utah there are many areas where sagebrush does not play a part in fawn bedding but perhaps in these areas other browse species take its place. Other browse species such as shadscale. Possibly the physical needs of the fawn are met by other species.

Pyrah: Most of the fawns in slides we saw yesterday, I noticed had made use of sagebrush. The fawns were ordinarily laying next to a sagebrush plant.

Beale: In some areas on the Salt Desert type range we have antelope fawning where there is no sagebrush.

Taylor: Do you try to correlate this with the actual fawning sight itself? Where the doe actually had the fawn? The bedding sight later on?

Pyrah: We only had measurement on about three or four birth sights. Our birth sights seem to have more cover than our fawn bedding sights. A doe frequently chooses quite a dense stand of sagebrush to have her young in. Once she is down, she is almost hidden and the way we see them most of the time is that she gets up and starts turning around while she's in labor and most of our observations indicated that they use a very small spot for parturition, too. I have some pictures (I do not have slides of it) of well tromped down areas with plasental fluids and hair stuck to it where she really does tear up the ground where a fawn is born. With those we have measurements on those of high cover volume up to 50 cubic feet of sagebrush volume.

Zobell: Larry Pate at Casper, Wyoming did some work on fawn bedding sights. This report by Wyoming Game and Fish Commission is probably available through Casper, Wyoming. It has information of about 400 antelope bedding sights.

Pyrah: We are not saying that what is typical in Montana is typical every place else. Some of the same principles of cover might apply. If cover is deficient, will this end up with a smaller fawn crop? Some of the other states that are having trouble with low fawn survival--how does their bedding sight cover compare with what we have?

Autenrieth: We're just getting our feet in the door on this, but on six fawning areas we've analysed some 23 bedding sights with fawns. The birth sights had 22.8% canopy cover compared with 28.3% for the bedding sights. The does were apparently selecting for fawning and the fawns apparently selected for bedding. We tried to measure outside the patch which gave us a mean of 16.3% canopy cover.

ANALYSIS OF SAMPLING PROCEDURES USED FOR ANTELOPE CLASSIFICATION COUNTS

Harvey S. Donoho, Colorado Division of Wildlife
Dale L. Wills, Roosevelt National Forest

ABSTRACT

Colorado antelope management unit A-13 was flown by helicopter along each east-west section line in September, 1973. All antelope seen were classified and their location recorded on a map. Data were analyzed by east-west transect. A total of 1431 miles of transect were flown and 1186 antelope were classified (16% adult males, 60% adult females, and 24% fawns). Systematic comparisons were made among transects to evaluate the sampling intensity necessary to estimate sex ratio (adult males/100 adult females), and production (fawns/100 adult females). Replicate counts were flown over an 80 square mile area on three consecutive days. Replicates were tested for variation in the count technique. Comparisons were made between the September helicopter count and February and September counts flown by a fixed-wing aircraft. An experiment was conducted on both the winter fixed-wing and summer helicopter counts to evaluate the use of a portable video-tape recorder system in increasing accuracy of count data and reducing flight time.

INTRODUCTION

Managers of antelope need good basic population size and structure information for intensive management. In eastern Colorado, antelope management has largely been limited to analysis of variations among attempted total antelope counts as related to an assigned goal to increase, hold or decrease herd size. A demand for more intensive management of this species is mandate in Colorado's growing human population and need for more recreational opportunities from less wildlife habitat. This mandate has required the use of computer simulation modeling of antelope populations for a more accurate prediction of population responses to management strategies. Antelope population size, sex ratio (males/100 females) of adults (>1 year) and production (fawns/100 females) information are believed necessary for adequate simulation of those responses. The need was to gather this information within given time, money and manpower limitations.

STUDY AREA AND METHODS

Antelope Management Unit A-13 was selected to test methods and intensity of sampling necessary to achieve a reasonable degree of confidence (95 percent probability) in data gathered. This management unit lies immediately south of the Nebraska-Colorado boundary in northeastern Colorado. The unit covers approximately 1500 square miles of short-grass prairie interspersed with cultivated crops.

The management unit was flown in September, 1973, by helicopter along each east-west section line. The crew consisted of a pilot and one observer who attempted to get a complete sex and age classification count of the whole antelope population. Individual antelope classified were recorded on a portable tape recorder. A number was given each observation of one or more antelope. This observation number was plotted on a map indicating the location of the antelope to the nearest one-half mile.

Data were grouped and analized by each east-west transect. To cover the entire management unit, 28 transects, totaling 1431 miles and 41 flight hours, were flown. The total count was assumed absolute for the purpose of establishing sampling intensity for each type of data desired. First, comparisons were made between every other transect (from north to south), then every third transect, then fourth transect and so on. The first sampling scheme gave two samples of the test population, the second three samples and so on. Statistical comparisons were made between samples of each scheme.

Replicate counts were flown over an 80 square mile area within the management unit. Replicates were flown on three consecutive days, during identical time periods, to estimate data variability inherent to the helicopter count technique and not attributable to the antelope population.

A comparison was made between the total management unit helicopter count (September) and a simular total count made from a fixed-wing aircraft (Cessna 185) the previous February. Another comparison was made between the total management unit helicopter count and a sample (every fourth transect) classification count from the fixed-wing aircraft during the same month (September).

A video-tape recorder system was used during some flights to test accuracy of counting and classifying antelope from aircraft. The video-tape system was capable of increasing accuracy of data and reducing flight time.

RESULTS AND DISCUSSION

Analysis of sampling schemes (intensity) revealed a high degree of variability when total population size was predicted (Table 1). These results indicated a non-random distribution of antelope. If the antelope distribution had been known prior to the count, sampling schemes could have been stratified. However, seasonal distribution was uncertain. As near a complete count as possible was necessary to establish an initial population for simulation modeling.

Ratios had more mathematical stability than numbers. Changes in sex and production ratios were used to monitor population changes and continually update the model. The sex ratio of adults were most efficiently estimated by counting every third

transect. The mean and ±95 percent confidence intervals were 27.66 ± 21.59 males/100 females. Production was estimated by counting every fifth transect. The mean and ±95 percent confidence intervals were 38.8 ± 9.2 fawns/100 does. At least every third east-west transect must have been counted to get both sex and production ratios.

Replicates over the 80 square miles test area showed a mean and 95 percent confidence intervals of 28.7 ± 79.6 males/100 females and 21.7 ± 10.8 fawns/100 females. These data were considered inconclusive because of conditioned escape behavior affects the helicopter had on the antelope. Perhaps a one week interval between replicate counts would have decreased these affects with a resultant decrease in count variability.

A total of 1186 antelope were counted from a helicopter in management unit A-13 in September 1973 and 1588 were counted from a fixed-wing aircraft in February 1973. There was no good explanation for the magnitude and direction of the discrepancy between these two counts. Movements and mortality could have been responsible for part of the discrepancy. However, it was doubtful that these two factors were capable of offsetting an estimated 32 percent increment into the population through production plus the implied loss of at least 402 adult antelope. There has been no evidence or mortality of this magnitude effecting the

population. An alternative hypothesis is to assume a variance in the "total" counts with that of actual population numbers.

A fixed-wing aircraft antelope count every fourth transect again showed the relative instability of male counts when compared to the helicopter total count (Table 2). The ratio of fawns to adult females again was remarkably stable.

Helicopter antelope counts taken from video-taped reproductions of antelope herds were significantly ($P < 0.05$) different and greater than conventional methods. Video-taped reproductions of herds counted from a fixed-wing aircraft were significantly ($P < 0.05$) different and less than conventional methods. The video-tape provided nearly indisputable evidence of herd sizes; therefore, discrepancies were attributed to inaccurate field counts.

A helicopter was used to classify individuals in 62 herds of antelope. There were no significant ($P > 0.05$) differences between numbers of antelope classified as does or bucks between conventional and video methods. There was a significant ($P < 0.05$) difference between numbers of fawns counted. The mean difference ($\pm$ 95 percent confidence intervals) between paired observations was -0.35 (-0.696 to -0.004). Because of misclassification of fawns as does the video method showed a 15 percent decrease in fawns/100 does and a 4 percent decrease in bucks/100 does as compared to conventional method results. Conventional classification data were assumed to be the more accurate.

The video-tape system did not appear to save flight time when used on herds of less than 10 animals. Time saved increased in direct proportion to increasing herd size above 10 animals. A minimum of 5 seconds and a maximum of 1/2 minute was required to tape each herd regardless of size. Roughly, 5 additional seconds were required to conventionally count and classify each additional increment of 10 animals per herd. Based on 62 comparable antelope herds, the time saved averaged approximately 10 seconds per herd.

Table 1. Predictions of total population size from four transect sampling intensities. The assumed true population was 1186 antelope.

Transect Sampling Intensity	Samples Mean	± 1/	Predicted Population Mean	± 1/
Every other	593	408	1186	816
Every third	395	1036	1185	3108
Every fourth	296	456	1184	1824
Every fifth	237	207	1185	1035

1/ ± 95% confidence intervals

Table 2. Comparison of results between winter and summer total counts and helicopter and fixed-wing aircraft counts.

Aircraft	Count Date	Males Per 100 Females	Fawns Per 100 Females	Total Counted
Helicopter	September 1973	27	40	1186
Fixed-wing	September 1973	43	43	436
Fixed-wing	February 1973	--	--	1588

A PORTABLE VIDEO-TAPE SYSTEM FOR COUNTING AND CLASSIFYING BIG GAME

Harvey S. Donoho, Colorado Division of Wildlife
Dale L. Wills, Roosevelt National Forest

ABSTRACT

Standard aerial field data census methods were compared with censuses made from video-taped reproductions of the same animals. Total counts from the tape were significantly different and greater than conventional methods. Counts made from the tape were assumed to be more accurate. Sex ratios (males/100 females) were reduced four percent and production ratios (fawns/100 does) were reduced fifteen percent by the use of the video method. The most common discrepancy was misidentification of fawns as does. Bucks were readily distinguishable. The video-tape system would have saved approximately ten seconds per antelope herd recorded. The video-tape system should be useful to the manager by increasing accuracy of some field data, reducing data collection time, improving inter- and intra-agency communications and aiding public relations.

A portable video-tape camera-recorder unit was used this past year in conjunction with standard aerial big game counts made by experienced observers. The tape allowed "instant replay" of game herd observations. Standard count data, taken in the field were compared with counts made in the office, or motel room, from video-tapes.

Significant ($P < 0.05$) differences were found in estimated sizes of 16 antelope (Antilocapra americana) herds counted from a fixed-wing aircraft (Cessna 185). Differences (video minus standard) ranged from -1 to 10 on herd sizes of 12 to 56 head each. The mean difference (±95% confidence intervals) was 2.2 ± 1.8 antelope. Generally, differences between paired observations increased in magnitude in direct proportion to increasing herd size. The video-tape provided indisputable evidence of herd size; therefore, discrepancies were attributed to inaccurate field counts.

Skill in the physical operation of the camera and getting the most out of available light conditions made classification of adult male, adult female and young-of-the-year possible. A helicopter was used to make 62 observations of antelope (observations ranged from 1 to 22 head each). There were no significant ($P > 0.05$) differences between numbers of antelope classified as does or bucks between standard and video methods. There was a significant ($P < 0.05$) difference between numbers of fawns counted. The mean difference (±95% confidence intervals) between paired observations was -0.35 (-0.696 to -0.004). Because of misclassifying fawns as does the video method showed a 15 percent decrease in fawns per 100 does and a 4 percent decrease in bucks per 100 does as compared to standard method results. Field classification data were assumed to be the more accurate. Relatively poor resolution capacity of the tape, taping at too great a distance from animals, poor camera operation technique (eg. avoidable camera movement, incorrect lens setting, inadequate framing of individuals and framing sequence of herds, etc.) poor light conditions, and the size variable relationship between fawns and does are potential causes of classification errors from taped reproductions.

Hard data using this technique are not yet available for other game species. Limited use of the video-tape equipment on mule deer (Odocoileus hemionus), elk (Cervus canadensis), and bighorn sheep (Ovis canadensis) show similar results to antelope data.

The video-tape system did not appear to save flight time when used on herds of less than 10 animals (approximately ½ minute per herd). Time saved increased in direct proportion to increasing herd size above 10 animals. A minimum of 5 seconds and a maximum of ½ minute was required to tape each herd regardless of herd size. Roughly, 5 additional seconds were required to field count and classify each additional increment of 10 animals per herd. Based on 62 comparable antelope herds, the time saved averaged approximately 10 seconds per herd. The net savings would have been approximately 10 minutes of flying time.

The main advantages of the video-tape system are: (1) instant replay without film development costs or time requirements, (2) animal movement is detectable, allowing for easier recognition of subjects, (3) tape reel length allows a full 30 minutes of recording time, (4) close inspection of subjects can be made by stopping the tape and

"hands-on" manipulation of tape reels, (5) a zoom lens (12.5 mm to 75 mm) allows versatility in framing herds or individuals, (6) sections of recorded tape can be edited to another tape for storage or copies can be made at a low cost if a second recorder is available, (7) audio is recorded and synchronized with video at the time of original recording, (8) tapes are reuseable almost indefinitely (>100 times). A portable video-tape system has the potential and flexibility of being useful to the manager in all phases of the management operation, from basic field data collection to formal presentations of the data to commission, and at technical, interagency, and public meetings.

Audience: What is used to power the recorder?

Wills: The recorder operates off a rechargeable battery and this is what it is operating off of now; also you have a convertor that you can recharge and operate off 110 volt.

Audience: How long can you operate on one charge?

Wills: The battery, when they're new, will get about 30 minutes--that's "on time" with the recorder, that means not recording time, but if you have to have the recorder on, or if it's on such as this, it would be on and your camera would be warmed up and it's running your battery down, so what we did was to shut it off and then each time (if the battery was fresh) it would take about 2 seconds to warm up. As the battery would run down, it would take about 3 or 4 seconds, then 5 seconds, and pretty soon it would be real slow, but it would be much better if you could just turn it on and leave it on.

Audience: How long does it take to recharge?

Wills: They recharge in about $2\frac{1}{2}$ hours or so.

Donoho: They have a larger auxiliary battery pack.

Wills: This is true--they have a bigger battery pack which is a pretty good sized unit and this will give you a long time. Again it is rechargeable.

Zobell: How many total counts did you fly? Was it in cloudy weather or sunlight?

Wills: Mostly in sunlight. I went right along with Harvey and whenever he was making his count, we would try to put some of the same stuff on tape--we didn't want to use special conditions.

Zobell: What I'm getting at is: Did your equipment work in any condition? Could you fly in all kinds of weather?

Donoho: If the weather was too poor we'd stop the count, generally we tried to fly when it was clear.

Wills: It certainly helps, if you are going to use the recorder, to position yourself with the sun at your back so you are not shooting into the sun.

Compton: What time of day did you take the total count? Did you go all the way through the day?

Wills: The total count?

Compton: Yes.

We found that this could cause gross error, particularly that period from about 9 o'clock until about four. The sun being hot, the observability of antelope at that time was effecting the count, we were getting a lot of reflection off the sagebrush and the antelope were hard to observe. This sould create a very bad gross error.

Wills: We're sure of this. The antelope bed down at this time and you can't see them. We didn't do anything special to tape as opposed to the way Harvey was conducting his count. We just rode along in the middle seat and took pictures.

Montei: What was the cost of the unit?

Wills: The cost of this particular recorder and the camera, tripod, and battery pack and a few things like this, runs about $1700. If you were going to buy one, I certainly recommend you shop around with various brands because we talked at a Wildlife Society meeting on it and Harvey had another fellow come up and he demonstrated another unit (I can't remember what the brand was) but it appeared that it had some advantages that the Sony did not have. So if you were going to buy one, say you were talking in the neighborhood of $2000 for a portable unit, I would check on several kinds.

A STUDY OF THE GREAT DIVIDE ANTELOPE HERD, MOFFAT COUNTY COLORADO (WITH SPECIAL EMPHASIS ON HERD DYNAMICS)

Claude E. White, Colorado Division of Wildlife

The vast 1000 square mile area of Antelope Area 3 was subjected to its first intensive census with fixed wing aircraft in November of 1967. Previously, the area had been spot checked and the number of antelope permits established on only a portion of the herd. The census of over 1500 animals was far higher than the number thought to inhabit the area.

In 1968, the area was divided into 5 sub units and reflown on an intensive ½ mile grid by sub unit. Ground studies were initiated to secure data with regard to herd movements, fawning and breeding areas, emigration and immigration data, and related multiple use data involving sheep, cattle, horses, and deer.

The census in 1968 and 1969 revealed that the herd was a vigorous and rapidly expanding antelope herd. It was obvious that successful management of the hered could not be initiated without more accurate data from harvest, herd composition and production.

In 1970, check stations were established to cross check data from our random surveys and to pinpoint areas of hunter preference and kill. Time was set up in the budget for helicopter time to establish both pre and post-season classification flights. The pre-season flight would be flown in September and the post-season flight would be flown in October immediately after the antelope season.

The fixed wing census flights were continued but were shifted from November to March and April in order to more accurately determine the extent of total herd drain from hunting season to the beginning of the fawning period.

Check station operations provided data with regard to sex and age composition of the harvest, hunter concentration and kill data and hunter saturation if any. Sex and age was determined by means of known age jaw boards and by dental cementum.

The decision to model the Area 3 antelope herd was made in 1972 and results from the above operations were placed in the computer at Colorado State University under the direction of Mr. Jack Gross, Acting Director of the CSU Coop. Unit. Simulations from the trial model were reviewed in 1973 and new simulations were run with the addition of the 1973 classification data.

In addition, herd population estimations were made using a formula developed by Doctor David Baudin of CSU. These data were cross checked by means of population projections based on the annual census. The decision was made to place the accuracy of the census at 90 percent of actual ground population prior to fawning.

Coordination was established with the Craig Office of the BLM relative to maximum herd numbers and impact of the herd on the area. A task force from the BLM Colorado Office established that the area could support 6000 wintering animals. Data was provided indicating additional use by 10,114 cattle, 65,745 sheep, 150 horses and about 11,000 deer on the area.

A review of antelope winter distribution patterns was completed and results indicated that winter antelope use was extremely intensive on three major wintering areas. During winters of heavy snows, the herd was vulnerable to severe winter loss. The major portion of sheep use in the area occurs in and adjacent to these three wintering areas. From this review, the decision was made to hold the herd at 4700 to 5000 wintering animals.

One of the more important factors considered in the review was the status of sage grouse in thearea. Antelope Area 3 contains the largest and most viable flock of sage grouse in Colorado.

The probability existed that given severe overuse by antelope, sheep and deer on the winter range areas, this would be very detrimental to the 12,000 plus sage grouse of the unit. During the past ten years, fire, the intrusion of wheat fields, spraying and discing had already severely reduced existing sage grouse habitat. It was felt that further reduction should be halted if possible.

HERD COMPOSITION

The composition of the Area 3 antelope herd is secured by means of both pre and post season classification flights by helicopter. Sample size was arbitrarily set at 1000 to 1500 animals per flight. The time required to secure this sample ranges from 5.5 hours to 7.5 hours, of actual classification time.

The 1000 square mile herd area was divided into five sub units, based on previously determined herd distribution patterns. It was known that preferred fawning areas and male distribution patterns were fairly consistent on an annual basis. In order to secure an adequate random sample of all of these areas, and portions of the herd therein, the decision was made to spread the sample evenly over all portions of each sub unit. It is possible to secure an adequate sample size from 60 percent of the area now flown. It is believed that if we did this, possible distortion of sex ratios achieved could occur, particularly on the male side.

MALE COMPOSITION OF THE HERD

Male composition data for the 4 year study period is remarkably consistent. A steady decline in the number of bucks per 100 does is evident. The number of males per 100 does declined from 57 in 1970 to 43 in 1973. The percent yearling males increased slightly, from 9.4 percent in 1970 to 11.7 percent in 1973.

In general, the harvest under the two listed management regimes has not materially effected the male composition other than the steady decline in numbers of trophy bucks 2½ years old or older.

FEMALE COMPOSITION OF THE HERD

The percent of females in the herd as indicated by pre-season data has steadily increased since the study was initiated. Data from the post-season sample shows

good consistency until 1973 when an unexpected drop in production forced the female portion of the sample up.

The most inconsistent data present in the 4 year study is the annual production. This was accentuated in 1973 as a direct result of a severe winter loss in the winter of 1972-73. This loss was estimated to be 400 to 500 animals, mostly fawns. Severe winter stress on the does resulted in a subsequent drop in production in 1973.

CHANGES IN HERD COMPOSITION AS A RESULT OF HARVEST

The steady decline of males in the pre-season sample is reflected primarily in the adult or trophy class 2½ years or older. Three years of check station data indicates that the percentage of adult males in the harvest declined from 53.3 percent in 1970 to 30.3 percent in 1972. During the same period, the percent of yearling males in the harvest declined 7.2 percent.

Harvest of females during the period has been insignificant.

SUMMARY

It was evident by 1970, that the Area 3 antelope herd was expanding rapidly and was underharvested. Since the crucial winter range areas were becoming overused and in direct competition with sheep, cattle and horses, and deer, an effort had to be made to halt the herds rapid increase.

Accordingly, the management regime was changed and two years of 1000 either sex permits were supplemented by 500 doe only permits. The new regime had little effect in halting herd increase.

In the winter of 1972-73, a severe winter loss of 400 to 500 animals, and a subsequent drop in herd production did finally halt the major portion of the herds increase.

When the winter loss and drop in herd production became known, the management regime was changed for the 1973 season to 800 either sex permits. As indicated by the 1973 post season data, the herd responded in a positive manner.

The decline in the percent yearlings in the herd halted and the percent mature bucks increased significantly. The percent of does in the herd increased to a further degree as a result of the drop in the 1973 fawn crop.

All available data was subjected to computer simulation at Colorado State University, under the direction of Mr. Jack Gross, Acting Director of the Colorado State Coop. Unit.

Prior to the 1973 antelope season, simulations were completed for two management regimes; 800 Either Sex permits and 1000 Either Sex permits.

In addition, because of hunter selectivity which dictates a high percentage of bucks in the harvest, one simulation, specified hunting for both bucks and does, was completed to show the effect of specified hunting in holding the herd at a specified level without materially changing herd composition.

The results indicate that an annual harvest of 850 to 900 bucks and 350 to 400 does would accomplish our objectives.

These objectives are: 1. To hold the herd at 4700 to 5000 wintering animals. 2. To maintain as a continuing resource, a high percentage of trophy animals, 2½ years old or older.

NORTHWEST REGION

AREA 3 ANTELOPE

SEX AND AGE RATIOS

Pre-Sea.

	1970		1971		1972		1973		1974		1975	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bucks	298	23.7	391	24.9	342	21.8	260	22.0				
Does	524	42.0	705	44.8	711	45.3	600	50.8				
Fawns	431	34.3	478	30.3	515	32.8	321	27.2				
Total	1253		1574		1568		1181					
Ratios	57/100/82		55/100/68		48/100/72		43/100/54					

Post-Season

	1970		1971		1972		1973		1974		1975	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bucks	223	14.4	222	15.7	226	15.9	275	17.9				
Does	816	52.8	746	53.0	747	52.8	946	61.5				
Fawns	507	32.8	439	31.3	442	31.3	315	20.5				
Total	1546		1407		1415		1536					
Ratios	27/100/62		29/100/59		30/100/59		29.0/100/33.3					

PERCENT YEARLING MALES

	1970	1971	1972	1973	1974	1975
Pre-Season	--	13.0	13.4	11.5		
Post Season	9.4	9.73	10.04	11.7		

NORTHWEST REGION

AREA 3 ANTELOPE

CENSUS

1968	1969	1970	1971	1972	1973	1974
1857	2523	2852	3542	4073	4060	

HARVEST

CHECK STATION

	1970		1971		1972	
	No.	%	No.	%	No.	%
Adult Males	154	53.3	141	34.8	118	30.3
Ylng Males	79	27.3	90	22.1	78	20.1
Male Fawns	11	3.8	36	8.8	44	11.3
Ad. Females	28	9.7	96	23.5	82	20.6
Ylng Females	10	3.5	19	4.6	28	8.0
Fem. Fawns	7	2.4	26	6.4	40	9.8

YEARLING HARVEST

1970	30.8%
1971	26.7%
1972	28.0%

RANDOM SURVEY

	1968		1969		1970		1971		1972		1973		1974	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bucks	193	82.5	406	78.8	762	81.2	731	54.0	669	49.7	496	75.5		
Does	37	15.8	101	19.6	159	17.0	443	32.7	475	35.3	125	19.0		
Fawns	4	1.7	8	1.6	17	1.8	180	13.3	201	14.9	36	5.5		
	234		515		938		1354		1345		657			

ANTELOPE AREA 3 - MOFFAT COUNTY COLORADO

MANAGEMENT REGIMES

1970	1971	1972	1973
1000 Either Sex Permits	1000 Either Sex 500 Doe only	1000 Either Sex 500 Doe only	800 Either Sex Permits

HARVEST DATA

PROJECTED POPULATION (MARCH)

3137 Pre-Season Pop. = 4455			3896 Pre-Season Pop. = 6112			4480 Pre-Season Pop. = 6509			4466 Pre-Season Pop. = 5680		
	#	%		#	%		#	%		#	%
Bucks	762	81.2	Bucks	731	54.0	Bucks	669	49.7	Bucks	496	75.5
Does	159	17.0	Does	443	32.7	Does	475	35.3	Does	125	19.0
Fawns	17	1.8	Fawns	180	13.3	Fawns	201	14.9	Fawns	36	5.5
Total	938	100		1354	100		1345	100		657	100

Harvest 21.05% of the Pre-Season Population	Harvest 22.15% of the Pre-Season Population	Harvest 20.6% of the Pre-Season Population	Harvest 11.5% of the Pre-Season Population
Hunter Success Ratio	Hunter Success Ratio	Hunter Success Ratio	Hunter Success Ratio

# Hunters	Success	# Hunters	Success	# Hunters	Success	# Hunters	Success
974	96%	1421	95%	1429	94%	740	89%

1972-73 winter loss was severe - 400-500 animals lost.

FORMAT FOR KANSAS' FIRST ANTELOPE SEASON[1/2/]

by

Kent Montei[3/] and Bill D. Hlavachick[4/]

INTRODUCTION

Every Fish and Game Department has a goal of bringing to the sportsman an opportunity to hunt a variety of wildlife species. In the early 1960's Kansas embarked on a feasibility study into the possibility of returning the pronghorn antelope (Antilocapra americana) to their native range in western Kansas. In 1974, Kansas hopes to initiate their first antelope hunting season. The season will be limited in comparison to that of many other antelope hunting states, but sportsman interest is already mounting. Now that the antelope has returned to Kansas the Commission must decide on the best methods in which to conduct a season.

HABITAT OF MAJOR ANTELOPE RANGE

Topography and Climate

Antelope occupy roughly 250,000 acres in Wallace, Sherman, and Logan counties in western Kansas. The terrain varys from a gently rolling type to broken ravines and stream bottoms. The Smoky Hill River is the prominent river valley.

Annual precipitation averages near 17 inches. Average high temperatures approach 80°F in July and dip to 23°F in January. Average snowfall of 28 inches

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1/ A contribution from Kansas Federal Aid Project W-23-R.
2/ A paper presented at the Sixth Antelope States Workshop, February 20-21, 1974, Salt Lake City, Utah.
3/ Kansas Forestry, Fish and Game Commission, Hays, Kansas.
4/ Kansas Forestry, Fish and Game Commission, Pratt, Kansas.

occurs during the October to May period with March showing the greatest monthly average.

Dominant Plants

A short grass community of Bouteloua, Buchloa, and Agropyron provide the vegetative makeup of the occupied antelope range. Buffalo grass (Buchloe dactyloides) and blue grama (Bouteloua gracilis) are dominant on uplands and dryer sites. Western wheat grass (Agropyron smithii) is found predominantly on lowlands and wetter areas.

Scattered throughout the occupied range are areas, usually on rolling hill-tops, of snakeweed (Gutierrezia sarothrea). Prickly pear (Opuntia sp.), few-flowered scurfpea (Psoralea tenuiflora), buffalo bur (Solanom rostratum), western ragweed (Ambrosia psilastachya), Russian thistle (Salsola kali), needle and thread grass (Stipa comata), red three-awn (Aristida longiseta), sunflower (Helianthus sp.), soapweed (Yucca sp.), and sand sage (Artemisia filifolia) are some of the more prominent species found on the antelope range.

Cultivated crops are interspered throughout the antelope range and often supplement the diet of antelope at certain times of the year. During the winter, antelope herds can regularly be located near winter wheat, a major food source through the winter.

Water

Water courses running through the range are of the small intermittent type, flowing only during excessive run-offs, usually during the spring and in times of heavy precipitation. Windmills and stock tanks usually provide a constant free water supply during the summer and fall months.

HISTORY OF ANTELOPE MANAGEMENT IN KANSAS

Transplanting Program

A 1963 summer survey showed 56 antelope in the state. These were scattered in small groups and were thought to be in danger of extirpation. When the habitat was found sufficient to warrent maintaining an antelope population, an antelope transplant program and negotiations for transplant stock were begun with Montana. In 1964, Montana delivered 75 head of antelope to be released at two sites in western Kansas.

Population Growth and Structure

Through 1969 the antelope population increased at an annual rate of 17%. The population had its first substantial growth during the 1967 season when antelope numbers reached 211 or 67 over the previous year (Figure 1). In January 1973, the population had reached 531 with the herd increasing at over a 20% annual rate during the 1969-73 period.

The antelope population has shown a good fraction of fawns (Figure 2). During 1969-1973, fawns have accounted for 29% of the population. Bucks and does made up 32% and 39% of the herd, respectively.

The 1973 summer survey showed the population contained 22% fawns. Although the past year had a decrease in fawning, the feelings were that the time had arrived to begin harvesting the antelope herd in western Kansas.

ANTELOPE SEASON

Once our antelope population reached a huntable size, recommendations governing the season that would provide a desired harvest were needed. Listed are recommendations that will be presented for Commission approval. As previously mentioned the antelope season will be very restricted in area open, length of

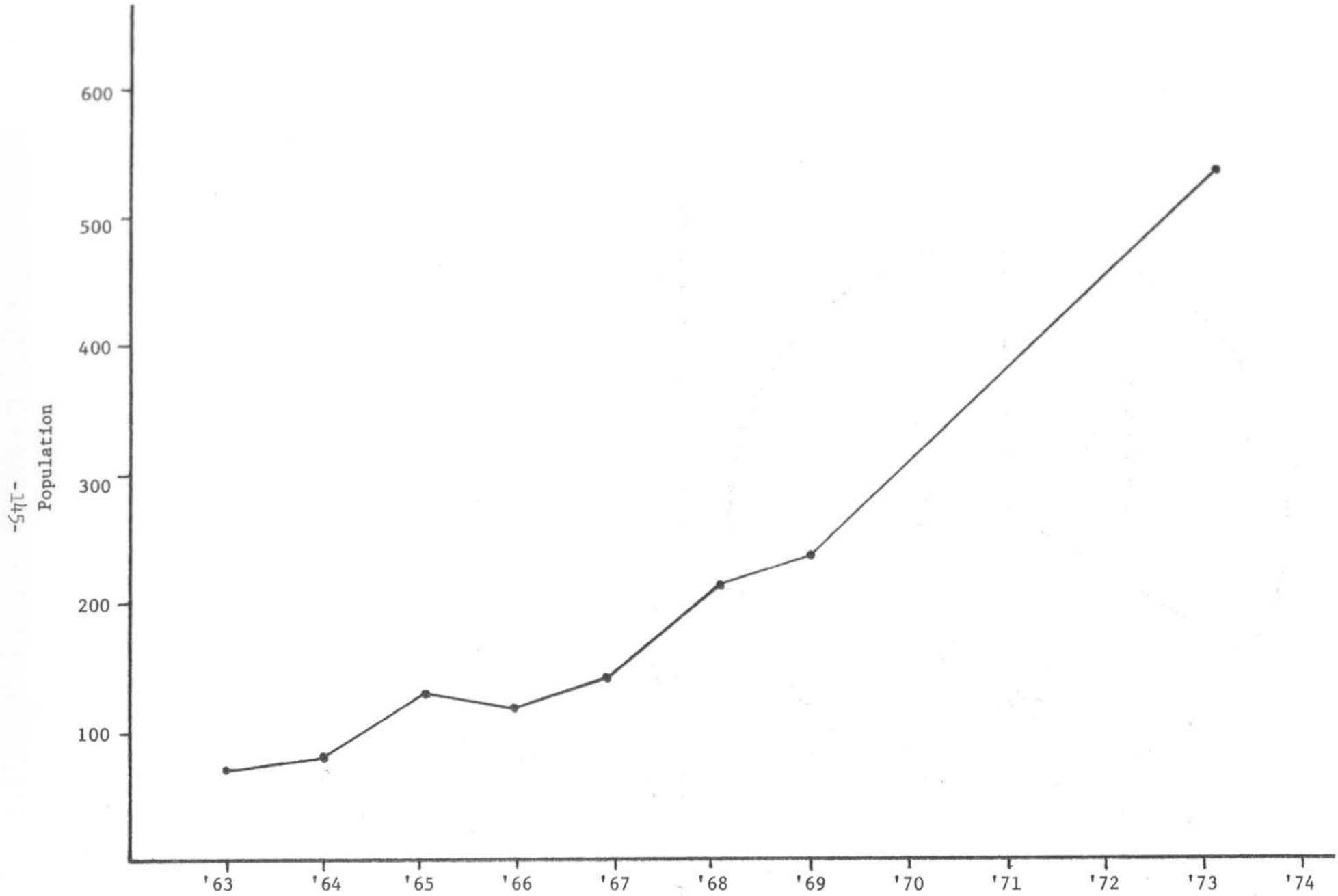

Figure 1. Winter survey of Kansas antelope.

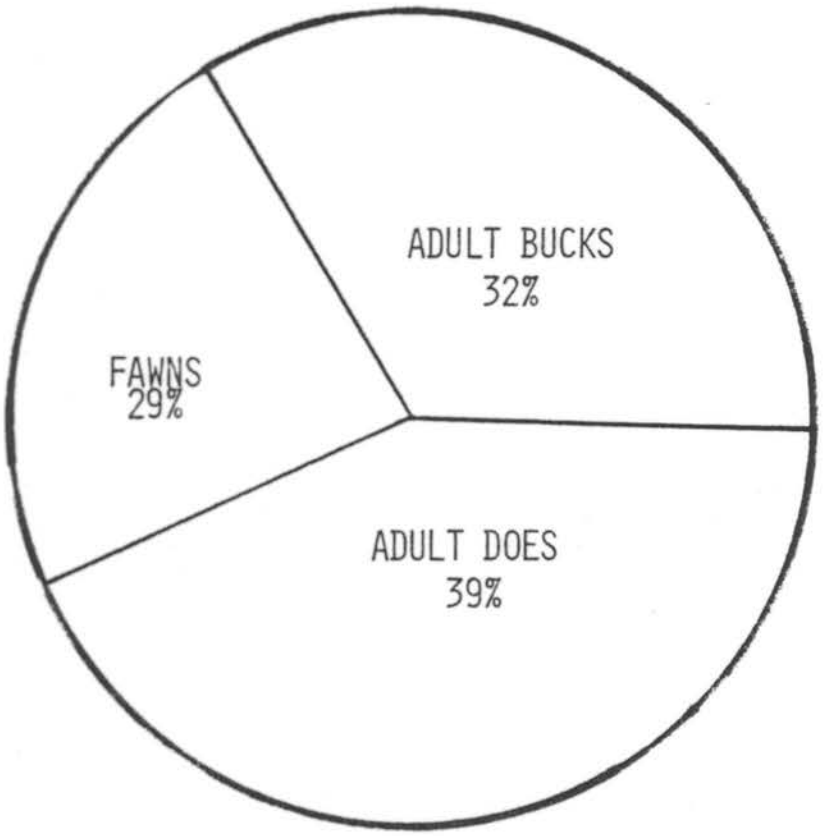

Figure 2. Average percent of bucks, does, and fawns in total antelope population during 1969-1973.

season, and number of hunters. Many have questioned the wisdom of having a season that undoubtly will cost the Commission more money than it will receive through the sale of licenses. But, a natural resource is being wasted and landowner attitudes towards antelope are becomming more and more possessive. Public relations to an antelope season may actually far outweigh the cost. Kansas needs an antelope season, and the Commission needs recommendations that will provide a good example for future years.

Recommendations

1. A three day season starting on Saturday, September 28, and running through Monday, September 30. These dates should allow for a greater hunter success since antelope are still scattered, should not interfere with reproduction since the season follows the peak breeding period, and should still provide good trophy animals. The September season may conflict with ranching operations, and warm weather may make for less than ideal hunting conditions.

2. Area open to antelope hunting is shown in Figure 3. The area in Wallace, Sherman, and Logan counties lying between the North Fork of the Smoky Hill River and old U.S. 40 would be open.

3. A bag limit of one antelope of either sex is recommended. Most hunters will undoubtedly try for a buck. By allowing does to be legal, a precedent will be set for future seasons.

4. The recommended number of permits is 75. This figure represents about 12% of the herd. Since we anticipate a hunter success near 90%, the total harvest should run around 10-11% of the population. This is a very conservative harvest, but feelings are that it would be better to underharvest rather than over-harvest the first year. A problem may develope if hunters are only

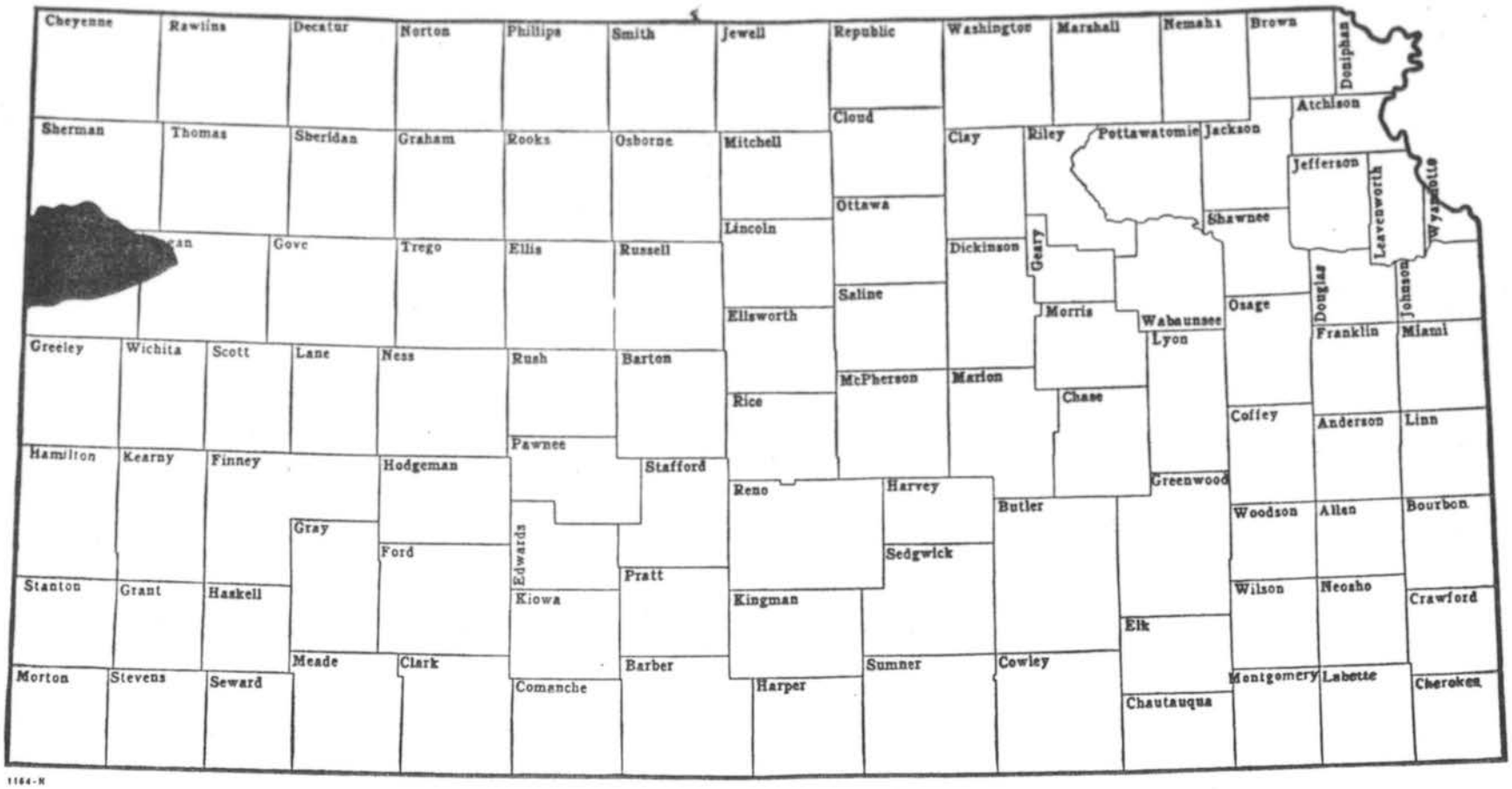

Figure 3. Area open for antelope season.

allowed access to a few areas. This low permit number should help insure that no herds are over-harvested.

Kansas law already provides for the issuance of 50% of the permits (38) to landowners and 50% to general residents (37). The fee for 1974 has been set at $10 increasing to $15 in 1975 with only Kansas residents qualified to receive a permit.

5. Legal weapons for hunting antelope would be rifles capable of firing a bullet greater than 0.23 (23/100 in dia.) caliber. Only soft-nose hollow point or other expanding bullets would be legal.

   Legal archery equipment would be a long bow of not less than 35 pounds pull at 28 inches of draw. Legal hunting arrows shall be equipped with broadhead points of which all parts are fabricated from steel.

6. Commission personnel will establish two check stations that will be operated through the entire season. All harvested antelope will be required to be brought to the station. Weight, sex, location of kill, and lower incisors will be obtained from each antelope. Successful hunters will collect and turn in a blood sample. Graduate students will determine age structure through tooth annuli; and hopefully students will help with a rumen analysis (collection of latter by students and/or hunters).

   A hunter questionnaire card will be issued to all permittees and each will be required to return this card. This survey will provide total harvest, percent success, man-hours of hunting, and other pertinent information.

7. One suggestion for the season would be a pre-season clinic for permittees. This clinic would instruct the sportsmen in sex identification and

recognition of trophy animals. The clinic could be held the Friday before the opening day of the season. Suggestions for landowner acceptance program have been discussed, but a good practical program has not been developed.

CONCLUSION

Kansas has waited ten years for the antelope population to reach a safe huntable size. Hopefully, recommendations will be accepted to establish a 1974 September antelope season. It is also hoped that a transplanting program involving Kansas antelope will be initiated. Field reconnaissance has shown that Kansas has other areas that should support an antelope population. Maybe in the coming years Kansas can provide its sportsman with the opportunity to hunt antelope in several areas throughout the state.

Barrett: How many antelope do you think this area will support? How does the 600 antelope compare to what your investigations indicate the carrying capacity to be?

Montie: As of today, the work that has been done indicates it could support several hundred and we are probably getting close to that number. I think before we actually reach carrying capacity, our landowners may start telling us they've had about enough. We're not getting any feedback, very few complaints. Like I said, the antelope did hit winter wheat, but we're getting very few complaints. Most of the landowners are so excited in just seeing the antelope around and they're really not doing any harm, so they found out. But I think we can get a couple more hundred in this particular area. If you noticed, I mentioned that on to the east of this area there is good antelope range, what looks like it anyway, that they should move into. They haven't been moving much as yet, they've just been building up withinthe area. We finally did have a herd that crossed the highway and set up a population of about thirty now, so it is beginning to move to the east, but I think prior to reaching our full level we may have the landowners thinking we are getting quite a few.

Barrett: Could you tell us what summer density of antelope per square mile you have?

Montie: We have about 250,000 acres there and we've got somewhere around 600 to 650 antelope now. Whatever that figures up to.

Audience: The person who draws antelope permits--will he have access to the area on private range? The private landowner--will he have to pay?

Montie: I don't know about paying. There are some leasing of land for hunting rights, but Kansas has very little paid hunting as far as paying to get on land on a day basis. We may see from this thing that the landowners learn that they can do this. Usually the landownership is small enough--most of them a couple thousand acres, so we are talking about a large number of landowners. Many of them own just maybe a section and so there are usually enough that they will say go ahead and hunt, but we have very little of this paid hunting. As far as the hunter, he will have to get permission from the private landowner. This is why we are kind of indifferent (as most everyone here is) that we don't have any public hunting--well, we do have public hunting--but not in large tracks like public land that we could have antelope on. The only large track we do have is the grasslands in the southwestern portion of the state, but we really have no public lands that we can put antelope on, so this is a problem.

Audience: How will the hunter know who the landowner is?

Montie: This is his responsibility to find out. You can go into courthouses and they have the records of who owns what land and there's enough farm houses out there that you can travel around and ask. So if you get a permit, you won't be able to ride out Friday and start knocking on doors to hunt--you're going to have to make an extra trip or make some contact early. So most of our hunters during the first year will come from the western part of Kansas and most of them will be probably from the northwestern part of the state.

Compton: I want to commend you on your starting off with either sex.

Montie: Thank you.

Compton: I'd be very careful with your indoctrination session also. We have over-sold this trophy hunting in all of our species and it is showing up in our bighorn sheep now, so I would be very careful about gearing it just to trophy hunting.

Audience: Would you review your winter snow condition?

Montie: We get about 28 inches total throughout the winter, and I can mention that very little of it will accumulate. This year we had what was unusual, in that we did have accumulation of about 16 inches in that area for about three weeks, but even in this we had a lot of wind, and this was a real soft snow--so most of the wheat fields were open and this is where you find the antelope. We really don't have a lot of problem with snow build-up and staying for any length of time.

Schwartz: A comment on giving half your licenses to resident landowners. Have you received feedback from landowners that they expect to receive a proportion of the permits? The reason I'm concerned with this is because in Iowa the landowner automatically gets a free hunting permit. Any additional permits are then given out to the public. We are running into problems now with the deer season. Landowners expect this and if they don't get it they close their land off to hunting. Our deer biologists feel that if we could go back and do the whole thing over, there should be no such thing as special consideration to landowner permits. We are starting the turkey season this year that way. This, in effect, means there will be no special landowner permits.

Montie: Ours are not free. They have to pay just the same as the general resident. This was put into law by State Legislature when they started the deer season. I really don't know whether we recommend it or not, I doubt if we did, it was probably something that just came up to try and appease the landowners to get more private land open to the hunter. This could be a problem--you never know until you have the first one. I think most of the landowners want to hunt for the first time (of course we are giving out only

38 permits to the landowners). Hopefully most of them will be coming from the northwest and the area that have the antelope and so maybe we can avoid some of the problems associated with it. It is a problem when you start trying to single out people- of course they have a much better chance of getting a permit than the general resident.

Schwartz: When you speak of landowner, does the landowner have to be an individual that owns a parcel of land with the antelope hunt on, or is it any landowner in the state?

Montie: The way it is set up, any landowner in the state can do it.

Schwartz: Then it's discriminating only against the people that live in the city?

Montie: Yes. It's a problem--it's something that we really do not have a good handle on--it's set in the statutes and we kind of have to go along with it. I just may add, though, that we had our first turkey season this year. We had to set it up following the same guidelines (50 percent to landowners) and after the drawing, most of the landowners (I'd say 95 percent, maybe more than that) did live in the turkey area. We found very few landowners coming in from other areas and with our deer season, we found the same thing. Of course we have had them for a number of years now, but we've had very little problem with landowners, say around the Kansas City area, coming all the way down for the turkey drawing, so I suspect we won't have a lot of problems with it in the antelope season. We had very few people applying for turkey permits from Kansas City, so maybe we won't have this problem, but we'll have to wait and see. We may get swamped with a mess.

Compton: Is it a local drawing in the area?

Montie: Usually we have these drawings located in Pratt and and anyone can put in. There has been some discussion of having the drawing in the area of the hunt, but anytime you have the drawing in the area, you have people saying, "Boy that's fixed because I haven't gotten a permit for three years straight and Joe down there has. Of course, it is a public drawing, so this is one thing maybe we can have it in the area. This is something that's been talked about.

ENERGY DEVELOPMENT IN WYOMING'S POWDER RIVER BASIN AND ITS POSSIBLE EFFECTS ON WILDLIFE

by

Raymond D. Mapston

The pronghorns of Wyoming's Powder River Basin, some 50,000 in number, and a variety of other wildlife, including some of the few remaining black-footed ferrets, are threatened by America's voracious appetite for energy. The reason: underlying this productive habitat area is one of the Nation's largest, most lucrative deposits of readily strippable, low-sulfur coal which is destined to play an important role in supplying future national fuel needs.

Already some 8 million tons of coal are being stripped from 6 mines annually and shipped to 11 states. This, however, is only a taste of what is coming. Numerous coal, oil and gas and power companies have acquired vast mineral holdings. Forecast developments in the next few decades include 43 coal mines, 21 power plants, 16 liquid fuel plants and 4 gasification plants.

Major ecological, economic and social systems will be seriously affected by the extent of developments anticipated. Virtually all wildlife species will be affected to some degree. For some, including the rare black-footed ferret and 10% of the world's antelope, the result may be disastrous.

Vegetative cover, topsoil, overburden and entire wildlife habitat complexes will be stripped from vast acreages -- perhaps as much as 500,000 acres -- to get to the coal. There are growing expressions of optimism that mined areas can be restored to productive use. Unfortunately, the productive use referred to normally means establishment of one or two species -- usually non-native -- of limited value to wildlife. In truth, no matter how careful the planning and the precautions taken during stripping and removal, our current reclamation technology falls well short of enabling restoration of the current diverse multi-species plant communities so vital to providing the basic needs of the abundant wildlife resource now living in the basin.

A large human population influx and possibly creation of new communities will accompany energy development. The resulting increase in human activity is likely to have a greater impact on wildlife than the physical destruction of habitat.

That much of the basin's readily accessible coal will be extracted is virtually a certainty. Hopefully, mining and energy development will be carefully planned so as to mitigate impacts on wildlife.

Assuming the best, the anticipated development will mean considerable modification of large acreages of high quality habitat and a proportionate decrease in wildlife populations. Assuming the worst, development will leave in its wake a vast area of manmade facilities, spoil piles and giant power plants suitable for inhabitation only by those few species highly tolerant to man's intrusion.

THE IMPACT OF A SEVERE WINTER AND FENCES ON ANTELOPE MORTALITY IN SOUTHCENTRAL WYOMING

BY: Chuck Oakley, Big Game Biologist
Wyoming Game and Fish Department

Phil Riddle, Game Warden
Wyoming Game and Fish Department

ABSTRACT:

A severe winter storm in Southcentral Wyoming forced antelope (Antilocapra americana) into a heavily fenced area north of Interstate Highway 80. Fences and the severe winter conditions took a heavy toll on the antelope. A comprehensive study was initiated to evaluate the losses. Utilizing belt transects and population data, several conclusions were made.

Overall loss to the antelope herd was an estimated 61.8%; fawns and yearling bucks suffered the highest percent mortality of antelope forced into the fenced complex. Woven wire fences caused the highest mortality. Compared to a relatively fence-free area, mortality per square mile was almost twice as great in the fenced area. Sex and age data indicates that, overall, bucks and fawns suffered the highest percent mortality. Yearling buck survival was highest and fawn production was greatest where antelope were not forced through fences.

During periods of heavy snow and adverse weather, observations indicate that all types of fences were detrimental to antelope.

INTRODUCTION

The 1971-1972 severe winter conditions on the Red Desert of Southcentral Wyoming took a heavy death toll on the pronghorn antelope (Antilocapra americana). From October 27 to October 31, 1971, a devastating storm from the northeast deposited an unusual amount of snow. Average snow depths over most of the area covered sagebrush 18 inches in height. Sub-freezing temperatures and ground blizzards prevailed for several days. Hundreds of antelope were forced into a heavily fenced area along the north side of Interstate Highway 80, west of Rawlins. In recent years, these antelope have normally wintered on the northern limit of the fenced area. Because of the extreme weather, many were forced into the fenced complex and many more followed fencelines in a westerly direction and finally moved south toward Interstate 80.

After the initial storm from the northeast, the wind shifted and came out of the west. Sub-freezing temperatures and ground blizzards continued for over two weeks. Browse was already in short supply due to deep and crusted snow, and movement into other areas was necessary for survival. Fences became formidable barriers to free movement.

A comprehensive investigation of antelope was initiated to determine overall winter loss, the influence of fencing on mortality, sex, and age classes lost and effects on reproduction.

In 1966, a study of the ecology of the pronghorn antelope was initiated (Wildlife Restoration Project No. FW-3-R, Work Plan No. 3, Job No. 4W). The major objective of this study is to evaluate the effects of fences on the antelope, and the winter of 1971-72 offered an ideal opportunity to investigate such effects during severe winter conditions. Mr. Charles Sundstrom, then a research biologist for the Wyoming Game and Fish Department, conducted a major portion of this study. Some of this information was used in determining the effects of the 1971-72 severe winter. Additional data were collected on herd numbers and composition by other project personnel. During collection of mortality information, assistance was provided by interested sportsmen, Bureau of Land Management personnel, and many Wyoming Game and Fish Department employees.

Description and History of the Area

Most of the Red Desert study area lies within the Great Divide Basin in Southcentral Wyoming. The area is bounded by Highway 287 on the east; by the Green Mountain-Crooks Mountain hydrographic divide and Sweetwater River on the north; by the Point of Rocks - Bar X Ranch road and Highway 28 on the west; and by Interstate Highway 80 on the south.

This area is primarily public land under the jurisdiction of the U.S. Bureau of Land Management. The southern portion along Interstate 80 is in a checkerboard land pattern for approximately 20 miles north of the interstate highway. In this portion, every other section is public land with alternate sections being private land.

From a vegetative standpoint, the area serves as year-long wildlife habitat and as grazing land for sheep and cattle. In the winter, because of deep snow and insufficient cover, antelope in the northern and central portions migrate (Figure 2) either eastward to Highway 287 near Lamont or southward to the checkerboard land area. Much of the private and some of the public land in this area has been heavily fenced (Figure 2). The earliest fencing of this area occurred in the late 1940's and early 1950's. Some livestock grazing allotments were fenced from Interstate 80 (then U.S. Highway 30) to the northern limit of the checker board land pattern. Because of the Interstate 80 right-of-way fence and the allotment fences, access to antelope winter ranges was severely restricted. As a result of that fencing, a majority of the antelope were forced to winter north of the fenced complex (Figure 2). After the October 1971 storm, winter antelope distribution appeared very similar to that observed before fence construction (Figure 2).

The findings in the report primarily pertain to the Chain Lakes Management Area and a control, or relatively unfenced, area located in the southern portion of the Table Rock Management Area.

Population Status

In July, 1969, an aerial count in the Chain Lakes Management Area produced 5,575 antelope. This represented a 36% increase over the August, 1967 trend count. The 1972 pre-season population for the area should have been 6,647 (Appendix I). The antelope were being managed to increase wintering populations and were, therefore, being hunted below potential.

METHODS

Five pastures in the fenced complex were selected for evaluation since they were located on the main travel route of the migrating antelope. The control area was located north of Interstate 80 and east and west of Patrick Draw, Wyoming. With the exception of the north-south fence on the eastern edge and the Interstate 80 fence on the south, the control area was fence-free. It was selected because of similar antelope numbers observed there after the initial storm and because terrain and weather factors were similar to the fenced area.

Initial attempts to locate dead antelope in December were abandoned because of deep snow covering the carcasses. Transects were covered as soon as bare ground was exposed in late March. Difficulty was encountered in locating some dead antelope, as scavengers and predators had scattered portions of the carcasses.

Mortality data were collected in the fenced area along fencelines and within pastures. Transects within pastures and the control area were established on north-south section lines from Interstate 80 northward. In the control area, transects were six miles in length. A total of 519 transect miles were covered - 184 miles in the control area; 224 miles within pastures; and 111 miles along fencelines. Transects could be followed with adequate

reliability since mile-post markers along Interstate 80 are on or very near section lines. The transects also intersected the east and west migrations of the antelope. Brass capped section corner markers, along with landmarks, were used to control transect direction. The transects were belt type, approximately 100 yards in width.

Personnel covering transects were instructed to maintain their direction after sighting an antelope carcass until at a right angle from the carcass. They would then walk to the dead animal and collect specific data but would not count antelope carcasses more than 50 steps from the center line of the transect. This control applied to all transects. Horseback personnel were instructed to dismount and walk to dead antelope.

A comparison of accuracy in locating and counting dead antelope was tested in March of 1972 using a helicopter observer versus ground observers along identical belt transects. Only five antelope carcasses were found by the helicopter observer as compared to 14 dead antelope found by the ground observers.

The age of dead antelope up to and including those three years of age, was estimated by the incisor replacement method (Dow and Wright, 1962). Middle incisors were collected from all antelope over three years of age and ages were determined by the annulus structure of the dental cementum (McCutchen 1969).

Sex of antelope, if not readily evident, was determined from the shape of the pelvic girdle (Taber 1956).

Natural mortality was calculated from trend counts in 1967 and 1969 and harvest and classification data from 1967, 1968, and 1969. It was based on an average of 34 fawns per 100 antelope in these prior years. By using the calculated natural mortality factor, an estimated population was obtained for the year 1969 and compares very closely to the summer trend count made in that year (Appendix I).

Population Information

The antelope in the Red Desert and the Chain Lakes Management Area have been under intensive investigation for several years. Aerial trend counts have been conducted periodically in established counting blocks. Data have been collected on migration routes, winter and summer distribution and population dynamics. Herd composition was obtained by field personnel using motor vehicles, binoculars and spotting scopes both before and after hunting seasons.

Annual hunter field checks were obtained, and since 1967, a special antelope harvest survey has been conducted by the University of Wyoming for the Wyoming Game and Fish Department. The survey, coupled with all field studies and observations, has resulted in a considerable knowledge of antelope in the area.

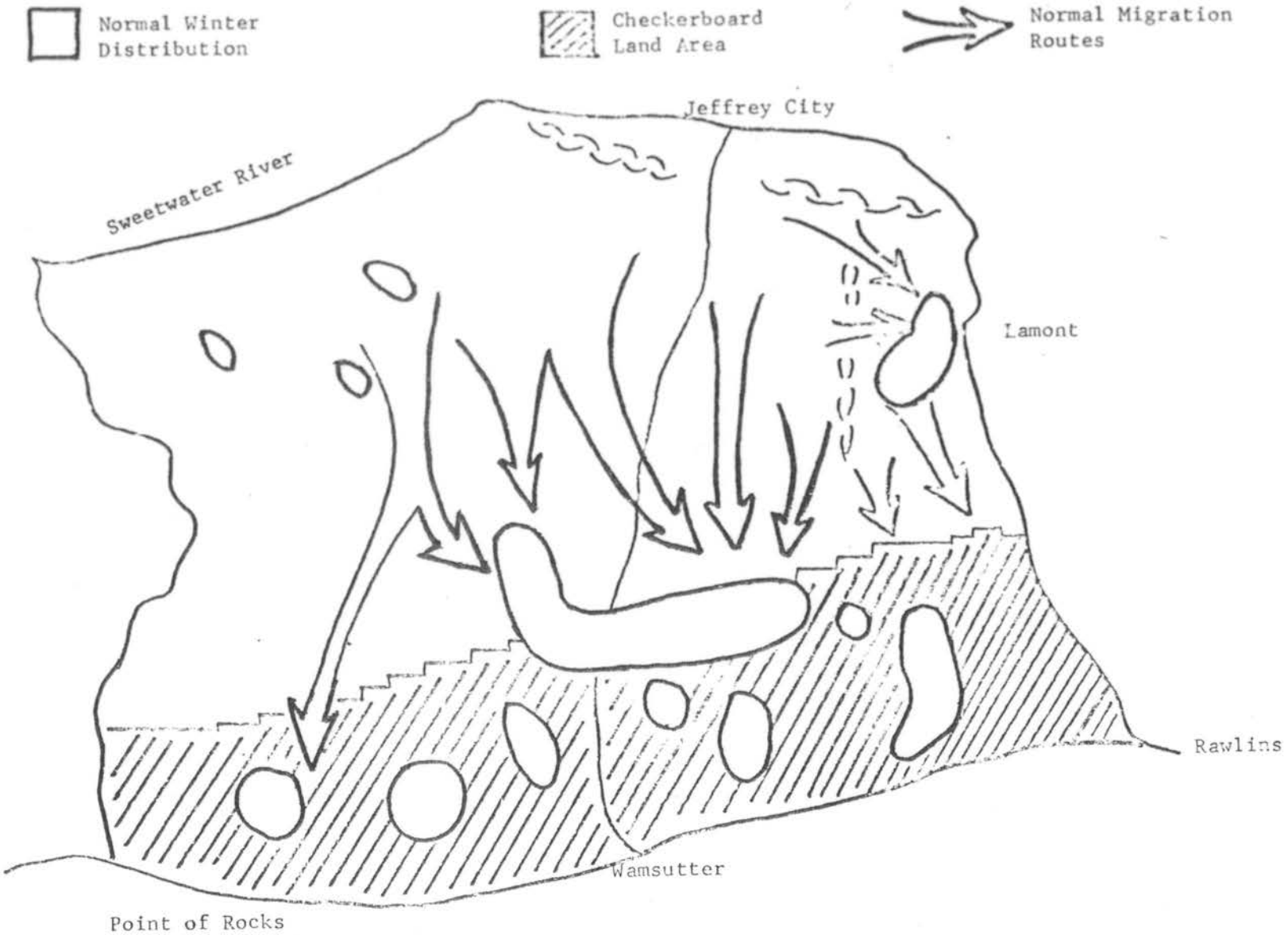

FIGURE 1. Normal migration routes, checkerboard land area and normal winter distribution of antelope.

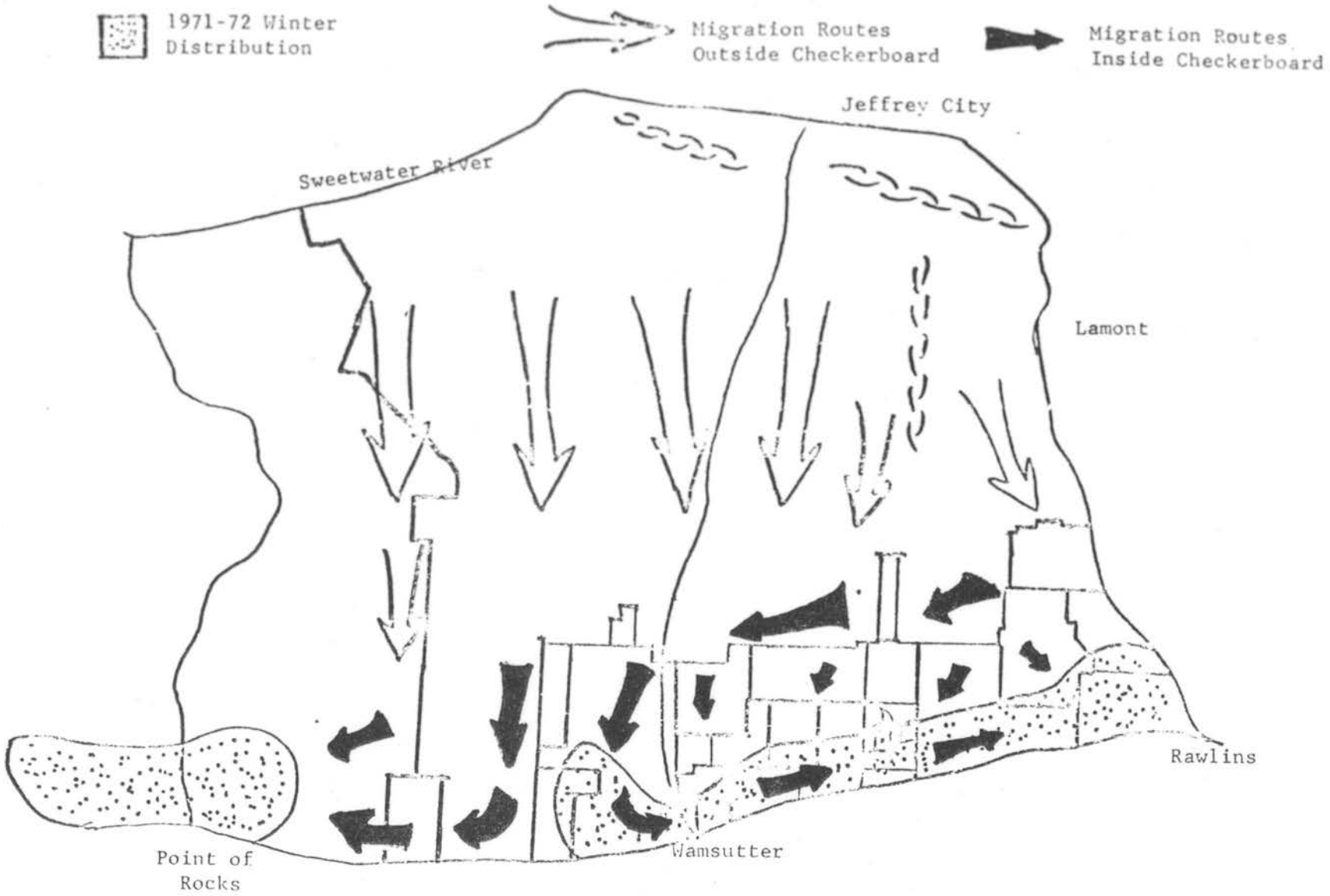

Figure 2. Approximate fence pattern, winter distribution of antelope pre-fencing and 1971-72, and antelope migrations 1971-72

An aerial trend count and distribution check of antelope was obtained in the study area during the second week of November in 1971. This count produced 1,608 antelope west of the Wamsutter Road to Point of Rocks in the control area. There were 1,768 antelope counted east of the Wamsutter Road in the fenced area.

FINDINGS

Estimated Loss to the Chain Lakes Antelope Herd

An average annual mortality of 22% above hunter harvest has been calculated for 1967, 1968 and 1969 (Appendix I). Using this percentage and other data collected through 1972, the antelope population for the Chain Lakes area should have been at least 6,647 in the summer of 1972 (Appendix I), however, only 3,536 antelope were recorded during an aerial trend count made in August of 1972. This represents an estimated loss of 3,111 animals above expected mortality, or a total estimated loss of 61.8% of the herd.

Influence of Fancing on Mortality

As the October storm moved into the Riner Block No. 5, the majority of these resident antelope were observed moving eastward into those portions of the block offering adequate cover and forage. Following the storm, the 1972 classification (Table 1) produced 87 fawns per 100 does in this block. In all other blocks (1 through4), where extensive movement was necessary for survival. The pre-season classification showed only 61-68 fawns per 100 does. This difference of up to 26 fawns per 100 does is believed to reflect the comparatively easy winter for the Riner antelope and the lack of obstacles restricting free movement.

TABLE 1
PRE-SEASON 1972 HERD CLASSIFICATION IN THE
CHAIN LAKES MANAGEMENT AREA

Counting Block No. & Name	Mature Bucks	Yearling Bucks	Does	Fawns	Total
1 (So. Green Mtn.)	36	17	209	140	402
2 (West Lost Soldier)	21	4	143	87	255
3 (East Lost Soldier)	29	7	100	68	204
4 (Pioneer-Divide)	61	10	119	83	273
5 (Riner)	136	78	333	290	837
Totals	283	116	904	668	1,971

TABLE 1 - Continued

	Yearling Bucks/ 100 Does	Bucks/100 Does	Fawns/100 Does
1.	8	25	67
2.	8	18	61
3.	7	36	68
4.	8	59	68
5.	23	64	87
Average	12.8	44	74

The Riner Block also had 23 yearling bucks per 100 does, while all other blocks had only seven to eight yearling bucks per 100 does. This further reflects the easier wintering conditions for the antelope in the Riner area. The eastern portion of this block was the only really suitable wintering area in the entire Chain Lakes Unit.

Antelope in Blocks 1 through 4 had from one to eight fences to cross to get to this favorable wintering area. The type of fence to be crossed greatly affected mortality. Table 2 presents antelope mortalities by fence type as determined by fenceline transects.

TABLE 2
ANTELOPE MORTALITIES BY FENCE TYPES

Fence Types	Mortalities Found	Percent Total Mortality	Miles of Fence	Mortalities Per Mile of Fence
(1W) - 26" woven wire + 1 barb 6" above	13	16.2	17	.76
(2W) - 26" woven wire + barb 4" + 1 barb 10" above	14	17.4	16	.86
(4W) - Rouse type 26" or 32" woven wire + 1 barb 4" + 1 barb 16" above	40	49.5	40	1.00
(4B) - 4 strand barbed wire	12	14.3	28	.43
(5B) - 5 strand barbed wire*	2	2.6	10	.20

*Few antelope contacted this fence type.

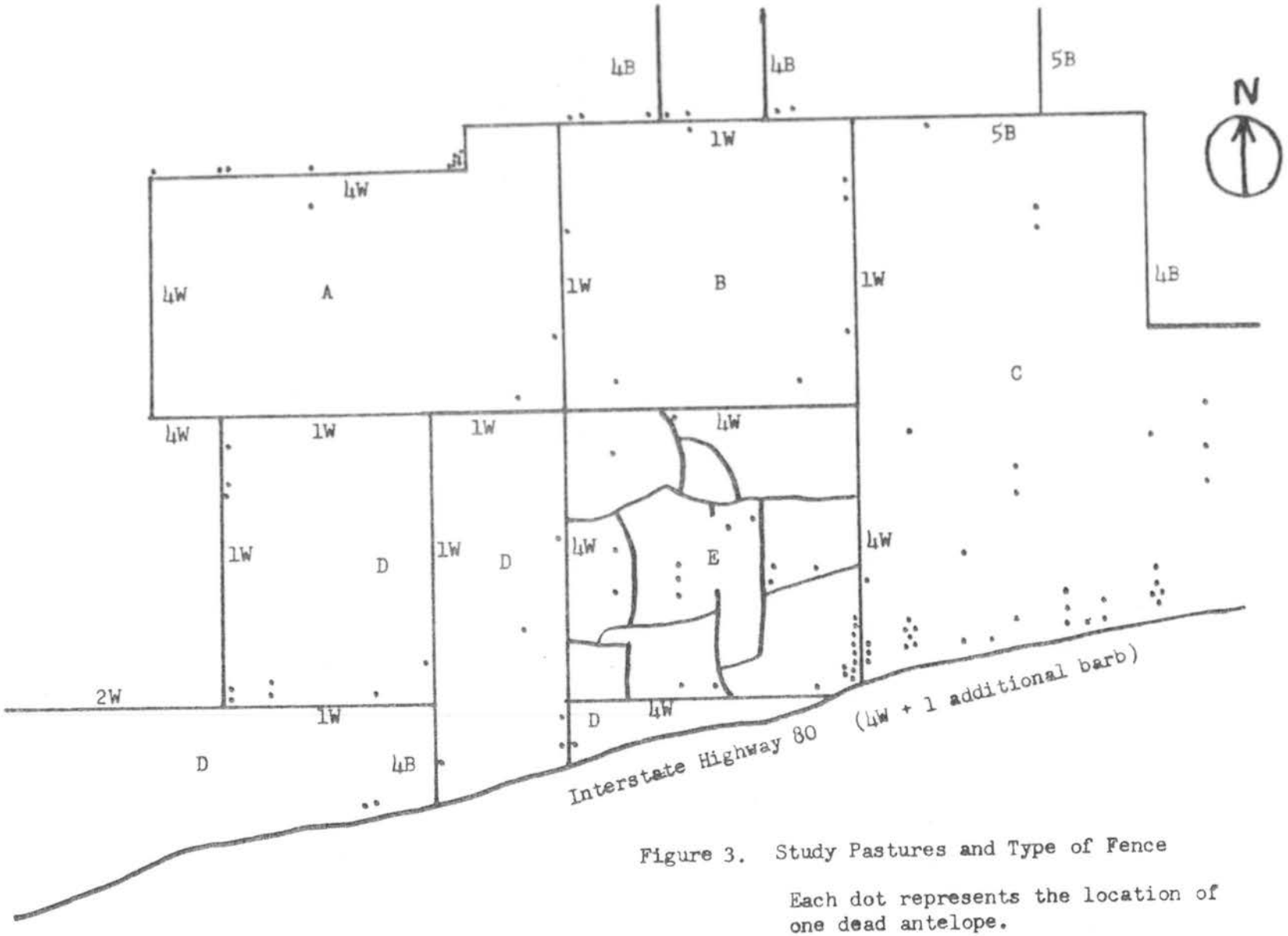

Figure 3. Study Pastures and Type of Fence

Each dot represents the location of one dead antelope.

In fenceline transects, the greatest number of dead antelope were found in association with the 4W Rouse-type woven wire fence. Although woven wire fences represented only 53% of all fenceline transects, they accounted for 83% of the fenceline mortality. Of the antelope found along fenceline transects, 23% were entangled in the fences. More mortalities per mile were found on transects of woven wire than on transects of barbed wire. Mortalities along the 4B fences were greater than expected because of snow depth. Regardless of snow depth, 5B fences in the area have insufficient clearance. It is believed that mortalities were less along the 5B fences because few antelope contacted them. Those areas where fences were not particularly detrimental to antelope were those where migration was not necessary and where basic needs were present.

Some antelope, exposed to fences for prolonged periods of time, can and do learn to jump them, if fences are not too high and if good footing is present. Even though some adults can and do jump fences of woven wire, these fence types normally do not permit fawns to pass. Antelope normally crawl under barbed-wire fences that have adequate clearance at the bottom and typically seem to prefer crawling under, rather than jumping fences.

Although transects were not selected by statistical design, antelope mortality and transect data were presented for analysis to Dr. David Bowden, Bio-Statistician at Colorado State University. Additional calculations were made by research biologist ElRoy Taylor of the Wyoming Game and Fish Department. Mortality data from all calculations, along with field observations of movement and the location of dead antelope found on transects, clearly indicate the movement of antelope in the study area. These data in Table 3 and Figure 3 show these relationships.

During the storm, it is believed that antelope contacted the northern limit of the fenced complex at Pastures A, B, and part of C. Pastures A and B are enclosed by woven wire fence, while Pasture C is enclosed on the north by 5B fence. Few dead antelope were found inside Pastures A and B and the northern portion of Pasture C, which demonstrates the barrier effect of woven wire and 5B fence.

TABLE 3
COMPARISON OF MORTALITY BY PASTURE

Pasture	No. Mi.^{2}	Estimated Mortality	Standard Error	95% Conf. Interval	Mortality per Mi.^{2}
A	47	20	20.2	1- 60	.43
B	36	42	25.9	2- 92	1.17
C	84.5	664	169.5	362- 966	7.86
D	75	204	78.3	62- 346	2.72
E	36	317	57.8	204- 430	8.81
Total					
Fenced	278.5	1,249	176.9	902-1596	4.49
Control	99.5	229	54.9	121- 337	2.30

Eighteen dead antelope were found along the north fenceline of these pastures (Figure 3). It is believed that no mortalities were found along the section of 5B fence because few antelope contacted that fence. The largest single concentration of dead antelope found in the study was seven. These were found along the fence of Pasture A. Sixteen dead antelope were located within one mile of that particular point. Tracks indicated that a few antelope were able to cross over the fences on snowdrifts and move south toward the interstate highway.

Most of the antelope followed the northern boundary of the fenced pastures in a southwesterly direction around the borders of the complex and were then stopped by the Interstate 80 right-of-way fence near Wamsutter. The antelope were held against that fence and the fences of Pastures D and E for approximately three weeks. During this period, antelope were observed pawing through the crusted snow for food, pacing back and forth along fences and concentrating in large numbers of up to 300 in pasture corners. This holding effect in areas with little or no forage and inadequate cover from ground blizzards and freezing temperatures undoubtedly lowered physical reserves.

The greatest mortalities per square mile were found in Pasture E. Almost all fences within that pasture and around its border are higher than 42 inches. The next highest mortality per square mile was within Pasture C. This mortality, in part, is believed to represent the resident antelope that moved into the southern part of the pasture during the storm and were held against the interstate fence and the eastern side of Pasture E. It is believed, further that this also represents the mortality of antelope that moved eastward through the fence complex and along the interstate fence. After getting through the fence complex, we feel they did not have enough physical stamina to travel on and survive. Twenty percent of the dead antelope found in this pasture, on initial transects, had sustained wire damage to legs. These injuries, in addition to the holding effect of the fences, undoubtedly contributed to mortality. Statistical analysis of transect data indicates that mortality in the fenced area was almost twice that found in the control area.

Sex and Age Classes of Dead Antelope

The sex and age was estimated on 164 dead antelope (Table 4). The ages of these animals ranged from less than one to 18 years. Antelope ten years or older comprised only four percent of the total. Before the storm, fawns comprised 26% of the herd. In the fenced complex, fawns accounted for 32% of that mortality but only 21% of the losses in the control area. The yearling bucks suffered high mortality along fencelines. Eighty-six percent of all yearling bucks found dead were within 50 yards of a fence. This was not true of yearling females. Bucks, post-season 1971, comprised 17.5% of the population, but constituted 31.7% of the total mortality observed. It is believed that the bucks were weakened during the rutting season and required more forage because of size.

TABLE 4
SEX, AGE AND LOCATION OF ANTELOPE MORTALITY

Sex	Fawns	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	Total
Fenceline Transects												
Bucks	12	18	3	5	2	1	1	2	--	--	1	45
Does	12	2	--	5	5	3	2	3	1	--	1	34
Interior Pasture Transects												
Bucks	10	3	--	3	2	2	1	--	2	--	--	23
Does	13	--	2	;	4	5	7	3	2	1	5	43
Control Area Transects												
Bucks	1	2	1	--	--	--	--	--	1	1	1	7
Does	3	2	2	--	2	1	2	--	--	--	--	12

Effect of Losses on Reproduction

In all blocks of the Chain Lakes Management Area, fawn production "appeared" higher after the hard winter than in the previous year (Table 5). Riner Block (No.5) had the highest fawn production and it is believed that this indicates better winter forage and cover found by these resident antelope.

Based on post-season herd composition, does comprised 56% of the herd before the storm, but accounted for only 35.8% of the total mortality. Low mortality on does during the winter and high fawn mortality makes the production appear higher than in past years. Seventy percent of the does lost were five years old or older. Compared to a normal herd, does remaining after the storm consisted of a larger percentage of highly productive animals.

TABLE 5
COMPARATIVE PRESEASON DOE/FAWN RATIOS

	Fawns/100 Does	
Block No.	1971	1972
1	62	67
2	43	61
3	69	68
4	34	70
5	68	87

SUMMARY AND CONCLUSIONS

1. The estimated loss to the antelope herd in the Chain Lakes area was 61.8% or an estimated 3,888 animals. This loss was attributed to the severe winter and fences, including B.L.M., private and Wyoming Highway Department.

2. Fawns and yearling bucks suffered the highest percent mortality of antelope forced into the fence complex.

3. The highest mortalities were recorded along transects of woven wire fences.

4. Mortalities per square mile were almost twice as great in the fenced area as compared to the control area, based on belt transect analysis.

5. Sex and age of dead antelope indicate that, overall, bucks and fawns suffered the highest percent mortality.

6. Yearling buck survival was highest and fawn production was greatest where antelope were not forced through the fence complex.

7. During periods of heavy snowcover and adverse weather conditions, observations indicated that all fence types were detrimental to antelope movement.

8. Since fencing in the study area resulted in greater mortality, it can only be concluded that more fencing in the area will increase mortality under similar circumstances.

It is recommended that efforts be made to modify fences on private lands and have those on public lands modified or removed to minimize mortality. Since excessive antelope losses were caused by fences, it is further recommended that no additional fences which would restrict free antelope movement be constructed on public lands in the study area.

ACKNOWLEDGEMENTS

Many people contributed time and labor in collecting the data used in this report. The authors want to give special acknowledgment and thanks to William I. Crump, District Supervisor, Wyoming Game and Fish Department and William G. Hepworth, Director of Technical Research, Wyoming Game and Fish Commission, for their review and constructive criticism of the text.

LITERATURE CITED

Dow, S.A. and P.L. Wright, 1962,"Changes in Dentition Associated with Age in Pronghorn Antelope", J. Wildl. Mgmt., 26(1):1-18.

McCutchen, H.E., 1969, "Age Determination of Pronghorn by the Incisor Cementum", J. Wildl. Mgmt., 33(1):172-175.

Taber, R.D., 1956, "Characteristics of the Pelvic Girdle in Relation to Sex in Blacktailed and Whitetailed Deer", Calif. Fish and Game, 42: 5-21.

APPENDIX I

The total mortality, other than from hunting, between the summer of 1971 and the summer of 1972 was arrived at by several calculations. These were derived from known herd information. The calculated mortality included the winter loss.

The population dynamics of the Red Desert and the Chain Lakes antelope herds are shown in the accompanying table and were derived as follows.

Trend counts and herd composition determination done in 1967 and 1969 showed there was a pre-season average of 34% fawns in the herd during 1967, 1968, and 1969. To balance the numbers harvested with the rate of increase between 1967 and 1969, and additional average mortality of 22% per year was calculated to have occurred. This 22% was assumed to be the average loss, if fawn production remained at 34%. During 1970 and 1971, fawn production decreased sharply. This difference in reproduction was deducted from the 22% mortality. Therefore, in 1970 and 1971, the mortality figures in the table are only 15%. Both years, fawn production was only 27% and this is a difference of 7% less than 34% and 7% plus 15% is 22% - the same as the mortality calculated for the previous years.

Using this information, the 1972 population in Chain Lakes should have been 6,647 antelope instead of the 3,536 counted. This was 3,111 fewer than would have been expected from the data obtained previously.

POPULATION CALCULATIONS FOR RED DESERT AREA

	1967	1968	1969
Actual Tred Count	9,174	-----	10,778
Estimated Population		10,298	10,834
Actual Hunter Kill	489	719	737
22% Other Mortality	1,910	2,107	------
Estimated Adults (spring)		6,775	7,472
Estimated Fawn Recruitment		3,523 (34%)	3,362 (34%)

POPULATION CALCULATIONS FOR CHAIN LAKES AREA

	1969	1970	1971	1972
Actual Trend Count	5,575			3,536
Estimated Population		5,460	5,818	6,647
Actual Hunter Kill	502	500	639	
Other Mortality	1,116 (22%)	744 (15%)	777 (15%)	
Estimated Adults (spring)		3,957	4,216	4,402
Estimated Fawn Recruitment		1,503 (27%)	1,602 (27%)	2,245

Estimated Population 1972 = 6,647

Trend Count 1972 = $\frac{3,536}{3,111 \text{ loss}}$ $\frac{3,111}{6,647}$ = 46.8% loss above normal
+15.0% normally lost
61.8% total loss

Pyrah: How many hunters do you usually have annually in that particular area:

Newman: About 800.

Pyrah: How many years of hunting permits does this 3000 antelope you lost amount to?

Newman: We have about 80 percent hunter success, so it involved several years harvest.

Pyrah: Could you have harvested more animals in light of this loss? Would mortality have been less with a higher harvest?

Newman: Possibly, yes. I went through a similar winter like this last year on deer and the same thought occurred to me. If I had known this winter was going to be 6 months long, we sure would have hunted more deer last fall. I don't know, it's hard to predict. I can cop out on that, not because I'm not a management biologist but I did not write the paper and I did not even have any input on the setting of the season over in that area. You could probably mitigate these losses to some extent by increasing the number of hunting permits.

Beale: Do you feel that a series of let down panels in the fences would eleviate some of the problems?

Newman: In my opinion, yes. I think that there could have been fence modifications designed into these various types of fences that would have lessoned these losses. When you have winter of this type, you are going to lose game and if you are in the stock business you are going to lose livestock. I think that Chuck and Phil were trying to point out that these losses are increased with some of these fence type patterns. To answer your question, I would say definitely these high losses would be reduced if you had structures or fence modifications to put in these things to open the fence up during the period of none livestock use.

Zobell: Were there any antelope passes in this area?

Taylor: Yes, but they were not in the places that the losses occurred.

Audience: Did you determine what your losses were by statistical analysis?

Newman: The data was submitted to Dr. Bowden and he made the analysis on the data, but because of the fixed transects as opposed to random sampling, the confidence limits were very wide. We learned from this that if you have a statistical problem, contact the statistician before you set up the study.

Taylor: The total loss on the desert, due to the fence and hard winter, was obtained by taking the annual summer count before and following this winter and obtaining the difference after taking into account hunter harvest and normal winter mortality.

C O M M I T T E E R E P O R T S

A N D

B U S I N E S S M E E T I N G

SUMMARY of BUSINESS MEETING

Antelope States Workshop
Salt Lake City, Utah

During the business meeting at 3:00 p.m., February 21, 1974, reports were presented from the committees on Rules and By-laws, and on Fencing of Pronghorn Antelope Range. These reports were discussed at length and some additions and revisions were made. The report from Rules and By-laws included, sections on objectives, organization, and function of the workshop. A slight name change was proposed to better reflect the representation of the groups. The name "Pronghorn Antelope Workshop" was preferred by most over Antelope States Workshop.

It was agreed that the report on fencing would be submitted to the Regional Fencing Workshop to be held in Cheyenne, Wyoming, March 22-23, 1974, and that a request be made to have one representative of the Antelope States Workshop present at this meeting.

A request was made for volunteers for holding the next workshop in 1976. Robert Autenrieth accepted for the Idaho Fish and Game Department.

The meeting was adjourned.

RULES AND BY-LAWS

At the Antelope States Workshop in Billings, Montana in 1972, affiliation of the Workshop with the Western Association of State Game and Fish Commissioners was discussed. It was the unanimous opinion of those present at the meeting that the workshop could best achieve its objectives by affiliation with a strong organization such as the Western Association. It was thought a close affiliation with the Western Association of State Game and Fish Commissioners would provide the following benefits:

1. A gain in recognition of the Antelope States Workshop.
2. Improved organization of the Antelope States Workshop.
3. Provide a stimulus for well thought out objectives and improve reporting of accomplishments.
4. Provide the support of a strong organization for carrying out resolutions and recommendations.

To obtain recognition by the Western Association the following requirements were made by the coordination committee.

Each workshop or technical committee seeking the sanction and recognition of the Western Association of State Game and Fish Commissioners shall provide to the Chairman of the Coordination Committee the following:

A. The objectives of the organization and any adopted by-laws or operating procedures.

B. A summary statement of past accomplishments.

C. A statement indicating the expected benefits to the Western Association if recognition is given to the applicant organization.

D. An agreement to provide the Western Association a written summary report of proceedings after each meeting of the applicant organization and an annual written report of accomplishments.

E. An agreement to provide the agenda of forthcoming meetings to all member states of the Western Association.

All of these directives except for rules and by-laws were completed in 1973 and submitted to the coordination committee of the Western Association. A workshop committee was appointed to draft a statement on by-laws and functional procedures and report to the Antelope States Workshop in February of 1974.

The final draft on Organization and Function of the Antelope States Workshop prepared by the committee follows in this transaction. There was some controversy over the section on voting. Some committee members thought voting should be open to all persons present at the Workshop meetings and only those present, while others thought a more formal system of voting should be followed. Perhaps what is proposed by the committee is a compromise between the two positions. I think this topic should be brought before the entire group at the 1976 workshop meeting in Idaho to get the thoughts of everyone. The important point is that the workshop remain "open" and that there continues to be participation from all organizations and individuals interested in pronghorn antelope and their management. This seems to be the concensus of many individuals whom I have talked to and who have participated in the Antelope States Workshop from the beginning. If voting should become a restrictive focal point it could possibly lead to selected participation and much narrower lines of communication. This in turn would tend to run contrary to the major objectives of the Antelope States Workshop.

Donald M. Beale, Chairman
Antelope States Workshop (1974)

ORGANIZATION and FUNCTION
of the
PRONGHORN ANTELOPE WORKSHOP

BY-LAWS

I. Designation

This organization shall be known as the "Pronghorn Antelope Workshop". The official publication of the Workshop shall be known as the Pronghorn Antelope Workshop Transactions.

II. Goal

The goal of the Workshop is to provide information relative to and encourage the perpetuation of sustainable wild stocks of pronghorn antelope as an ecological, aesthetic and recreational natural resource on western range ands, both public and private, at their most productive levels consistent with other proper land uses.

III. Objectives

A. To provide an opportunity for all persons interested in pronghorn antelope to meet and discuss current research and management of the species and its habitat.

B. To provide a vehicle for disseminating research and management findings to the various agencies and organizations concerned with pronghorn antelope managment.

C. To promote species-oriented research for development of new information on all aspects of pronghorn antelope ecology, life history, behavior and management on western ranges.

D. To identify particular problems associated with pronghorn antelope management and to formulate recommendations and resolutions directed to the appropriate agency or organization including the Western Association of State Game and Fish Commissioners.

E. To promote cooperation among all agencies and organizations concerned with antelope management, particularly between the various state and federal agencies with the primary responsibilities of managing this species and its habitat.

IV. Organization

A. The Pronghorn Antelope Workshop shall be open to any person interested in pronghorn antelope and its management.

B. Voting

Voting members shall consist of one representative of each of the following:

1. States, provinces and countries.

   Alberta, Arizona, California, Colorado, Idaho, Kansas, Montana, Mexico, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Saskatchewan, South Dakota, Texas, Utah, Washington, Wyoming.

2. Federal Agencies

   Bureau of Land Management, Forest Service, Soil Conservation Service, Bureau of Sport Fisheries and Wildlife, National Park Service.

3. Universities and Colleges

   The chairman may appoint one person to represent colleges and universities. This appointee shall come from any college or university actively engaged in antelope research.

Voting representatives for the states, provinces and countries shall be appointed by the agency directly responsible for wildlife management within the above named states, provinces and countries.

The chairman shall request that each of the above named federal agencies appoint one voting member. This request shall be directed to one of the regional offices or service centers in the western United States.

Voting shall be accomplished only by those authorized representatives in attendance at the business meeting of the Workshop.

C. The Pronghorn Antelope Workshop will be scheduled biennially on even numbered years. The host state, province or country shall select the time and place of the meeting. The host shall appoint one of its representatives to act as chairman. The duties of the chairman shall be:

   1. To serve as chairman for a two year period following his appointment.

   2. To call for papers and prepare an agenda for the Workshop and assemble and distribute any recommendations or resolutions made or passed at the Workshop.

   3. To organize and conduct the meeting and business of the Workshop.

   4. To appoint committees as necessary.

   5. To maintain the goals and objectives of the Workshop.

   6. To prepare and distribute the transactions of the Pronghorn Antelope Workshop for which he has been responsible.

7. To prepare and make a formal report to the Western Association of State Game and Fish Commissioners.

D. The new host state, province, or country shall be selected and announced at the business meeting of the Workshop. It is the intent of the Workshop that host state, province or country will be volunteered on a rotating basis among the actively participating member states, provinces and countries.

E. The mailing list of the Pronghorn Antelope Workshop shall be:

1. The Western Association of State Game and Fish Commissioners.

2. The Director and Game Chief of every member state, province and country.

3. All biologists known to be conducting antelope research.

4. All state B.L.M. offices and B.L.M. Regional Service Centers in the western United States.

5. All Regional Forest Offices of the western United States.

6. All regional offices of the B.S.F.W. in the western United States.

7. All regional offices of the S.C.S. in the western United States.

8. All Cooperative Wildlife Research Units in the western United States.

9. All persons attending the Workshop.

10. Any persons or organization requesting a copy of the Transactions.

F. The chairman shall forward the mailing list and any other pertinent materials to the new Workshop chairman upon completion of his responsibilities as chairman of the current Workshop

Antelope States Workshop,
Rules and By-Laws Committee

Al Boss, Chairman
Bill Hepworth
Karl Menzel
Gary Myers
Errol Neilson
Duane Pyrah

FENCING ON PRONGHORN ANTELOPE RANGE

A statement prepared by the Fence Committee
for the
Antelope States Workshop

Biologists who have had experience with fences on pronghorn antelope ranges were selected to serve on the fence committee for the Antelope States Workshop. The committee felt that a higher priority should be given to pronghorn antelope when considering new fencing projects. Pronghorns are an immensely valuable wildlife species, both economically and aesthetically. Greater effort must be made to harmonize livestock and pronghorn antelope range use. Past efforts have been concerned with searching for ways to modify behavior of pronghorns or manipulate them to minimize the effect of fences. Methods of uniting livestock management and pronghorn antelope management have not been adequately determined. It cannot be assumed that antelope will adapt to changes in habitat resulting from livestock use or that they will learn behavior patterns that will permit them to thrive where their physical environment has been altered by fences.

The committee feels that there should be no fencing on pronghorn ranges until a complete evaluation has been made. This evaluation should be made jointly by state and federal wildlife biologist, range managers and livestock operators and should determine the probable effect that the proposed fencing would have on pronghorn antelope and the benefit to livestock management. A study of the range and its vegetation should be made. This should include such items as food habits of livestock and involved wildlife, movements and behavior patterns of livestock and wildlife, and an analysis of terrain and climatological conditions. Possible changes in vegetation and habitat resulting from differences in use brought about by fencing should be

considered. Where fencing is deemed advantageous to the total land use picture, the minimum amount of fence should be used and the design worked out cooperatively to serve as a maximum benefit to livestock and a minimum hinderance to antelope.

State wildlife agencies should prepare management plans for important pronghorn antelope ranges outlining migration patterns. Many movements need to be accounted for. The fencing of a waterhole in dry summer range may exclude antelope as effectively as fencing off a migration route. Important movement areas could then be designated as critical--not to be fenced. Thus positive recommendations would be on record and would not seem to be a negative afterthought.

No specific fence design for pronghorn antelope ranges can be universally applied. Any such design might serve as a "green light" for fencing without adequate consideration of other alternatives. The committee recommends that each proposed fence be fully evaluated before construction is begun.

Generally speaking, the fence design most compatable with pronghorn movements consists of three or four strands of wire with a smooth bottom wire 16 to 18 inches above the ground. This type of fence can serve satisfactorily for holding cattle. Where the fence is designed to hold sheep the problem is more complex. Any fence that will contain sheep is also restrictive to some age class of pronghorns. Net wire should not be used on pronghorn antelope ranges.

Many types of pass structures have been tested and, under some conditions,

they have worked satsifactorily or have shown promise for doing so. Use of pronghorn antelope "passes" has been limited and in many areas, under practical conditions, they have received little or no use. This is particularly true where pronghorns encounter such devices infrequently. Let-down panels have not been utilized extensively but may serve pronghorns well. Gates being opened when livestock is not present could alleviate many of the fence problems. If facilities are provided which require manual operation a time schedule should be drawn up and responsibilities delegated.

Basically, the committee feels that less emphasis should be placed on fencing and that livestock operations, especially sheep operations, should be managed so that fencing is not required.

Antelope States Workshop,
Fence Committee

Donald M. Beale, Chairman
ElRoy Taylor
Robert Antenrieth
Buck Compton
James F. Johnson