PROCEEDINGS OF THE 7TH BIENNIAL PRONGHORN ANTELOPE WORKSHOP

FEBRUARY 24-26, 1976

BLUE LAKES INN

TWIN FALLS, IDAHO

PROCEEDINGS

of the

SEVENTH

PRONGHORN ANTELOPE

WORKSHOP

TWIN FALLS, IDAHO

FEBRUARY 24-26, 1976

CHAIRMAN

ROBERT AUTENRIETH

PREFACE

The Idaho Department of Fish and Game hosted the Seventh Pronghorn Antelope Workshop in Twin Falls, Idaho, on February 24-26, 1976. Robert Autenrieth served as workshop chairman.

Sixty-eight participants attended the workshop representing 11 states, two provinces, five universities, four federal agencies, and private industry. As seen from the program, the technical session provided a variety of information on research, techniques and management.

The workshop session focused on three subjects, i.e. methodology, competition and behavior. These topics provided the basis for developing management guidelines. In addition, sections on history, current knowledge, predators, mining, fencing and off-road vehicles were added at the business session. Writing responsibilities were accepted by those in attendance. It is the goal of the workshop to have the guidelines available to all land management agencies by late summer, 1976. We hope to eventually publish the guidelines in a publication such as the Wildlife Society Bulletin.

The opening remarks, state reports, American Pronghorn progress report, panel discussions and comments were all transcribed from tapes. Readers are cautioned that total accuracy was not always possible due to instances of garbled recording.

The Province of Alberta will host the Eighth Pronghorn Antelope Workshop in 1978.

As chairman, I wish to thank the discussion group leaders and those presenting papers. I particularly wish to express my appreciation to Dr. Edson Fichter who has continued to serve as an advisor since graduate school days. His talent as an artist is displayed on the Proceedings cover. Office secretaries Charlene Bateman and Linda Arellano are recognized for handling the extra typing load resulting from workshop responsibilities.

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PRIOR WORKSHOPS

Year	Place	Chairman
1965	Santa Fe, New Mexico	William S. Huey
1966	Denver, Colorado	George D. Bear
1968	Casper, Wyoming	John L. Newman
1970	Scottsbluff, Nebraska	Carl Menzel
1972	Billings, Montana	H.O. Compton
1974	Salt Lake City, Utah	Donald M. Beale

OPENING REMARKS

Summary of Opening Remarks, Bob Salter

Following a welcome to Idaho and Magic Valley, Bob reported on the antelope catastrophe which occurred in early February when a Union Pacific train killed 132 Idaho pronghorns. The impact on that herd will be felt for several years.

He indicated the main thrust of Department work has been with deer and elk but mentioned the antelope trapping and tagging program conducted in the early 1950's. Aerial surveys are conducted to establish the number of hunt permits. Over 2,000 permits are issued and success is around 60 percent.

Mention was made of the current study with the Idaho National Engineering Lab and the University of Minnesota to determine antelope migration routes in eastern Idaho.

Bob discussed the continued loss of antelope habitat through turning sagebrush range into agricultural lands. Migration corridors will be cut-off if pending Desert Land entries and Carey Act applications are approved.

The importance of providing the Western Association of State Game and Fish Commissioners with copies of the Workshop business session and resolutions was emphasized. He reported the next Western will be in Sun Valley in July, 1976.

STATE AND PROVINCE REPORTS

ALBERTA

It is best to give the essences of what has happened to our population and provide a couple additional comments. We had some bad winters in the late '60's. We had approximately 5,000 pronghorns in Alberta. We have been favored recently with good weather and had tight control over hunting. We currently estimate 12,000 pronghorns and we should get a sizeable increase this year. The northern winter ranges that were earlier decimated have responded well and tripled in total antelope numbers in the last several years. Some of the southern ranges have been rather static.

Hunting has increased annually the last five years and will continue to do so. Six of the seven traditional units are being hunted. These are tightly controlled. We expect to open the remaining unit this coming year. I will conclude by saying we have an active research program involving distribution of animals through marking, working on range inventory with emphasis on winter range and arriving at reasonable carrying capacity models for our winter ranges.

ARIZONA

Arizona issued 1,200-1,300 permits and has done so for the last 10-15 years. Hunting success is 55 percent. We have 22 units and permits are determined by fawn production surveys, number of bucks observed and past hunter success. Hunters

must wait three years after a successful hunt before reapplying. The season length is three days. Some units this year will have a six-day season. Also, we have two archery units. In the two past years, archers have taken only two antelope. Classification flights have been made in June. Two years ago we changed time to July. In some areas we got better results in July and in other areas little difference was noted. We survey 5,000 antelope a year. In 1968 some of the northern herds suffered as a result of the severe winter. We also have two desert herds of antelope, the sonoran pronghorn occurring along the Mexican border and Mexican antelope along the Colorado River. Neither herd is hunted. There is currently a special investigation on the sonoran pronghorns since they are classed as a rare and endangered species. The work involves distribution and food habits. Distribution and status work on the Mexican herd is being done.

The major research is the Anderson Mesa fawn survival study to determine why these animals have not recovered from the winter of 1968. It is just beginning and Don Neff is the project leader.

COLORADO

No report.

IDAHO

Idaho issues around 1,900 permits with 60 percent hunter success. The season is three weekends long and we have 31 hunt units. The archers are growing in interest and participation. We sold 548 archery tags last year. They harvested 27 antelope. The research studies were mentioned by Bob Salter. The past three years August fawn-doe ratios declined in many of our units. Some ratios dropped as low as 26 fawns/100 does. Our better units maintained 74 fawns/100 does. The trends are not good, but at least we are now monitoring them and hope to eventually document causes.

Of the 132 antelope that were killed by the freight train, 43 were adult does of which only one did not have twin fetuses. The impact on this herd was tremendous.

Seventy-seven specimens were necropsied but have as yet not been worked-up.

KANSAS

(Ken Montei was unable to attend but sent the following information.)

KANSAS PRONGHORN HERD

Location: Extreme western Kansas (Wallace, Sherman, Logan and Thomas counties).

Population Growth: Summer Survey (August): 1974 - 77 fawns/100 does

1975 - 56 fawns/100 does

Winter Survey (January total range count): 1975 - 673

1976 - 790

Harvest: 1974 (First season, September 28-30): 97% hunter success

9 does and 61 bucks harvested

8 1/3 year-old--oldest animal taken

Bucks Harvested: 21% yearlings

79% adults

1975 season: 97% hunter success

8 does and 68 bucks harvested

Bucks Harvested: 25% yearlings and

75% adults

CALIFORNIA

The Modoc National Forest encompasses up to 80 percent of the remaining antelope habitat in California. The antelope populations are limited to the four extreme northeastern counties. The state and federal agencies conduct two censuses yearly. A total of 4,869 antelope were counted on a survey last month. This is the highest population recorded since 1953 when aerial surveys were begun. The composition was 26 bucks/100 does which is 10 bucks below the five-year average and 41 fawns/100 does which is 13 below the five-year average. Hunting is buck only. Permits are allotted in seven hunting units based on 75 percent of the surplus, about the 20 bucks/100 does breeding density. This averages between 300-400 permits per year. Drawings are on a statewide basis for residents only. Tags are $15.00.

Odds of drawing are 30 to 1 to several hundred to 1. Hunting success has varied from 59 to 80 percent. The average is 73 percent.

Causes of population increases are not well documented. The Forest Service and BLM have decreased sheep use on antelope range.

MEXICO

No report.

MONTANA

In 1943, after a closed season dating back 40 years to 1903, antelope hunting by controlled permits was resumed in Montana. There were a few buck only seasons in 1934, 1935 and 1936 in selected counties. All hunting permits since 1958 have been for antelope of either sex (GAME MANAGEMENT IN MONTANA, p. 84). Montana has a special archery antelope season.

Applications for antelope hunting permits increased 64 percent (from 28,176 to 46,092) between 1970 and 1974. The 1975 application rate remained near the 1974 level, but that may indicate travel restrictions imposed by more costly gasoline rather than a test of the demand for this hunting resource.

The number of permits issued during the past six years ranged from 26,104 in 1970 to 32,404 in 1973. The number of permits issued generally reflected the results of the most recent aerial surveys with permits accounting for 30 to 40 percent of the latest survey. Successful applicants of the current year received last consideration in drawings the following year, distributing the permits more generally than when done randomly. In addition, up to 15 percent of the permits in a hunting district were reserved for bona fide resident landowners. Each year several thousand successful applicants did not hunt. Average success for antelope hunters was 70 percent and was on a slight downward trend.

In southeastern Montana, fee hunting for antelope is a widespread practice. Much of the fee hunting property is not open to general public access for hunting, a situation seriously affecting management of antelope hunters as well as antelope in those hunting districts.

Recently, the number of antelope permits issued was changed to relate more to the availability of antelope in the areas open to public access. Some split seasons were initiated in 1975 to reduce opening day hunter density. Landowner resistance to increased hunter density during other hunting seasons (such as deer and game birds) resulted in some restriction of the antelope season, also. The game management division has recommended a shorter hunting season in 1976.

Antelope management in Montana is gradually changing from the "3-year count and shoot" stage. Antelope research, conducted as part of the sagebrush ecology project, developed some population parameters and monitoring procedures that should improve our understanding of antelope population changes and the effects of hunting on antelope populations. These population parameters make possible better comparisons between years, populations, and/or areas. They should lead us into a better evaluation of carrying capacity of range lands for antelope. The monitoring procedures can estimate differences between summer and winter fawn mortality, between fawn and adult mortality, and between hunting and nonhunting mortality.

The sagebrush ecology project was completed and showed detrimental effects on antelope of sagebrush spraying and contour furrowing in central Montana. Studies of population changes, antelope use of vegetation types, social structure of antelope herds, and fawn bedding cover measurements, are in reports or are in preparation at present.

A very significant difference in horn length was found between yearling and mature male antelope aged by dentition. Thus, yearling males can be classified with reasonable accuracy during summer aerial surveys.

The planning division is also contributing to the management of antelope by coordinating district data into new maps of antelope distribution, average antelope densities, land ownership and access status, and hunter distribution.

By these efforts, better control of hunter distribution and antelope harvest can be made.

The present research is limited to a continuation of the aerial surveys in the Yellow Water Triangle to follow population change, and to the effects of coal strip mining operations on antelope in southern Montana.

NEBRASKA

We conduct animal aerial surveys in the majority of the better range which is in the panhandle of Nebraska. We sample from one to three to one to eight. Our most recent estimate was 7,000 antelope. The count one year prior was 8,500 which was the highest since surveys were initiated 20 years ago We issue 1,800 permits with 80 percent hunting success. Permit application rate is two to one with a two-year exclusion of successful hunters. Archers took seven last year.

The primary problem is all habitat is privately owned. Major problems are depredation and land owner tolerance. For this reason, antelope numbers are held below carrying capacity. We had a major increase in center-pivot irrigation which is causing problems and will cause more.

NEVADA

No report.

NEW MEXICO

Our current population in New Mexico is probably 25,000 antelope. We currently issue 1,600 landowner permits and 1,000 apply for a permit in alternate years. We hold three day seasons in September. We have a few either sex hunts. On surveys, we fly 100 percent aerial surveys then a 33 percent sample in a grid pattern the two succeeding years. Last year in our nine hunt units success ranged from 57 to 95 percent. We had two bow hunts with low success. A bow hunt at Fort Wingate provides a harvest of 25 percent. We harvested 1,300 bucks, 105 does and 40 fawns, for an average

total hunt success of 70 percent. In 1973, we began a new permit system in an effort to open up more land to hunting. We issue permits on a given ranch. We have tried to manage on that basis. If a landowner has deed to 100 percent of his land, he is given all the permits for that area. He may do with them as he chooses. He may sell trespass fees, give them away, etc. With the majority of antelope habitat on deeded land, most permits are given to the landowner. The hunter dislikes this system because he feels there is too much control by the landowner and we are currently attempting to work out a different system.

NORTH DAKOTA

No report.

OKLAHOMA

No report.

OREGON

No report.

SASKATCHEWAN

Several changes have occurred in Saskatchewan antelope management since the last workshop. In 1974, the aerial surveys revealed the lowest July population and kid:doe ratios since 1964. The best population estimate for the province indicated about 5,000 antelope or 38 percent below average. Kid:doe ratios were .49:1 or 30 percent below average (.70:1).

The factors which appeared to be responsible for the low population and poor reproduction were:

1) The severe 1973-74 winter condition experienced in the northern portion of the antelope range.
2) Relatively dry summer and fall experienced in 1973 which we believe likely suppressed reproductive success because of does entering the breeding season in poor condition.

3) Late spring snowstorm during the 1974 fawning period.

The combination of low population and poor reproduction resulted in the closure of the 1974 hunting season.

In 1975, the July aerial surveys revealed a 15 percent increase in total antelope numbers. The provincial population was estimated at about 5,500 antelope.

A 16 percent increase was noted in the kid:doe ratio on the survey blocks (.59:1). With the increase of the population, a rather conservative season was set. In 1975, 4,210 people applied for 1,600 antelope licenses which were issued by computer draw. Two thousand six hundred (2,600) people were eligible for the first priority "A" Pool.

License quotas were allocated for the first time on a zone basis. Changes in zone boundaries were made to eliminate a mixture of ecological land use and habitat factors in the same zone. As well, the province was divided into five major land use divisions termed: Grassland, Farmland, Parkland, Commercial Forest and Shield.

The Grassland division was designed primarily for antelope management. The zones in the Grassland division allow separate management of local wintering herds and migratory herds.

Harvest estimates for the 1975 season are not available but preliminary reports indicate a successful hunting season with hunting success close to previous years' success rates.

I believe that at the last workshop, I mentioned we were experimenting with an August survey to determine if better data could be obtained on reproduction and total population. The August survey was initiated in 1972 and was continued through to 1974.

In combining all the survey blocks, generally higher counts were obtained in the August survey. There was a significant difference between the

August and July counts when the 1973 and 1974 data for the survey blocks were combined. However, there appeared to be no definite trend in individual survey blocks, as some showed higher counts in July.

The kid count was also higher in August than July on the combined survey blocks, but when considering individual blocks, some blocks showed higher counts in July than August. The differences in kid:doe ratios between the two surveys possibly can be attributed to two factors. The behavioural characteristic of kids concealing themselves during the first few weeks after birth likely contributes to a lower kid:doe ratio than actual in July. In August, most of the kids and does were found in groups lessening the possibility of missing kids. The main problem encountered in August was the difficulty in distinguishing kids from does. This bias could have had a significant affect on the kid:doe ratio.

We concluded that while there were some differences between the July and August survey, the differences were not significant enough to consider changing to an August survey.

In our situation, one main problem with an August survey would be to be able to analyze the survey data, set a license quota, have a draw and distribute the licenses before the hunting season in October.

SOUTH DAKOTA

In the spring, we have an aerial survey about the middle of May. We run belted transects about a half mile wide on a mile and a half center line. Approximately one third of the population is censused. We classify sex and age. A doe-fawn count is made in late June and we question its reliability. Our problem occurs with the setting of the seasons. Late summer counts would be too late for issuing permits. A total population figure is estimated for the county and the hunting units. In summertime, we use doe-fawn data and knowledge of landowner tolerance and establish the number of permits for the

fall season. We have a nine day season beginning October 1. Permits are limited to residents on a three-year basis. Our primary range is west and northwest South Dakota. We had a population in 1975 of 43,000. We issued 12,000 permits and harvested 10,000 animals for a success of 85 percent. Of this success, 65 percent were bucks and 35 percent were does. We have 17 hunting units. Our archers took 500 permits, 67 animals were killed for 20 percent success.

We have continued to increase in population each year. In the 50's, we began a transplant program and continued relocations to the resulting 40,000 antelope population today. We have reached our peak regarding landowner tolerance. We look in the future to refining our hunt units and requiring a doe quota be harvested.

Currently we have no research projects.

TEXAS

Pronghorns were once abundant over the western two-thirds of Texas but by 1900, it was evident that total numbers and their distribution were drastically reduced. Causes of the decline were attributed to sport and market hunting, slaughter to reduce competition with livestock, and fencing to confine sheep. The State Legislature closed the hunting season in 1903 but the decline continued. By 1924, the statewide population was estimated at 2,407 antelope.

In 1939, the Texas Game, Fish and Oyster Commission initiated a restocking program which ultimately involved the transplanting of over 5,000 antelope to suitable habitat that was devoid of adequate broodstock. Largely as a result of this program, antelope began to increase, reaching a peak population of approximately 18,000 in 1973.

Antelope presently occur in huntable numbers in four ecological areas--the Trans-Pecos, western Edwards Plateau, Rolling Plains, and High Plains.

Prior to 1974 an attempt was made annually to census the entire population through aerial surveys of all ranches known to have resident antelope. In 1974 and 1975 Department aircraft allocations were restricted, permitting surveys on approximately one-third of the antelope range. During these two years, population estimates have been derived by extrapolating results from the 1973 census.

The aerial surveys are supplemented by ground fawn-at-heel observations to determine annual production. These data are then evaluated to determine harvest quotas.

All antelope hunting in Texas is controlled by permits which are issued to landowners, who in turn distribute them to their hunters. Since there are no huntable populations on the limited public land available, access is controlled by the landowner who charges trespass fees for the privilege of hunting on his property. The current hunting season is nine days in the southern antelope ranges and four days in the northern range (Panhandle). The bag limit in all areas is one antelope per hunter per season.

Pronghorn populations declined drastically in 1974 due to a dry summer in 1973 followed by a hard winter. The total population for the state was estimated at 8,200. Hunting permit quotas were correspondingly reduced and the resulting harvest was 345 antelope, compared to 1,131 in 1973.

In 1975 populations recovered significantly, due primarily to an excellent fawn crop. The statewide population was estimated at 12,700. A total of 877 hunting permits was issued, with a resulting harvest of approximately 550 pronghorns.

At the present time there is no antelope research in Texas. Needed research concerns development of a sampling technique to arrive at population

estimates. The feasibility of providing supplemental feed to antelope during critical seasons needs to be investigated as a possible deterrent to future die-offs.

A management handbook to provide guidelines for land operators to properly manage pronghorn populations on their property is undergoing final editing. Publication is tentatively scheduled for late 1976.

UTAH

At present, there are roughly 3,000 pronghorn antelope in small scattered bands on sixteen different areas or herd units over the State of Utah. About one-half of these occupy the western desert areas and the remainder are in the northeast corner and in the south central part of the State. Hunting of male antelope is allowed on permit basis. In recent years, some herds have increased and the numbers of permits issued have been increased accordingly. In 1975, 245 permits were issued and 190 bucks were killed. This was slightly below the number of permits issued in 1974 and 1973, but a small increase in harvest. It was a substantial increase in harvest over earlier years such as 1965 when 51 bucks were taken on 85 permits. It was also a twenty percent increase in harvest over 1970. The increase in harvest in the past four years results largely from established new herds and from lower fawn mortality from 1968 through 1970.

The Utah Division of Wildlife Resources is attempting to expand the present pronghorn antelope range by introducing animals into new areas where there is suitable habitat. In 1965 an introduction was made on Parker Mountain, a plateau ranging from 7,000

to 9,000 feet in elevation. This herd has increased about twenty percent annually since the introduction and in the fall of 1975 there were over 600 animals present. Six additional introductions into different areas have been made in the past four years; two of these in December of 1975. Most of these herds are doing well and hunting seasons have been held on two of them.

The Utah Division of Wildlife Resources has been active in pronghorn antelope research for the past 15 years. Research to date indicates that considerable pronghorn antelope range exists in Utah and that much of this range will support many times the number of antelope that are now present. Fawn birth rates are usually high (1.6 to 1.8 fawns per mature doe), but fawn mortality is often excessive. In some years over 80 percent of the fawns born in May are lost by September.

High fawn mortality during summer months continues to be the main reason for the static population trends of many of the herds. Currently, we are conducting a research project to determine the relationships of mortality among pronghorn antelope fawns as affected by their distribution and feeding patterns, the range used by bobcats and coyotes and the abundance of their prey species.

In summer of 1975, predation was again the major cause of fawn mortality on the study area at the Desert Experimental Range, but losses were due to coyotes and golden eagles, rather than bobcats, as was experienced from 1967 through 1971. From a sample of 22 fawns marked with radio transmitters, 8 were killed by golden eagles and 6 by coyotes. Only five survived to fall. Blacktailed jackrabbit populations were extremely low and this may have contributed to the high rate of predation experienced.

Management data obtained in Utah on an annual basis consist of late summer fawn/doe ratio counts and winter trend counts. In 1975 fawn/doe ratios on the sixteen individual herd units ranged from a high of 80 fawns to 100 does, to a low of 15 fawns per 100 does. Most herd units had less than 50 fawns per 100 does.

If management techniques can be developed which, directly or indirectly, reduce the high fawn mortality rate that occurs with many pronghorn antelope herds in the State of Utah, the productivity of the herds should greatly increase.

WASHINGTON

No report.

WYOMING

An estimated winter population of 167,900 antelope seasonally occupy some 65,600 square miles of habitat throughout Wyoming. Some 51,366 license holders harvested approximately 44,688 antelope in 1975. The rate of hunter success was 87 percent (1975 figures from Department Strategic Plan).

Approximately 44 percent of the antelope occupy the sagebrush steppe and saltbrush-greasewood habitat type. Forty percent are found in the grama-needle-grass-wheatgrass type, seven percent in the wheatgrass-needlegrass-shrub steppe type, five percent in the wheatgrass-needlegrass type and four percent on the grama-buffalo grass range type (Sundstrom, 1973).

Recent trends indicate anoverall increase in antelope numbers. In 1970, there were an estimate 200,000 antelope on Wyoming winter ranges. A massive winter mortality occurred in 1971-1972 in southwestern Wyoming. Population increases since that winter indicate the population will achieve the pre-die-off number in most areas by pre-hunt, 1976.

Variability in forage use occurs by season and locality. Maximum mean browse use ranges from 90-100 percent in winter to a minimum of 57 percent in

the summer. Major browse species include big sagebrush (Artemisia tridentata), silver sagebrush, (Artemisia cana), fringed sagewort, (Artemisia frigida), Douglas rabbitbrush, (Chrysothamnus vicidiflorus), lanceleaf rabbitbrush, (Chrysothamnus nauseosus) and three tip sagebrush (Artemisia tripartita), respectively. The greatest variability in forage use occurs with forbs. Forb use seldom exceeds 17 percent in the fall or two percent in winter. Grasses incur the greatest use in the spring. Mean spring grass use is about 7.5 percent. Key forb and grass species in the antelope's diet include: biscuit root, (Lomatium spp.), prostrate knotweed, (Polygonom aviculare), and an assortment of legumes: western wheatgrass (Agropyron smithii), needle and thread (Stipa comata), and bluebunch wheatgrass (Agropyron spicatum). Differential availability of grasses and forbs probably accounts for local variations in their use (Creek, 1967).

Since the first records by white man, the pronghorn distribution has not changed dramatically in our state. The distribution of antelope closely coincides with the distribution of the vaseyana subspecies of Artemisia tridentata. An exception to this would be high elevation ranges, greater than 8,000 feet, which are discontinuous with lower ranges, have showed an increased use by antelope in recent years.

Our antelope management goal is to maintain a density and distribution of antelope that offer optimum consumptive and nonconsumptive recreational opportunity. Current and proposed management parameters are provided in Table 3.

Management Framework

1. Maintain a winter population of at least 165,000 antelope.
2. Maintain 64,000 square miles of occupied antelope habitat.
3. Maintain a hunter density of less than 1.0 hunters per square mile per day in any antelope hunting area.
4. Maintain at least forty-five calendar days of antelope hunting opportunity, annually.

Problems and Strategies

1. Antelope movements in some areas are impeded by highways, railroads, fences, and other man-made structures.

   a. Cooperate with Department personnel in the location and design of highways, railroads, fences and other man-made structures.

   b. Maintain a liason with land management agencies and land owners and seek cooperation in the type and location of fences.

2. Antelope hunters tend to congregate their activities toward the early part of the hunting season and close to centers of population.

   a. Design hunting seasons such that hunters are distributed in time and space.

3. Antelope hunters are reluctant to harvest does and fawns.

   a. Offer doe-fawn licenses in areas where the sex ratio or herd numbers suggest a reduction of this segment of the herd warranted.

4. There is a high demand for antelope on public land areas or private land where trespass fees are charged.

   a. Encourage hunters to recognize that hunting on private land is a privilege and that landowners are entitled to monetary compensation.

5. Lack of adequate water on some ranges prevents good antelope distribution and habitat use.

   a. Promote the development of water sources in arid areas.

By 1980, we anticipate a human population increase of 19 percent as compared to the 1975 population level. Presently, the Wyoming Game and Fish Department has direct responsibility for the management of wildlife on 91,716 square miles. We now incur about 952,255 man-days of recreation for big game hunting. By 1980, we anticipate an increase of 173,051 recreation days of hunting. It is my personal feeling that these projections are probably conservative if anything. Projections for 1985 are on the order of a 40 percent increase from

1975 population levels. The bulk of the development will occur on seasonal antelope ranges.

Other Local Management Problems

Existing and future development on Wyoming's ranges are bound to effect our antelope population capabilities. To date, significant impact appears to be from the human encroachment per se. The high wages have attracted the "wondering renegade". Their attitude and behavior is portrayed in the greater incidence of illegal taking of wildlife. Utilizing the formula and constants derived from the work of Vilkitis (1974) in Maine and Idaho, we obtained an illegal kill estimate for antelope in southwestern Wyoming of 1,369 animals. This estimate covered the period January 1 - December 31, 1975. If this estimate truly depicts the illegal kill, it represents a loss of 3.8 percent of our total District antelope population in 1975. The area in which the estimate was made is on Wyoming's greatest mineral impact areas. To date, we have not compared this estimate with lesser developmental impact areas.

Of course, habitat destruction and alteration cannot be disregarded. A great problem will be the rate of habitat destruction and alteration relative to habitat restoration and the affects in the interim.

Sagebrush spraying and eradication efforts today are at a minimum on public lands.

In these times of economic strife, private livestock operators are becoming less tolerant of wildlife use on their lands. We have damage problems on alfalfa (stacked and standing), grain (standing and windrows), and standing forage (private rangelands and irrigated pastures). Fencing on public lands is also at a minimum, anyway those which may restrict or alter antelope movements and distribution to a significant degree. Our greatest problem with fencing is that on highway right-of-ways and private lands. Antelope often become trapped

in agricultural and urban areas by fences. In such instances, they become almost impossible to move and difficult to regulate through hunting.

Recent Research and Management Projects

A study of the carrying capacity for antelope on the Red Desert was recently completed by ElRoy Taylor. This publication should be out of press anytime now.

We are exploring methods for obtaining increased harvest on the female segment of antelope populations in some areas.

The strategic and operational planning efforts, in which we are presently engaged, hold promise for better coordination of management programs. Populations' data analysis may take on a new perspective with the implementation of simulation modeling.

More intensive land use practices, increased demand for the wildlife resource, increased human harassment and illegal killing of wildlife and socio-economic strife complicate the old as well as the new problems confronting management today.

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TABLE I.

WYOMING
ANTELOPE DISTRIBUTION 1965

TABLE 2.

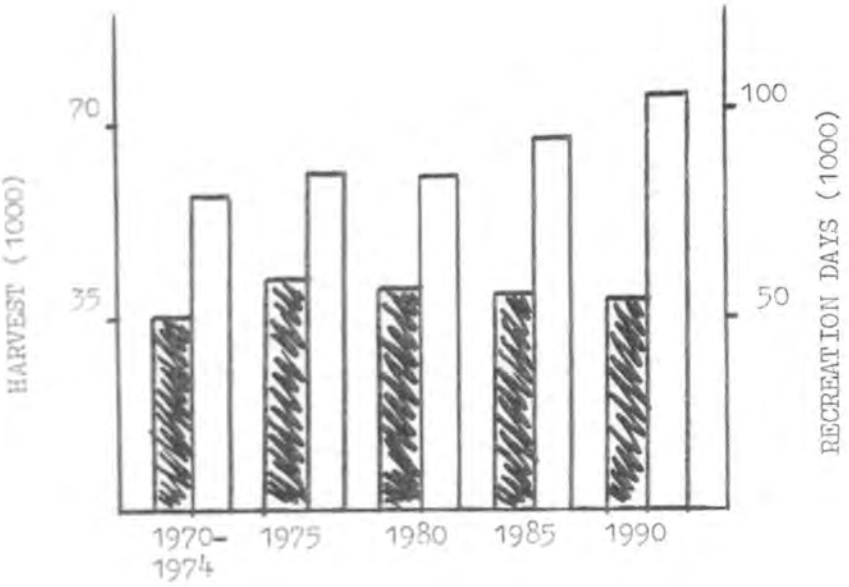
WYOMING
A STUDY OF SAGEBRUSH, BEETLE 1960
Distribution of Big Sagebrush A Tridentata subsp. vaseyana

Table 3.

CURRENT AND PROPOSED MANAGEMENT PARAMETERS

Year	Wintering Population	Harvest	License Holders	Percent Hunter Success	Days Hunted Per Animal	Total Recreation Days/Years
1970-74	150,000	36,000	41,250	87%	2.0	82,500
1975	167,900	44,638	51,366	87%	2.0	89,376
1980	171,900	39,985	47,041	85%	2.2	87,967
1985	169,940	38,955	47,506	82%	2.5	97,388
1990	170,090	38,968	38,968	80%	2.8	109,110

PRESENT AND PROJECTED ANTELOPE
HARVEST AND HUNTER RECREATION



TECHNICAL SESSION

ASPECTS OF INTRASPECIFIC SOCIAL VARIATION IN PRONGHORNS[1/]

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Abstract: Variation in a species social system from one population to another is known for several African bovids. Recently, several behavioral studies of the pronghorn (*Antilocapra americana*) in ecologically dissimilar areas show differences in their social organization. This paper reports on the behavioral differences in three pronghorn populations; a Montana territorial population, a Colorado harem population, and a Wyoming intermediate population. Specifically, we focus on the variation in the structure and duration of mating groups and the behavioral processes mediating group structure (including male-male and male-female interactions).

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PRONGHORN SOCIAL ORGANIZATION

For the past thirty years investigators have observed and described social organization and behavior of the pronghorn (Antilocapra americana). Several reports state that pronghorns have a harem-type mating system where dominant males actively acquire and hold females in cohesive and defendable herds (Einarsen 1948, Buechner 1950, Gregg 1955, Folker 1956, Prenzlow et al. 1968, Deblinger and Ellis, in prep.). Others present evidence that pronghorns have a territorial social system where a specific area rather than a herd of females is defended (Cole 1956, Cole and Wilkins 1958, Bromley 1969, Pyrah 1970, Kitchen 1974). Still another study describes a social organization involving both harems and territories (Ingold 1969).

Since territoriality has only recently been verified in ungulates (Buechner 1961, Walther 1964, 1965, Leuthold 1966, Estes 1969, Spinage 1969), it is possible that early reports of pronghorn harems were made by investigators unfamiliar with territoriality, thus causing them to misinterpret their observations. Alternatively, pronghorns, like some African antelopes, may actually have different social systems (ranging from harem to territorial systems) in different situations.

The existence of intraspecific variation in social organization has been well documented for ungulates [wildebeest (Estes 1969), Uganda kob (Leuthold 1966), impala (Leuthold 1970)] as well as for many other animals (Crook 1970*a*). Likewise current hypotheses suggest that social systems are shaped and modified by the ecological characteristics of the local environment (Eisenberg et al. 1972; Crook 1965; 1970*a*,*b*; Jarman 1974; Crook, Ellis, and Goss-Custard, in press). But Crook (1970*a*) also points out that variations in social organization must inevitably be the result of variation in social dynamics, i.e., the behavioral interactions

among individuals. So while ecological variables may be the ultimate causes of social variation, the proximate causes must be found in social dynamics.

We are aware of no studies which have analyzed either the correlations between ecological parameters and social variation or the behavioral processes which mediate social variation. This paper compares results from a preliminary study of social behavior in a group of captive pronghorns displaying a harem organization[2/] (Deblinger and Ellis, in prep.), with published information on social behavior in wild territorial pronghorns (Bromley 1969, Kitchen and Bromley 1974, Kitchen 1974). Our purpose here is to begin to analyze the behaviors which determine the structure of pronghorn social organization.

VARIATION IN PRONGHORN SOCIAL ORGANIZATION

Structure and Duration of Mating Groups

Pronghorns inhabiting the National Bison Range in northwestern Montana and Wind Cave National Park, South Dakota, evidence a territorial social system (Bromley 1969, Bromley and Kitchen 1974, Kitchen 1974). Males begin sparring with each other for dominance in early March (Fig. 1). The high ranking males establish territories which they defend until the rut. Non-territorial (bachelor) males establish dominance in large herds; however, these groups decrease in size until the rut, at which time they contain two to five bachelor males (Kitchen 1974). From early April until the rut, bachelor males were not allowed to enter territories.

[2/] Data were taken at the Pawnee Site located on the Central Plains Experimental Range, administered by the USDA Agricultural Research Service.

Describing female social patterns, Kitchen (1974:48) states,

> "Changes in size of female groups coincided with major events in the annual cycle. Parturient does frequently left the herd to fawn and scattered about the range from late May to mid June. Sixty-eight percent of all adult females observed at that time were alone or in association with a yearling doe, usually her fawn of the previous year. When fawns were old enough to keep up with the herd, does aggregated and formed nursery herds which lasted until the rut."

Pronghorns in northcentral Colorado have a very different social system. No spring social interactions take place among males; instead males begin their social activity in July by herding doe-fawn groups into harems (Prenzlow et al. 1968). Other summer social interactions include the establishment of dominance relationships among males since dominance status is a prerequisite to the establishment of a harem.

Pregnant females leave large, mixed-sex winter aggregations in May and travel to the fawning grounds (Prenzlow et al. 1968). After parturition and when the fawns are old enough to travel, females form doe-fawn groups. They remain in these groups until September. By mid-September males have organized females into harems, or have themselves joined bachelor groups. So while the territorial system includes territorial males, bachelor males, and doe-fawn groups, the harem system is composed of a harem male with his group of females and separate bachelor groups. Spatially the territorial male is restricted to a specific area, whereas the harem male and his females have free access to their home range. Bachelor males may be more solitary and aggressive in the harem system.

For the first seven to ten days of the rut, either lone males, or a small group of bachelors might surround a harem waiting for the opportunity to separate females (Prenzlow et al. 1968); and during most of the rut bachelor males appear alone rather than in groups. As the rut progresses, "single males invaded a herd and attempted to mount a female(s) without separating her from the group" (Prenzlow et al. 1968:11). In the territorial system bachelors remain in groups outside of the territories during the rut. Occasionally, though, a subordinate bachelor was allowed on a territory during the height of the rut if he did not display to females (Kitchen 1974).

Thus, territorial males begin social activities earlier than harem males by establishing territories in the spring (Fig. 1); mixed winter groups remain intact longer in the harem than in the territorial system, consequently bachelor groups form earlier in a territorial system. So a major difference between these systems is the duration of territorial defense vs. harem defense.

A third intermediate social system has been described by Ingold (1969). In this system male pronghorns begin herding females into harems (containing no fawns) in March, but parturient females leave these groups in May to fawn. From this time until September, males revert to bachelor herds, while females group together in nursery herds. Males establish dominance status during the summer, but subsequent mating success may not reflect this status (Ingold 1969).

In comparison to the territorial and harem systems, the intermediate system has some characteristics typical of each of the others. Like the territorial system, males begin social activity in the spring. Males establish dominance over other males by sparring. Then the dominant males form harems by herding females together. These spring harems

remain intact until the pregnant females move to the fawning grounds in early June to give birth. Ingold (1969:35) suggests that the spring harems function in providing a "framework within which social rank among old bucks is established or reinforced." Kitchen (1974) points out that the establishment of a territory is a long and arduous process while the defense of an existing territory is relatively simple. Therefore, the adaptive significance of establishing harems or territories in early spring may be the assurance of a combat-free rut where males can devote most of their energy to courtship and other sexually related behaviors.

Once the females depart from the spring harems, the harem males join large bachelor groups in which they continue dominance interactions by threatening and sparring with other males. These bachelor groups remain quite large until the rut. Prior to the rut, females and their fawns form nursery groups. Like the large bachelor groups, these nursery groups remain intact until the rut. Therefore, the spring behavior of these pronghorns resembles the territorial system since no spring activity occurs in the harem system, but instead of forming spring territories, the intermediate population forms spring harems. Summer behavior resembles neither the harem nor the territorial systems in that all males are found in bachelor groups whereas in the territorial system dominant males are already on their territories and harem males have already begun female herding.

During the rut, the intermediate system is composed of both territories and harems depending on the age and dominance status of the adult male (Ingold 1969). "Autumn harem groups consisted of one sexually mature buck with about 8-15 does and fawns. The formation and maintenance of harems was a result of the unilateral influence of harem bucks. Some of the older harem bucks established and maintained harems in restricted

areas or territories. These territories were seldom invaded by foreign bucks." (Ingold 1969:30)

During the rut, the intermediate system appears to be truly intermediate; as in the harem system, males herd females into harems, and older dominant males restrict the harem's movement, thus establishing a harem-territory. After the rut, pronghorns in all three systems form large, mixed-sex winter aggregations.

Variations in Behavioral Processes Mediating Group Structure

Based on these accounts it appears that pronghorns employ different mating organizations under different circumstances. Although differences in ecological variables and population parameters are likely the ultimate causes of the observed social variation, differences in specific behaviors must, in fact, support this social variation.

Male-male interactions

Male pronghorns appear to use the same basic behavior patterns regardless of social system when interacting with each other. However, differences do occur in the object of defense (i.e., defense of a boundary vs. defense of a harem). For example, male pronghorns in both territorial and harem systems threaten each other by approaching with head lowered, threat-snorting, a broadside display, and a chase (Kitchen 1974, Deblinger and Ellis, in prep.). But territorial pronghorn orient threats to territorial neighbors near their contiguous boundaries, so broadside displays may turn into parallel walk displays (Kitchen 1974). Similarly, territorial males scent mark territorial boundaries, whereas harem males appear to scent mark at random and do not parallel walk in the absence of definite boundaries. Comparisons of these behaviors in different systems may suggest how social dynamics determine the form of social organization, so a description of various behavioral processes

in the harem and territorial systems follows. (The intermediate system is not compared due to the lack of behavioral data.)

Agonistic approach.--In a territorial system, males frequently used an agonistic approach if more than 3 meters away from each other (Kitchen 1974). "Walking towards a potential antagonist was the most common approach. Typically, ears were oriented forward, gaze directed at the opponent, head held at withers level, and mane and rump patch compressed. Laying the ears back while approaching showed greater aggression and was frequent in territorial bucks as they approached intruders." (Kitchen 1974:20)

In our harem system herd, aggressive interactions began with the agonistic approach (Deblinger and Ellis, in prep.). When a bachelor or subordinate male was seen by the harem male, he approached, either trotting or walking, toward the subordinate with his head lower than his withers, his horns directed slightly forward, and his ears, mane, and rump patch compressed. Frequently, although not always, the harem male adopted a stiff-legged pace (in which both legs on the same side of the body are moved together) while approaching the subordinate male. This particular gait appears to have a display value (Deblinger and Ellis, in prep.). In conjunction with the above visual displays, males in both systems threaten rivals with a threat-snort vocalization.

Confrontation.--Territorial males confronted other males after an approach with a direct stare, cheek patch display, broadside display, or parallel walk. In a male-male context a direct stare is a threat, or a means by which one male may show relative dominance to another male. Avoidance of eye-contact tends to show submission (Kitchen 1974). Males also show relative dominance by displaying the subauricular gland area (cheek patch) to another male. Kitchen (1974:25) stated, "This display

was used exclusively by males. It begins from the lowered head walk and consists of lifting the head above withers level and slowly rotating it through a 180° arc, ears depressed." Territorial and bachelor males often orient themselves broadside to a subordinate animal in a dominance display (Kitchen 1974). The broadside display (Kitchen 1974:22) is "an intense threat used only by highly aggressive individuals." Territorial neighbors often dispute boundaries with a broadside display while walking parallel to each other. Kitchen (1974:22) stated, "Parallel walking bouts lasted 6.4 min. before either the encounter ended or another act followed. ... Occasionally, bucks marked the ground with feces and urine and/or marked vegetation with their cheek patches while walking parallel."

Male-male confrontations in harem social system may be resolved with the direct stare, broadside display, a stereotypic circling sequence, and a chase. The cheek patch display and parallel walk were never observed. Once the harem male had approached within 5 m of the bachelor male, he usually avoided eye contact and walked broadside to the bachelor. As the latter remained stationary with ears erect and head above withers level while watching the broadside display, the harem male walked to the posterior of the bachelor. The broadside display terminated, and the harem male lowered his head and compressed his ears as if to butt the bachelor's rump. Invariably, the bachelor moved away a few steps, and a chase ensued.

The chase.--Although an interaction could end during or after any of the above threatening displays, the end often came in both the territorial or harem system with the dominant male chasing the subordinate (or bachelor) from the area. Kitchen (1974:22) states, "A chase

at a lope or run was a trenchant expression of dominance. Territorial males were involved in more chases than any other sex or age group." Once dominance is clearly established, males often chase subordinates from an area without prior altercation or display. Kitchen (1974:22) states, "...25 percent of all territorial defenses were started by chasing intruders from the area."

In our study, as the harem male moved to the rear of the subordinate, the subordinate began walking away and a chase quickly developed. The intensity, speed, and distance of the chase varied from time to time. At the initiation the chase was generally at a rapid walk or slow trot. As the chase intensified, both animals picked up speed and it was impossible to determine which animal was responsible for the increase in speed. Often as the chase reached its highest intensity, with both males running at or near top-speed, the harem male uttered "growl" vocalizations as they ran. The chases were usually linear in direction and sometimes continued for distances up to 500 m. Termination of the chase appeared to take place when the harem male slowed down or stopped. The intensity and speed of the chase appeared to decrease with increasing distance from the female herd, until it was terminated. Upon termination of the chase, the harem male would make his way directly back to the female group while the subordinate male remained at or near the point of chase termination.

Male-female interactions

Kitchen (1974) observed territorial males to interact with females more often than with other males and this probably relates to the amount of time females spend on territories. Territorial males also mounted females at a greater rate than other males, and in addition received the

head twist rejection by females at a lower rate. Kitchen (1974:73) believes, "Territorial males were more selective in the does they courted than were bachelors..." He further states that "...63.9 percent of all their [territorial males] courtship was directed towards receptive does." On the other hand, "No estrous does stood readily for bachelor males, and all breedings observed occurred after extended chases, or a series of them. All extended chases were by bachelor males." (Kitchen 1974:74) Furthermore, estrous females approached by large bachelors always acted sexually unreceptive (Kitchen 1974).

Females in the harem systems are protected from bachelor males by a single harem male. Therefore, almost all sexual approaches are made by the harem male. Unlike territorial males, the harem male spends most of his time herding females into a defendable or cohesive group. Females are not allowed to wander far from the harem and certainly not to another male.

A potentially important implication develops due to differences in male-female interactions in the two different systems. In the territorial system, mating appears to be a matter of female choice; in the harem system, females only mate with the harem male. Thus exclusive mating rights accrue to harem males while territory confers the right to attract females.

Herding and courtship comprise the two major forms of male-female interactions. Since territorial males must restrict their activities to a specific area, herding plays a very different role in a territorial system as compared to a harem system. However, courtship behaviors appear almost identical in two systems.

Herding.--In a territorial system, females approach males who defend the boundaries (and the females if they are within the boundaries)

of a territory. Territorial males strive to keep females inside and to the center of the territory. Females escape from territorial males by running to adjacent territories or out of the territorial area completely, thus causing most herding attempts to be unsuccessful. During the rut, territorial males court and breed females on their territories. Males show peaks in herding behavior just prior to fawning and during the rut (Kitchen 1974).

Herding is accomplished in the same manner on territories as in harems. The male approaches the female in a threat posture, i.e., head lowered, ears back, and approaching females from the rear. Females react by walking to the center of the territory or running to an adjacent territory.

In the harem system the first sign of the approaching rut is the increasing cohesiveness of the pronghorn herd. During much of the year our study herd was frequently fragmented into smaller sub-groups of varying composition. As the rut approached, the herd became more cohesive and essentially remained together continuously from early August until early October. While together, movements and herd direction appeared to be initiated by different individuals at different times, but as the fall progressed the harem male began taking on a larger role in determining the spatial dispersion of the individuals in the herd, and their direction of movement, although he only occasionally initiated movements himself.

The initial herding process consists of simple prevention of any individual female wandering far from the group. The male accomplishes this by approaching wandering females which in turn avoid his approach by moving on. The approach by the male continues until the female rejoins or moves into close proximity of the remainder of the herd. The

approach of the male is direct and aggressive in nature. He approaches with head at or slightly below withers level and frequently moves with the same stiff-legged pace as described when approaching an invading male.

The results of herding are that the females do remain in a cohesive band. As long as the female continues to vigorously avoid the male, his approach ends in her returning to the herd. As her avoidance becomes less vigorous, the male's approach becomes less aggressive, more ritualized, takes on more display characteristics and essentially becomes a sexual approach rather than herding per se.

Courtship.--Territorial males use the same behaviors during courtship as harem males although the sequence and frequencies may differ. Quantitative aspects of courtship in a harem system will be considered in detail elsewhere (Deblinger and Ellis, in prep.). Following is a brief description of the basic courtship behaviors as observed by Bromley and Kitchen (1974), Kitchen (1974), and Deblinger and Ellis (in prep.).

Courtship behaviors are different from behaviors that males use as threats, and in some cases are exactly opposite. Kitchen (1974:31) stated, "The conformation of a courting buck is different from that of a threatening one, again demonstrating antithesis of displays with different functions." Thus, the aggressive components of the male approach are replaced with appeasement behaviors (i.e., tongue-flicking, whining, lip smacking, head erect, and horns placed posterior) during the sexual approach.

Head-erect.--During an aggressive or herding approach, the male holds his head slightly below withers level, a generally aggressive

posture. In a sexual approach the head is held quite high, the neck nearing a vertical posture and the lower jaw more or less parallel to the ground.

Head-waving.--Along with the head-erect approach, the male often waves his head from side to side. This behavior may have visual display value in emphasizing the subauricular area (cheek patch) or may provide olfactory stimulation by relasing a pungent secretion from the subauricular gland while head waving (Müeller-Schwarze and Müeller-Schwarze 1972).

Stiff-legged walk.--During courtship and herding, the harem male in our study often assumed a gait in which both legs on the same side of the body were moved simultaneously (as in a pace). This gait may have display value as it appears to convey the intention of the approaching male.

Tongue flick and lip smack.--Courting males use these displays which may function as appeasement gestures, thus reducing the female's fear of the male approach. Fawns elicit nursing from their mothers by tongue flicking and lip smacking. The harem male may be mimicking this appeasement behavior while courting females.

Whine.--Males add a vocal dimension to courtship by whining while following females. Sometimes associated with whining is the erection of the hair surrounding the median gland.

Female rejection.--Rejection behaviors appear identical in both the territorial and harem system although the result is somewhat different. Female rejection in the harem system may be dealt with by male aggression, continued courtship, or indifference and the cessation of approach, but the female remains in the harem. Female rejection toward a territorial male either puts an end to the courting bout, or the female simply leaves the male and enters an adjacent territory.

Kitchen (1974) observed females to walk, trot, or run off with heads lowered. Rejection intensity varied with the rank of individual males. Kitchen (1974:31) stated, "A non-receptive doe has an unmistakable rejection display, the head twist. ... A head twist rejection display was more successful in stopping courtship than simply walking off." Females displaying rejection in this manner lower their heads so their outstretched neck is approximately parallel to the ground and move the head laterally while retreating.

Since only one male courts females in the harem system, rejection intensity appeared to be a function of male approach intensity, the estrous condition of the female, and individual variation between females. Some females used the head-twist regularly while others never used it. Rejection was occasionally met with a chase by the harem male. Females usually vocalized (grunt) and ran away from the male but inevitably back to the female group.

Female reception.--In order for copulation to occur a receptive female must stand for an approaching male. Kitchen (1974) observed receptive females to stand with tail erect and stare at territorial males. Courtship then intensified and ended in copulation (Kitchen 1974). Females may stand still with tail raised while the male mounts many times before copulation occurs. Her posture is often slouched unlike any normal standing female. The male rises on his hindlegs while balancing his chest on the female's rump. Copulation occurs when the male intromits and performs an ejaculatory thrust where the male's hind feet leave the ground and he pushes the female forward. Pronghorn females breed only once during the rut.

CONCLUSIONS

Although there are substantive regional variations in the structure and duration of pronghorn mating groups, specific mating behaviors appear to be highly stereotypic and consistent among different social systems.

Based on the information available at this time, the major behavioral difference between harem and territorial mating organizations appear to be:

(1) The timing of the initiation of socio-sexual activity by males. Territorial males begin defending territories in March; harem males begin herding females in mid-September.

(2) The spatial orientation of visual displays and olfactory marking in territorial systems and the absence of such a spatial orientation in harem systems.

(3) The spatial orientation of agonistic encounters among territorial males, and the lack of spatial orientation in male-male encounters in the harem system.

(4) The extent and effectiveness of herding by harem males as opposed to territorial males.

(5) The perogative of mate selection. In the harem system, males determine mate-selection whereas females do in the territorial system.

Although a few specific behaviors (such as the parallel walk) appear to be system-specific, the majority seem to be consistent, to be stereotyped, and to occur in both mating systems. We must caution however that these conclusions are based on rather preliminary behavioral analyses, and subsequent, more thorough studies may alter our viewpoint considerably.

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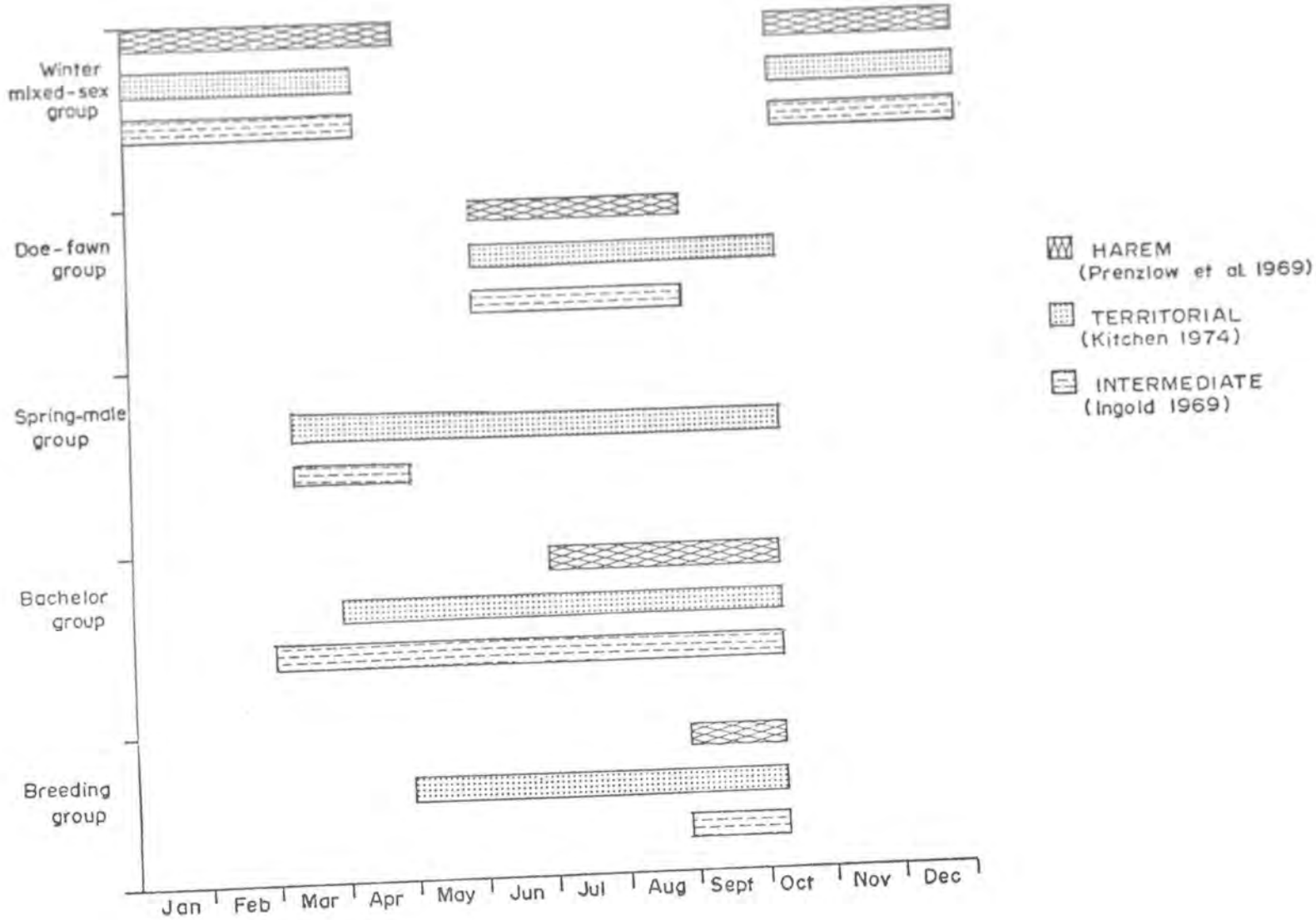

Fig. 1. Annual group structure in three different social systems.

COMMENTS AND QUESTIONS

Neff: I am interested in your habituation technique. What role did you play with the trained antelope and how did they respond to you?

Deblinger: As far as I could tell, they ignored my presence. These animals were the same hand-reared animals that Chuck Schwartz worked with. They were habituated to people from birth. During my study, it appeared they ignored me.

Simpson: Did you observe laufschläge during the premating ceremony?

Deblinger: No, laufschläge, as he refers to it, is a display seen in many African ungulates where the male places his foreleg between the female's legs as a precopulatory display. Once we saw a male partially lift his leg, possibly a precurser to laufschläge, but we did not confirm laufschläge.

Simpson: You were talking about random marking in your territories. Did you have any linear territorial establishment with your solitary male? He did not have another territorial male with whom to establish a line, and I think you are talking on the one hand of a harem herd and on the other of a territorial herd. If you don't have a concert territorial male, it may not be possible to establish a true territorial system.

Deblinger: The study did have restrictions including the fact they were in an enclosure and there were only two males. Something of interest was Prenzlow's study of a harem type social system. That study was done only 20 miles from my study area and he saw no evidence of territoriality. As far as looking at population social structure, you should use his study. My work is limited in that respect.

Simpson: Your study did show territorial behavior, i.e. scent marking, etc.

Deblinger: Yes, pronghorns in all areas scent mark and thrash. Just because a buck scent marks does not mean he uses it for a territorial boundary. There are many African ungulates that have facial glands and scent

marks that are non-territorial and vice versa. There are territorial ungulates with no glands, such as the impala. Just because they do these behaviors does not mean they are territorial or harem. Yet there may be some subtle differences that we should look at, i.e. rates of scent marking, the location of the scent marking. Scent marking did peak in our study but was not spatially confined. We did not see him scent marking any boundaries.

Pyrah: This relates to the fact that with an artificial system, no outside antelope allowed in, an obviously immature social system inside the enclosure exists. I wonder if this is a good test of the behavior you are discussing. You only have 2½ year old males which probably are not mature enough to exhibit this behavior.

Deblinger: There are limitations to the study. I mentioned there were only two males and they were relatively young. The reason that I carried out the study was to get quantitive data on these specific behaviors so that we can compare with a different system, i.e. Kitchen's Montana territorial systems.

I am going from this study to a wild population in Wyoming to look at social structure and get quantitive data on wild animals. This study was to get a refined data base of these behavioral processes; not to say, pronghorns are harem formers here and are not territorial here, and are vice versa somewhere else.

Pojar : Did you notice any interaction with antelope from outside the area?

Deblinger: I spent many hours with these pronghorns during both rutting seasons. I never saw any interaction along the fence line. There was one instance where a large old buck without a harem (during the rut) came to the fence and did a explosive roar (an alarm vocalization) and my pronghorns

responded to it by staring at this animal but did not interact. Occasionally large groups of pronghorns came to the fence line, but there seems to be no interaction.

HABITAT-TYPE CLASSIFICATION OF SAGEBRUSH-GRASS RANGES

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There is need for another classification system of rangelands. The present vegetation type classification system is based on current vegetation. If the potential vegetation can be determined in addition to the present vegetation, it would enable the range manager to determine those lands with similar potential and also enable him to delineate those ranges that appear superficially alike but do not respond with similar results to management. He would be able to better predict the outcome of his management efforts.

The habitat-type classification system depends on climax vegetation as the measure of potential. The measure of potential productivity offered by this classification system is largely qualitative and not of absolute amounts. The habitat-type is the collective area that supports or supported (before disturbance) the same climax vegetation. Furthermore, the endpoint of secondary succession, regardless of history of use, of all areas within a habitat-type returns to the same climax, unless severe soil loss has occurred. The delineation of rangelands by habitat-types provides a sound ecological base for a meaningful quantitative assessment of productivity and predictable responses to manipulation of the landscape.

The scarcity and difficulty in identifying the climax state in sagebrush vegetation forces us to emphasize the endpoint of secondary succession rather than to seek examples of climax vegetation.

A new conceptual model of secondary succession has been developed to aid us in determining what kinds of plant communities occur in a particular habitat-type. The model is visualized as a solid cone, which represents the habitat-type, and is composed of all the community types that occur in the habitat-type. The cone's apex represents the endpoint in secondary succession or the least disturbed community type available. At the base of the cone are the most disturbed community types and those most different from the community type are located at the apex. Lesser disturbed community types occupy positions that are intermediate to the apex and base. Community types equidistant from the apex but significantly different from one another, indicate that they are in the same successional stage but have experienced different histories of use.

The problem of separating one habitat-type from another is more difficult when vegetation is disturbed than when dealing with climax vegetation. We rely heavily on soils to aid us in separation of habitat-type. Using soil as a base, we use the premise that all stands, regardless of present vegetation, belong to the same habitat-type if they occur on the same soil, i.e. at the series and type level of soil classification. This is because the same factors that developed the soil also developed the climax vegetation and the two developed more or less concurrently. Where detailed soils information is lacking, site information is used. Plant communities that occur in the same local climate (i.e. precipitation, temperature, and distribution is the same) and on sites with the same exposure, elevation, slope, parent material and depth of soil belong to the same habitat-type.

Using the various approaches and common sense, individual stands can be grouped in one habitat-type or another. Admittedly, some errors will

be made, but they should be minimal and when found the error will be corrected.

Thus, with this basic approach, plant communities regardless of their disturbance history can be placed into habitat-types, particularly when substantiating soil and site information are available for the development of the classification system. In addition, we would be able to indicate the next probable stage in secondary succession.

After the community types have been classified by habitat-types, a dichotomous key would be developed to enable a person with limited experience classify a piece of vegetation as to its community type, its habitat-type and successional status. The potential vegetation and associated community types are described and characterized in a narrative format. In addition to the description of vegetation, management implications pertinent to the community types are stated. This portion of the narrative is enlarged and updated as information, data and experience become available.

The usefulness of classifying rangelands as to their habitat-types and using the secondary succession model, should be apparent. The lands would be classified as to their potential and also where the present vegetation is in relation to its potential. The habitat-type classification would enable the delineation of all areas of similar potential and these areas can be recognized or identified by the current vegetation. Furthermore, the classification scheme provides for the logical storage and easy retrieval of information that is pertinent to management of rangelands under the multiple use concept.

COMMENTS AND QUESTIONS

What would you guess were the primeval fire frequencies in sagebrush range?

Hironaka: That is hard to answer. We have had an encroachment in southwestern Idaho of the western juniper. The encroachment has been due to the succession of fires. During the last hundred years, the fires have been less frequent and, therefore, we are getting juniper coming down into what was previously a pure sagebrush type. So, to say how frequently, I would say in the class of 30 or 50 years was not unusual. That would be my guess. I am not a fire history expert. We do have fires in the dryer areas. I have seen good sized fires due to lightening strikes. We get them more frequently in some areas due to available fuel such as cheat grass and medusa.

Lowery: What do you think, in this situation, where the juniper is invading sagebrush (we have areas where it is killing the sage)? Do you believe pinyon juniper is the climax species and will remain such?

Hironaka: Very likely. The sage or grass will not crowd out the juniper once it is established because of the shading factor.

Lowery: Would you consider pinyon juniper to be the climax species?

Hironaka: Yes, but you do not always have to manage for a climax. I think this is important. This may be a misconception of what we call range condition. Range condition has been equated to that of climax, but this is not necessarily so. For management purposes, condition relates to the objective for the range.

Pyrah: You didn't say much about erosion as it affects attainment of climax vegetation. In some of our areas, we have such a shallow A horizon. Is it possible that half of it could have eroded away and we are thus unable to attain the historic climax?

Hironaka: You have altered the inherent site potential with the soil removal. You can't expect the vegetation to return to the historic climax. As long as you are loosing soil, you cannot have an upward trend in range conditions.

Autenrieth: Do you have a publication forthcoming on your habitat type classifications?

Hironaka: No, I don't. It may be available within three years.

PRONGHORN POPULATION CHARACTERISTICS IN CENTRAL MONTANA*

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ABSTRACT:

Results of aerial surveys of the Yellow Water Triangle from 1966 to 1975 were presented. The population of 6 herds doubled in 5 years, from 548 in 1967 to 1,086 in 1972. All herds increased approximately twice. Density of total antelope increased from 2.57 to 5.10 during those 5 years. Density of adult females increased from 1.24 to 2.26 at the same time. The population decreased in 1974 due to loss of adult females and much below average fawn survival. Average survival of fawns to the August aerial survey was 0.73 per adult female and 0.96 per mature female (not counting yearlings). Highs and lows in fawn survival occurred simultaneously throughout the study area, in all herds indicating the primary influence of good or poor weather and/or range conditions in any year. Livestock grazing was the major zootic influence and thus modified range conditions greatest. Changes in livestock grazing management, which rotated pasture use, appeared to increase antelope carrying capacity as was indicated by an increase in fawn survival in the herds affected by the change. Classification of yearling females (by enlarged udders) and yearling males (by short horns) was discussed. Yearling males can be classified during aerial surveys with high accuracy. It was assumed that yearling males and females occurred equally, based on a near 50:50 ratio from large samples (966 females and 751 males classified) in 1972 and 1973. The yearling classification permitted additional mortality and survival analysis from the aerial survey data. Annual mortality of adult males was 48 percent, 36 percent to hunting and 12 percent to other factors (but including crippling and illegal kill). Annual mortality of adult females was 19 percent, 7 percent to hunting and 12 percent to other causes. Adult female mortality occurred as intermittent periods of high mortality, apparently not related to severe winter weather. Summer fawn mortality averaged 55 percent before the summer aerial survey (based on 1.9 fetuses per mature doe). Winter fawn mortality averaged 32 percent of the previous summer count, 10 percent to hunting and 22 percent to other causes. This loss was correlated with severity of winter weather at low levels of the population but not when the population reached its highest levels. Thus, 1.9 fawns per mature doe was reduced to an average of 0.96 by the time of the August count and to an average of 0.62 yearlings by the following year's aerial survey. Recruitment was 33 percent of the fawns presumed to be born. Total mortality was 47 percent to hunting and 53 percent to other causes. Thus legal hunting figured as a mortality agent for only approximately 16 percent of the fawns born, other mortality factors removed the remaining 84 percent. This population was hunted and conservative (9 percent) to moderate (19 percent) harvests were taken.

*A contribution of Montana Federal Aid Project W-105-R in cooperation with the Bureau of Land Management.

Chart #1. Aerial survey data, Yellow Water Triangle, 1966 to 1975.

Year	Total Antelope	Females	Fawns
1966	529	246	181
1967*	548	263	181
1968	553	202	233
1969	692	316	253
1970	860	411	299
1971	919	402	313
1972	1,086	481	375
1973	1,133	537	371
1974	913	474	199
1975	953	518	273

Chart #2. Density of total antelope and adult females by year in the Yellow Water Triangle, 1966 to 1975.

	Density	
Year	Total Antelope	Adult Females
1966	2.5	1.2
1967	2.6	1.2
1968	2.5	1.0
1969	3.2	1.5
1970	4.0	1.9
1971	4.3	1.9
1972	5.1	2.3
1973	5.3	2.5
1974	4.3	2.3
1975	4.5	2.4

Chart #3. Density of total antelope by herds in the Yellow Water Triangle, 1966 to 1975.

Herd	Herd Range Area	Density		
		Low	High	Average
I	32	1.6	5.2	3.0
II	27	2.5	10.5	6.3
IV	8	4.4	11.5	7.8
V	44	3.2	5.6	4.4
VI	83	2.1	3.7	3.2
VII	18	3.0	7.7	5.2

Chart #4. Density of adult females by herds in the Yellow Water Triangle, 1966 to 1975.

Herd	Herd Range Area	Density		
		Low	High	Average
I	32	0.7	2.9	1.6
II	27	1.1	4.6	2.9
IV	8	1.3	5.6	3.7
V	44	1.2	2.9	1.9
VI	83	0.7	1.9	1.6
VII	18	1.2	3.7	2.4

Chart #5. Fawn production by herds in the Yellow Water Triangle, 1966 to 1975.

Herd	High	Low	Average
I	1.4	0.2	0.64
II	0.9	0.4	0.72
IV	1.4	0.3	0.76
V	1.1	0.5	0.82
VI	1.2	0.4	0.70
VII	1.4	0.5	0.83

Chart #6. Classification of adult male antelope by dentition classes from Yellow Water Triangle checking stations in 1975.

Dentition Class	Number in Sample	Horn Length Mean (Inches)	Horn Length Standard Deviation	Horn Length Range Min.	Horn Length Range Max
1 pair of permanent incisors	40	6.7	0.8	4.8	8.5
2 pair or more of permanent incisors	78	10.1	0.9	8.5	12.5

Chart #7. Assumptions for population analysis from aerial surveys.

1. Accurate counts and classification.
2. Minimal ingress or egress.
3. Highest count of a cohort is the better one.
4. Yearling males numerically equal yearling females.

Chart #8. General formulas for population analysis.

1. Adults-Yearlings = Matures ($X_A - X_Y = X_M$)
2. $X_{A(Yr\ R)} - X_{M(Yr\ R+1)}$ = Number dead, mortality
3. $X_{M(Yr\ R+1)} / X_{A(Yr\ R)}$ = Decimal survival
   a. 1 - Decimal survival = Decimal mortality
   b. 100 (Decimal survival)= percent survival
   c. 100 (Decimal mortality) = percent mortality
3. Total Mortality - Hunting Mortality = Natural Mortality

Chart #9. Mortality and survival for adult females.

$♀_A - ♀_Y = ♀_M$

$♀_{A(Yr\ R)} - ♀_{M\ (Yr\ R+1)}$ = Number dead

$♀_{M(Yr\ R+1)} / ♀_{A(Yr\ R)}$ = Decimal survival of $♀_A$

$1.00 - ♀_A$ Survival = Decimal mortality of $♀_A$

100 ($♀_A$ mortality) = Percent $♀_A$ mortality.

Chart #10. Fawn production and survival.

$FF/♀_M$ = Annual production

1.9 (?) - $FF/♀_M$ = Fawn (neonatal?) mortality

Yearlings ($♀$ $♂_y$) / $♀_M$ = Recruitment

$♀ ♂_{Y(Yr\ R+1)} / FF_{(Yr\ R)}$ = Yearling survival

or

$1.00 - ♀ ♂_Y$ Survival = Winter fawn mortality

100 ($♀ ♂_Y$) survival = percent yearling survival.

Chart #11. Summary of production and survival in the Yellow Water Triangle, 1966 to 1975.

Parameter	Year 1969	1970	1971	1972	1973	1974	1975	Ave.
FF/♀$_A$	0.80	0.73	0.78	0.78	0.69	0.42	0.53	0.66
FF/♀$_M$		0.95	1.07	1.04	0.87	0.57	0.61	0.85
♀♂$_Y$/F	0.71	0.74	0.76	0.59	0.69	0.65		0.69
♀♂$_Y$/♀$_A$	0.57	0.54	0.59	0.46	0.47	0.27		0.48
♀♂$_Y$/♀$_M$		0.70	0.80	0.61	0.60	0.37		0.62

Chart #12. Life table for adult female mortality in the Yellow Water Triangle, 1966 to 1975.

	Year 1970	1971	1972	1973	1974	1975	Ave.
Adjusted aerial survey	411	408	481	537	491	518	466
Hunting mortality	16	29	25	46	40	54	31
Fall survivors	395	379	456	491	451	464	434
Following year ♀♀$_M$	298	361	427	364	451		
Estimate of Natural Mortality	97	18	29	127	0		54
Estimate of Total Mortality No.	113	47	54	173	40		85
%							

Chart #13. Summary of total mortality (numbers) in the Yellow Water Triangle, 1970 to 1974.

	Year					Total	
	1970	1971	1972	1973	1974	No.	%
Hunting mortality	90	106	97	182	199	674	47
Other mortality	156	113	222	224	59	774	53
Total mortality	246	219	319	406	258	1,448	

Chart #14. Summary of mortality (percent) for hunting and other causes in the Yellow Water Triangle, 1970 to 1974.

	1970	1971	1972	1973	1974	Ave.
Males-Hunting						
Mortality	40	27	23	43	49	36
Other causes	0	19	25	7	11	12
Females-Hunting						
Mortality	4	7	5	9	8	7
Other causes	24	4	6	24	0	12
Fawns-Hunting						
Mortality	7	7	5	10	19	10
Other causes	20	18	36	22	16	22

CONCLUSIONS

1. Reasonably accurate aerial surveys can be very useful in analyzing antelope population changes.
2. Antelope have the productive capacity for rapid population expansion under suitable conditions.
3. Density of total antelope and especially adult females are important parameters to consider in antelope management.
4. Yearling error can be removed from fawns/adult females production figures so production is related to fawns/mature female.
5. Production varied throughout herds by years indicating the overriding influence of weather and/or range conditions.
6. Livestock management is the most influential zootic factor and thus is next most important, maybe most important over the long term.
7. Production varied inversely with density of adult females.
8. Change in livestock management to a pasture rotation apparently benefited antelope so they had increased fawn production, indicating improvement in antelope carrying capacity.
9. We don't understand the population consequences of predation. At present it appears to be a factor secondary to weather-range, and livestock management.
10. Yearling males and females can be classified on ground surveys; yearling males on aerial surveys. Present assumption is that yearling females equal yearling males which are readily classified on aerial surveys.
11. These classifications make possible determination of:
    a. fawns/mature female (production or summer survival of fawns)
    b. yearlings/fawn (winter survival of fawns)
    c. yearlings/mature female (recruitment)
    d. mortality and survival of adult males and females
12. Total mortality can be divided into hunting and non-hunting to show effects of hunting on the population.
13. Antelope apparently are short-lived and underharvests of females result in periodic natural mortality.
14. Population control by low fawn survival and periodic loss of adult females.

COMMENTS AND QUESTIONS

Nellis: The other factors of natural mortality somewhat biases the interpretation of your results when you say hunting contributes 47% total mortality. When in reality, if current guesses on crippling loss on antelope are near correct, hunting may be more important than that because of illegal kills and crippling losses.

Pyrah: If you have data to show this to be so, we would be glad to look at it. I can't estimate those factors with any confidence.

Barrett: Please comment on the inverse relationship between density and survival.

Pyrah: We have three figures, i.e. total animals, total adults and total adult females, that was the gradation in which the correlation coefficient was higher (it increased progressively between those categories). The lowest producing unit had the significant correlation between the density of adult females and the production of fawns. It had a coefficient of 25. The others were above .5. The coefficient did not hold up. We changed the pasture management (a unit had a better coefficient before we changed the pasture management and that made it deteriorate). I interpret that to mean we increased the carrying capacity for the antelope. I think forage availability is most of our problem.

CONCENTRATIONS OF RADIONUCLIDES IN TISSUES OF ANTELOPE ON AND NEAR THE INEL SITE

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ABSTRACT

Pronghorn antelope (Antilocapra americana) are present throughout the year on the Energy Research and Development Administration's Idaho National Engineering Laboratory (INEL) 231,500 ha (571,800 acres) Site in southeastern Idaho. During late fall, additional antelope migrate onto the INEL Site primarily from the Little Lost River, Birch Creek and Crooked Creek-Medicine Lodge Creek valleys north and northeast of the Site. Both resident and migratory antelope have been observed browsing near the Idaho Chemical Processing Plant (ICPP) and other INEL Site facilities. Soil contamination exists near some of the facilities, and the ICPP emits trace amounts of particulate radionuclides into the atmosphere. Subsequent movement offsite makes these animals available for harvest by sportsmen. Tissues and rumen samples have been collected from antelope on and near the INEL Site and analyzed for radionuclides. Rumen samples from antelope collected near the ICPP contained detectable amounts of 13 radioisotopes. However, the only gamma emitting isotopes present in liver and muscle samples were cesium-137, cesium-134, cobalt-60 and manganese-54. The only isotope consistently detected in muscle and liver was cesium-137. Concentrations of cesium-137 in tissues from 15 antelope within 10 km of the ICPP averaged 538 (range 29-1520) pCi/kg muscle and 973 (60-2660; N=13) pCi/kg liver and were significantly higher ($\alpha < .001$) than tissues collected from the remainder of the INEL Site antelope and from offsite antelope. Antelope from the remainder of the INEL Site had average cesium-137 concentrations of 60 (16-130; N=22) pCi/kg muscle and 61 (13-146; N=16) pCi/kg liver. Offsite animals averaged 42 (18-92; N=14) pCi/kg muscle and 52 (20-139; N=12) pCi/kg liver. Concentrations in offsite antelope are thought to result primarily from worldwide fallout resulting from previous above ground nuclear detonations.

The consumption by an individual of all the muscle and liver of an antelope which contained the maximum concentration obtained to date represents a radiation dose of less than four mrem. This dose is similar to that received in a round trip flight from Washington, D. C. to the west coast, and is a small amount when compared to the approximate 160-180 mrem dose that each person in this area receives from naturally occurring background radiation.

Metacarpals from 11 antelope collected within 10 km of the ICPP had average strontium-90 concentrations of 15.0 pCi/g ash and were significantly different (α = .02) than metacarpals collected on the remainder of the INEL Site (4.3±5.2 pCi/g ash; N=14) and from offsite areas (5.3±1.4 pCi/g ash; N=11).

Analyses of antelope lungs for plutonium indicate that lungs of seven antelope collected within 6 km of the ICPP and two others within 35 km of the ICPP had higher Pu-238/Pu-239 ratios than would be expected from worldwide fallout while lungs from 21 other antelope had ratios similar to that observed in worldwide fallout. These higher ratios are apparently the result of inhalation of ICPP Pu atmospheric releases and/or dust particles containing Pu from near the ICPP. Resuspension of dust particles could result from wind transport or foraging activities. However, the maximum concentration (1.8×10^{-4} pCi Pu-238/g) in any antelope lung was only a factor of 10 higher than the minimum detection limit for the analysis.

Thyroids from antelope collected during the study as well as thyroids from hunter harvested antelope are currently being utilized to monitor iodine-129 in the environment of the INEL Site and the upper Snake River Plain.

A radio-telemetry study of the antelope on and near the INEL Site is in progress to document movements and migration routes from the Idaho Mountain valleys north and northeast of the Site and from adjacent areas of Montana. This study will determine the extent and location of winter use of the INEL Site as well as movements by summer-fall residents on the Site. These data will assist in the interpretation of the radionuclide-tissue data and will enhance the value of these antelope tissue samples as bioindicators of radionuclides. Data will also be collected on summer ranges, habitat selection and mortality. The telemetry data is essential for formulating management policies and land use decisions.

Over 200 antelope were captured just north of the INEL Site in the three mountain valleys during December 1975 and January 1976. Fifty-four were radio-collared and an additional 106 were ear-tagged. Each radio-collar utilizes a different frequency and each is equipped with two thermoluminescent dosimeters to measure radiation exposure. Although the winter is mild and radio-tracking of short duration, antelope from two of the valleys have entered the Site.

COMMENTS AND QUESTIONS

Pojar: What is the biological half-life of strontium-90?

Markham: Strontium-90 half-life is probably two years in the young and 10 years in the adult. The cesium-137 is very short. The maximum situation I mentioned for cesium in the muscle will probably not occur because the INEL is closed to hunting and the biological half-life is only about two weeks.

?: Will cesium-137 be carried off by water?

Markham: For cesium-137, because of the relatively high clay content that we have; it is almost immediately fixed in the ground. We will not get any siphoning in the particular area.

Barrett: Do you have necropsy results for radio collared pronghorns that died shortly after leaving the trap?

Markham: We have some reports from those animals which died during the trapping.

Barrett: I was thinking of the ones you mentioned that had no evidence of trauma but were found dead. We have experienced this and wondered if you could point to any organic source which led to their death?

Markham: Possibly on one we can. One of the animals mysteriously disappeared and we found it later high in the valley, apparently shot. Predators had worked on it so it was difficult to be sure.

NOTES ON A PRONGHORN ANTELOPE WINTER RANGE*

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Abstract:

A period of five months, Jan. 15, 1974 thru June 15, 1974, was spent in the Pahsimeroi Valley of Idaho to determine distribution and size of wintering bands of pronghorn antelope, to determine preferred forage and range conditions and to observe winter behavior.

Direct aerial and surface counts indicated a total population of 825 antelope. Mean group size from January 15 to March 15 was 48 animals. Spring dispersal began in the last half of March, when the mean group size dropped to 16 animals.

Relatively flat alluvial fans merged to form the valley floor. Vegetation on these fans was predominately sagebrush-grass. Artemesia tridentata, A. arbuscula, and A. spinescens were dominant species in different areas. Prominent grasses included Poa secunda, Sitanion histrix, Agropyron spicatum, Oryzopsis hymenoides, and Sporobolus cryptandrus.

Antelope occupied areas of these fans between 5,000 and 7,000 feet that were not frequently disturbed by human activity. Some fans were not utilized for no apparent reason.

Concentrated vegetative analysis of feeding sites was done on one representative fan. Parts of the fan were dominated by Artemesia tridentata, part by A. arbuscula, and part by Tanacetum nuttali. In averages of 27 feeding sites over the whole fan, A. tridentata made up 23% of the diet (as determined by examination of the feeding area), A. arbuscula was 32%, and Tanacetum nuttali was 33%. In the Tanacetum-dominated area, it made up 90% of the diet, though A. tridentata and A. arbuscula was scattered through the feeding area. Diet varied in different parts of the valley.

Because of a thaw at the beginning of the study and generally mild winter conditions thereafter, there was little snow in the wintering areas during the study period. Forage appeared to be plentiful in most areas of the valley. In a year of heavy snowfall, the low growing Tanacetum would be quickly covered. Artemesia tridentata, because of its greater height, would probably become more important.

Social interactions were very rare in the mixed wintering bands. Predation appeared to be insignificant to active antelope.

* This paper reports on work supported in part by the Idaho Department of Fish and Game, Bureau of Land Management and Idaho State University.

Winter range conditions are often the most important factors affecting an antelope population. Dirschl (1963) said extent and quality of winter range are the limiting factors governing size of pronghorn populations in Saskatchewan. Ingold (1969) in Wyoming found "fawn production in pronghorns is ultimately a function of the quality of the range, especially in the critical winter and early spring months". Egan (1972) claims "an antelope is nothing more than vegetation baled up in an antelope hide", emphasizing the importance of adequate range.

I spent five months, from January 15, 1974 to June 15, 1974, in the Pahsimeroi Valley of Idaho studying winter-spring habitat and populations of pronghorn antelope. Objectives were to determine distribution, size, and dispersal of winter bands in relation to snow depth, terrain, and range, to determine preferred forage and range conditions and to observe winter behavior.

Direct aerial and surface counts indicated a total population of 825 antelope. This may be somewhat low; some investigators estimate only 80% of the animals are seen from a plane. It is also possible to miss some animals during surface counts.

Composition counts made between January 15 and March 15, indicated a buck: doe: fawn ratio of 25.3:100:41.8. This ratio was based on classification of 396 animals, using the best single classification count from each of the major bands, to avoid duplication.

Mean band size during this period was 47.7 animals. During the last half of March, as green grass began to appear, mean band size dropped to 16 animals. I considered this to indicate the end of winter range.

and the beginning of spring dispersal. Mean band size for the first half of April was 11.1; for the last half, 6.5; the first half of May 3.8. During the fawning period, including the last half of May and the first half of June, mean group size was 2.6.

Density decreased with spring dispersal. During the winter period, density averaged 10.7 antelope per section of occupied winter range. Density of individual wintering areas ranged from 17.4 to 7.6 antelope per section, though size of these areas ranged from 4 to 37 square miles. During the first half of April, density was 5.4 animals per section with a range from 8.4 to 4.1; in the last half, the average was 3.4 with a range of 6.7 to 3.0. In the first half of May, density was 1.7 animals per section with a range of from 4 to 1.6. The areas retained their relative density through the dispersal period; an area which had high density during the winter remained at a relatively high density during dispersal.

The flat alluvial fans which merge to form the valley floor were the preferred wintering areas though extensive areas of these fans which appeared to be suitable winter range was not occupied. Foothill terrain was used very little until dispersal began. The winter areas ranged from 5,000 to 7,000 feet elevation. There was little snow up to the 7,000 foot level during most of the study; running bands stirred up dust in January in the upper part of the valley. Wintering areas were separated by topographical features and farm lands.

The principal vegetation type on all of the wintering areas was Artemesia-grass. Artemesia tridentata, Artemesia arbuscula and Artemesia spinescens were dominant species in different areas, with significant amounts of Atriplex convertifolia. Prominent grasses were Poa secunda, Sitanion histrix, Oryzopsis hymenoides, and Sporobolus cryptandrus. Range improvement areas consisting of big sage and crested wheat were seldom occupied.

Double Springs fan, which lies mid way between the upper and lower ends of the valley, was selected as a representative wintering area for vegetational study. This area was occupied by about 50 antelope, but in some winters is occupied by larger numbers.

Feeding sites were determined by direct observation. Later the vegetation was analyzed by a slight modification of the method described by Daubenmire (1959). Forty 2x5 decimeter plots were randomly located along a 100 meter transect, evaluated for canopy coverage, and totalled. Frequency and utilization data was gathered from these plots.

There was variation in the vegetation available on this fan, but it was assumed that by analyzing all of the positively located feeding sites, an approximation of the vegetation preferences of the antelope would be obtained. By combining 27 transects of feeding areas from this fan, (figure 1) I obtained information for each species present on percent ground cover, percent of frequency of occurrence, percent of diet (from examiniation of feeding areas), percent of canopy cover utilized for forage, and percent of frequency of use.

Artemesia arbuscula was 5% of ground cover, with 32% of the diet. Canopy utilized was 2%. Artemesia tridentata was 4% of ground cover, with 23% of the diet and 2% use of the canopy cover. Tanacetum nuttallii was 3% ground cover, 33% of the diet with 4% use of the canopy cover. Poa secunda was 3% of ground cover, 5% of diet with 1% use of canopy cover. Artemesia tripartita, Atriplex convertifolia, Eurotia lanata, Cryptantha humilus, and Sitanion histrix made up 6% of ground cover, 7% diet and only a trace of canopy use. Other plants were available in trace amounts. Bare ground/ litter was 75% of ground cover.

Tanacetum nuttallii has not been mentioned in the literature to my knowledge as an antelope food, yet the part of the fan where it occurred was occupied to a degree far out of proportion to its area. In this area, in ten feeding transects, (figure 2) Tanacetum made up 6% of the ground cover and 90% of the diet. Four percent of its canopy was utilized. Artemesia tridentata and Artemesia arbuscula were readily available in this area in narrow strips. In the feeding sites, Artemesia tridentata was 1% of ground cover, 5% of the diet with 1% of its canopy utilized. Artemesia arbuscula was 1% of the ground cover, 1% of the diet, with a trace of the canopy utilized. Bare ground/litter was 77% of ground cover. In other locations in the Salmon District where Tanacetum occurs, it also appears to be utilized by antelope.

Eight transects on the Double Springs fan which had little or no feeding by antelope showed average ground civer of 15% Artemesia tridentata, (figure 3) 2% Atriplex, 2% Poa and 75% bare ground/litter.

When these transects were analyzed, a sample was taken from an Artemesia tridentata bush which had been fed upon by antelope and one from a bush which had not. These samples were analyzed by chromatography by Idaho Fish and Game labs to separate the subspecies of Artemesia tridentata. Of all the bushes which had been fed upon, 71% were Artemesia tridentata wyomingensis; the remaining 29% were Artemesia tridentata tridentata. All of the non- utilized bushes were Artemesia tridentata tridentata. Though the sample size was small, this suggests that Artemesia tridentata wyomingensis was much more palatable but less prevalent than Artemesia tridentata tridentata. Artemesia arbuscula showed a similar condition, with Artemesia arbuscula nova apparently preferred over Artemesia arbuscula arbuscula.

These apparent preferences of antelope for a species or subspecies may or may not be of major importance. The diet showed considerable variability in different parts of the valley, based on scattered transects taken on other wintering areas in the valley. In one of the major wintering areas, Artemesia arbuscula made up 69% of the vegetation present and was 97% of the diet.

In one area, Opuntia was very frequently eaten, while in other areas where Opuntia was available it was rarely eaten. A rumen sample from an area adjacent to the study area contained 51% lichens; these lichens were available throughout the study area, but examination of feeding sites cannot detect use of these lichens as forage. In other antelope ranges Eurotia lanata and Artemesia frigida have been reported as significant parts of the diet. They were prominent in the Double Springs fan area, but I found little use of Eurotia lanata and no use of Artemesia frigida in the transects. This variability in diet prevents a simple identification of good antelope winter range from vegetation type.

One of the objectives was to determine amount of forage available above the snow. However, a thaw began as I arrived on the study area in January and the snow on the winter range melted. Later snows did not exceed four or five inches, except in drifts, and melted within a few days. Snow in this mild winter appeared to have no effect on availability of forage. Much low browse extended above the snow, and antelope pawed through snow to reach preferred forage. The frequent winds in this valley cleared snow from many areas.

In a year of heavy snowfall, when the entire valley floor is snow-covered, the amount of available forage may be critical, especially if weather

conditions resulted in crusting of the surface. Artemesia tridentata would undoubtedly become more important under these conditions because of its height.

During this mild winter I did not observe any alteration in daily activities due to severe weather. Mean length of feeding periods of 280 animals was 2.02 hours; length of rest period for 639 animals averaged 1.48 hours. These feeding and rest periods alternated throughout the day, with no apparent relation to time. It was common, when two groups could be observed simultaneously, that one group was resting while the other group was feeding.

The total number of antelope in a wintering area did not change significantly during the winter. A band sometimes would separate into groups, which later would recombine. The successive groups varied in size. No animals were marked on this study so it could not be determined if the same animals associated in these groupings.

Flight distance ranged from 1/4 to 1-1/2 miles. This distance hindered observation of behavior, and prevented diet study by direct observation. No obvious habituation occured, though flight distance appeared to be lower in bands wintering near roads.

There was little social interaction in the mixed wintering bands. During 4,500 antelope-hours of observation I noted only 2.1 incidents of social interaction per 100 antelope-hours. Bucks were involved in 58.3% of these, does in 16.7%, fawns in 15.6%. In April, after spring dispersal had begun, there were 14.6 interactions per 100 antelope-hours. Bucks entered 66.3%, does 10.8% and fawns 20.7% of these.

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FIGURE 1

Double Springs Fan Feeding Sites Summarized

Species	% Ground Cover		%-* Frequency		% of Diet	% Canopy Cover Used	%-** Frequency of Use
	$\bar{X}$	SD	$\bar{X}$	SD			
Tanacetum nuttallii	2.8	3.3	25.4	25.3	33.1	4.0	23.9
Artemesia tridentata	3.6	3.4	17.1	13.3	23.4	2.2	17.4
Artemesia arbuscula	4.5	7.2	18.3	28.8	32.0	2.4	14.9
Artemesia frigida	0.2	1.1	2.4	10.7			
Artemesia spinescens	0.5	0.7	7.5	10.3			
Artemesia tripartita	0.2	1.2	0.8	4.3	1.8	2.9	22.2
Atriplex confertifolia	3.4	2.8	29.0	20.1	2.1	0.2	2.3
Eurotia lanata	0.8	0.9	13.7	11.4	1.8	0.7	1.4
Leptodactylon pungens	0.2	0.7					
Cryptantha	0.3	0.4	7.9	9.5	0.3	0.2	1.1
Halogeton	0.3	0.7	3.2	5.5			
Lichens	2.0	1.4	63.2	34.0			
Poa secunda	3.0	1.9	48.8	19.9	4.7	0.5	1.9
Sitanion hystrix	1.5	1.2	26.8	22.3	0.9	0.2	1.0
Agropyron spicatum	0.5	0.9	8.5	14.4			
Bare Ground	71.1	7.2	100.0	0			
Litter	3.8	2.4	51.5	17.3			

* Based on occurrence in the 2x5 decimeter-

** % frequency of use = number of plots with utilization / number of plots containing the species

FIGURE 2
Tanacetum Type Feeding Sites Summarized

Species	% Ground Cover		% Frequency		% of Diet	% Canopy Cover Utilized	Frequency of U
	$\bar{X}$	SD	$\bar{X}$	SD			
Tanacetum nuttallii	6.4	2.6	55.2	12.4	89.5	4.4	27.1
Artemesia tridentata	1.4	1.6	7.3	7.2	4.7	1.1	18.2
Artemesia arbuscula	0.7	1.8	2.5	7.1	0.6	0.3	10.0
Artemesia frigida	0.6	1.7	5.5	17.4	---	---	----
Artemesia spinescens	1.1	0.7	18.0	10.0	---	---	----
Atriplex	3.8	2.3	37.2	12.3	1.3	0.1	2.2
Eurotia lanata	1.3	1.2	21.8	12.9	---	---	----
Cryptantha	0.4	0.5	9.2	10.5	0.6	0.5	2.7
Lichens	2.6	0.9	79.0	16.9	?	?	?
Halogeton	0.8	1.0	7.3	5.9	---	---	----
Poa secunda	2.6	1.3	47.2	19.2	2.5	0.3	2.6
Sitanion hystrix	2.2	1.1	40.5	22.2	0.6	0.1	1.2
Bare Ground	73.5	2.8	100.0	0			
Litter	3.0	0.9	48.8	8.4			

FIGURE 3
Double Springs Fan Areas Seldom Used

Species	% Ground Cover		% Frequency	
	X	SD	X	SD
Artemesia tridentata	15.1	4.2	56.6	16.1
Atriples confertifolia	2.1	1.8	16.6	12.5
Poa secunda	2.2	1.5	35.3	20.9
Lichens	2.6	1.2	72.8	20.5
Cryptantha	T			
Tanacetum nuttallii	T			
Artemesia arbuscula	T			
Agropyron sp.	T			
Phlox	T			
Bare Ground	75.5	4.9	100.0	

COMMENTS AND QUESTIONS

Simpson: Did you follow 24-hour activity cycles or were they just during the day light?

Bernt: Observations were only made during the day. I tried night watching but it didn't work for me.

FORAGING BEHAVIOR OF PRONGHORN AND CATTLE ON A SHORTGRASS PRAIRIE IN COLORADO[1/]

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Abstract: Foraging behavior of tame pronghorn (*Antilocapra americana*) and cattle was studied on a buffalo grass-blue grama type shortgrass prairie. Pronghorns were observed from May 1973 through April 1974, while cattle were observed from May through October 1973. Results indicate that pronghorns spent about 53 percent of the time grazing and 40 percent resting. Cattle spent 62 percent of their time grazing and 32 percent resting. Peaks in foraging activity for both herbivores occurred near sunrise and sunset. Seasonal trends indicate that feeding activity for pronghorn was more frequent and less intense during the

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summer than during winter. Goodness of fit comparisons between the observed and expected usage of four terrain types indicate that cattle and pronghorn preferred to graze on lowland flats and plateaus ($P < 0.10$). Pronghorn also preferred to graze on warm slopes from January through June. Both species of herbivores tended to avoid cool slopes and ridge tops for grazing. Multiple correlation-regression analyses indicated that there was a significant ($P < 0.05$) relationship between the amount of time pronghorns spent grazing in an area and the frequency of those plant species comprising 5 percent or more of their diet. Although a significant relationship was found, the frequency of plant species in the diet never accounted for more than 16 percent of the grazing activity in an area. Speculations relating grazing behavior to forage quality, herbivore body size, and energetics are also presented.

The pronghorn antelope is the largest wild herbivore naturally occurring on the shortgrass prairie and is an important component of the consumer trophic level of the grassland biome. To understand the role of pronghorn in the grassland ecosystem, it is essential that certain parameters be measured and understood. Part of the Grassland Biome (IBP) analysis of the shortgrass prairie ecosystem involved determining the forage habits, nutritive quality and intake (Schwartz and Nagy 1973), and foraging behaviors of pronghorn. The objectives of this study were to describe, quantify, and discuss the foraging behaviors of pronghorns and cattle and relate these activities to terrain, vegetation, and food habits.

We would like to thank S. Kerr and R. Souther for care and maintenance of pronghorns. We would also like to thank the many members of

the IBP Natural Resource Ecology Laboratory who aided in various phases of the project: M. Travis and C. Dickinson for data collection, K. Stevens, J. Peltz, R. Shipley, and V. Baker for computer programming, M. Campion for statistical analysis and J. Ellis, D. Swift, and L. Menges for manuscript reviews. We also thank USDA Agricultural Research Service for use of data.

METHODS

Foraging behavior of tame pronghorns was studied on the Pawnee Site located 40 km south of Cheyenne, Wyoming and 19 km northeast of Nunn, Colorado. Our studies were confined to the north half of section 21, T10N, R66W. Vegetation of the area is dominated by blue grama (Bouteloua gracilis), buffalo grass (Buchloe dactyloides), a variety of forbs and half-shrubs including fringed sagewort (Artemisia frigida), and has been described by Klipple and Costello (1960) and Jameson (1969). This area is part of a long-term research study area of the Central Plains Experimental Range administered by the USDA Agricultural Research Service where varied intensities of cattle grazing have been studied. Half-section 21 N represented a "moderate use" pasture where approximately 50 percent of weight of the current herbage growth of the dominant forage grasses (blue grama and buffalo grass) was grazed by the end of a 6-month grazing season, approximately 10 May to 10 November (Klipple and Costello 1960:13).

The 114-ha pasture (1.4 × 0.8 km) was divided into 264 equal quadrats (67 × 64 m). Each quadrat was classified as one of four terrain types: (1) lowland flats and plateaus; (2) hilltops, ridges, and crests; (3) cool slopes, which included north, east, northeast, and northwest aspects of hillsides; and (4) warm slopes, which included south, west, southeast, and southwest aspects of hillsides. For each quadrat, frequency of

plant species was determined in 25 half-meter square plots along a line transect bisecting each quadrat. Three sampling dates (5 April, 22 June, and 10 August 1973) were chosen to determine differences in plant frequencies throughout the pasture over the growing season for forbs and annual grasses. Shrubs and perennial grasses were estimated only once since changes in frequency were likely to be minimal in one season.

Pronghorn activities were observed from 30 minutes before sunrise to 30 minutes after sunset from 19 May 1973 through 16 April 1974. Antelope were observed from 100 m distance with the aid of a 15-45X spotting scope. On each observation day, pronghorn activities (grazing, resting, travel, and others) and locations by quadrat were recorded at 15-minute intervals. An "activity hit" was defined as an antelope performing a given activity at a given location in a given 15-minute interval. A total of 26 days of observations was made for a total of 354 observation hours (Table 1). Animal losses due to poaching and disease resulted in pronghorn of different ages throughout the study (Table 1).

Botanical composition of pronghorn diet was determined using the "bite count" method and has been described by Schwartz and Nagy (1973) and Wallmo et al. (1972). The average observation distance was 3 m. The same pronghorn were observed during food habit studies. To quantify forage preferences, individual pronghorn were watched for 15-minute intervals during which all plant species eaten were recorded. A total of 53 days of observations was made with 112 animal observation periods (15 min) for a total of 28 observation hours.

To determine changes in activity by season, six activity periods were chosen: (1) March-April, (2) May-June, (3) July-August, (4) September-October, (5) November-December, and (6) January-February. The number of observation days per activity period varied from 3-7 for activity

observations (Table 1) and 10, 9, 19, 8, 5, and 2 days for food habit observations for periods (1)-(6), respectively. Food habit observations were intensified during the plant growing season when changes in plant preferences and availability were expected.

Ten nonbreeding Hereford cattle were observed currently with the pronghorn from May through October, 1973. In addition, cattle were observed for one day during December.

Analysis of foraging activities for both herbivores was based on the amount of time spent grazing, resting, traveling, and other activities (i.e., drinking, playing, etc.). From these data, time budgets were constructed and patterns of foraging identified. Since there were unequal observation days each month, data were averaged on a monthly basis; period means represent the mean of the two monthly means for that period. An annual summary for adult pronghorn activities was based on the mean of 12 monthly means. Since both adult and juvenile pronghorn were observed, and juveniles received milk supplement twice daily until weaning on 11 October 1973, the two groups were analyzed separately. The annual summary for juveniles was based on 10 months since juveniles were not sampled in May and June.

To analyze the relationships between foraging activities and terrain types, observed locations of both grazing and resting were compared to expected locations during each of the six sample periods using a chi-square (χ^2) goodness of fit test described by Snedecor and Cochran (1969:236-238) for both cattle and pronghorn. Terrain types with activity frequencies adding most to the tabulated values were assumed to be highly favored or avoided. Since the pronghorn in this study constituted one herd or social unit at most times, juvenile and adult animals were

treated together; an interaction chi-square indicated homogeneity among the juvenile and adult ratios, therefore the two were legitimately pooled (Snedecor and Cochran 1969:240-241). To test whether a specific observation occurred more or less frequently than expected, conservative confidence intervals were calculated with a Bonferroni Z statistic and 0.10 level of probability (Neu et al. 1974: 543-544).

To test if a relationship existed between plant frequency and grazing locations, we used a stepwise multiple correlation-regression analysis where grazing activity (number of grazing hits per quadrat) was correlated with the frequency of all plant species comprising at least 5 percent of the total bites; each of the six sample periods were analyzed separately for both juvenile and adult pronghorn.

RESULTS AND DISCUSSION

Both age classes of pronghorn spent most of their time grazing or resting (Table 2). Seasonal time budgets for adult and juvenile pronghorn were quite similar from January through April, but juvenile spent less time grazing and more time resting than adults from July through December. This difference was probably a direct result of the milk supplement fed to juveniles. Cattle spent more time grazing and less time resting than pronghorn during the periods cattle were sampled (Table 2). The amount of time spent grazing fluctuated less for cattle over periods than for pronghorn. In a similar study Ellis and Travis (1975) found that the percent of time spent grazing by cattle fluctuated more than that of pronghorn. These contradictory results may indicate a high degree of variability.

In all periods during which cattle were sampled, they spent more time grazing than either juvenile or adult pronghorn. Ellis and Travis

(1975:412) found that cattle spend more time grazing than pronghorn during June, July, and August, but the two herbivores spent equal times grazing during October. According to Bell (1971:6) "in general the smaller the animal, the higher the metabolic rate. In considering the matter as it affects the ecology of wild animals, one must take into account both the relative maintenance requirement (per unit weight per unit time) and the absolute maintenance requirement (per animal per unit time). ... With regard to the relative maintenance requirement, the effect of the higher metabolic rates of small animals is that they need more protein and energy per unit weight per day than larger animals. ... Although the relative maintenance requirement is higher for a small animal than it is for a large one, the reverse situation holds for the absolute maintenance requirement." With regard to relative maintenance requirements, the daily requirement of protein of a 45-kg pronghorn per unit weight is from 2-4 times higher than the requirement of the larger 454-kg cow. The reverse situation holds for the absolute maintenance requirement where a pronghorn needs to consume only about 20 percent (5-6,000 kcal of digestible energy) of the amount of food in a day that a cow would require (18,000 kcal digestible energy). The values for cattle represent NAS-NRC (1963) requirements for mature pregnant cows, wintering. Values for pronghorn were extrapolated from data obtained on white-tailed deer (Odocoileus virginianus) from French et al. (1955). Depending upon the area, forage abundance and quality probably determine whether the large or small ruminant will spend more time grazing. On an area with abundant forage of low quality, the large herbivore can likely meet its nutritional requirement faster than a small ruminant while the reverse situation holds for a pasture with low biomass of high quality forage. Since the study area represented a

moderately grazed cattle pasture, much of the abundant, low quality forage (mainly grass) was gone while the high quality forage (forbs and shrubs) were widely scattered. Applying the theories of Bell (1971) it seems logical that cattle required more time to graze to meet their nutritional requirements than pronghorn.

Peak foraging activities for pronghorn occurred in the morning and evening for both juveniles and adults (Fig. 1). When averaged over the entire year, periods of most intensive feeding occurred between 0600 and 0800 hours and between 1900 and 2100 hours for both juveniles and adults. Juveniles peaked an hour later and earlier in the morning and evening, respectively. In addition to the two major feeding peaks, there were several (3-4) intermediate peaks during the day. Peaks in grazing activity occurred at 2-3 hour intervals and were generally followed by similar peaks in resting activity. Travel generally followed or preceded grazing activity. Kautz (1942), Einarsen (1948), Buechner (1950), Prenzlo et al. (1968), and Ellis and Travis (1975) also observed pronghorn feeding most intensively during the early morning and late evening.

Frequency of pronghorn foraging activity appeared to be related to day length and/or seasonal changes (Fig. 2). Daily peaks (periods) for feeding activity were more frequent and of less intensity (amplitude) during the summer (July-August) than in late winter (January-February). Spring and fall periods were intermediate. Times of feeding also appear to be related to day length. Peak feeding periods during the summer were earlier (0600) and later (2100) than those of winter which were 0800 and 1800, respectively. These peaks in feeding occurred near sunrise and sunset. It is not known if similar peaks occurred earlier in winter, however, since sampling was done only during the day. In examining the

time interval between peaks, it appears that pronghorn tend to feed less intensively and more often during the summer (every 2-3 hours) and feed more intensively and less often during the winter (every 3-4 hours).

Similar trends in foraging activity by season were also found for cattle. Daily peaks in feeding activity were of less intensity in summer than in spring or fall (Fig. 3). A 1-day sample from 12 January 1973 verified this trend and was similar to that for pronghorn.

The differences in the period and amplitude of the grazing activity during the summer and winter for both herbivores can be related in a general way to nutrient quality and digestibility of the forage and behavioral differences due to weather. Schwartz and Nagy (1973) found that the nutritional quality and digestibility of tame pronghorn diets were highest in late spring and gradually declined through late winter. The rate of passage of particulate matter out of the rumen is a function of digestibility (Campling et al. 1961, Jones 1972) which is a function of forage quality. Therefore a high quality diet will pass out of the rumen faster than a low quality diet. Likewise the faster the rumen empties, the more often an animal can graze. Differences in grazing activity can also be related to behavioral adaptations of the two species of herbivores which tend to establish a balance between the heat production of the animal and the physical process of heat exchange with the environment. According to Moen (1973:286), "animals respond behaviorally to the thermal regime, altering the balance between heat loss and heat production by changes in orientation, posture, activity, or the selection of cover." Likewise Moen (1973:287) demonstrated that at an air temperature of -20°C the heat loss was about twice as great for a standing deer as for a bedded deer, and this heat loss was three times greater with a 12 mph

wind. Wesley et al. (1973) found that the lower critical temperature for fasting pronghorn was near or below 0°C, while Blaxter and Wainman (1961) showed increased heat production for fasting cattle between 16-20°C. For fed animals, these values dropped to approximately -20 to -30°C for pronghorn and to 6-8°C for cattle (Wesley et al. 1973:571). The mean of the minimum daily temperature of days sampled for the four cold months (December-March) of 1973-74 was -9, -10, -6, and -1.5°C respectively. These reported cold temperatures should influence grazing activities for both pronghorn and cattle, especially if wind chilling is considered. It appears that both species of herbivores benefit by intensive periods of grazing followed by long periods of resting during the winter.

Goodness of fit comparisons showed that grazing activity within terrain types differed significantly ($P < 0.01$) from the occurrence of the four terrain types during all six sample periods (Table 3) for both pronghorn and cattle. Pronghorn appeared to prefer to graze on lowland flats and plateaus during all seasons except the May-June period when the percent of time spent grazing these terrain types was equal to the percent of terrain type in the pasture. Likewise pronghorn did not utilize cool slopes for grazing activity. The percent of time spent grazing these areas was always less than the percent of terrain in cool slopes. Pronghorn appeared to prefer warm slopes from January through June and to avoid these areas from September through December. During July and August utilization for grazing was about equal to the occurrence of warm slopes. Grazing activity on hilltops, ridges, and crests was less than the percentage of these terrain types except during July-August and November-December when grazing was about equal to the occurrence of the terrain type.

Cattle appeared to prefer to graze on lowland flats and plateaus during all seasons sampled and the percent of grazing activity was almost two times greater than the percent of terrain in lowland flats and plateaus. All other terrain types were grazed less than the percentage of these terrain types in the study area.

Both species of herbivores favored lowland flats and plateaus. In a very general sense, these areas have deeper soils, have a higher plant density, and are more productive than the hillsides and ridge tops. If these observations are considered in the context of the total daily forage requirements of cattle and pronghorn and then in light of Bell's hypotheses, cattle would spend more time in an area of high herbage biomass. Pronghorn can afford to graze in areas of low herbage abundance and still meet their daily requirements. They can also graze in areas of high herbage abundance but select only forage of high quality. Our results agree with this speculation since the cattle spent almost twice as much time grazing the lowland flats and plateaus.

Trends in terrain types used for resting by pronghorn do not follow the same patterns as those in terrain types grazed. Pronghorn preferred to rest on hilltops, ridges, and crests from November-February and on lowland flats and plateaus in all seasons except May-June. Pronghorn appeared to prefer cool slopes during September-October and warm slopes during May-June.

Cattle appear to rest mainly on cool slopes from May-August and on lowland flats and plateaus during September-October although this terrain type was also used from May-August. Hilltops, ridges, and crests were always used less than the percentage of occurrence of those types in all seasons while warm slopes were used less than their occurrence except

during September-October when use was about equal to occurrence. Cattle appear to prefer to rest in cool areas during the warm seasons (May-August) and move to a warmer area on the lowlands during the cooler season (September-October).

Food habits data (Table 4) indicate that pronghorn consumed a large portion of shrubs from November-April and a large portion of forbs from May-October. Grasses never contributed more than 21 percent of the total bites, but appeared important in the early spring and late fall. Multiple correlation-regression analyses indicated that there was a significant ($P < 0.05$) relationship between the number of grazing activity hits per quadrat and the frequency of those plant species comprising 5 percent more of the total diet for several sampling dates. Although a significant relationship was found, the frequency of plant species in the diet relative to their frequencies in the grazed quadrats never amounted to more than 16 percent of the grazing activity in a quadrat. This relationship is partially explained by the fact that most species which made up 5 percent or more of the diet were distributed throughout the pasture and were found on several terrain types. Since pronghorn appear to prefer to graze on certain terrain types and not others, their grazing activities could not directly attribute to plant frequencies alone.

CONCLUSIONS

Although this report deals with only the preliminary analysis of a complex grazing behavior study, certain trends in the grazing-resting cycles for both cattle and pronghorn were apparent. Many factors, both biotic and abiotic, affect where, when, and how herbivore species graze

and rest on the shortgrass prairie. Weather variables like ambient temperature, wind speed, and direction plus others may influence foraging activity. Additional analyses on data collected during this study coupled with further field research should add to our knowledge and understanding of factors which influence activity patterns in free ranging ruminants.

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Table 1. Observation schedule for pronghorn and cattle activity studies on the Pawnee National Grassland, May 1973 through April 1974.

Sampling Dates (Day/Month/Year)	Number of Animals Observed				
	Pronghorn[a/]				
	Adults		Juveniles		
	Females	Males	Females	Males	Cattle
19 May 1973	2	3	0	0	10
6 June 1973	2	3	0	0	10
13 June 1973	2	3	0	0	10
20 June 1973	2	3	0	0	10
26 June 1973	2	3	0	0	10
11 July 1973	2	1	3	2	10
17 July 1973	2	1	3	2	10
24 July 1973	2	1	3	2	10
31 July 1973	2	1	3	2	10
9 August 1973	2	1	3	2	10
23 August 1973	2	0	3	2	10
29 August 1973	2	0	4	3	10
6 September 1973	1	0	4	3	10
20 September 1973	2	0	4	3	10
24 October 1973	2	0	4	2	10
12 November 1973	2	0	4	2	0
29 November 1973	2	0	4	2	0
9 December 1973	2	0	4	2	10
8 January 1974	2	0	4	2	0
29 January 1974	1	0	4	2	0
7 February 1974	1	0	4	2	0
20 February 1974	1	0	4	2	0
5 March 1974	1	0	4	2	0
19 March 1974	1	0	4	2	0
26 March 1974	1	0	4	2	0
16 April 1974	1	0	4	2	0

[a/] Adults were 3 years old; juveniles were captured 6-8 June 1973.

Table 2. Time budgets for pronghorn and cattle on the shortgrass prairie, Colorado.

Sample Period	Species and Age	Percent of Daylight Period			
		Grazing	Resting	Traveling	Other
March-April	Pronghorn				
	Adult	57.9	36.0	5.6	0.5
	Juvenile	54.6	38.8	6.2	0.4
	Cattle	--	--	--	--
May-June	Pronghorn				
	Adult	52.3	42.6	4.3	0.8
	Juvenile	--	--	--	--
	Cattle	63.1	30.4	4.0	2.5
July-August	Pronghorn				
	Adult	48.2	46.6	5.1	0.1
	Juvenile	37.8	57.8	4.2	0.2
	Cattle	62.4	33.4	3.3	0.7
September-October	Pronghorn				
	Adult	56.3	35.1	8.6	0.0
	Juvenile	48.4	41.0	10.0	0.2
	Cattle	61.0	32.8	6.1	0.1
November-December	Pronghorn				
	Adult	70.6	21.5	7.9	0.0
	Juvenile	62.0	26.8	10.6	0.6
	Cattle	--	--	--	--
January-February	Pronghorn				
	Adult	35.2	56.7	8.1	0.0
	Juvenile	38.8	54.2	6.4	0.6
	Cattle	--	--	--	--
Annual mean	Pronghorn				
	Adult	53.4	39.8	6.6	0.2
	Juvenile[a/]	48.4	43.7	7.5	0.4
	Cattle[b/]	62.2	32.2	4.5	1.1

[a/] Annual mean based on 10 months (July through April).

[b/] Annual mean represents summer period only and was based on months May through October.

Table 3. Percentages of terrain types and pronghorn and cattle grazing and resting activities observed on Pawnee National Grassland, Colorado 1973-1974.

Terrain Type	Animal Species	Sampling Date											
		March-April		May-June		July-August		September-October		November-December		January-February	
		Grazing	Resting	Grazing	Resting	Grazing	Resting	Grazing	Resting	Grazing	Resting	Grazing	Resting
Lowland flats and plateaus (32)[a/]	Pronghorn	40*	41*	31	21*	42*	41*	64*	40*	48*	42*	44*	32
	Cattle	--	--	62*	42*	70*	43*	65*	74*	--	--	--	--
Hilltops, ridges, and crests (22)	Pronghorn	12*	10*	18*	17*	24	22	11*	12*	25	36*	15*	34*
	Cattle	--	--	7*	3*	5*	14*	9*	5*	--	--	--	--
Cool slopes; N, E, NW, NE aspects (21)	Pronghorn	17*	25*	15*	26*	11*	16*	9*	38*	16*	11*	8*	9*
	Cattle	--	--	16*	52*	15*	41*	12*	0*	--	--	--	--
Warm slopes; S, W, SE, SW aspects (25)	Pronghorn	31*	24	35*	35*	23	20*	16*	10*	11*	11*	35*	25
	Cattle	--	--	15*	3*	10*	2*	14*	21	--	--	--	--
Total observations	Pronghorn	993	712	962	912	1179	1751	570	531	603	274	472	682
	Cattle	--	--	1481	422	1691	966	784	445	--	--	--	--
Calculated chi-square[b/]	Pronghorn	90.1	67.6	61.8	89.2	101.6	86.8	280.2	157.7	111.6	72.4	78.3	89.6
	Cattle	--	--	625.4	367.3	1145.6	480.4	395.5	407.8	--	--	--	--

[a/] Number in parentheses are percentages of each community type within study area.

[b/] Chi-square tabular value, 3 df, 0.01 level of probability = 11.34.

*Observed usage differed significantly ($P < 0.10$) from expected usage as determined by a Bonferroni Z statistic.

Table 4. Seasonal food habits of tame pronghorn on the shortgrass prairie, Colorado.

Taxa[a]	Sampling Periods					
	March-April	May-June	July-August	September-October	November-December	January-February
Grasses and sedges						
Agropyron smithii	5[b]	T[c]	T	2	T	--
Bouteloua gracilis	1	T	2	6	14	1
Carex eleocharis	1	6	T	T	T	T
Sitanion hystrix	13	2	T	5	4	--
Subtotal[d]	21	9	3	15	20	2
Forbs						
Comandra pallida	--	4	T	--	--	--
Erigeron bellidiastrum	--	--	--	6	--	--
Eriogonum effusum	T	8	12	11	8	T
Evolvulus nuttallianus	--	--	6	T	--	--
Haplopapus spinulosus	1	T	1	T	T	6
Kochia scoparia	--	10	15	2	--	--
Lepidum densiflorum	--	6	1	--	--	--
Leucocrinum montanum	4	3	--	--	--	--
Plantago patagonica	--	8	1	T	--	--
Polygonum aviculare	--	5	--	--	--	--
Portulaca oleracea	--	--	3	--	--	--
Salsola kali	T	T	5	6	--	--
Senecio tridenticulatus	8	T	2	4	5	3
Sphaeralcea coccinea	T	11	22	27	T	T
Thelesperma filifolium	--	5	T	--	--	--
Townsendia grandiflora	15	T	T	1	--	--
Subtotal	32	82	89	67	17	9
Shrubs						
Artemisia frigida	46	8	8	16	55	87
Chrysothamnus nauseosus	T	T	T	1	7	2
Subtotal	47	9	9	18	63	89
Total bites 43,315	7,097	10,470	15,096	5,386	3,248	2,018

[a] Includes only taxa with values of at least 3 percent of the total bites eaten in at least one sample period.

[b] Five percent of 7,097 bites for the March-April sample period.

[c] T indicates less than 0.5 percent usage.

[d] Includes all species eaten.

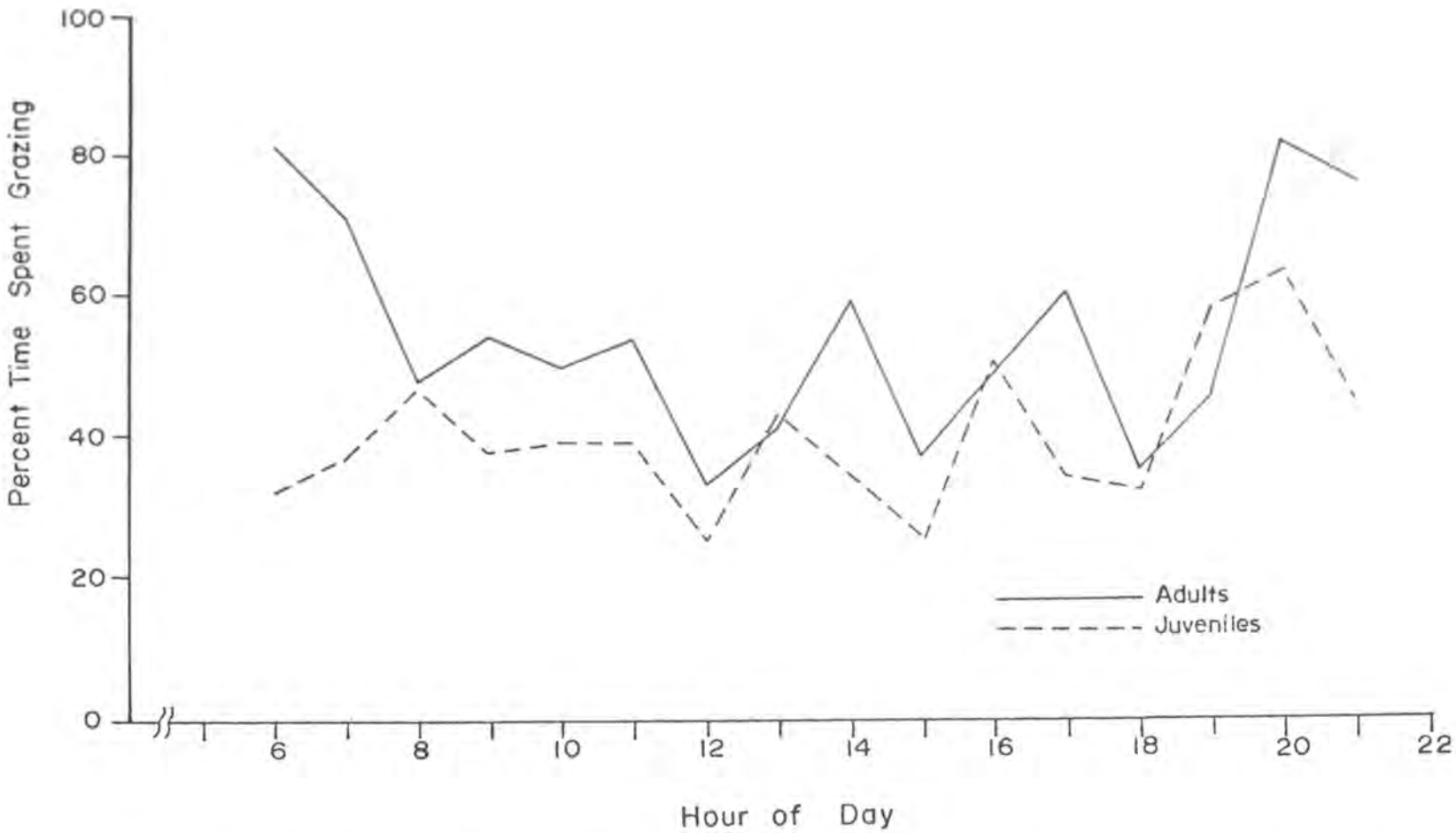

Fig. 1. Daylight grazing activity patterns for juvenile and adult pronghorn based on mean values for the entire study.

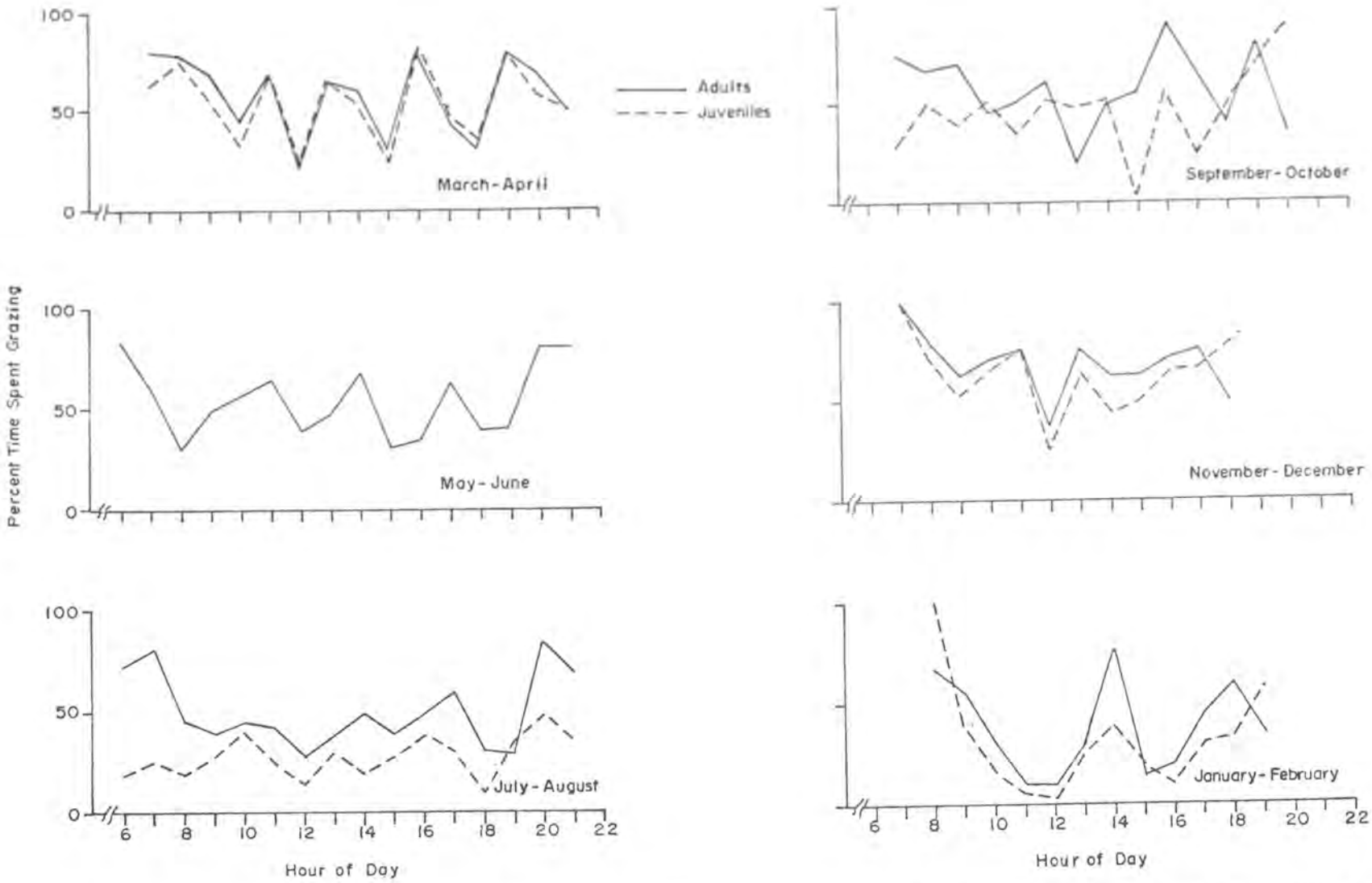

Fig. 2. Seasonal variation in time spent grazing by juvenile and adult pronghorn during the daylight hours. Plotted points are means of the two monthly means in that period.

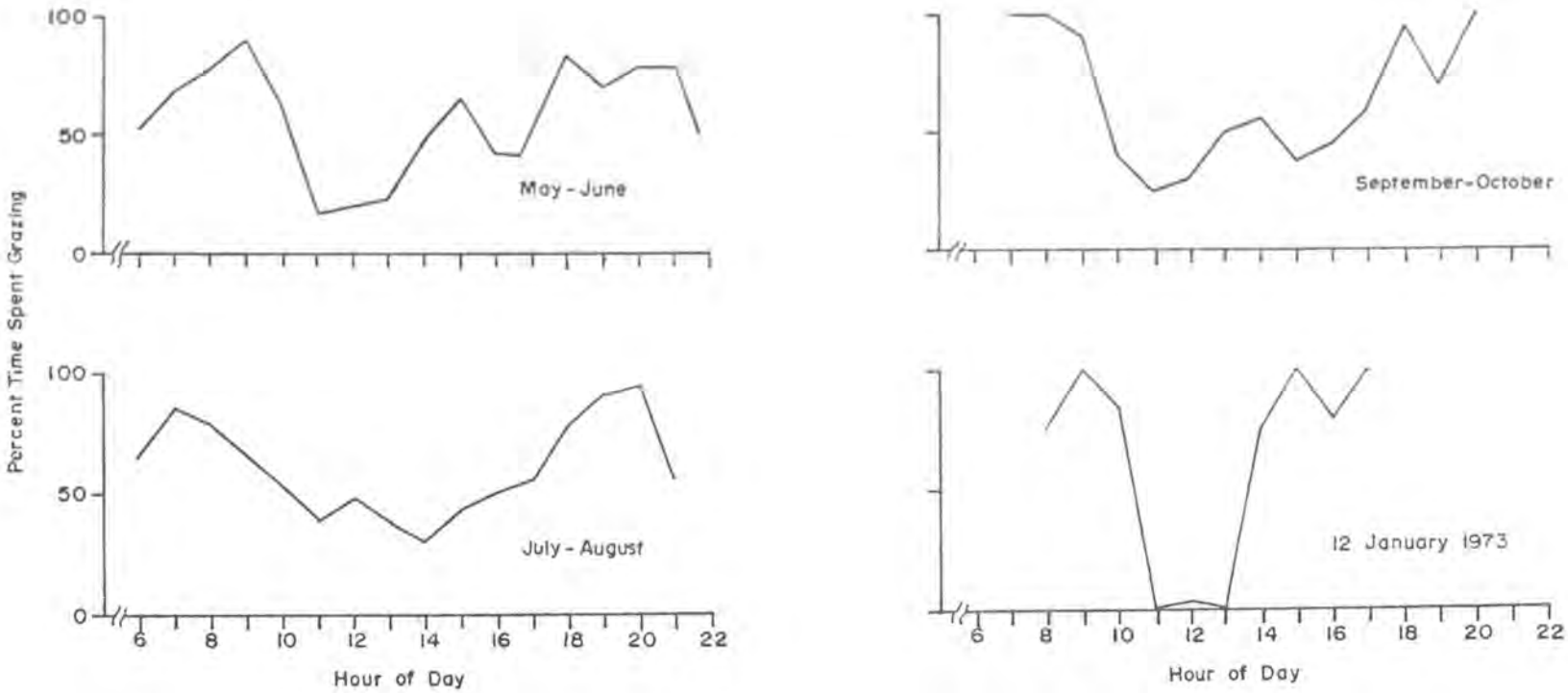

Fig. 3. Variation in time spent grazing by cattle during the daylight hours for the three periods May through October and for 1 day in January. Plotted points are means of the two monthly means in that period.

COMMENTS AND QUESTIONS

?: What was the water distribution on your study area?

Schwartz: There was a water trough located in one pasture. In the amount of time spent in certain parts of the pasture, there appeared an obvious bias. There was a lot of antelope activity in June, July and August around the watering area. This was due to, in effect, an irrigated area due to water overflow from the trough. We had a high density of succulent forbs. When we analyzed our data, we threw out those quadrants. We wanted to eliminate the effect of the waterholes. There is some information from Australia regarding sheep grazing studies, where it is apparent there are grazing zones. In Australian grasslands, the zones are related to watering areas, resting areas and shading areas. As you leave these areas, the amount of grazing decreases. We plan to analyze our antelope data in this way but have not yet done so.

Lowery: Did you notice any preferences, i.e. if the cattle used one area, did the antelope use another?

Schwartz: We have overlays showing there are times when cattle and antelope graze compatibly and other times when they grazed separately. I don't now know if there is an avoidance; however, I don't think so. This is a small study area (320 acres). The number of preferred grazing sites were not many. The animals were in effect required to graze together.

Simpson: Did you evaluate humidity and ambient temperature?

Schwartz: Yes, we measured temperature, wind speed and direction, percent cloud cover, precipitation if any, etc. We plan to see if there is any relation between activity and weather factors. It seems that sheep in Australia graze into the wind. Their pastures have an overgrazing pattern related to the prevailing wind. The sheep graze into the wind until they reach the fence where they remain and heaviest use occurs. We have yet to

look at this.

Simpson: Aspect is another important factor.

Schwartz: This is also measured on our quadrant system. There is a ton of data accumulated on our study and much is left to be analyzed.

?: Were you able to determine significance of night feeding?

Schwartz: No, another study looked at night time grazing. Pronghorns did feed at night while cattle did not. What affect this has on trends of winter time vs. summer time grazing (because you are dealing with a longer daylight period) I am not sure. I don't think it is going to change because the distance between peaks is related to an hourly time base.

AMERICAN PRONGHORN, A PROGRESS REPORT

Jim Yoakum, Bureau of Land Management, Reno, Nevada

Bart O'Gara, University of Montana, Missoula

Yoakum: The Wildlife Management Institute is updating its various books on big game. Our assignment is to write a book on pronghorn. We will cover total distribution, historical presence, life history, management and habitat. We were to complete this by the bicentennial year. At the current rate, we will be lucky to have it completed by the tricentennial year. The main problem is there is enough material for six books.

O'Gara: I am charged with four chapters of the book. There are people here with a lot of expertise. If you are knowledgeable of some of these subheadings, please see me. One chapter is the fossil records. No one has ever pulled the entire record together. Putting it in order is difficult. I used Simpson's 12 genera classifications and then added two genera that have been named since.

Another chapter is on classification. It will be short and will compare pronghorns with other Artiodactyls in an attempt to dispute the idea that it should be a separate family. I am trying to delineate the ranges of the five subspecies.

The biggest chapter I have is physical characteristics and behavior. The subheadings are: general description, movements, herding behavior, seasonal ranges, senses, vocalizations and mechanical sounds, speeds and gaits, sizes and weights, coloration and pelage, skin glands, horns, eyes, teeth, longevity, territorial behavior, courtship, reproduction, doe-fawn interractions, fetal development and rapid growth of fawns.

The final chapter is on hunting including techniques. The slob and road hunter will be discussed. Care of meat and trophies will also be mentioned.

Yoakum: I will be working on distribution, abundance, historical accounts and habitat. We would like to emphasize that we need more information. That's one reason we are not trying to hurry the book. We want to gather more specific information to provide a longer book value. Any help would be appreciated.

A revised and updated literature review will be included in the book.

The National Wildlife Magazine will have an issue on pronghorn and will probably be available in June.

BASELINE HEMATOLOGIC AND CLINICAL CHEMISTRY VALUES FOR PRONGHORNS

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Abstract: In 1973 and 1974, in excess of 100 adult and 100 neonatal pronghorns (*Antilocapra americana*) were bled by jugular venipuncture. Findings for six hematologic parameters and 12 clinical chemistry parameters are presented. Numerous age and sex specific differences were found. Environmental temperature at the time of capture and bleeding appeared to influence the level of five parameters for neonates. Statistical treatment and data presented in this report are preliminary.

Hematologic and clinical chemistry values have been reported for nearly all indigenous North American ungulates except pronghorns (*Antilocapra americana*). Despite the thousands of animals trapped during the past four decades the only published data for pronghorns are for four captive animals (Dhindsa et al. 1974; Dhindsa et al. 1975). No published data exist for wild pronghorns.

Blood analysis has outstanding promise of becoming a useful management tool as it reflects among others, dietary intake, diseases, stress, range quality and

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seasonal variation. Problems of interpretation exist because many endogenous and exogenous factors influence the magnitude of parameters. Because of this variation, data presented will become more useful as further information on factors influencing results are quantified.

The purpose of this paper is to present baseline hematologic and clinical chemistry values for adult and neonatal pronghorns. This manuscript reports preliminary results and consequently conclusions may change pending the addition of further data and more detailed analysis.

METHODS AND MATERIALS

Adult pronghorns sampled were captured in early December of 1973 and 1974 by the drive trap technique. Neonates were caught when less than 7 days of age during May of 1973 and 1974. All samples were obtained in Vacutainer tubes by jugular venipuncture from live animals. EDTA was the anticoagulant used for hematologic determinations.

Hematologic analysis included total erythrocytes (RBC), total leukocytes (WBC), hematocrit (Hct), hemoglobin (Hb) and differential leukocyte count. Basic methadology is outlined by Schalm et al. (1975). Clinical chemistry parameters included Calcium (Ca), magnesium (Mg), phosphorus (P), sodium (Na), potassium (K), urea nitrogen (BUN), total protein, albumin, cholesterol, glucose, serum glutamic oxaloacetic transaminase (SGOT) and alkaline phosphatase. Basic methodology for clinical chemistry values is reviewed by Kaneko and Cornelius (1970, 1971).

This report is preliminary in nature and is presented in a descriptive fashion. Statistical tests to determine whether significance exists between treatment groups have not been completed.

RESULTS

Basic hematologic data are presented in Table 1. RBC, WBC, Hct, and Hb values tend to be appreciably higher in adults than neonates. Leukocytes showed more variation than erythrocytes as evidenced by the larger standard deviation. Differential leukocytes counts for both adults and neonates reflected high levels of neutrophils.

Clinical chemistry findings are summarized in Tables 2 and 3. Sample sizes are considerably less for all chemistry parameters than for hematologic ones. There was not a consistent trend of higher levels in adults for most parameters. Neonates had appreciably higher levels of phosphorus, alkaline phosphatase and SGOT. Cholesterol, glucose, BUN, SGOT and alkaline phosphatase levels showed considerable variation between animals. Glucose, albumen and BUN levels were considerably higher in adults than neonates.

A comparison of blood parameters was made between neonates classified as singles and twins (Table 4). Almost without exception there appeared to be no differences based on this contrast. However, we caution that it is impossible to locate consistently, each member of a set of twins and therefore many individuals classified as singles, in reality, would have a sibling. This situation would reduce differences between singles and twins, if indeed, any existed.

Parameters which showed a tendency to reflect sex specific variations are presented in Table 5. Leukocytes and neutrophils levels were higher in neonate and adult females. Alkaline phosphatase, BUN, and SGOT showed sex specific trends but the differences were not consistent for neonates and adults. Lymphocytes, Na, cholesterol and glucose showed sex specific trends in either neonates or adults.

Table 1. Baseline hematologic values of neonatal and adult pronghorns in Alberta.

Blood Parameter	Neonates				Adults			
	n	Mean	±	1 S.D.	Mean	±	1 S.D.	n
RBC ($10^6/mm^3$)	122	9.68	±	1.01	11.55	±	1.26	130
WBC ($10^3/mm^3$)	122	3.97	±	1.85	5.17	±	1.88	130
Hct (%)	110	39.70	±	3.94	51.24	±	4.51	127
Hb (g/100 ml)	116	14.56	±	1.72	18.26	±	2.11	127
Lymphocytes (%)	120	33.94	±	14.22	31.65	±	11.91	125
Neutrophils (%)	120	59.86	±	14.51	65.39	±	12.72	125

Table 2. Baseline clinical chemistry values of neonatal and adult pronghorns in Alberta.

Blood Parameter	Neonates				Adults			
	n	Mean	±	1 S.D.	Mean	±	1 S.D.	n
Ca (mg/100 ml)	49	12.35	±	1.31	9.57	±	1.42	27
Mg (mg/100 ml)	49	2.22	±	0.28	1.60	±	0.48	27
Na (mEq/L)	49	137.53	±	14.04	153.75	±	9.57	27
K (mEq/L)	49	6.11	±	0.91	5.52	±	2.01	27
P (mg/100 ml)	49	9.11	±	2.07	5.38	±	1.83	26
Cholesterol (mg/100 ml)	56	69.30	±	41.30	57.78	±	13.23	27
Glucose (mg/100 ml)	26	157.26	±	96.92	212.63	±	83.76	27

Table 3. Baseline clinical chemistry values of neonatal and adult pronghorns in Alberta.

Blood Parameter	Neonates				Adults			
	n	Mean	±	1 S.D.	Mean	±	1 S.D.	n
BUN (mg/100 ml)	27	16.22	±	5.65	37.61	±	5.77	27
Total Protein (g/100 ml)	46	4.78	±	0.56	6.53	±	1.12	20
Albumin (g/100 ml)	46	2.36	±	0.34	4.06	±	0.47	20
SGOT (R.F. u/ml)	57	157.02	±	87.26	112.04	±	41.49	25
Alkaline Phos. (K.A. u/ml)	40	43.53	±	17.22	2.39	±	1.78	26

Table 4. Blood parameters of pronghorn neonates showing typical lack of difference between singles and twins.

Blood Parameter	Singles[a]	Twins[a]
RBC ($10^6/mm^3$)	9.68	9.68
WBC ($10^3/mm^3$)	4.04	3.90
Hct (%)	39.96	39.43
Hb (g/100 ml)	14.64	14.48
Ca (mg/100 ml)	14.44	12.25
Mg (mg/100 ml)	2.27	2.16
Na (mEq/L)	136.95	138.14

[a]Data represent mean values.

Table 5. Blood parameters of pronghorn neonates and adults which showed variation between sexes.

Blood Parameter	Neonates[a]		Adults[a]	
	Males	Females	Males	Females
WBC ($10^3/mm^3$)	3.67	4.44	4.48	5.29
Lymphocytes (%)	35.71	31.94	-	-
Neutrophils (%)	61.20	64.82	62.98	65.92
Na (mEq/L)	140.98	132.35	-	-
K (mEq/L)	-	-	6.43	5.14
BUN (mg/100 ml)	13.73	18.41	41.76	35.86
SGOT (R.F. u/ml)	167.82	149.07	97.43	117.72
Alkaline Phos. (K.A. u/ml)	38.42	47.18	3.71	1.80
Cholesterol (mg/100 ml)	59.92	79.75	-	-
Glucose (mg/100 ml)	-	-	176.38	227.90

[a]Data represent mean values.

Table 6. Blood parameters of pronghorn neonates, which appeared to be influenced by environmental temperature.

Blood Parameter	Ambient Temperature		Grand Mean
	$< 10^{\circ}$ C	$> 20^{\circ}$ C	
WBC ($10^3/mm^3$)	4.8[a]	3.9[a]	4.0
Ba (mEq/L)	139.6	130.2	137.5
K (mEq/L)	6.7	5.7	6.1
P (mg/100 ml)	10.1	8.5	9.1
BUN (mg/100 ml)	15.8	18.2	16.2

[a]Data represent mean values.

Ambient temperature at the time of capture and bleeding neonates appeared to influence WBC, Na, K, P and BUN levels (Table 6). The grand mean presented in Table 6 is the average for all samples. In the absence of statistical analysis and larger sample sizes, these differences can be considered as trends only.

DISCUSSION

Many of the results presented reflect not only species specific variation but the effects of method of capture and inevitably, stress. Nevertheless, the pronghorns sampled in this study were captured by the methods consistently used to capture neonates and adults. Our values should be comparable if subsequent values are reported for pronghorns.

Four of the basic hematologic parameters in pronghorns are compared to published values for other North American ungulates. Pronghorns in our study had levels near or at the upper limits for RBC, WBC, Hb and Hct values compared in Table 1. Our values suggest that pronghorns may have relatively superior oxygen carrying capacity. Dhindsa et al. (1974) reported lower values for Hb and Hct in four captive Wyoming pronghorns.

Values for some clinical chemistry parameters presented in this study are compared to similar values for other ungulates in Table 8. Calcium, phosphorous and protein values were similar to the species compared. Cholesterol levels in this study were lower than those reported for most other ungulates. Conversely, levels of BUN and glucose reported herein are higher than those reported for other ungulates (Table 8). Levels of BUN are of particular interest as potential indicators of nutritional status and nitrogen balance in ungulates. High glucose levels reported in this study contrast with low values reported by Dhindsa et al. (1975). We caution that many stress related hormones such as glucagen, epinephrine and norepinephrine cause increases in peripheral blood glucose levels.

Table 7. Comparison of four hematologic values for adult pronghorns and other selected wild ungulates.

Species	RBC ($10^6/mm^3$)	WBC ($10^3/mm^3$)	Hb (g/100 ml)	Hct (%)
1. Pronghorns[1]	11.55	5.17	18.26	51.24
2. Whitetails[2]	17.04	3.2	20.8	56.3
3. Moose[3]	6.2[4]	4.19	14.9	40.4
4. Mule Deer[5]	9.2	3.0	16.4	47.0
5. Elk[6] (males)	4.79	3.9	16.0	50.2
6. Caribou[7]	10.4	-	16.8	46.7
7. Pronghorns[8]	11.62	-	16.8	42.7

[1]This study; [2]Johnson *et al.*, 1968; [3]Le Resche *et al.*, 1974; [4]Karns and Seal in Le Resche *et al.*, 1974; [5]Anderson *et al.*, 1970; [6]Vaughn *et al.*, 1973; [7]McEwan, 1968; [8]Dhindsa *et al.*, 1974.

Table 8. Comparison of six clinical chemistry values for adult pronghorns and other selected wild ungulates.

Species	Ca (mg/100 ml)	P (mg/100 ml)	BUN (mg/100 ml)	Protein (g/100 ml)	Cholest. (mg/100 ml)	Glucose (mg/100 ml)
1. Pronghorns[1]	9.6	5.4	37.6	6.5	57.8	212.6
2. Moose[2]	10.6	5.6	13	6.9	87	121
3. Elk[3] (females)	7.3	4.8	24.5	6.3	72.4	170.6
4. Whitetails[4]	10.9	10.6	22	7.5	97	139
5. Bighorn Sheep[5]	9.0	3.9	17.9	6.0	79.3	112
6. Pronghorns[6]	9.6	6.4	35	7.4	37	97

[1]This study; [2]Le Resche et al., 1974; [3]Vaughn et al., 1973; [4]Tumbleson et al., 1968; [5]Franzmann and Thorne, 1970; [6]Dhindsa et al., 1975.

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COMMENTS AND QUESTIONS

Buoy: What time of year were the antelope collected?

Barrett: Early winter--adults, December, fawns in late May.

Buoy: Was it within a week for the adults?

Barrett: Within three days. I haven't yet analyzed the year to year variation.

Trout: Did you have difficulty with hemolysis and how did you solve the problem?

Barrett: I kept the collecting tubes warm with a gas heater. We had to exclude some samples because hemolysis was not totally prevented. This is particularly a problem for obtaining phosphorus parameters.

Trout: What collection equipment did you use?

Barrett: We used vacutaners with EDTA or the red top stoppers with no additive for the other chemistries.

7th BIENNIAL PRONGHORN ANTELOPE WORKSHOP

February 24-26, 1976
Blue Lakes Inn
Twin Falls, Idaho

E. H. STAUBER, DVM, Ph.D.

ABSTRACT

Transmission of Disease between Wildlife and Domestic Animals

Preliminary data of a serological survey using serum from three pronghorn herds trapped in eastern Idaho in December, 1975 and January, 1976 indicate exposure to a variety of bovine pathogens. The percent of seropositive pronghorn found was: brucellosis, 0.0%; anaplasmosis, 0.0%; IBR, 28%; BVD, 1%; PI_3, 49%; adenovirus 7, 14%. Additional tests on other pathogens known to affect livestock have yet to be performed. Exposure to the pathogens as evidenced by serological conversion does not imply that pronghorn develop clinical disease after exposure to any of these pathogens. The effects of the pathogens on pronghorn has to be determined by experimental exposure under controlled conditions.

The evidence that wild animals are seropositive to pathogens known to be capable of causing serious disease in livestock raises the question of the importance of transmission of disease between wildlife and domestic animals. The question of transmission should be investigated thoroughly for the following reasons:

1. The methods and procedures for testing responses to pathogens affecting domestic animals are well worked out and understood.
2. Pathogens known to cause serious disease in livestock often have similar effects on wildlife (and, therefore, wildlife may serve as sentinels).

3. The concern over wildlife transmitting disease to domestic animals and vice versa is justified in a world demanding increasing supplies of protein.
4. The concern over disease transmission from domestic animals to wildlife at a time when there is increased utilization of wildlife habitat by domestic animals is also justified.
5. The concern over the wellbeing of our wildlife population for aesthetic reasons and the need to protect and preserve an invaluable heritage is laudable and ecologically desirable.
6. The need to gain information about the disease status of wild animal populations to assess the feasibility of implementing local or national disease control or eradication programs in livestock is essential.

We need to know more than is presently known about disease transmission between wild and domestic animals. More knowledge about this interaction will help us make intelligent judgements on the future management of wildlife and domestic animals.

COMMENTS AND QUESTIONS

I found no pronghorn testing positive for brucellosis. Anaplasmosis is another test but we have not done the serological tests to date. For the disease studies, we take spleenectomized calves into the field and take five to ten cc's of heparinized blood and inject it into the calves. All calves remained normal and thus we assume the pronghorns do not carry anaplasmosis. We checked for IBR (infectious bovine rhinotrachyitis). It is a serious cattle disease infecting the respiratory and reproductive tracts. We found an incidence of 28 percent (a higher percent in adults than fawns). B.V.D. (Bovine viris diahhrea) was checked for and found one reactant. PI3 is a disease which causes respiratory system problems similar to influenza. We found 49 percent reactors which is high. We had a high incidence in one herd and very low in the others. Additional tests yet to be run include leptospirosis, blue tongue and hipozootic hemorrhagic disease of of deer.

Murrell: Did I understand correctly that brucellosis is not carried in deer? You mentioned elk and bison.

Stauber: There have been no documented reports of brucellosis occurring in deer.

Murrell: I understand the elk on the feed ground in Wyoming are high in brucellosis. Is that correct?

Stauber: That has been documented.

Murrell: The potential could be serious if the planned transplant in Idaho occurs?

Stauber: Yes, it could be a problem. We don't know what type of brucellosis it is. There are several strains. It can be serious if cattle react positively to serum taken from those elk.

Blood Analysis of Idaho Pronghorns

Lester E. Trout
Idaho Department of Fish and Game

During December of 1975 and January of 1976, 161 pronghorns were trapped and tagged. Trapping areas were located in each of three major drainages, Little Lost River, Birch Creek, and Crooked Creek. These drainages are adjacent to each other and drain southward toward the Snake River in southcentral Idaho.

Blood samples were drawn from a representative portion of the trapped animals. The blood samples drawn were from 22 pronghorns in the Little Lost River drainage, 27 in the Birch Creek drainage, and 48 from Crooked Creek. All of the samples were subjected to blood chemistry and hematological analysis. Relatively cold weather encountered during all three trapping operations caused some problems in the blood collecting techniques. It was difficult keeping the blood collection tubes warm during the collecting process. Varying degrees of hemolysis of the blood serum were encountered which resulted in some unreliable values, particularly those of the kinetic enzymes.

The following blood chemistry tests were run on the serum using a Clinicard Analyzer Model 368: total protein, glucose, urea nitrogen, total bilirubin, calcium, SGOT, alkaline phosphatase, and L.D.H. Hematological values obtained from the Little Lost River and Birch Creek antelope consisted of grams per deciliter of hemoglobin, hematocrit, white blood cell counts and differentials. In addition to the above data, erythrocyte counts were made from the Crooked Creek antelope blood. Because of the lateness of the trapping operations, a complete analysis of all blood data has not yet been made. At this time I can only report on some cursory examinations of the data and their possible implications.

Shown in Tables 1 through 6 are the values obtained from the trapped antelope at the three trapping sites previously mentioned.

Table 1. Little Lost River drainage antelope serum chemistry values.

Sample Size: 22	Sex:	Female	11	Male	11
	Age:	Adult	7		6
		Yearling	1		0
		Fawn	3		5

Fraction	Range	Mean	Std. Dev.
Total Protein GM/DL	5.37-7.92	6.45	±0.55
Glucose GM/DL	106-332	216	62.03
Urea Nitrogen MG/DL	28.2-52.8	39.9	6.42
Total Bilirubin MG/DL	0.3-1.1	0.75	0.25
Calcium MG/DL	8.97-13.73	10.65	1.08
Transaminase (SGOT) I.U.*	259-579	384	
Alkaline Phosphatase I.U.	17-243	86.9	61.2
L.D.H. I.U.*	570-1421	935	4.0

*The values too few for standard deviation determination.

Table 2. Little Lost River drainage hematology values.

Sample Size: 23	Sex:	Female	11	Male	12
	Age:	Adult	7		6
		Yearling	1		0
		Fawn	4		5

Component	Range	Mean
WBC ($x10^3$)	1.0-9.55	4.4
HGB (gms)	16.3-22.0	18.3
HCT (%)	32-67	56.9

Table 3. Birch Creek drainage antelope serum chemistry values.

Sample Size: 27	Sex:	Female	15	Male	11	?-1
	Age:	Adult	8		4	1
		Yearling	5		4	
		Fawn	2		3	

Fraction	Range	Mean	Std. Dev.
Total Protein GM/DL	5.66-7.30	6.30	0.44
Glucose GM/DL	120-276	185.3	39.74
Urea Nitrogen MG/DL	5.8-16.4	11.05	2.80
Total Bilirubin MG/DL	0.5-0.9	0.66	0.11
Calcium MG/DL	10.92-13.21	11.83	0.67
Transaminase (SGOT) I.U.	190-392	306.2	56.2
Alkaline Phosphatase I.U.	23-115	60.2	21.23
L.D.H. I.U.	382-1252	705.76	218.31

Table 4. Birch Creek drainage antelope hematological values.

Sample Size: 26	Sex:	Female	14	Male	11	Unk.	1
	Age:	Adult	7		4		1
		Yearling	5		4		
		Fawn	2		3		

Component	Range	Mean
WBC ($x10^3$)	1.6-5.6	3.1
HGB (gms)	15.0-19.5	16.8
HCT (%)	49-59	54

Table 5. Crooked Creek drainage antelope serum chemistry values.

Sample Size: 47	Sex:	Female	25	Male	22
	Age:	Adult	19		12
		Yearling	1		2
		Fawn	5		8

Fraction	Range	Mean	Std. Dev.
Total Protein GMS/DL	5.26-7.76	6.64	0.55
Glucose GMS/DL	127-286	188.3	34.81
Urea Nitrogen MG/DL	11.6-27.3	17.85	3.23
Total Bilirubin MG/DL	0.6-1.4	0.98	0.22
Calcium MG/DL	8.74-12.12	10.55	0.81
Transaminase (SGOT) I.U.	141-525	272.95	78.45
Alkaline Phosphatase I.U.	17-82	50.00	18.45
L.D.H. I.U.	381-1194	755.73	221.95

Table 6. Crooked Creek drainage antelope serum hematological values.

Sample Size: 46	Sex:	Female	25	Male	21
	Age:	Adult	19		12
		Yearling	1		2
		Fawn	5		7

Component	Range	Mean
WBC ($x10^3$)	1.00-6.85	3.34
RBC ($x10^6$)	1.01-1.80	1.26
HGB (gms)	14.7-19.3	16.0
HCT (%)	48-58	52
MCV (u^3)	29.4-51.5	39.7
MCH (uu gms)	9.1-17.5	12.5
MCHC (%)	27.2-37.1	31.6

Differences between trap preparations at the Little Lost River and Birch Creek trapping sites were believed to result in variations in hematological values. The Birch Creek trap had canvas draped around the inside of the trap whereas the Little Lost River trap did not. It is felt that the presence of the canvas had a calming effect on the trapped antelope. The overall differences in some hematological values is believed to be the direct result of differences in antelope excitation. The average hemoglobin values for the Little Lost River pronghorns was 1.5 grams per deciliter higher than the average found in the Birch Creek animals. In addition, the neutrophil:lymphocyte ratio was higher for the Little Lost antelope than those in Birch Creek, 2.74:1 compared to 1.75:1. It is known that muscular activity and emotional state of the animal has an influence on the N:L ratio (Schalm, et al, 1975). I am not aware of

what the normal N:L ratio is for antelope, but I assume that difference between the above averages is primarily due to the degree of excitation.

For management purposes, perhaps the serum chemistry values should receive careful scrutiny. The total protein content of the serum of antelope from each of the drainages was not significantly different from one another. These values were 6.45 grams per deciliter for Little Lost River, 6.30 for Birch Creek, and 6.64 for Crooked Creek.

The amount of blood urea nitrogen (BUN) collected from the Little Lost River antelope was significantly greater than that of either the Birch Creek or Crooked Creek antelope. The blood from the Little Lost River drainage pronghorns contained an average of 39.9 mg per deciliter as compared to 11.1 and 17.9, respectively, for animals from the Birch Creek and Crooked Creek drainages. Excessive muscular activity and excitation will elevate blood urea nitrogen levels over time (6 hours plus). The differences in BUN values between the pronghorns from the different drainages is not believed due to excitation because of the relatively short period of time, 2 hours or less, between initial antelope excitation and blood collection. These differences are believed to be more closely related to protein utilization. In other words, the forage consumed by the antelope in the Little Lost River drainage may contain more usable protein than that in either of the other two drainages.

As mentioned previously, time has not permitted a more thorough analysis of the available data. Samples of serum collected from each of the three drainages were delivered to another laboratory for a comparative and more complete analysis on a SMAC analyzer.

Although I have not had the time to thoroughly study the two sets of data it appears they compare favorably with one another. For example, the average total protein in the serum was exactly the same by either technique. The BUN content was slightly higher using the SMAC analyzer, but not significantly different from the Clinicard results.

Of interest, perhaps, is the SMAC analysis of cholesterol content. The pronghorns from Crooked Creek had considerably higher readings of cholesterol than did those from either Little Lost River or Birch Creek, 60.5 MG/DL, 37 MG/DL and 35 MG/DL, respectively. This may indicate a higher intake of fatty acids by the Crooked Creek pronghorns (Franzman, 1971).

A more detailed analysis of these data may provide further insight into the value of these drainages as pronghorn range.

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COMMENTS AND QUESTIONS

?: Were the high serum cholestrol levels from the same drainage where you had the high B.U.N. levels?

Trout: No, the high cholestrol readings were from Crooked Creek. The high B.U.N. readings were from the Little Lost River.

?: Do you see any superficial differences in ranges?

Trout: I think there is more agricultural activity in the Little Lost. Possibly antelope are eating alfalfa there, where it is not generally available in the other two drainages.

?: Is there no correlation study on habitat?

Trout: Not yet, but I suspect there will be.

Barrett: Do you have the values for SGOT and CPKs?

Trout: The SGOT results appear to be within the normal range of the analyzers without diluting. I have those figures in the tables that will appear in the Proceedings.

Pyrah: Did you look for blood parasites?

Trout: Eric Stauber was working on blood disease analysis and he will give his results later.

A STUDY OF BIRTH SITES SELECTED BY PRONGHORN DOES AND THE BED SITES OF FAWNS

Robert E. Autenrieth

Idaho Department of Fish and Game, Jerome

INTRODUCTION

Various references are made in the literature regarding antelope fawning grounds with the implication that they are traditional use areas not unlike sage grouse strutting grounds. Fawning grounds can supposedly be located and censused from year to year. Ingold (1969) described the fawning ground in his Wyoming study as an area about 3 square miles of the 24 square miles the population inhabited: "Approximately 90 percent of the pregnant does in 1968 gave birth to their fawns on this area." Einarsen's (1948) section on "kidding grounds" quoted A. R. Williams of the Texas Game and Fish Commission: "They come back to the same range every year to kid if fences do not check them, except during a very dry year. Then they will go where there has been some rain and the weeds are green, if fences permit." The guidelines for the management of antelope printed in the 1962 Interstate Antelope Conference Transactions included "kidding grounds" as one of the key areas of antelope range to be identified.

It is the contention of Dr. Edson Fichter (1971) and myself, after more than 2,400 man-hours of pronghorn observations over a 20-year period, that fawning areas may not be predictable. While particular locations of the Pahsimeroi study area are sometimes used for fawning, ground condition, vegetative type, brush height and canopy coverage appear to influence site selection by preparturient does.

It seems we may have backed ourselves into a corner with the term fawning ground. Frequently, the Bureau of Land Management and the Forest Service

request information regarding fawning ground locations. It is our opinion, based on our Pahsimeroi and Big Lost observations, that it is more instructive to supply the vegetative types and parameters selected by parturient does.

This opinion was first based on observations only, but in 1973 we began to quantify the vegetation at birth sites and fawn bed sites as an Idaho Department of Fish and Game study. In 1975, it became a Pittman-Robertson funded project.

THE STUDY AREAS

Work thus far has been conducted in the Big Lost and Pahsimeroi river drainages. The study areas are divided by the Lost River mountains, with the Big Lost to the southwest of Borah Peak and the Pahsimeroi to the northeast. Eroded and dissected foothills and intervening valley fills characterize the terrain. Hills are marked by outcrops of Carboniferous sedimentary rocks and Challis volcanics. Glacial and alluvial deposits that form the valley floors occur largely as moraines, stream terraces and open flats. The soils are gravelly and light colored. The Big Lost River, Pahsimeroi River and Mahogany Creek are the primary permanent streams. Of the 7.9 inches and 9.6 inches of precipitation received in the Pahsimeroi and Big Lost valleys, respectively, about 35 percent occurs during May and June.

The vegetation is primarily a sagebrush-grass habitat type. Three subspecies of big sage are found including *Artemisia tridentata*, *A. vaseyana* and *A. wyomingensis*. *Artemisia arbuscula*, *A. nova* and *A. frigida* are also known to occur. Bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*) and Sandberg bluegrass (*Poa sandbergii*) are the most abundant grasses. Many species of forbs are abundant during spring and summer. Both study areas are located on lands administered by the Bureau of Land Management or Forest Service.

METHODS

Fawning occurs on the study areas from about 20 May to 10 June. A three-man crew was used during this period to observe does from vantage points usually located on hilltops. Observations were continuous during daylight hours. Binoculars (7 x 35) and spotting scopes (30X and 15-60 zoom) were used. Movements and behavior of mature does were observed with emphasis placed on lone does. Once the doe's behavior indicated parturiency (Autenrieth and Fichter, 1975) full attention was given to her activities. A minimum of three hours after birth of the second fawn was allowed before two of the crew members were directed to the site by the spotter. Walkie talkie communication was used. The birth site was marked with engineering flagging and plotted on a map. The fawns were marked with temporary collars of color coded engineering flagging. Subsequent bed sites of marked fawns were located and marked in the manner mentioned above.

Analysis of vegetation was conducted following termination of fawning. A hundredth-acre circular plot was established with the birth or bed site as the center. Twenty-five 2 x 5 decimeter plots (Daubenmire 1959) were analyzed along north, south, east, and west radii. Shrub height, canopy coverage and frequency were determined for all species in the plot. Where the site occurred near an ecotone, the non-used community was measured in the same manner.

RESULTS AND DISCUSSION

Support for questioning the fawning ground concept occurred when the 1973 and 1975 data was compared for the Pahsimeroi. A late spring left snow patches and drifts in the Upper Pahsimeroi during the 1975 fawning period. Most fawning occurred low in the valley at 6900 feet above sea level. Conversely, fawning occurred up to 8000 feet in 1973. Little if any snow cover was left on the flat during this fawning period. Had observations been limited to one season, our conclusions would probably have been different.

Using the Student t test to compare the vegetation of the six 1973 birth sites with the ten 1975 sites, we found no significant difference for brush measurements. Canopy coverage was 20.6 percent, average maximum height 41.9 cm. and total coverage 37.4 percent. Pyrah (1974) measured 85 bed sites in Montana for an average canopy coverage of 21.2 percent and a total coverage of 66.7 percent.

The parturient does selected for similar birth site cover both years even though in different areas. Birth site cover is not in abundance in our study areas. The 12 non-use birth sites measured 5.1 percent canopy coverage, 10.05 cm. shrub height and 15.5 percent total coverage.

During three fawning seasons, 31 birth sites and 12 non-use sites were measured. In addition, 131 bed sites and 11 non-use bed sites were analyzed. Eighty-seven percent of the birth sites occurred in big sage (Artemisia tridentata). Seventy-three percent of the bed sites were located in big sage. The remaining birth and bed sites occurred in low sage (Artemisia arbuscula).

In comparing the birth sites with the non-use birth sites, we found significant differences (95 percent confidence limits) in brush canopy coverage, total coverage and average maximum shrub height. Significant differences were also found for the same measurements between bed and non-use bed sites. There can be little doubt birth and bed sites are not randomly selected. The sites chosen exhibit greater than average brush cover, total cover and mean shrub height.

Few data are yet available regarding habitat imprinting in pronghorn fawns. We obtained five subsequent bed site measurements on fawns from two birth sites in the Pahsimeroi. One birth site was characterized as poor cover while the other was classed as good. A paired t-test was used to compare the bed sites. No difference was found in total coverage but the fawn born in "good" cover chose significantly higher brush coverage and mean shrub height than did the fawn born in "poor" cover. Morley Barrett (1973) observed, while trapping 159 pronghorn

fawns in Alberta, that habitat types at birth and subsequent bed sites were similar, even though the fawns were on a native grass prairie and not associated with brush. He suggested pronghorns in Alberta select parturition and subsequent bed sites which afford maximum visual surveillance of their surroundings. Fawns bedded near small objects such as sticks, wheel ruts and rocks which would help break their outline (see also Autenrieth and Fichter 1975:40). He observed that rugged terrain, such as that found in Idaho parturition and bed sites, seemed to be selected to afford maximum seclusion.

At best, the above data are tentative indications of habitat imprinting. Better information should be forthcoming after the 1976 field season when subsequent bed sites will be measured on transmittered fawns in two valleys.

SUMMARY

Data to date indicate parturient does in the Idaho study areas select for a habitat type providing greater than average brush canopy coverage, total coverage and brush height. They apparently do not return to a particular location to fawn. Traditional fawning ground locations are not relevant for pronghorns on our study areas. Providing land management agencies with vegetational parameters at fawning sites appears to be the proper management goal.

Bed site analysis indicates fawns select for greater than average brush canopy coverage, total coverage and brush height. Initial data support the contention of habitat imprinting although more data is needed.

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COMMENTS AND QUESTIONS

Lowery: Do you have sagebrush that is higher than the averages given?

Autenrieth: Yes, we did, in both our sage grouse and antelope studies, it has not been the largest brush thatwas selected. Montana can probably state the largest brush they have is what is used.

Barrett: Do you believe that the fawn bed site selection changes with age?

Autenrieth: We are restricting our bed site studies to the first three weeks following birth.

Barrett: Does habitat use during the first week differ from that of the third week?

Autenrieth: I have yet to analyze the data for those differences.

Fichter: I might comment on that. It is my feeling that after two weeks old there is less tendency to select the higher cover densities.

Pyrah: You used the term learned, in connection with imprinting. What consideration have you given to the genetic base for this behavior regarding habitat selection?

Fichter: This is a difficult question. When you discuss what is inate behavior and what is learned, you set up an artifical dycotonomy. They have the inate capacity to learn. Imprinting is thought to be one kind of learning process.

Pyrah: There are examples, i.e. the orientation of the salmon, that there is genetically controlled behavior at birth.

Fichter: Pronghorn fawns exhibit inate behavior. For example, the rump-up position. The first time a doe makes a certain set of moves to the fawn's rear or her tongue touches its rear, the fawn assumes a rump-up posture. It does it right the first time.

The question of selecting a bed site and saying this is more inate than

learned behavior becomes questionable.

Simpson: There is evidence for habitat imprinting. Have you done aerial measurements of the size of sagebrush patches selected?

Autenrieth: No, we have limited our measurements to the 1/100 acre plot. If the site occurs on an ecotone then we measure the non-use community.

Yoakum: Are there certain areas in the Pahsimeroi valley that are historic fawning grounds?

Fichter: A number of years ago, 30 does had their fawns on an area known as big flat. I decided this would be the area to build an observation tower. The work was delayed, thankfully. The next spring, there were virtually no does fawning on that area. Based on the first year, one would have considered big flat an ancesteral fawning ground. The next summer provided an opposite view.

Yoakum: You would then say you do not have information supporting the historic fawning grounds theory?

Fichter: It is not my belief that there are traditional fawning grounds in the Pahsimeroi valley. Ingold apparently did have them in Wyoming.

It is another example that what you find in one situation may not be applied in another as far as behavior is concerned. There is a real danger in extraplating from one area to another until we know more than we do now.

Beale: In relation to fawn imprinting, we have observed thousands of them over seven or eight years of work and we noted individual animals tend to replicate their bedding sites. In most cases, we did not observe the birth site,but through radio-tracking,we followed individual animals and observed the type of site it picked. One that bedded in the rocks continued to do so with the same being true for other site types, at least for the first two or three weeks.

Autenrieth: We hope to further document habitat imprinting with transmittered fawns this spring.

PRONGHORN ANTELOPE MANAGEMENT POTENTIAL ON MINING INDUSTRY LANDS

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ABSTRACT: Most surface mining companies own land in large, contiguous blocks, which offers an ideal chance for managing pronghorn antelope herds in an orderly fashion. However, due to varied agricultural leasing agreements made by companies, initial control of hunting rights and herd management may be difficult to achieve. When proposing management of pronghorns to a company, the company management needs to be shown that the time and expense spent will be rewarded with a return income and improved public relations. Initial management of pronghorns by the authors on Amax Coal Company lands near Gillette, Wyoming, was directed toward censusing the animals and controlling the harvest. Administration of the hunts was done jointly by the authors and Amax tenants, who collected modest access and guide fees. The only problem with the hunt was that not enough animals, particularly does, were harvested. Future management of the herd will be directed toward producing trophy bucks and maximizing the economic return. Current research being done on pronghorn movements, pronghorn-cattle food habits and competition, and rangeland reclamation will provide data useful in developing habitat manipulation programs beneficial to pronghorns.

Mining of various minerals is an important industry in all of the states where pronghorn antelope (*Antilocapra americana*) are found. In most cases, minerals such as copper, coal, bauxite, sand and gravel, and taconite are most economically extracted by large surface mining operations. Before any surface mining can take place, however, the mining company must obtain legal control of the property overlying the ore deposit. For most surface mines, this means that much land, usually measured in thousands of acres, must be purchased or leased in one fairly contiguous block, so that the mine can expand

in an orderly manner.

Any large block of land under the control of one organization offers an ideal chance to manage resident wildlife populations, such as pronghorns, because the property is big enough to contain the entire home ranges of many individuals. We, as biologists employed by Amax Coal Company, were confronted by this opportunity. We are reporting the results of our program here, with the hope that our success will encourage other mining companies and biologists to realize the benefits of wildlife management on their lands.

DESCRIPTION OF AREA

The land we work with is located just north and south of the town of Gillette, in Campbell County, Wyoming (Figs. 1-a and 1-b). This area is in the shortgrass prairie biome, and native range is characterized by short and midgrasses such as blue gramma (*Bouteloua gracilis*), western wheatgrass (*Agropyron smithii*), needle and thread (*Stipa comata*), and cheatgrass (*Bromus tectorum*). Dominant shrubs are big sagebrush (*Artemisia tridentata*), silver sagebrush (*Artemisia cana*), and rabbitbrush (*Chrysothamnus spp.*). The only native trees found in the county are sparse populations of ponderosa pine (*Pinus ponderosa*) and juniper (*Juniperus sp.*) stands on the higher rocky outcrops, and a very few plains cottonwood (*Populus sargentii*) and willow (*Salix spp.*) trees along major stream courses. Preliminary land use inventories by Amax employees on Amax lands indicated that major vegetation categories were as follows: range - 83 percent, cultivated range (mainly crested wheatgrass (*Agropyron desertorum*) hay) - 10 percent; grain (wheat and oats) - 6 percent; and miscellaneous (buildings, roads, etc.) - 1 percent. The county has one of the largest pronghorn antelope populations in North America. The 1973-74 estimated winter population of pronghorns on five Game and Fish Department management units roughly covering the entire county was 17,700 animals (U. S. Department of the Interior 1974:323). Another common big game animal found in the county is the mule deer (*Odocoileus hemionus*).

Much land surface was bought or leased in Campbell County by Amax Coal and several other mining companies during the late 1950's and early 1960's. The companies realized that the underlying coal seams were immense (70 - 100 feet thick versus 4 - 6 feet thick for most eastern seams), and they foresaw the increasing national need for coal as an energy source. Amax Coal opened its Belle Ayr Mine in Campbell County in 1972, and the mine will produce about 9 million tons of coal in 1976. The total amount of land disturbed by the mine as of January 1, 1976, was about 425 acres.

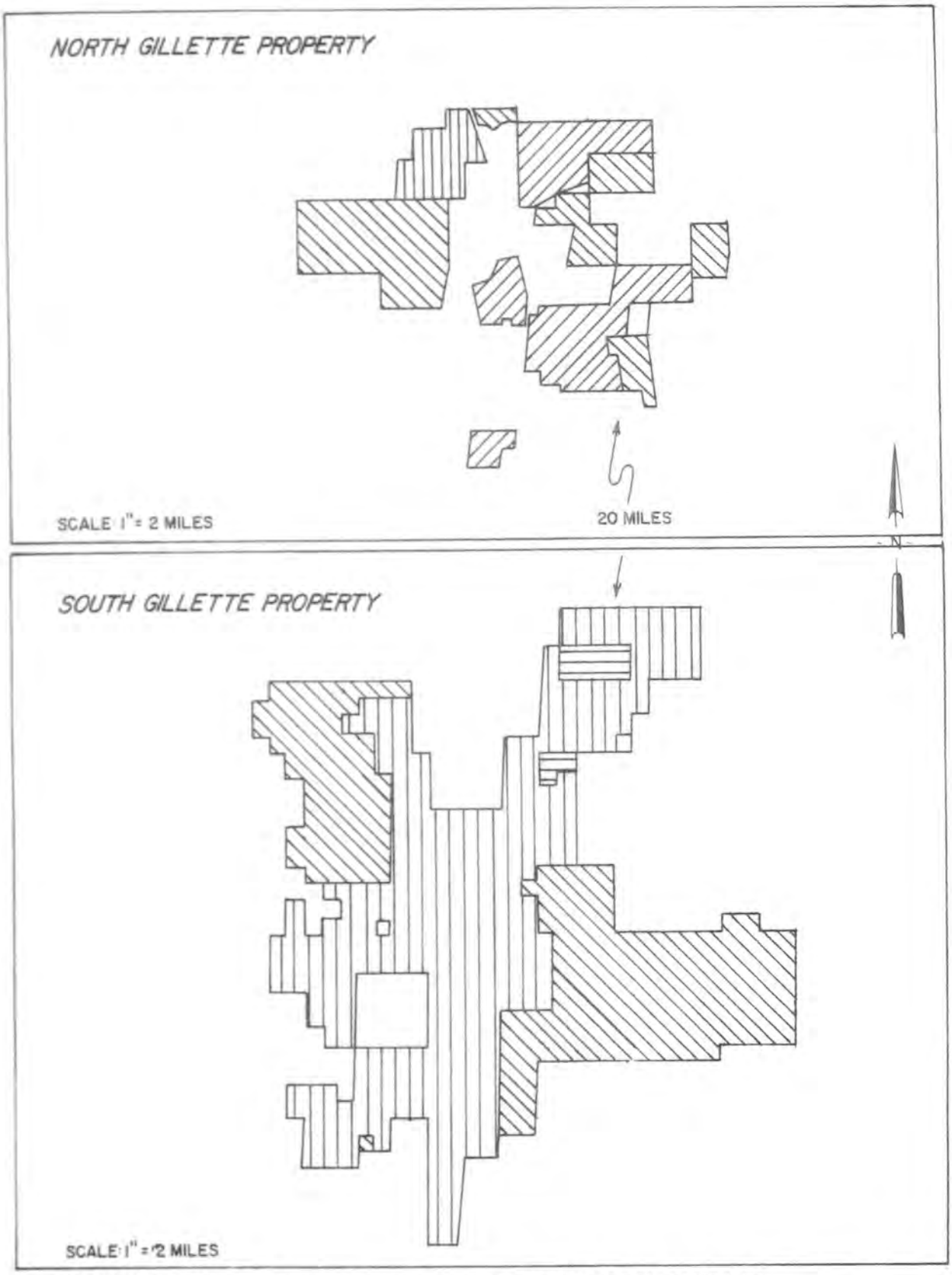

FIGURE 1a – Northern Surface control patterns of AMAX COAL COMPANY at Gillette, Wyoming.

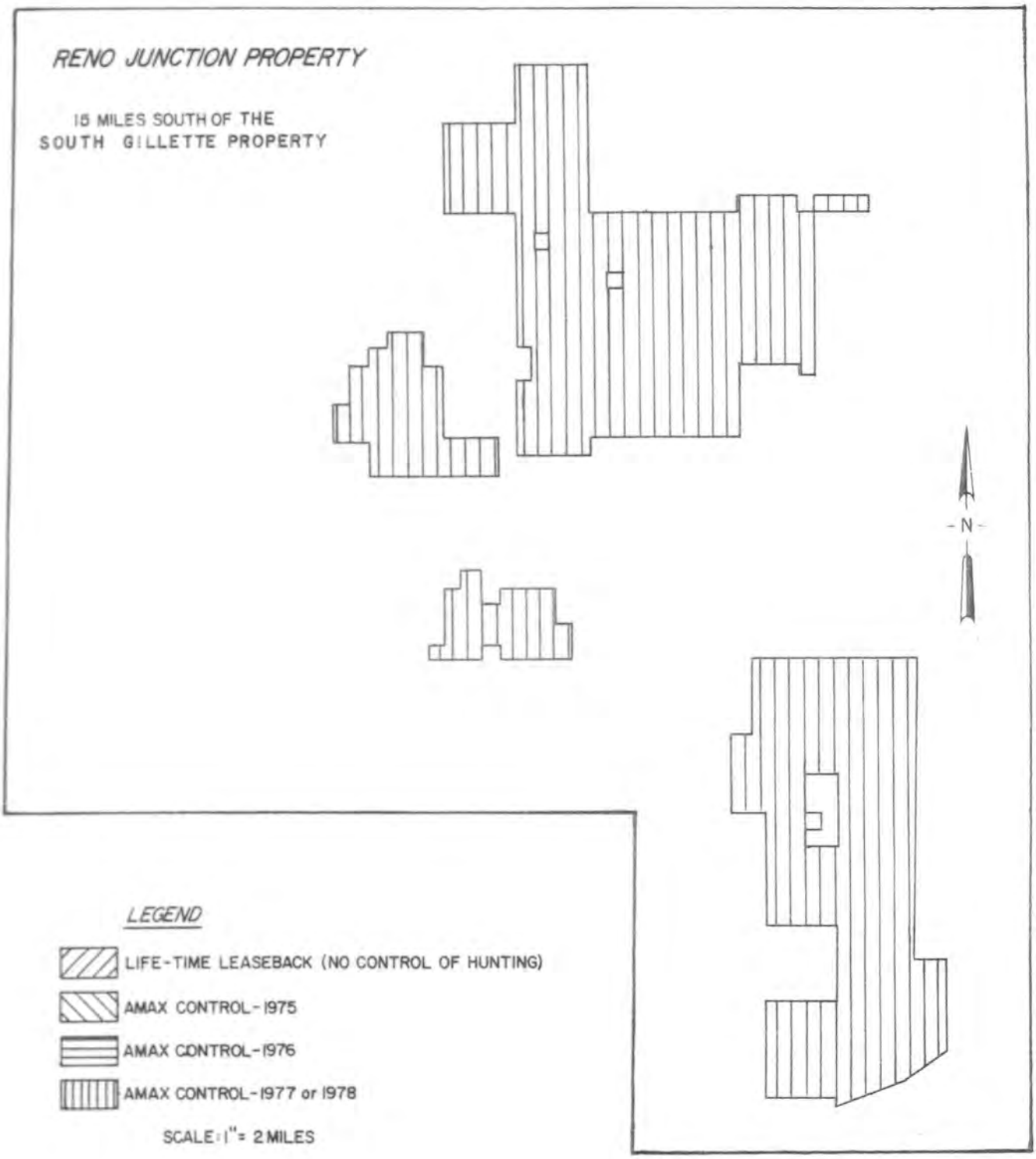

***FIGURE 1b — Southernmost** Surface control patterns of AMAX COAL COMPANY at Gillette, Wyoming.*

In securing surface rights for this mine, and possibly two other future mines, Amax Coal bought, or leased, approximately 45,000 acres of land in three main units (Figs. 1-a, 1-b). The primary purpose of the Amax land agents in dealing with private landowners was to secure rights to mine the underlying coal. Thus, almost any kind of land bargain was negotiated in achieving this goal. Since most mine companies obtain surface rights in this fashion, and since this bargaining process can affect the rights of the biologist in managing wildlife on company lands, we will briefly describe the major types of land surface agreements reached by Amax Coal Company. These were:

Table 1. - Major types of surface control agreements made by Amax Coal Company and other mining companies when buying property.

Company Surface ownership status	Agricultural Management status	Average length of lease
a. bought outright	50-50 joint venture with a local rancher	no lease
b. contract for deed	whole property leased back to original landowner for a low fee	3 years
c. contract for deed or bought outright	prior landowner had previously leased the property to a third party - has not expired	as was arranged
d. contract for deed or bought outright	leased in parcels to other tenants on a flat fee per acre or animal unit	1 year
e. bought outright	leased back to original owner for no fee	lifetime (except when being mined and reclaimed)
f. bought outright	no long term management - being mined or to be mined within months	no lease

Table one shows how complicated a company's surface ownership can become in an area; which, of course, complicates the wildlife management program. Also, in most of the leasing agreements made by company land agents, wildlife hunting rights were not even mentioned. In the few cases where hunting rights were discussed, it was because

the lessee specifically requested the rights - which were freely given by the agents. (During the first year of our management program, only 9,700 acres, out of a possible 45,000 acres under company control, were available for us to manage pronghorn hunting pressure.)

The result of this haphazard approach to securing hunting rights (which would astonish most European land agents) on company-controlled lands is that any plan of coherently managing wildlife habitat is usually killed before it starts. When the company officers are approached about managing wildlife, or permitting hunting, on company controlled lands, they usually have little idea as to which specific parcels of land can be legally utilized. Faced with this, and the fear that hunters may damage property structures, the easiest way out of the problem is for the officer to simply decree that no hunting or management will take place on company lands-and this does occur often.

Fortunately, however, there are benefits to companies that find a way out of the land tangle (which can be done with time) and manage their wildlife populations. The following describes how we have tried to manage pronghorns on Amax Coal Company lands to the benefit of the company, the public, and the animals.

CURRENT AMAX PRONGHORN ANTELOPE MANAGEMENT

General Policy

Through a subsidiary company, Amax Coal Company manages its Campbell County properties to make a profit from agricultural goals - both before and after mining occurs. Since all of the land management takes place in cooperation with local lessees, it is natural that their traditional attitudes and practices have influenced management of the properties.

One of the prevalent attitudes among local ranchers is that the abundant pronghorn antelope are a serious competitor with livestock for forage, and that their only value is a slight amount of hunting fee income each autumn. For example, Amax land near Gillette, Wyoming, is stocked in the spring with approximately one antelope per 15 acres, based on our aerial counts. If differences in food habits are ignored, and the traditional approach to stocking rates based upon body weight is used, the ranges are stocked to about 0.33 capacity with pronghorns (using the conversion equivalent from Stoddart and Smith 1955). Even though food habits differences between various livestock classes and pronghorns make grazing capacity adjustments based on body weight somewhat arbitrary, this competition does have an effect on the landowner's profit margin.

With this prevailing background attitude, we realized that, to gain company support for a pronghorn management program, the company would have to receive some tangible benefits. The most direct way to achieve this, under present State law, was through fee hunting. Fee hunting for antelope is an established custom in the Gillette area, where 80 percent of the land is in private ownership (Hockley 1968). Neither is the question of profitability something new. Buechner (1950) calculated that net income from antelope exceeded that from cattle on the same Texas rangeland. Two other benefits we wanted to show the company from the management program were good public relations with local and out-of-state hunters, and better rapport with environmental and conservation groups, who are concerned about the compatibility of large surface mining operations with the survival of healthy wildlife populations.

1975 Hunting System

As with most new wildlife management programs, our first year's efforts were mainly directed toward regulating the harvest. Starting with the summer of 1974, we began to make two aerial censuses per year - one in late winter (before herd breakup) and the other in late August. These data, combined with sex-age ratio ground counts made in August, provided us with estimates of fall-winter mortality and spring-summer reproduction which, in turn, allowed us to set the total fall, 1975, harvest figure.

Since most of Amax's land was leased to local ranchers, the first hunting permit system we used in the fall of 1975 was based upon this. Under the agreements made with each tenant, the majority of the income derived from antelope hunting went to the tenant. The basic setup was as follows:

a. All hunters were required to observe all applicable 1975 Wyoming antelope hunting laws, and could hunt only on Amax properties within the hunting zone mandated by their State Permit. Thus, we were ensuring our compliance with the State's master plan for coordinated management of all antelope herds. However, division of Amax lands among four State hunting units handicapped us in our own management efforts. One entire ranch with a dense pronghorn population was not hunted because none of our clients had permits for that State management unit.

b. Within this State management framework, Amax established a maximum kill quota for each tenant, which was equal to 25 percent of the number of animals counted on that tenant's land. This equaled a total harvest quota for the two most northerly land units of 212 animals. No harvest was scheduled for the southern property, as this was not

yet under control for hunting rights.

c. Within this kill quota, the tenant, his family and guests could hunt without fee, but were supposed to report all animals killed. All fee hunters, (at the request of the tenants), had to be guided by the tenant or someone from Amax.

d. Fee hunters paid Amax a flat $15.00 trespass fee for the opportunity to hunt, which was valid for the whole season, and was normally collected for Amax by the tenant. Their fee was less than the access fee charged by many local ranchers (up to $50.00), yet it did provide the company an economic return for its pronghorn antelope resource. We did not make the fee lower, such as $5.00, because this might have been too much competition for other ranchers, which might have lowered the company's local image, and discouraged the ranchers from protecting their herds.

e. In almost all cases, the tenant guided the fee hunters for a "per-head" charge ranging from $10.00 for a doe, to $25.00 for a buck. Usually, the hunter needed only one day to harvest a pronghorn. When tenants had unexpected conflicts in their guiding schedule, Amax personnel guided hunters. This service was provided free of charge by Amax.

f. Wyoming antelope hunting licenses contain a "landowner coupon" worth $5.00 both for a resident license and for a non-resident license. After the successful hunter signs the coupon, the cooperating landowner may redeem it with the Wyoming Game and Fish Department. Amax allowed the tenants to redeem these coupons to further their interest in pronghorn antelope management.

g. Each hunter filled out a questionnaire (which was his "permit") that included both socio-economic and biological data. Any animal killed was classified as to sex, age (fawn or adult), and horn size. Two front incisors were collected and preserved in alcohol for a later age determination by cementum layer counts (after McCutchen 1969). The guide oversaw the completion of the form and its return.

h. In order to encourage an adequate harvest, Amax locally advertised the availability of hunting on its properties. Respondents were referred to an Amax coordinator, who scheduled the hunts in advance with available tenants.

We tried to limit the number of hunters to a maximum of four per day per tenant, to prevent overcrowding and preserve the quality of hunting and guide services. Amax personnel also aided in stopping trespass violations as a further means of ensuring quality hunting.

The results of this management scheme were encouraging. No serious problems arose during the hunts, and both hunters and tenants appeared pleased with the system. A total of 40 pronghorns was harvested (Table 2) by 41 hunters, for a success rate of 98 percent.

Table 2. - Sex and age breakdown of the 1975 Amax Coal Company antelope harvest.

	Fawns	Adults	Total
Males	1	27	28
Females	2	10	12
Total	3	37	40

At the present time, we plan to continue this system in 1976. However, we are wrestling with the major problem common to antelope management in the Gillette area - how to get a satisfactory kill of does so that the population is stabilized; thus preventing undue complaints from landowners about too much antelope competition for forage and depredation on grain crops. An attempt to induce hunters to remove surplus does late in the season by offering free hunting elicited faint response, probably because most hunters we had were non-residents, and these hunters usually wanted a trophy with horns to show for the time and expense they spent on the hunt. One option we are considering is to require guided hunters to possess a second antelope permit and to kill a doe on it if they also kill a buck. The main obstacle to removal of does through free hunting for local residents is the reluctance of our tenants to allow unguided hunters on the land, and local hunters usually do not feel a guide is necessary.

Since we only harvested about 20 percent of what we thought the maximum antelope harvest could be (40 versus 212), we intend to increase our advertising efforts next year to include statewide and some out-of-state coverage.

FUTURE HERD MANAGEMENT GOALS

Our first goal in future management of the antelope herd is to gain control of the hunting rights on all of the Amax lands. This will provide management unit tracts sufficiently large to help ensure that animals will not move on, or off, of nearby non-managed lands when hunting or habitat management begins. Also, this may enable us to allow some hunting without guides in areas where there is no chance for hunters to interfere with ongoing ranching operations.

Our long-term management goal is to realize as much profit per animal unit from antelope as could be made on cattle on Amax range lands (Table 3) and, at the same time, maximize the quality of hunting.

Table 3. - Estimated potential annual monetary return from cattle (cow-calf) versus antelope, on Amax rangeland.

ITEM	CATTLE	12.5% Fall ANTELOPE HARVEST (1
Weight Ratio	1	0.11
Spring Population Density	1/40 acres	1/15 acres
Gross Income Per Individual in Spring Population (2	$202.50	$11.65
Production Expenses Per Individual in Spring Population (3	$139.60	$3.90
Net Income Per Individual in Spring Population	$62.90	$7.75
Net Income Per Animal Unit (Calves sold at weaning)	$62.90	$69.75
Net Income Per Acre Based on Present Antelope Population and Projected Full Cattle Use	$1.57	$0.52

(1 Believed to be a realistic harvest goal achievable within four years.

2) Income from cattle is the sale price of the calves at 90 percent survival rate. Income from pronghorns is calculated from 1975 sex and age harvest ratios and the planned trophy fee schedule.

3) Land costs and appreciation excluded. For cattle includes interest and depreciation on: brood stock ($38.00), machinery, fencing, buildings ($44.20); supplemental feed ($34.20); medicine and trucking ($5.00); and hired labor but not management labor ($20.00). For antelope: censusing ($0.17); advertising and administration ($0.73); harvest ($3.00).

As indicated in Table 4, high quality "trophy" hunting should provide the greatest level of economic return from the antelope herd. By "trophy" we mean any buck with over a 12 inch horn beam length. We anticipate creating a larger pool of mature trophy bucks by selective management. The resultant combination of a larger percentage of older bucks and an increased fee for them should return significantly more net income from the antelope harvest. Initial calculations indicate an increase on the order of 50 - 75 percent over the existing program.

Table 4. - Projected fee schedule for the proposed Amax trophy antelope management system.

	Age			
CATEGORY	FAWN	1 ½	2 ½	3 ½ +
Buck access fee	$5.00	$25.00	$50.00	$100.00
Buck guide fee	5.00	25.00	50.00	100.00
Total	$10.00	$50.00	$100.00	$200.00
Doe access fee	$5.00	$10.00	$10.00	$ 10.00
Doe guide fee	5.00	10.00	10.00	10.00
Total	$10.00	$20.00	$20.00	$ 20.00

We consider the southernmost two of our three major land holding blocks to be sufficiently large to allow management of the herds for trophy hunting. Since Kitchen (1974) observed that mature pronghorn bucks occupied territories of up to 4.34 km^2, we feel that only large, solid management units would provide enough huntable trophy bucks in one place to make this system worthwhile. However, it will

take a few years to rebuild the mature buck component on Amax lands after the many years of selective buck hunting that have previously taken place. For example, of the bucks harvested in 1975 on Amax land, only a few (estimated from horn size and tooth wear at 16 percent) were 3 years or older; whereas Hockley (1968) found 47 percent in this age group in his 1967 Gillette area survey. To increase the mean age structure of the bucks, we are contemplating reducing the hunting pressure on yearling bucks during 1976 and 1977. However, it may be that agonistic behavior within the 1½ - 2½ year olds and subsequent emigration from our land blocks will partly negate this approach, as suggested by data from Mitchell (1972). We plan to measure this through a tagging program, although results will not help us for at least two years.

The northern land holding unit is not sufficiently large in one solid unit to allow herd management for trophy quality. Subsequently, our goal will be to balance herd structure and harvest to achieve the maximum sustained yield of animals; probably about a maximum of 25% of our fall population (Bear 1968). In reality this goal is probably not achievable due to ranch tenant attitudes, antelope mobility, and state license availability.

RESEARCH TO REFINE MANAGEMENT TECHNIQUES

Control of the harvest is only the first step in our long-term pronghorn management program. Eventually, we hope to be able to manipulate the habitat so as to maximize the production of both livestock and pronghorns. At present, we are pursuing three research projects which will provide data needed for effective habitat manipulation. A brief summary of the studies is as follows:

(a Pronghorn movements and behavior

This project will utilize radiotracking techniques to determine the broad seasonal and daily habitat requirements of pronghorns. Reclamation and range management techniques will then be adjusted to meet these requirements. Preliminary observations indicate mining activity does not influence antelope usage of surrounding habitat.

(b Pronghorn - cattle food habits and competition

Food habits of pronghorns and cattle will be determined through time-area counts similar to Taylor's (1972) animal minutes - microgrid technique. Range condition will be monitored by obtaining standard measurements of forage plant vigor, such as density, frequency and cover. Once the range utilization requirements of both animals are determined, we will adjust stocking rates to most fully maximize production.

Our initial observations,which are supported by data from Beale and Smith (1966) and Hepworth (1970), indicate some ranching operations are actually helping to maintain the very high antelope population in Campbell County. For example, in late summer, when native forbs have been consumed or have dried up, the pronghorns turn to alfalfa. During the fall, winter wheat is used. Finally, in spring, the emerging spring wheat helps feed the pronghorns again. The value of such high quality forage prior to the breeding season and again in late pregnancy should not be underestimated.

c) Reclamation research

When reclaimed mine land is reseeded, native forage plants, useful to both cattle and pronghorns, must be reestablished. We are currently conducting growth tests on nearly 40 grass, forb, and shrub species to determine what soil types produce the best results. Also, various site preparation techniques, such as mulching and gouging, are being tested to determine what produces the best vegetative cover. Judging from results of other reclamation research, we do not expect any major obstacles in returning the land to original levels of production. Reclamation offers both great challenge and opportunity. The opportunity is to create a range composition ideally suited to our pronghorn management goals. The challenge is in providing the creativity and technology to do it.

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COMMENTS AND QUESTIONS

Oldenburg: If you are primarily interested in greater income, why don't you raise more sheep then harvest coyotes that are worth more than the sheep. I don't like your program and I hope you never come to Idaho because I don't buy any of it.

Scott: The primary purpose of the program is not to just make money but to get some public relations value out of it and to allow hunting on some land where normally large companies would disallow it. Most of the money goes to the land tenant. In Cambell County, Wyoming, much of the hunting on private land is fee hunting.

Oldenburg: What bothers me most is I am totally opposed to fee hunting. You seem to be promoting it.

Scott: I am opposed to it too, but in this area it is the established practice. The company is not trying to force the general populace into adapting to their ways. It is not our intention to take away the control from the tenant and allow uncontrolled hunting which would displease the tenant. We have to live with what the tenant is used to and that's fee hunting.

Oldenburg: I'm not speaking with reference to the tenant, I am representing several hundred thousand hunters. You are concerned with benefiting seven tenants rather than the 50,000 members of the club to whom that resource belongs to. This resident species is the property of the public.

Scott: I agree. Game is the property of the state. I would be glad to visit Cambell County and discuss it with the landowners. They are the land managers who are losing their money because of antelope depredations.

Lockman: We have damage claims in court for standing forage on native range land on private ground. Ranchers are hiring competent range people to

advise them. Farm Bureau people are telling us we should be paying for wildlife use on private land and public land. It is a complex situation.

Terrell: We probably have the most dense antelope population in North America. On some ranches there is an antelope per one to 12 acres. This is near one third of the total carrying capacity. To the landowner, this is a sizeable loss.

Chu: You mentioned that your company tried to acquire more hunting rights. I don't see any advantage to your fee system as opposed to the tenant fee system. They are both based on economics.

Scott: This is to provide for managing the herd for sustained yield.

Chu: Is there a problem with the Wyoming Department managing the herd?

Scott: No, there is nothing wrong with Wyoming's programs and we have adjusted our program to fit in with their broad management goals. They set the harvest limits for the districts. We only set sublimits with these districts. We are trying to encourage maximum harvest. The pronghorns are underharvested on our properties.

Pyrah: Looks like you will have problems trying for a trophy hunt when you are currently underharvesting. To have a trophy hunt, you must shoot more females than males.

Terrell: The ranchers are an obstacle. They will not allow an unguided hunter. They will not guide for free. So we return to our basic problem. We can't use local hunters because they won't pay a guide fee. We can't use non-residents to kill does because they want a trophy. This is our problem.

Kozacek: In my areas in Idaho, even though the land is closed to hunting other species, if a sportsman requests permission to hunt antelope,

they would be allowed on for no fee. The landowner is glad to have the hunters there because of the depredation problem. You probably boxed yourself into fees by showing them it is there.

Scott: It is a strange paradox in Wyoming.

Radio Tracking - the State of the Art

Robert E. Hawkins

7th Pronghorn Antelope Workshop

The past 5-10 years have seen exciting innovations in wildlife telemetry. We at Wildlife Materials, Inc. (WMI) can state with pride that we have accounted for many of these innovations, and we look forward to participating in the unlimited future of radio-telemetry.

Lithium cells have been a real boon to many medium- to long-term telemetry projects. WMI was the first manufacturer to offer transmitters powered with lithium batteries. These cells are good for cold temperature and low-drain usage, and also have a much more favorable weight-to-energy relationship than mercury. At present, however, lithium batteries are not available in sizes smaller than 25x14 mm. (7.5 g.) or voltage lower than 2.9.

A Transmitter especially suited to long-term studies is the solar-powered unit. These have rechargeable NiCd batteries and an expected life of several years. We have some in the field that have been operating more than two years. They are produced to weights as low as 8 g. Wildlife Materials, Inc., is the only company offering the solar-powered transmitter for sale.

WMI has adapted a number of commercially available switches to wildlife applications. A mercury switch is used to vary pulse rate of transmitters by a factor of 2 to 3 with motion, allowing monitoring of activity of animals. Temperature-activated switches permit construction of transmitters with unique tracking characteristics. One such switch is used in construction of transmitters for mortality studies that only become activated when the animal dies and cools down to a predetermined temperature. Another variation changes pulse rates by a factor of 2 to 3, either faster or slower, when the animal dies and cools down.

Still another variation is the multi-use transmitter. This has a motion-sensitive switch which varies pulse rate with activity. In addition, a temperature-activated switch converts pulse rate to a faster or slower pulse rate (or a constant tone) with lowered body temperature (death).

The ultimate in the use of switches involves the Activity-Location and Mortality Transmitter System (ALMTS). This consists of two completely independent transmitter units. One unit has an activity switch and is used to determine location and monitor activity. The other unit has a temperature switch and only becomes activated with lowering temperature brought about by the animal's death. Both units have magnetic on-off switches.

Other specialized transmitters made by WMI include our fish tag units in the 30-50 MHz frequency range and dart transmitters in the 150-151 MHz frequency range. The latter enable a researcher to use a mild-acting drug, since the animal can be found by the transmitted signal for a considerable time after darting.

WMI has had heart-rate and short range temperature transmitters for some time. We have recently developed a longer range temperature unit (up to .3-.4 mile) in the FM frequency range. Pitch of received signal is correlated with temperature. A decoder is required which converts the signal to millivolts. This can be read directly from millivolt meter of decoder. Accuracy of this unit is about 0.3° C.

A cause for concern to researchers in the past has been finding a high-quality receiving unit to assure a successful telemetry project. Our TRX-24 receiver is made especially for wildlife tracking studies and assures the researcher of dependable receiving capabilities. Noteworthy points of the TRX-24 include: good sensitivity of 2.5 db or better; 24 channel capacity enabling tracking of over 70 animals at a time; availability in several frequency ranges; three-way switch enabling one to determine signal strength with both internal speaker and meter, meter only or meter and flashing light; jacks for recorder and headphones; and, a one-year guarantee against faulty workmanship and materials.

For small studies of ten or fewer animals, we have the TRX-3, which has the same features as the TRX-24 but much less capacity (3 channels). It is also considerably less expensive.

We have recently developed a new receiver which is similar to the TRX-24 except that it has automatic scanning and lock-on capabilities as well as operation as a manual unit. It has fast advance button and both slow and fast scan speeds. This unit has digital array to show channel being scanned.

The WMI Model 500 and 600 strip chart activity recorders, along with a number of precut antennas and headphones, round out our line of telemetry equipment. We are constantly working on new telemetry techniques and welcome the opportunity to work with a researcher to develop units to meet specific needs.

That's the state of the telemetry art as of February 24, 1976. Ten years from now, we expect to have readily available automatic tracking systems, long range physiological transmitter packages to monitor a number of parameters, and closed circuit television monitors to enable one to see what an animal sees. The sky is the limit--or is it?

COMMENTS AND QUESTIONS

Oldenburg: What is the current information regarding the new Fed. rule that states that all transmitters will operate on frequenices of 40.66 to 40.70 or 216 to 219?

Hawkins: If this is indeed a regulation, I don't think it will be enforced. The FCC representatives say our equipment is such low power output, a license is not required. Our two stage transmitter unit only has ½ mv output. Neither of the frequencies you mention would function and provide any useable data.

WORKSHOP SESSION

PRONGHORN MANAGEMENT METHODOLOGY
PANEL SESSION

PANEL CHAIRMAN: Dave Lockman, Wyoming

PANEL MEMBERS: Morley Barrett, Alberta
Kent Jackson, Arizona
Tom Pojar, Colorado
Bob Sherwood, Idaho
Duane Pyrah, Montana
Karl Menzel, Nebraska
Jim Yoakum, Nevada
Dan Pursley, New Mexico
E.R. Wiltse, Saskatchewan
Bob Hauk, South Dakota
Jack Kilpatric, Texas
Don Beale, Utah
ElRoy Taylor, Wyoming
Dr. Edson Fichter, Idaho State University

CHAIRMAN: We would like each state to give a short presentation on techniques employed in populations' management, habitat management and habitat restoration. Key problems and current research should also be stressed. After the presentations we would like to leave it open for discussion of key points on management methodology.

ALBERTA (BARRETT, Department of Lands and Forest)

In Alberta we employ the same basic techniques of population inventory as used elsewhere. Part of our input into the last workshop was relative to monitoring the chemical composition of our winter range. We have continued to monitor browse utilization on winter range. Most future attention will focus on ranges which through previous monitoring, were deemed to be close to carrying capacity limits. In these areas we will intensify our sampling efforts.

The identification and mapping of winter ranges is an "on-going" project. We are habitat-type mapping all winter ranges, some 13,050 square miles in total area. Using a control system, we are trying to obtain carrying capacity models. Using these models, we will then extrapolate to obtain a theoretical carrying capacity for each range. Coupled with movement data to and from important winter ranges, we can determine which populations should be controlled through hunting.

Presently, we have no programs on habitat restoration. Our biggest battle is maintaining what we have. This past year another government agency installed some 40 miles of "high" quality fence which separated summer and winter pronghorn range. After documenting the influence of fences on pronghorn migrations, the agency involved went in and changed them for us.

We are experimenting with fertilization to increase forage quality and quantity on pronghorn winter ranges.

ARIZONA (JACKSON, Arizona Game and Fish Department)

Arizona flies production count surveys only, unless it's a particularly bad winter. Production surveys are conducted in June. We have found no differences between production surveys conducted in June or July on low elevation ranges; however, on higher elevation ranges we observed significantly more antelope and a greater production in July when compared to a June survey. Survey precision and accuracy is determined by the relative production and number of bucks observed. We have no periods of complete snow cover or green grass to provide a background as they do in the northern antelope ranges.

Antelope management is conducted on a game management unit basis. We sample 100 percent of our antelope areas with a hunter questionnaire; however, never obtain a 100 percent return.

Our major problem is lack of control over land and lack of influence over land administrators. Most lands are school-state trust and private lands. School-state trust lands are treated as private land by the leasee.

Guzzler-type rain catchments have been used on antelope ranges. One large ranch has done extensive water development work; however, antelope have not really benefited as the water is turned-off when the cows leave the pasture.

Last year, our south-central unit conducted a management investigation to determine what was happening to the area's fawn crop. We found only three water sources in the area, all stock water troughs. These troughs, 2½ feet high, were not accessible to antelope fawns. Ramps were built up to the edge of the troughs to allow access for antelope fawns.

The spring is extremely dry and water availability is critical at fawning, unless it snows. If it snows we often lose fawns.

Simulation modeling has just been applied to antelope populations.

COLORADO (POJAR, Colorado Division of Wildlife)

In Colorado, population simulation modeling is a relatively new management tool that has been added to our management methodology. We realize that if all the population parameters pertinent to managing a population could be adequately measured, then the need for modeling would be greatly diminished. However, there are many parameters of a population that are either impossible or impractical to measure under present constraints. Population modeling helps fill these voids in information with estimates based on empirical information that is biologically feasible. Simulation modeling provides the analysis system that integrates all available population information into usable form.

Initially a population is simulated, basing the simulation on all information available for that population. Of course, the more data that is available the more realistic and reliable the simulation will be. Once the demographic processes are characterized for a population then the simulated population can be used to explore various management strategies. Management games are played with the simulated population, subjecting it to various harvest regimes to determine the effects on the population.

Another spin-off benefit of simulation modeling is that it is a fast and efficient bookkeeping system. A single computer print-out contains everything we know and everything we think we know about a population. In other words, it contains quantified data and empirical data relating to a particular population. Having this information assembled in a standardized form enhances communication concerning the particular population through all levels of management. It is especially useful in communicating the conceptualized demographic processes of a population when management responsibilities are transferred from one person to another. This, I believe, adds consistency to management.

I would like to reiterate that the main advantage of simulation modeling is that it allows us to apply any number of management strategies to a population surrogate rather than the real population. This allows us to select the best apparent course to attain our herd objectives.

IDAHO (SHERWOOD, Idaho Department of Fish and Game)

Presently, we use only two census methods in Idaho. Fixed-wing counts are flown for a wintering antelope inventory. A helicopter is used for flying late summer herd composition counts and to determine fawn survival. We monitor movement by usual observation techniques.

Radio telemetry is currently being used to monitor the movements of antelope summering in Montana and wintering deep in Idaho. Some of these antelope are migrating over 160 miles. We have some problems with data collection due to state-lines on these herds.

Check stations and hunter report cards are used in harvest determinations. We issue "either sex" permits on all our antelope units. Under the best of circumstances, we have almost no doe or fawn harvest. Some units will run around 9 percent "non-bucks" in the harvest. The high buck harvest indicates an increasing population.

When the doe harvest comes up to 30-40 percent that indicates a herd in trouble.

Little data is gathered on habitat utilization. We are working on habitat types, particularly as utilized for reproduction in the fawning period. Maintenance of forage consists of our input on Federal Land Management programs. Idaho's antelope are on federal lands most of the time. The Highway Department has given us some problems with right-of-way fencing with net wire in areas of antelope migration. With most of our antelope we have a summer range problem as well as a winter range problem. We lack a large homogenous block of summer range for all our antelope. Antelope are confined to long, narrow mountain valleys. Their summer range area is not much greater than their winter range area; consequently, we must look at the yearlong range when considering forage competition, etc.

We don't have any problems with low water availability on antelope range. Currently, we have not developed any keys for habitat restoration on impacted sites.

When we determine what antelope need on "impacted sites", I am sure types of restoration will be considered. We contribute as best we can with land use planning and inter-agency planning programs.

Current antelope research is headed by Bob Autenrieth and is concerned with tying fawn concealment and birth site to a habitat type. We are also participating in a study on movements using radio telemetry. A master's project by one of our personnel is being conducted to determine the causes of fawn mortality in the Pahsimeroi drainage.

MONTANA (PYRAH, Montana Fish and Game)

Our counting system is similar to that used in other western states. We count one-third of our hunting districts each year. This is probably not an adequate survey for an intensive management program. Under present harvest conditions, where mainly males are shot, a population is capable of expanding considerably in a very short period of time.

I have tried to encourage the experimental use of winter surveys. We presently fly summer surveys once every three years. I think that with the same amount of flying time we could fly a better survey every year in the winter than we are every three years in the summer. Herd composition surveys are conducted in the summer period. Helicopter surveys obtained essentially the same counts as that of fixed-wing surveys. Helicopter use did provide two real advantages: 1) we could observe better with one person keeping records of numbers and mapping locations and the other person observing all of the time, and 2) we could work in a more advantageous position with respect to the antelope.

I believe it very important to provide input and cooperate with the B.L.M. in the formation of the Wildlife Habitat Management Plans. We have input on forage objectives. We emphasize the need to benefit forbs, to change season of use, to reduce livestock competition and to locate fences in areas which do not restrict antelope movements.

I believe every state is ready to begin more intensive management of antelope and this will require some drastic changes in our approaches to management.

Montana does not appear to have a summer water availability problem. Prime antelope habitats are in areas which receive the least use from livestock. Addition reservoirs only increase livestock use on the lightly grazed areas.

We wonder to what degree antelope require water in the winter period. In winter drought periods, when the soil is dry, water sources are frozen and snow is unavailable, there is little or no water available. These conditions might provide a stress period for antelope.

In the spring territorial males appropriate reservoirs as center spots for territories, which would indicate at least by then reservoirs are significant behaviorally.

Shrub control problems have diminished on public lands but are still very great on private lands. Fencing is still a problem on private lands, and I presume that it always will be until we can impress on people that the antelope are "theirs" and not "ours".

We found that we could detect annual changes in vegetation cover with our fawn bedding ground surveys. We classified vegetation as forbs, grasses, and shrubs and measured canopy coverage by six-inch height classes. An annual cover value was obtained. A detectable difference was obtained between

the two years surveyed. Currently, we have no active research project on antelope.

NEBRASKA (MENZEL, Game and Parks Division)

Our seasons in Nebraska are set in March or April. Aerial surveys, conducted in mid to late July, provide population estimates and herd classification data. Our surveys include approximately 3/4 of Nebraska's antelope population.

Depredation on wheat is our major problem with antelope. There is a lack of literature of the effects of trampling and grazing by antelope on wheat.

Currently, we are considering acquisition of key wintering areas for antelope. Such acquisitions might also alleviate some crop depredations and reduce the need to drastically reduce some populations.

NEVADA (YOAKUM, B.L.M.)

It is B.L.M. policy to emphasize habitat and to recognize that species management is a responsibility of State Wildlife Agencies.

Present emphasis by the B.L.M. is on a tool which is called an H.M.P. (Habitat Management Plan). The H.M.P. is an inventory of the present situation, both quality and quantity, and recommendations to maintain or improve habitat conditions. Let us illustrate the use of an H.M.P.: We know that the water requirements for antelope habitat are best served when water is available every two or three miles. Let us say the inventory shows that water is only available every seven miles. The habitat improvement recommendation would then be to develop water availability every two-three miles.

The action plan itself comprises about 20 percent of the report; the remaining being the basic inventory and analysis plan. In the action plan the objectives are stated. These objectives should state what is needed to provide the habitat requirements for a species in that habitat.

Then the recommended projects section would specify those projects necessary to accomplish habitat management objectives. These plans will document the situation, what is needed and what action is required.

It is suggested that this group follow the "Sage Grouse Workshop" and develop a set of recommended guidelines for pronghorn antelope habitat management.

NEW MEXICO (PURSLEY, New Mexico Department of Game and Fish)

Population surveys are flown in the spring, as soon as we get a green grass background. Fawn crop surveys are flown in July and August.

To determine harvest a 100 percent card survey is conducted. Field hunter checks are intensified by staggering area hunt dates and concentrating field personnel in each hunt area.

New Mexico contd.

The B.L.M. in New Mexico conducts some habitat management programs on lands they administer. We have an input into their land use planning programs. Some of our Forest Service land does have antelope.

Fencing is a problem in some areas, mostly along the eastern side of the state. We still have a considerable number of sheep ranches. Many sheep ranches have converted to cattle, but the fences are still in existence. This certainly does limit antelope movements to and from water. Water availability is a problem. Ranchers will not leave the windmill turning or the pumps running when the livestock are out of the pasture.

Poaching and predation are becoming more important, however, we have not measured their effects to date.

SASKATCHEWAN (WILTSE, Department of Tourism and Renewable Resources)

Aerial surveys are conducted in July. We have ten survey blocks established which cover about 90 percent of the antelope range. The blocks are flown on a 50 percent coverage. These surveys provide data on population size, herd composition, trend and movements. Winter counts are not used to a great degree, as most of our antelope winter in Alberta or Montana.

Check stations and questionnaire survey are used to determine harvest. We obtain a 50-60 percent return on questionnaires.

We are not presently involved in habitat management projects. Our greatest problem is loss of habitat. We are losing critical wildlife habitat to agricultural developments. Presently, we are attempting to classify our habitat, soils, vegetation cover and land use. Hopefully, we will then be able to delineate critical areas for wildlife and maybe save them from being developed for agriculture.

SOUTH DAKOTA (HAUK, South Dakota Department of Game, Fish and Parks)

Aerial counts are conducted in May with a background of green grass. We count one-third of our total areas each year. A small migrational movement through the southwest corner of the state occurs in the winter. Doe-kid counts are flown in June to determine reproduction. (All hunters receive a hunter report card and we obtain a 65 percent card return. There are currently no projects on habitat restoration.)

Hopefully, we can set a quota for does and bucks this season by issuing a set number of doe permits and a set number of buck permits. In our deer herds we found we were overharvesting our males and creating an old age structure in the females by "buck only" hunting.

This year we are also surveying landowners with a questionnaire to determine their "tolerance levels" toward hunters and wildlife numbers. We have a feeling for the problem of landowners and game damage in Wyoming--their coupon system, etc. We want the landowners in South Dakota to get involved in the decisions on wildlife populations on private lands and get a handle on this thing before it gets away from us.

WYOMING (TAYLOR, Wyoming Game and Fish Department)

I would like to briefly discuss some of the methodology we used to determine the antelope carrying capacity of Wyoming's Red Desert.

Most carrying capacity methods have been developed through work done with domestic livestock. Antelope cannot be managed as intensively as livestock because of many variables over which managers have little control. Pronghorns are not turned into and out of pastures on predetermined dates (indeed the weather has more control over seasonal distribution than managers do), water developments and other range improvements are generally not economically feasible, and harvesting is not precise as unusual weather during a hunting season may result in a harvest far different than expected.

Intensive management is difficult to apply because of the vast areas which must be covered with limited manpower. As an example, there were over 4,200 square miles in the Red Desert study area and, for the purposes of this study, I was the principal investigator and the field team.

Also it is difficult to measure the plant resource most used by antelope. On the Red Desert nearly half of the year-long antelope diet was big sagebrush (Artemisia tridentata) but no good method was found for measuring production or utilization of this plant. With limited manpower, time and methodology there was no feasible way to determine carrying capacity by a production/utilization method. However, in spite of these obstacles to precise management, we do need to know the maximum number of antelope that a range will support on an "average" year.

We surveyed the available carrying capacity methods and selected the compressed crown cover procedure described by Brown* as being the most practical.

$$\text{CARRYING CAPACITY} = \frac{\text{Forage Acres}}{\text{Forage Acre Requirement}}$$

where forage acres = percent cover x weighted proper use factor x surface acres, and the forage acre requirement is from feeding trials.

However, there were shortcomings to this method also. I don't believe there is a good practical method for determining antelope carrying capacity available at present.

Compressed crown cover was much easier to obtain than were production/utilization measurements. Rather than attempting to measure plan availability over the entire Red Desert, three smaller areas were selected for intensive study and data from these were expanded to cover the desert. Aerial photographs and ground truth checks were used.

Compressed crown cover was measured immediately after plant maturity on the intensive study areas. This method does not accurately measure all components of the plant community. During the measurement period some ephemereal forbs were sprouting and growing while others were dying out. This was relatively unimportant because there were only 12 plant species each of which made up more than one percent of the annual pronghorn diet. Carrying capacity was based on these species.

*Brown, D. 1954. Methods of surveying and measuring vegetation. Commonwealth Bureau of Pastures and Field Crops, Hurley, Berks. Bull. 42. Commonwealth Commonwealth Agr. Bur., Farnham Royal, Bucks, England, 223 pp.

Range availability had major annual changes and was an important factor in carrying capacity determinations. The extent of winter and summer ranges varied with the severity of the winter and water availability during the summer months while the length of time spent on each seasonal range was also dictated by the weather. On the Red Desert winter range is the limiting factor.

The weighted proper use factor posed another problem as we had to select a species to base it on. In other words, the use a species would receive at carrying capacity is determined by its palatability relative to the key species. We used rabbitbrush (Chrysothamnus spp.) because it was the first of the important browse plants to receive proper use. Proper use of rabbitbrush was set at a conservative 30 percent because it was receiving some use throughout the year. This selection resulted in light use of some of the other important browse plants.

I've presented an outline of the method we used to determine antelope carrying capacity along with some of the method's shortcomings. I would be interested to know what others are doing to determine antelope carrying capacity and in hearing any comments concerning our methods. Of course we are open to suggested improvements in method or procedure.

Comment--Morley Barrett: In Alberta we are monitoring vegetative changes in each of four habitat types in enclosures using known numbers of antelope. We are determining carrying capacity by this method. We use three separate measurements to determine primary cattle use, antelope use and no use. We believe we can readily distinguish annual sage growth and are clipping plants of Artemisia cana to determine yearly production.

ElRoy Taylor: This is good someone is approaching it in a confined, controlled situation.

Duane Pyrah: I don't know if you can manage antelope over a longer period of time. I don't believe that because you might have an extra 100 pounds of forage per acre one year, you can increase your antelope harvest by 20.

ElRoy Taylor: I don't believe we are near that yet.

Duane Pyrah: Our regression indicates whether you have exceeded your carrying capacity. An inverse regression of fawns per adult female indicates that you have exceeded carrying capacity.

ElRoy Taylor: Have you done any work to correlate that with range use, livestock competition, water, etc?

Duane Pyrah: Correlation of the two would be the best thing.

Don Beale: You just mentioned that a few years back you lost 3/4 of your antelope in one winter, so doesn't that over-ride any problems other than vegetation? Don't you have to shoot for some general average figure in terms of density that you are going to carry through the winter to allow for population lows after a bad winter and highs in periods of more normal winters? I don't see how you're going to manage in terms of animals to utilize certain quantities of forage available, when this potential winter situation may over-ride.

ElRoy Taylor: This is really a thorny problem.

Comment: Colorado started with mule deer in looking at area habitat trends. They looked at summer, intermediate and winter ranges from the standpoint of available forage. They know the dietary constituents and the nutritional requirements of the deer on that range and how much of the requirements were met by the available forage.

Summer range has a high carrying capacity; however, at the other extreme the winter range for deer essentially has a zero carrying capacity as far as nutritional quality is concerned. The forage taken in at this time does not meet the minimum protein or energy requirements for maintenance. So the carrying capacity is related to how long those animals have to spend on the winter range. The carrying capacity should be looked at not only from "what plants are there", but "what's in it" in terms of nutritional quality.

ElRoy Taylor: This is definitely another aspect and the annual variation is something which we don't know how to take care of yet.

Don Beale: Reducing the numbers of animals on a range, when the nutritional quality is poor, may not necessarily increase the quality of forage.

Comment: Due to a lawsuit, the B.L.M. does have to come up with some plans and it will be up to you people to have inputs into these plans. If you don't cooperate in this planning then antelope will be the one to suffer.

PRONGHORN ANTELOPE - LIVESTOCK COMPETITION
PANEL DISCUSSION
Edited by Duane Pyrah, Panel Chairman

PANEL CHAIRMAN:

Our panels generally involve two areas: 1) where there is a lack of standardization, and 2) where there is a general lack of information.

The literature has quite a bit of information that says that there is essentially no competition between livestock and antelope. I think there are a number of people who now question those conclusions.

I'll write down four headings on the blackboard and ask each state to either comment on them directly or, if they have other comments prepared already, to present them as they relate to antelope-livestock competition.

The four headings were:

1. Specific data, measurements of density, production and harvest by class, season, and intensity of livestock use.

2. Avoidance behavior

3. General observations

4. Livestock management

ALBERTA (BARRETT)

Alberta hasn't been working appreciably on cattle-pronghorn competition problems other than in some control areas relative to trying to set up our carrying capacity "experiments". We have a few preliminary observations. They are more indirect than the main purposes they were intended for. Perhaps I can summarize them by saying that occasionally, on some of our winter ranges where we do have transects, we have noticed a severe and significant contribution of livestock grazing on our browse species. This has been most prevalent in areas where cattle have been allowed to remain in the pastures in late fall. I think the problem is one of, perhaps, nutritional differences in different classifications of forage. Many browse species retain higher levels of protein and other parameters at this time of year than do grasses and many forbs. So, late fall and winter cattle grazing have been noted and documented in some areas, and it is that portion of the problem that we think is most significant. I have not done any work on the influence of cattle on the survival of young pronghorns. I heard Duane (Pyrah) mention a couple of times that fawn survival was lower in pastures with high forage utilization. I would like to hear documentation on how that mechanism works - the mechanism by which cattle numbers directly decrease the survival of young pronghorns.

ARIZONA (JACKSON)

Well, looking at this list over here I can probably give a very short talk on that. We don't have any information. We don't make any measurements or surveys. As far as food habits are concerned it's the consensus of our field people that our antelope ranges are overgrazed. Now, what effect that has on our antelope, we don't know. In the areas I'm familiar with in antelope range, the forage is removed entirely every year. As great an amount of forage as is removed on our antelope ranges, there is a definite possibility that there is competition for forage. However, we have no quantative information to indicate that. I also suspect there is competition for water. Not only are the cattle sucking the water hole dry, but the ranchers are turning the water off where there are no cattle. The only thing I can say on behavior is, I've never seen the antelope avoid cattle. We don't have any indication that they do.

NEBRASKA (MENZEL)

We feel there is comparatively little direct competition between antelope and livestock. In some cases probably, grazing by livestock is beneficial to antelope, particularly in the mid-grass areas, by utilization of the grasses, allowing more forbs to come in, which the antelope use considerably more.

WYOMING (TAYLOR)

On this carrying capacity project just completed, we have done some work on competition. I think that competition ought to be defined a little bit differently than maybe just saying competition. Let's say competition for food first, because there are a lot of other kinds of competition. You can have competition for water, space, and maybe some other habitat requirements that are limited through interactions. First, the competition between antelope and cattle on the Red Desert was studied. I only studied spring, fall and winter seasons because during summer I was so busy running transects, I didn't get to study cattle or sheep food habits. But, during the three seasons that I studied, competition with cattle runs about 18 percent. Now, that's quite a lot higher than has been suggested by several authors in the literature. The reason for that is, part of this study was done during a severe winter when cattle were forced to eat rabbit brush and sagebrush and some of the things that are staples in the antelope diet. But again, when you talk about competition you need to be more specific than just saying 17.8 percent or 18 percent of about 20 percent. Let's indicate which season of the year we are talking about, because it makes a tremendous amount of difference. In winter time, it's about 20 percent, in the spring it's about 14 percent, in the fall it's about 17 percent. And then again, what species you're talking about? In the springtime, competition is about 14.7 percent between antelope and cattle for Sandberg bluegrass; whereas, in winter time there's no

competition. During the fall, there's 3.5 percent for the same item. So it varies; but on an overall basis competition averages 17.8 percent between antelope and cattle. The picture is quite a lot different between antelope and sheep. Again, using the same three seasons, it runs 6 percent in the springtime, 28 percent in the fall, and 47 percent in the winter time, for a weighted average of 33 percent competition. Again this is for different species at a different time of the year. Big sagebrush in the spring time is not competed for at all; whereas, in the winter time there is 26 percent dietary overlap. I would like to pose this question to this group, since we've got all these thinkers together, "If you could measure competition to 4 decimal points accurately what do you do with it?" We had a formula on the board a minute ago. If we assumed that the formula would work, where do you put competition on the formula for carrying capacity? Do you arrive at carrying capacity alone and then subtract all competition? Do you subtract half of it? There's a real problem there. If you discuss competition with land owners, ranchers, and operators of livestock operations on the desert country or anywhere else, you can get into some real good discussions on what to do with competition. I can tell you what I did with it, I did the easy thing. I subtracted all competition and said, I'm setting a low carrying capacity figure. We are going to try it and see if we can increase our antelope populations. After that we'll watch it and see what we can do with it." But being a very cautious individual, I set my carrying capacity low because of competition with livestock.

One other kind of competition, maybe compatability would be a better word, would be between livestock and antelope themselves. I heard a lot of things like, "Antelope and sheep do not mix." I think this is more a function of grouping or of other activities than of the antelope not liking the sheep or vice versa. For example, scattered sheep seem to associate well with scattered antelope. As the sheep begin to form herds, the antelope seem to avoid them. And when there are large herds with associated camps, dogs, camp tenders hauling supplies in and out, and what have you, then they start to avoid one another quite a lot. The same thing seemed to me, in my casual observation, to apply to the relationship of antelope with cattle. A few scattered cattle they associate with well, a few scattered horses they associate with well. As groups form they associate less well.

QUESTION:

How do you measure your percentage competition?

ANSWER:

Okay very good, I'll take just a minute to tell you. I studied the food habits of all of them and we compared the percent overlap. In other words if you have 8 percent of a species in one diet and 6 percent in another, the percent overlap is 6 percent.

QUESTION:

Was that study by dry weight? How did you determine the food habits?

ANSWER:

It's a little bit difficult to make the comparisons directly because the antelope were done on a rumen basis. We collected 112 of them over a couple of years; I reported on that before. The livestock was on a frequency type measurement, in the field on my knees in the prickly pears.

UTAH (BEALE)

I'll keep this short. I'll relate my comments to the situation we have in Utah, and particularly the cold desert shrub habitats where a larger portion of our antelope live. We have three types of livestock grazing, we'll say systems, on this cold desert range. One of them is winter grazing by sheep under a herded situation; this is on about a six month basis starting in November and going through April. The second is winter grazing by cattle; this usually is for six months too, and under this type of grazing the unit is usually divided into several pastures. The cattle are grazed in one pasture one month, another another month or six weeks until spring when they're taken off. A third grazing system, if you call it that, is cattle grazing during summer months. This is relatively new for most of the cold desert ranges, at least in the Great Basin, and is something that has increased with the decline of sheep herds. Units are being converted from winter sheep use to fit a cattle grazing program. Of these three systems, cattle in winter is by far the least competitive, as far as antelope are concerned. Cattle are feeding on one browse plant, Eurotia lanata and about four perennial grasses. None of these plants is used by antelope in the winter time to any real extent. You can enter in many other factors, such as fencing, stocking rates, etc. and this could be approached by percentage overlaps in diets etc. But at the antelope stocking rates we have been talking here, one antelope per square mile or in most cases ten square miles to one antelope, you're not going to get anywhere working on percentages of diet and this type of thing.

Sheep in winter? Obviously their diets overlap very much. So here we have to rely entirely on stocking rates of sheep to insure that adequate forage is left for the antelope. They are feeding on essentially the same things. Cattle in summer, the third type of grazing, has raised many problems. The cattle and antelope summer diets overlap almost 100 percent. The cattle, as well as the antelope, utilize the forbs and the young green grasses in the spring. So here the season and intensity of use, whether or not it's rest-rotation grazing, all of these have to be considered. This is not a herded situation so they want to put in pastures which require fencing and this raises additional problems. Generally speaking then, this has not been favorable in areas that I have worked, at least as far as antelope are concerned.

COLORADO (SCHWARTZ)

The Colorado Game and Fish Division has pretty much wound down their antelope research. But the I.B.P. program has spent a lot of time and a lot of money looking specifically at these factors of competition between various species of ruminants in two types of grazing situations: one was what they call a heavily grazed cattle pasture and the other a lightly grazed cattle pasture. We looked at competition for cattle, bison, antelope and sheep under different seasons of the year and so on, we had some nice results. I think it is important to consider results of these studies as just one measurement of a situation at one point in time. It's difficult to take that point in time and try to apply it to a lot of areas in a lot of different places, with the plant communities and everything in continuous flux. Just because you measure food habits for all these species at one point, and come up with some index of competition, that doesn't mean that is a great and glorious number that will be the same again next year. It's a dynamic situation, it's constantly changing and I think this is something that management people have to consider. Is the condition of the range, forage availability, the time of the year, the species of herbivore, or the species of livestock that we're talking about comparable between years? A lot of people today have been saying livestock. I think it's critical to decide whether we're talking about sheep, cattle or horses because these ruminents have different food habits and grazing patterns. I think that you should be aware of this when you formulate plans or think about looking at competition.

COMMENT:

In Colorado, we have eliminated some of our antelope work in the last four or five years. We did have a good study on our unit three, one of the western slope units. On the livestock management it seems like most of the western slope is going out of the sheep business. I think they figure they've lost about 60,000 sheep just in our little area around Craig. We feel this is one reason in our area around Craig that the antelope are really burgeoning, it's quite a dynamic thing to see. We got a lot (of antelope) out of Wyoming when they had their bad winter. We see a lot of movement and we see another part of fence jumping behavior that I haven't heard anyone mention yet. In the five years I've been there I've seen two antelope herds go from not being able to negotiate a fence in any way, to not even being stopped by a fence. They built a new highway through the valley, the only paved road in my whole 9,000 sq. mile district. They fenced it sheep-tight on both sides and I thought, "I'm really going to have problems." Within two years, antelope were able to cope with the fence. They'd come to that fence and go over it just like a deer. I've seen only one antelope caught in a fence. They seem to negotiate fences quite well. We had some trouble with fawns. I've got some gaps in the fences. I've got pictures of fawns separated from does. She seems to stay around and finally go back to the fawn and they negotiate the fence through a gap or something. In my area it's mostly winter use with livestock and summer use is very light so all the fences can be left open.

QUESTION:

So you have observed them actually jump?

ANSWER:

When I first went there, we never saw antelope jump fences, now we can see twenty or thirty jump the fence going from one side of the road to the other. It is something really interesting to see that they have completely overcome fencing in that corner of the state.

QUESTION:

How high are your fences?

ANSWER:

Forty-two inches.

IDAHO (SHERWOOD)

We have determined a number of areas of competition between livestock and antelope, but not the specific degree that Elroy (Taylor) has. Bob (Antenrieth) showed you a fawn bedding site study in the Pahsimeroi. We've conducted that in other drainages as well. Most of our habitat, as you know, is in long narrow mountain valleys. We have conducted these bedding site surveys in the Little Lost, Birch Creek and a number of other areas. Where they trail large numbers of sheep through fawning habitat, we've repeatedly observed fawns boosted out of their bedding sites and does disturbed on birth sites by these large concentrations of sheep. In some of these valleys there is a spring-summer grazing allotment but they also trail several thousands of sheep at a whack through in the spring to get to the summer ranges. They string these through there at production time, around the last of May and the first of June. We have mapped fawning grounds for years. As Bob says, this isn't entirely valid, but we do find large areas that are used for production say seven years out of ten. Where these things are in the path of these big sheep migrations, there is widespread disturbance of fawns and does because the sheep are bunched. It doesn't give the antelope much place to go if they have a function they want to perform at that time.

In some of these areas we have a pattern of winter grazing that's extremely detrimental. In one area in the Upper Little Lost we've measured the impact of cattle on deer winter range, which is adjacent to antelope summer range and integrated with it. We've found that 80 percent of the available browse was used up by the cows before the deer got there. The impact on the antelope was probably comparable. We have cattle on this range. They graze it in the spring, take them off in the summer probably ten days late, and then they run them in there until the last of December or early January. They seem to base the stocking rate on what they can get the gate shut on.

This cannot help but have an adverse impact on antelope forage. As I stated before we have a critical summer range problem with many of our summer ranges smaller than our winter ranges. We do not have a quantative measurement of what this does to us, but the impact has to be fairly high. Edson (Fichter) a number of years ago demonstrated a correlation between moisture and forb availability, and antelope production. If you have heavy spring grazing and these large bands of sheep trail through the same area, this can't help but reduce the productive capacity of the area. We have a lot of problems with competition, we're finding more of them as we go along. We call antelope the left-over species because he gets the left-overs after these more competitive domestics get done with it.

COMMENT: (FICHTER)

I'd like to say a few words about direct behavioral interactions between pronghorns and cattle which I've had an opportunity to observe. I suspect, however, that such interactions between pronghorns and cattle are not particularly important to management of the pronghorn. The Arizona representative says he has never seen pronghorns avoid cattle. I hope I'm quoting you correctly. In my experience, interaction is quite variable on the same area and during the same season. And certainly the reasons for the variation are not clear to me. Sometimes pronghorns will avoid cattle and sometimes they do not seem to avoid them. When they do not seem to avoid, the avoidance may be so subtle that I can't see it; and anybody that studies behavior by way of direct observation very soon becomes convinced that he is not seeing everything, simply because he does not have the power to see what the pronghorn is doing, not nearly the powers that the other pronghorns have.

For example, and I suppose we can call this competition for space, that term has already been used once this morning, we find calves frequently investigative toward pronghorn of any age and the pronghorn avoids as the calf approaches. I have had a few chances to observe a doe with new born fawns, within a day or so old, in the immediate presence of a fair number of cows, maybe 15 or 20, and the fawns are bedded down in what we had chosen to call the "lying-in'seclusion" period. The cattle are scattered and grazing surrounding the area where the fawns are bedded down and the doe is trying to get in among the cattle and move the fawns. In every case that I have observed, the doe is successful although it takes a little while and she is, if you please, quite nervous about the operation. Sometimes I see the avoidance is at a considerable distance; sometimes it is very close. The reasons for these variations certainly are not clear. I have wondered if perhaps pronghorns do not interact with cattle much as they did with bison. Somebody could get at this if they worked in such a place as the National Bison Range or Yellowstone Park. My closing comment in that connection is that pronghorns seemed to be doing okay in pristine times right among the bison.

SOUTH DAKOTA (HAUK)

We don't have anything new to add on this. We don't have any study to measure competition. We've got only casual observations of the difference in competition between the sheep and cattle. In the major sheep areas, you don't find the antelope in high numbers. We have very few large herd type operations. Most of them seem to be on a pasture-rotation system and it's probable the best system.

The problem there is fences, and I really haven't observed antelope learning to adapt and go over these fences. They seem to be in an area pretty much to stay. Probably the major change that we are seeing now, in the last couple of years, is that a lot of people going out of the sheep business in South Dakota. During the last couple of winters, we had a couple of major storms that caused tremendous losses. Of course, there are complaints and comments towards the predation caused by coyotes. We do have quite a few larger sheep operations going out of business.

BLM (YOAKUM)

I've heard the term "gut reaction" and I can't think of a more appropriate one for the pronghorn-cattle issue at the present time. In looking at the pronghorn-cattle situation and traveling parts of Mexico, Canada, and United States, I see where there's some areas where we have good antelope production and survival in areas with livestock. I see other areas where we don't have it. If we had on this table all the food we wanted there's no competition for food; but, if there's only one loaf of bread here and we all have to eat it we've really got a competition problem. If we look at the antelope populations overall and if the PLLRC report was properly accomplished, we find that over 50 percent of the antelope populations are on private lands. On that basis, let's face it, it's up to the private individual whether he wants that vegetation for his economic gains. That's a matter we should keep in mind at all times.

But let's look at the matter from a public lands standpoint and I would just like to throw this out for you. I know of an area of roughly 60 million acres of public land - that's quite a bit of public land. Let's look at that 60 million acres. The demand by law, the legal demand, is roughly 80 percent for cattle, 15 percent is for antelope. We're not even in the picture, and that's legal. That's what our society is sanctioning right now. Not in Canada nor in Mexico but here in the United States. And when this is the way we're operating I wonder why our antelope have problems. So in summary I hate to be too pessimistic about the future for antelope. The way things are going at the present time, it might be good times for us but it is not good for antelope. The only reason we have cattle out there is because of us and our good way of life.

I think we have an antelope crisis to a certain extent. I think we have an insidious loss of antelope habitat. Not drastic, not startling, it's constantly going on. Both the quality and the quantity of antelope habitat is going down. It has been going down, and it's going to go down more and more and more. I think this particular group can do something about it, if it will sit down and work together as a group. I think private landowners should be on this panel. State and Federal agencies can get together and come up with some guidelines for public lands. I'm looking forward to doing this tomorrow.

COMMENT:

Private individuals aren't interested in attending.

ANSWER:

No, we have some here right now.

COMMENT:

I mean as far as the SCS is concerned, they didn't bother to respond.

COMMENT:

I don't consider the SCS as private.

COMMENT:

Well they represent private landowners.

ANSWER:

I don't know if they respresent them or not. Cattle and sheep associations and such as this represent private landowners. Another government agency cannot represent private individuals.

COMMENT:

I think that's a good point. If that's one of the places where we have a problem, then it behooves us to try to invite these people. We can't cooperate with them unless we have them in an area where we can communicate with them and exchange some kind of ideas.

TEXAS (KILPATRIC)

I'll start out by saying that essentially all our antelope range is on cattle ranches. We feel that competition is insignificant. I believe livestock management policies in our area of the country has contributed tremendously to the distribution of the pronghorns by establishing water supplies. Of course we have the problem of educating the landowners so they'll maintain these water supplies after the livestock are moved out of the pasture. But, I think that's an important point. Also with

the decline of the sheep herds in our part of the world we are experiencing tremendous influx of predators. We don't know how much this is affecting our antelope herds. We know we're having a hell of a lot of coyote predation. I think on ranches where we have a few sheep, not stocked entirely with sheep, I feel like the antelope have a better chance of fawn survival there than on our straight cattle ranches, where not much coyote control is conducted.

SASKATCHEWAN (WILTSE)

Saskatchewan hasn't carried out any studies concerning antelope-livestock competition. We've made some general observations, I think most of them have already been discussed by the other panel members.

NEW MEXICO (PURSLEY)

Anyone who is familiar with the New Mexico rangeland will agree that any livestock management practice that would improve the range in any fashion would certainly improve antelope range in New Mexico.

MONTANA (PYRAH)

I'll draw a chart for a study done in Montana. We recorded whether there were cattle in the same pasture with antelope at the time of the antelope observation. This is an accumulation of data for three years involving something like 9,000 animal sightings. In April, 5 percent of the antelope were in pastures with cattle. In May, it jumped up to 30 percent, as they started to turn out cattle. In June, it was 56 percent, at the highest level. This is when fawns were young, does were pretty much limited to exactly one area where they could forage. In July it declined to 25 percent and August 27 percent. In September as they turned cattle back into fall and winter pastures, it increased to 33 percent. For the summer period, 70 percent of the antelope were observed in pastures where cattle were not present, and those pastures made up less than 30 percent of the total summer habitat. We interpret this to be a very definite avoidance reaction of the antelope to the presence of cattle. So antelope distribution definitely relates to the use of the area by livestock.

The kind of figures I was after for our panel to talk about related to density. Even if they only represented small areas they would have been acceptable at this time. Before we can draw conclusions on the effects of livestock, we need, in addition to some of the other things we talked about, forage competition, competition for space, and behavioral problems, some quantification of what that results in. So on our study area we have an antelope density of about 3.8 antelope per square mile as an average. This is on cattle range. It's on what we would probably classify as moderately grazed, and it is grazed primarily in spring, summer and fall.

QUESTION:

Is that a wintering figure?

ANSWER

No. Summer.

Our fawns per female average is .73, and that's per adult female. We prefer to use fawns per mature female, but I felt that very few others would have production data as fawns per mature female. Our fawns per mature female was .85. We harvest .6 antelope per square mile. I think that when we can compare these on cattle ranges and sheep ranges, intensively used as opposed to lightly used, and with different seasons, we'll begin to get a picture of where antelope fit in this antelope-livestock competition.

We think antelope-livestock competition is pretty much as Don Beale described it. In wintertime we have strong competition between sheep and antelope. I hope that some of you got the idea from the charts yesterday that all of the herds didn't have the same density. It just so happens that they all don't have the same kind of livestock grazing. The one that had 10.5 antelope per square mile was sheep range. But there aren't any sheep there during the time that the antelope are there. It's winter range for sheep and the antelope use another area for winter range. So that just the fact that it's sheep range is rather immaterial as long as it constitutes antelope habitat, when no sheep are there. It's fine antelope summer habitat. Our greatest problems are on areas where we have cattle and antelope competing during the summer time. You saw the areas with lowest densities, those are on cattle summer range. No competition between antelope and cattle? I don't believe it.

QUESTION:

I have a question to direct to Jim (Yoakum). What law says antelope are only allowed 5 percent on public land. I think I heard you say that today. Or is that just a policy?

ANSWER:

I stated that 80 percent is going to cattle by demand, 15 percent to wild horses, 5 percent to wildlife. It's legal according to existing laws right now, which establish demand procedures. This is an example for public land at the present time, for lands under BLM administration. There is no mandate from Congress or the public saying that multiple use will be practiced on public lands.

QUESTION:

What you are saying is the Taylor Grazing Act, the traditional law, you're operating under is . . .

ANSWER:

Not relative to wild horses. The Wild Horse and Burro Act would be relative to that. There are over 4,000 laws on the books relative to managing the public lands.

QUESTION:

The law doesn't specifically state the percentages just . . .

ANSWER:

No. No. I said the demands. These are the demands on the public lands. And according to existing laws, they're in conformance with them. That was my point. And I think unfortunately, John Q. Public, and in many respects the managers, are not aware of these conditions. I think we've missed the boat, I think we're fighting battles of whether 50 percent of this grass should go to this animal or that and we're losing the war. And that's what really worries me.

QUESTION:

Along those same lines, the Taylor Grazing Act has a reservation of forage for wildlife, they use a word called reasonable. A reasonable amount of the forage will be allocated to wildlife. It's up to people like you to come forward in these planning sessions to determine to the manager what reasonable is. Reasonable at the present time, as Jim has pointed out, is 5 percent. If you have areas with buffalo and antelope and deer and elk all in the same area and they are allocated only 5 percent of forage, is this to be considered as reasonable? It's legal. Nobody questions it. It's up to you people, the state fish and game agencies, the Wildlife Federation, etc. to demand that reasonable means more than 5 percent.

ANSWER:

I really believe there's a chance we can get together and work up some guidelines in the next day or so, I sure hope so, which you may be able to take back to the Western Association. You should also take them back to the different agencies.

QUESTION:

Jim, I don't really want to get up and lecture. However, something occurs to me that all of us need to think about and really need to think about hard. We've talked about competition. Just about all the work has been geared to looking at the overlap between species "A" and "B" wildlife and livestock. One of the most recent breakthroughs in competition was done in a study in Australia, only recently published. They looked at the introduced Indian Water Buffalo in the swamps in Australia. I think they adopted an approach that all of us need to look at as maybe the answer to our problem. They said, "Let's not look at the overlap zone, let's find out where they differ." If you think about it for a minute, where you have two species in complete competition, they are completely sympatric. The whole system of evolution wipes out one species and the other persists. This is how it's all put together.

The only thing that permits two closely allied species to coexist, is a separation of niche, not an overlap. We've been talking in terms of where does this overlap occur and how much joint participation there is in the niche. I think it might be a thought when we go to lunch, to think about possible ways of looking at how the two differ, pronghorn and livestock. It might be worth trying to manage to produce, shall we say, the requirements for pronghorn rather than for cattle and sheep and horses or whatever by making more available in the "non-competitive" niche.

PANEL CHAIRMAN:

The panel chairman asked for participation from the audience.

COMMENT:

Where I'm stationed, there is a large valley which is winter sheep range. I've noticed that antelope move in relation to the sheep. As they move the sheep around the valley, the little herd of about 75 antelope in this concentrated locale move around away from the sheep. Maybe it's the dogs and the bells and the blatting and everything. They don't like the sheep and they will move and change their position in relation to the sheep band.

COMMENT:

Last summer we were out observing fawn bedding sites for Autenrieth in my area and we were awaiting the doe to come back to the fawn. In the meantime a sheep herd was moved into the area and the doe would not come close. She circled the sheep about three times. We watched for two and a half hours and when we left the area, she had left the area too. During the time we were there she didn't pick up her fawn and the sheep herd had pretty well encircled the area where the fawn was bedded. The fawn was left for a long period of time. Usually the does would come back within a couple of hours but she was gone from that fawn for at least four hours.

COMMENT:

I might mention some stuff here that was done in Wyoming by Sundstrom in 1973 describing optimum antelope habitat. His criteria for optimum antelope habitat in Wyoming were: vegetative cover relatively open, 40 to 60 percent ground cover; the height of the cover not averaging more than 18 inches; plant composition of 10-20 percent Artemisia spp., 5-15 percent other browse species, 25-35 percent forbs, and 40-60 percent grasses; preferred browse species of a. Artemisia tridentata, b. Artemisia frigida, c. Artemisia cana, d. Chrysothamnus viscidiflorus; water at 3-5 miles apart; and land irregularities for cover on winter range. In setting up grazing regimes in some of these habitat plans we're working on now in cooperation with the BLM, are we looking at enough at this aspect on how it's going to meet some of these criteria for antelope?

COMMENT:

Within the next twelve years the BLM will be going through an adjudication program. That is, allotting so much forage for livestock and so much for wildlife. This is by court decree that this will be coming about. A series of environmental impact statements will have to be made. The bureau went through an adjudication several years ago and I would say that wildlife lost that round altogether. It's actually gone through a couple of rounds and I'd say we lost, or struck out possibly twice. We are around again,and I think there's a good possibility that this time more could be done for antelope, deer and other species with a little time and effort spent on it.

Consequently I would recommend for consideration of this group tomorrow during the business meeting, that this matter be looked into and considered for reporting on to the Western Association. Also, possibly consideration of a committee to set up guidelines as to what extent and how can antelope best be covered, in recognition of these EIS statements on range management.

CHAIRMAN:

We need some recommendations now for what we should try to do. If livestock and antelope competition is indeed a problem on antelope range, then we should try to develop guidelines that will lessen the conflict that is caused by that competition. Dr. Simpson, do you want to re-introduce your ideas again?

COMMENT:

I've heard several comments on it and I think it might be worth tossing around a little. First of all, to elaborate a little bit on what I said before lunch, when you think in terms of competition, you're not really looking at animals going out and competing with each other. This is not an active participation in a public competitive action. There is a resource available, an animal requires it, and it uses it. So the whole concept of competition is one that I think we have developed in trying to evaluate the interaction of one species with another. From there perhaps it might be worth going one step further. No matter where we are or whether we are talking about wildlife-livestock or wildlife-wildlife competition, in just about any situation, you have an ecosystem which has evolved and has gone through a process of adding a few species and dropping a few species here and there. As ecologists, I hope we're all that, we should try to apply basic ecological concepts when we try to find answers to some of the problems. And in my view here, it might be a lot more practical for us to look at how two or three or five of whatever species as such coexist in a normal balanced ecosystem. The pronghorn and the buffalo evolved together and they got along together pretty good. No doubt they overlapped quite considerably in their feeding requirements and utilization of various resources.

I feel that when we're talking at the range level, it might be worth looking at livestock, not as something that is a direct threat to our pronghorn ranges, something that we can get rid of (because let's face it, as Jim pointed out, it's here to stay) but as something we must learn to live with it. Otherwise, pronghorns are going to lose, not the livestock. So instead of looking at it as something we can possibly get rid of, or certainly curtail its expansion, maybe we should look at how we can develop that aspect of pronghorn resource requirements which is not utilized or only very, very lightly utilized by livestock.

COMMENT:

I think the bison and the antelope were coexisting in an entirely different situation than we have today. It has been my observation that bison herds in the intermountain area have different requirements from antelope and they are quite a bit different from cattle. Forage utilization has increased so competition between antelope and bison or cattle is not comparable. I think now we have a situation on most of the ranges that I'm familiar with, where the cattle and the antelope and the sheep are eating all the forage. So there is competition. If we had our ranges in A-1 condition, and there was a grazing system so they could go into different niches the antelope could exist on the part of the range that the cattle or the sheep weren't using. But most of the ranges we have aren't in good condition. I think that the bison-antelope ecosystem was in such a balance if you will that they could coexist on what was there. It was ample for the antelope and ample for the buffalo, but most of the ranges I'm familiar with, they're not ample for just one, let alone two or more different species.

CHAIRMAN:

Some of you I'm sure have read R.H.V. Bell's article in Scientific American on the grazing ecosystems in the Serengeti. They talk about the bison-antelope association as though it were a system similar to that one in Africa, but it is without any scientific evidence, observation or anything. This is strictly theory or speculation. As another speculation, in dense grassland areas where there is excessive coarse vegetation and in its removal you expose the more nutritious green material near the ground, antelope could have been dependent upon the bison as Bell described the succession of ungulates in the Serengeti. In much of the dry intermountain plains, our sagebrush ecosystems, we do not have that kind of forage production. It doesn't appear to me that there is that much of an excess of old foliage, or coarse foliage, as to affect the availability of the more nutritious forage for antelope.

COMMENT:

On all of our antelope habitat there weren't that many bison. On the sagebrush-bunch grass association there is no record of many bison. This is an entirely different ecosystem and not nearly so productive an ecosystem as the short grass prairies or the deep soil Great Plains area where these animals existed in such abundance side by side. What bison we had, there were a few, had freedom of choice. They didn't have to hit the range nearly as hard as a cow held in by the fence, when there's too many cows inside the fence. I don't think we can apply that

on any Idaho ranges, I don't think we can apply any buffalo-antelope comparison at all.

COMMENT:

What I would like to point out is that we should look at this as a situation that has changed, yesterday it was pronghorn, bison and elk and whatever, and today it happens to be pronghorn and sheep and cows. I'm not for one minute suggesting that since bison were here, therefore why can't the cows replace them. This is ludicrous. I agree with you the ranges are completely depleted. But the point is that we are going to get answers that Jim (Yoakum) has asked for to start long range planning. We are going to get these answers a lot better if:

1. We accept that right now the pronghorn has got to learn to live with livestock; he is stuck with it. It isn't going to stop, and it's going to continue to encroach.

2. We can improve the non-overlap zone to the maximum benefit of the pronghorn. I'm not saying for one minute to ignore the overlap zone of the competition.

3. We are able to look beyond just the range itself in terms of food availability and fence it.

We learned in Colorado that they can now jump fences. I'm not doubting this because from Texas it's been reported too. We're talking now on long range plans, let's say for argument's sake, BLM foresees in the future, pressure on their lands to fence. What about putting up now low fences between winter and summer range? Let the pronghorn cross these low fences which they can do and through time change their behavorial patterns. We know they are physically capable of jumping fences. Five years from now BLM might have to fence between summer and winter range.

We should look at some of the factors restricting the pronghorn from getting out of the competitive overlap zone and getting into a non-competitive zone outside of forage competition. Again and again this conference has mentioned fences. We can now start taking precautions, or start educating the behavorial characteristics, so that five years from now, when the public demands the BLM lands are fenced, that these things are capable of jumping fences. This is what I'm looking at. Instead of saying this is where it is competitive and this is where it is not, we must try to do this or that within this overlap zone. Let's try to approach the whole business of living together, pronghorn and livestock, from the outside. How can we take the pronghorn out of this overlap zone into the zone where we don't have forage competition. I'm sorry if I misled you about saying buffalo-pronghorn. I didn't mean it as a set thing, merely as a concept.

COMMENT:

I think BLM has already moved along these lines. We have now adapted a manual format for antelope fences, anywhere there are antelope. Again if we can impress upon the state agencies to become involved with the planning system where these fences are planned. The manual now states that antelope fence, or fences built in antelope areas, won't be over 36 inches high, if it's a sheep area alone. And if it's in a sheep and cattle area, it won't be over 39 inches high. There are also other types of fences that can be built which they can go underneath. Net-wire fences cannot be over 36 inches high. There will be a 14-16 inch gap underneath barbed wire fence. So this kind of programming is in the books, we can demand that it be done. Also the BLM is even changing fences at this time. If it's a high fence and the pressure is put on, they will replace it with a new fence.

COMMENT:

This is the way to go at it.

COMMENT:

We might speed up this process, by taking some of these trained fawns that these people down in Fort Collins are using and teach them to jump fences, and putting them out there.

COMMENT:

Tradition is very important in animals in leadership and local behavorial patterns. For instance, you get a herd as we found in Colorado (to learn to jump fences). How long did this change take to occur?

COMMENT:

I first noticed it about five years ago. Since then, I don't worry about antelope crossing fences. I've eaten a lot of crow on this, because I fought fences. The first time I noticed it, seven of them came up to a fence and four jumped as I continued down the road with my pickup and three of them turned back. These three, did they turn back because of the pickup, or did they turn back because they couldn't jump the fence? I don't understand to this day. But the other four, as I continued on down the road, turned and jumped the fence back and they went back out into the field. And this completely amazed me because I'd heard that they didn't jump fences. Since then at various times, I've seen them jump fences. I had five near Craig do the same thing, only as I continued on down the road, they all five jumped the fence and went back out into the field. I've had eleven come up to a fence like this and this time I did stop, and if I'd had a camera with me I could have got a beautiful picture because it was just a file of antelope, just like deer and sheep. The antelope come up one right after another, crossed this fence, went over and jumped the other fence on the other side of the road and went on across.

QUESTION:

Were they mixed sex and ages?

ANSWER:

Yes, there were no fawns with them, but there were yearlings. They were just a small herd of antelope and they went across the fence.

COMMENT:

I would just like to caution against an over-generalization here. We have a wintering situation talking about five or six month-old fawns, but if we're talking about a month or two or maybe even three month old fawns, I have yet to see a fence that is usable for livestock that this age class of fawns could negotiate, unless they can go under.

COMMENT: . . . I've set back and watched them for about two hours and finally she did go back and rejump the fence and stay with her fawn. This is a situation where you can go in now in a planning situation, if you know where these fawning grounds are, and demand that the fences be the type that they can go under as well as over. In a winter situation, going under it may be out of the question, the snow may be too deep. We're changing a lot of the fences in our district. we're cutting the bottom three squares off netting fence and we've lowered the top wires to 39 inches or 36 inches, depending on where it is. I think it behooves the state fish and game agencies to get out and know these areas and get together with the BLM or Forest Service and see that they spell out a plan and see that they are built this way.

COMMENT:

Our group did have input in the last workshop. Everybody that's been there is aware of that. Regarding the fencing guidelines, we as a group did have input with the BLM. The guidelines are pretty close to what we recommended, is that correct, Don (Beale)?

ANSWER:

Yes. We'll have a report on fencing guidelines at the business session tomorrow, by the way.

COMMENT:

I'm not proposing that anything so drastic as removing livestock from the range but sometimes . . . (tape change)

COMMENT:

To solve the antelope-livestock conflict, whether it be some kind of overlap in food habits, livestock density that Bob (Autenrieth) mentioned, competition for first choice forage where antelope lose out, or strictly avoidance behavior, regardless of which it is, we have rotated pastures. This makes a niche that antelope have access to where we have at least reduced competition. We might have to resolve the conflict, not through species management, but through

rotated pastures. The number of antelope we have in many of these areas is not at a high density like livestock.

COMMENT:

I apologize for monopolizing the time from the panel members from Idaho, this is the point that Jim (Yoakum) and I have been trying to get across, that the time is ripe for you people to see that these types of things are injected into allotment management plans, and I'm assuming that everyone knows what an allotment management plan is. Most of the BLM lands are divided into allotments and now we are being forced to devise allotment management plans that meet criteria that the National Resource Defense council will buy off on. One of the objectives in these plans is to see that wildlife and especially important wildlife species are taken care of. If a plan goes through without your input, or if you don't put the type of input into it that you want, then you have no one to blame but yourself. If you have an allotment that you know has an important wintering antelope range, one of the objectives in that allotment should be that the management of livestock will take care of that situation.

QUESTION:

Have you got this across to the area managers as well as you have to us?

ANSWER:

I'll tell you what, you can't just sit back and be a wildlife biologist, it has to come from you people as well as other agencies, other groups, and other organizations to show that this is a demand of the public. That's why we're here and if we sit back and let it go on the way it has been we have no one to blame but ourselves. Wildlife can't benefit if we don't get in there and see that it does.

QUESTION:

Well, this is what we're doing in recommending seasons and patterns of use on our antelope range - changing things that aren't compatible. I'm not recommending that they take the livestock off or anything like that.

ANSWER:

Well, that's what I'm getting at.

COMMENT: This is very good. This is our approach to the niche situation as I see it now.

QUESTION:

I've sat and listened to these things and there's a lot of knowledge here, it's sitting, floating around and being tossed about, and nobody is saying, "Let us make the following recommendations to BLM or to somebody. One, two, three, four." Everybody's got a bunch of good ideas. This stuff from Montana shows that grazing rotation really aids pronghorns. But as someone just said they've got plans to do. Now are we, as a workshop, going to get together and specify recommendations for those plans. Dr. Fichter and Duane (Pyrah) suggested a committee - maybe this is what antelope needs - not us as a bunch of biologists but maybe antelope need somebody who's a watchman, who says such and such an area is about to go into sort of a complete survey. What's happening there? Do we have to do something for antelope right in there. I'm not being hyper-critical, I just feel that there is an urgency here. We by no means have all the answers, but there are beginning to be some answers. We need to come forward with some general recommendations at this meeting, and also have some sort of a standing committee that operates over the next two years as an overall watch committee on various things. A committee where BLM, for instance, can write to them and say, "Look we're redoing this area. There are pronghorn here, what are your specific recommendations for this area?" and that committee can send them some specific recommendations.

COMMENT:

Beale and I have been working on this, but we have a huge amount of acreage in the _____ Plateau. Right now it's the most productive antelope herd in Utah. Now we're being forced into livestock management systems and maybe the ones they'll want to do will not be beneficial to antelope. That's what we have got to show in the objective. If summer use by cattle would be detrimental, that should be brought out very strongly so that anyone reviewing that plan would see that the opposition to this change is there, it should be made clear that it is detrimental to antelope; it's there in black and white.

COMMENT:

When I've worked with our BLM District wildlife biologist, we've boiled it down to three important concepts that we try to get. We would like to see livestock grazing managed in such a fashion as will encourage the restoration of forbs on most of our rangelands; we're dealing mostly with vernal forbs. This means reduce livestock grazing pressure during the spring of the year. We'd follow with another suggestion that if light grazing is practiced on this piece of land during the spring of the year, then it could be grazed again later in the summer after the critical period of the fawn production has passed and when the cows are utilizing primarily the mature forage. Any kind of a rotational system must have all of the pastures with a corner in the range of a doe band area. If it doesn't, then there is a cumulative effect of having a pasture heavily used all season one year, heavily used part of a season the next year, and a rest season the other year. The breeding population is encumbered with two bad years before the one good year. The antelope are expected to do well in that rest year. They just can't do it. They must have access to a niche of their own in this management rotation, that is available to them because of their traditional use of the area.

QUESTION:

How much more effective would this "work" between ourselves and the local BLM man be, if you had something very specific and clearly stated as coming from this workshop and eventually the Western State Commissioners organization? I think this is what we're getting at. We've got to get going and start getting some very hard backup data. We've got some of this; it's scattered all over the place, but we've got it. Now we need somebody who is going to have some say, some pull or some influence. That's what this conference is. It is the National Conference on Pronghorn. Now you might have a first-class relationship with the local BLM man, and you two might work out a perfect sort of plan for BLM land administration. But maybe his regional office doesn't know you at all, and say, "This is nonsense, it doesn't fit in with what I'm trying to do in the other part of the state." Whereas, if you and the local BLM man can say, "Look we are implementing what the National Antelope Workshop recommended, or what the Western States Commissioners recommended," you've got a lot more punch. I think the time has come for us to make some specific recommendations. That's exactly what Jim said. That's what Don is saying. Everybody is saying "These are the recommendations for pronghorn administration made by the workshop." Now I know this comes tomorrow, but I think it's a good time to mention it today so we can start thinking about it. What are we going to recommend?

COMMENT:

That's real interesting. I'm a District Biologist for the BLM in Boise. I'm very interested in what's being said right now. Bob made the point that one of the area managers from BLM was from my office.

There's two points I want to make and it might shed some light on the approach we're taking, at least in the district I work with. We're putting on a team whose total job is to write allotment management plans, to do the job right. We're putting on a multi-disciplinary team. We're putting on three wildlife people, seven range people, a soil scientist, and right on down the line. I'm thankful in the Boise district I don't think we have a real problem with our area managers but I know in some districts in BLM they do. Our Area Managers aren't going to be able to really dominate what goes into this plan. The plan is going to be written the way it should be and I think it's very important that the state agency people realize this.

Don't worry about what problems you had in the past, if you tried to talk to the Distrist Manager or the Area Manager, and they haven't listened to you. Because now is the time we can get our information and ideas to the multi-disciplinary team. It's important that we do it right. We just ordered 15 new desks in our district, and those people are going to be working on this team. That's their sole purpose. We've heard a lot of problems but I'm telling you that opportunity light is really shining right now so we better get our licks in.

COMMENT:

It might be pointed out that in Idaho the planning process is going on right now. There have been two or three meetings already. One of the things that's been suggested as a possibility for some of the restorations of overgrazed land is seeding crested wheatgrass in a large number of areas with the possibility of leaving perhaps 20 percent of the sagebrush in the area. Resting has had very little effect there because, for various reasons, areas have been left for 9 years and recovered very little. Range scientists are suggesting that planting crested wheatgrass might be the solution. I think Bob (Sherwood) may want to comment on that. It appears that the Idaho Fish and Game Department should have a very strong influence on whether or not this is done.

COMMENT:

I wanted to mention the fact that in the Big Lost and Little Lost I could not point to one crested wheat seeding that has been in antelope habitat and hasn't damaged it severely. Almost to the total elimination of antelope use over most of the area. And then they come out with these plans with so many thousand acres to be treated in this fashion. We know and they know. The Area Manager know, and certainly his staff of wildlife people know, that this is going to knock antelope in the head and still they come out with these proposals. We can comment on them but we don't know how far our comments are going to go. We can point to instance after instance in both drainages where we've been bombed out of winter range, bombed out of summer range and just generally knocked out of the picture on antelope due to crested wheat seedings. And it's been proven over and over again that these things do nothing beneficial for antelope under any circumstance.

COMMENT:

But you've got a lot more pressure if you've got a national body that can make the recommendations.

COMMENT:

Time and again we've had it out with the Forest Service and the BLM. When it gets down to the District Ranger or the Area Manager in this matter of shrub eradication and reseeding, we made a recommendation, we draw them out, and everybody agrees on the recommendations for wildlife, but the manager goes ahead and sweeps it clean like he planned to do in the first place.

COMMENT:

I've worked for the Division of Wildlife in Colorado. Each area is different. I've noticed this as I've gone into the Vernal area, Craig area or wherever. If you will work with them (BLM) it will help. We stopped sagebrush spraying on Pull Spring Mountain area with the sagebrush guidelines that came from the sage grouse workshop. These guidelines help. We went to the BLM, worked it out, and showed them what

we wanted. They stopped the spraying. Reseeding? We've had reseeding and we had the same thing. We had a deer study plot of an acre enclosure; they came in and plowed clear around that thing and reseeded it to crested wheatgrass. But this was before; now, we can work together, and they don't do that anymore. We haven't had a crested wheatgrass seeding in the Craig area for probably five or more years. We have had browse reseeding areas for wildlife. If you see an area that is overgrazed or has too many AUM's you can ask them to have some livestock taken off. Although, it is a matter of not asking for more than you should.

This came from Wyoming. In this area just north of me, they are pushing this now and it's working. They're starting to cut back some of their allotment, because they are overgrazing.

We've lost, as I said before, 60 to 100 thousand sheep in the Craig area - it's a great big area, but it's had to make the difference in the antelope. I personally feel that our antelope herd has just started increasing. We really have high success, keep increasing permits, and such.

COMMENT:

I'd like to reinforce a couple of statements made here. What we have to do, I feel, is to summarize in some detail and with as much documentation as we can, what the problems are. We must be specific enough so that we can identify whether or not the problem pertains to any particular state or province. We must address ourselves to recommending a possible solution relative to specific problems. I don't think that we can continue in the abstract. I don't think that we can make recommendations to solutions without reasonable documentation of problems. That has to be done. Then we must respond with specific recommendations about how to alleviate the problem. We all get hung up on cattle. Is the cattle problem significant? Well I think we have to look at it from the standpoint of the cattle use on fawning range, or on winter range, or on a number of specific areas, and respond in specific detail.

COMMENT:

I work for the National Park Service. Thankfully, we don't have to be involved with livestock management. But don't ignore us. We're finding out some interesting things about fire and deer and other wildlife. We're doing a fair amount of (fire) research. I'm sure some of you know a lot about fire, but in developing your management guidelines and your ideas about antelope management don't just get involved with livestock. Please try to think about prescribed fire and wildfires as a possible management tool. Tomorrow at your business meeting just give it a few seconds of your thoughts.

COMMENT:

I'm the only representative from the Forest Service. I'd just like to make a comment and give you an example. About six months ago the head of the Wildlife Division for the Forest Service retired. The Chief of the Forest Service felt that service-wide all over the United States, there's a poor relationship between the Forest Service and the State Departments of the Fish & Game. He handpicked _____ _____ who at that time was director of Michigan Dept. of Natural Resources.

He is on a two-year contract to the Forest Service and his specific mission is to improve the relationship between states and the Forest Service. I spent an evening with him about three weeks ago. He's meeting with the State Directors. His intention is to get the proper consideration for wildlife on national forest rangeland.

STATEMENT:

I believe it would be well at these sessions to define those alterations and requirements of pronghorn habitat which could be incorporated into guidelines for habitat protection. We should delineate criteria such as fencing, sagebrush control, water developments, reclamation of disturbed sites, forage allocation procedure, grazing practice, etc. A committee should be formed on each criteria which might be included in the guidelines. The committee should review the current knowledge of the pronghorns' requirements relative to their guideline topic, determing whether their guideline topic can be applied and included as a resolution for adoption by all antelope states, adopt a list of guidelines to be considered when planning programs to alter habitat or pronghorn ranges and present recommendations about the resolutions. These committees or a committee should consist of interagency, interdiscipline, and interstate personnel if at all possible. Final prepared statements from each committee should be presented and reviewed at a special meeting. All resolutions should be presented to each agency, the Federal land management agencies and Environmental Protection Agency for review and comment. If these or other portion of these can and will be adopted by all concerned they should be adopted by the Pronghorn Antelope Committee as guidelines for habitat protection on pronghorn antelope range.

COMMENT:

It's obvious to me at this time that we do need to sit down and recommend procedures to try to reduce conflicts between antelope and livestock. I would like to request that if any of you have specific recommendations related to a specific topic, be it fencing, rest-rotation grazing, any kind of rotational grazing, intensive grazing, water developments, fences, etc. would you please write them down on a piece of paper and give them to me? When we meet tomorrow and try to develop these guidelines, I'll try to have them structured some way so that we can review them and at least leave this conference with something for a committee to work with. I think that we will need an interim committee to develop these guidelines so they will be far enough along to be amended at the next antelope workshop.

PANEL DISCUSSION ON

THE RELATION OF BEHAVIOR TO MANAGEMENT

Summarized by Edson Fichter, Chairman

Preparation for this panel discussion began about five weeks prior to the convening of the Workshop. By mail, the chairman asked members of the panel to inform him of any questions, speculation, and/or findings, however tentative, that they might have regarding the behavior of pronghorns in relation to management. Of 15 comments, suggestions, and questions submitted, including one question from the chairman, 13 were organized into seven more or less discrete subject areas which were then ranked by each panel participant in the order he preferred they be discussed. The resulting "agenda" is given here, following the opening statement, in conformity with the panel's cumulative ranking.

The panel's ethological base, articulated in the course of the discussion, was the principle that behavior is adaptive through time so as to maximize the survival of the species by way of survival of the individual. It was emphasized that the session should be concerned with how we can use behavior as a tool in game management.

Chairman's Opening Statement

At the 30th North American Wildlife Conference in 1965, Stokes and Balph (1965) presented a paper on "The Relation of Animal Behavior to Wildlife Management." Their closing statement (p. 410) was: "We predict that in twenty-five years animal behavior will be as much a part of wildlife management as population ecology is today."

Five years later, at the 11th Symposium of the British Ecological Society, Geist (1971), gave a paper entitled "A Behavioural Approach to the Management of Wild Ungulates." In it he said (p. 413): "Evidently, some very important aspects of animal behavior have not yet fully penetrated circles of professional behaviorists, let alone those of wildlife managers." Geist pointed out (p. 420) that "In the North American conception of wildlife management, the amount of wildlife is primarily related to both the amount of available habitat and the quality of habitat." But, he went on to say (p. 421), "If we are to conserve and manage all ungulate species in the wild state," we must have knowledge, not only of each species' habitat requirements, but also of its total biology, "including its diverse behavioural adaptations."

I suggest that wildlife managers have been using some knowledge of animal behavior all along, although much of the information may have been incidentally or casually secured, was probably superficial, and even erroneous. Now there is increasing evidence of progress. For example:

(1) The same year that Stokes and Balph made their 25-year prediction, the Colorado Department of Game, Fish, and Parks and the Colorado Cooperative Wildlife Research Unit published "A Literature Review of Pronghorn Behavior" by Prenzlow (1965) --

(2) and a year later "A Literature Review on Behavior of Mule Deer" by Dorrance (1966).

(3) Since 1964, at least six numbers of Wildlife Monographs have dealt with behavior or social organization (which is a corollary of social behavior) -- some of them with non-game species (which I think is increasingly appropriate).

(4) In November 1971, an International Symposium on The Behavior of Ungulates and its Relation to Management was held at Calgary. The 2-volume (1974) publication resulting from that meeting contains 56 papers totaling 940 pages. Following are examples of findings or areas of concern elucidated in some of those papers:

(a) "The nature of the social organization" of elephants relative to planned reduction of numbers by cropping (Laws 1974:528).

(b) ". . . the 'carrying capacity' of each habitat type for roan [antelope] is determined primarily by (i) physiognomy [external aspect] and quality of the vegetation and (ii) social spacing . . . " (Joubert 1974:673). (Social spacing is a function of agonistic behavior.)

(c) "A knowledge of the annual cycle of socio-sexual behavior [of impala] suggests some times of year as better than others for cropping . . . obviously not during the calving season, the pre-weaning period, or the rut. Repeated disturbance disrupts normal socializing within a herd, drives animals out of their home ranges, disturbs daily activity patterns, and causes herds to move further and split up" (Jarman and Jarman 1974:880).

(d) In the pronghorn, territorial bucks do most of the breeding -- reported by Bromley and Kitchen (1974:358) and further verified by Kitchen (1974) in Wildlife Monographs No. 38 -- based on studies in Montana and South Dakota.

(5) Kitchen's (1974:78) finding that the zone of a pronghorn buck's territory used most (up to 90%) "always contained the best resources," a fact that lends support to "the observation that pronghorn territories may be placed in relation to local abundance and quality of forage."

Finally -- and this may sound like a pep-talk -- we all have the opportunity (given the right administrative climate), not only to pioneer in research on animal behavior, but to pioneer in the application of the findings of such research to wildlife management. A little over four years ago, at the Calgary symposium, Lent (1974:44) said: "Application of . . . behavioral knowledge to the management of wild species is only beginning."

In this connection, Richard Denney of the Colorado Game, Fish and Parks Department has made an incisive point (one I suspect most wildlifers are aware of): "Research is usually predicated on the needs of management, therefore, by the time that management realizes certain needs for immediate application, research many times produces results in a belated manner. It is for this reason that all research cannot be termed as 'applied,' but demands that a certain amount of 'pure' research be conducted to supply background data to be available at the time it becomes needed" (Dorrance 1966:iv).

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(1) a. To what extent are normal seasonal movements of pronghorns influenced by tradition as opposed to environmental conditions?

b. Can seasonal distribution of pronghorns be significantly influenced by isolated habitat improvements such as areas ungrazed by livestock, fertilized fields, greenfeed, etc.?

c. In cropland areas, where antelope depredation problems occur, would antelope respond to "bait crops"?

d. How do high rates of predation affect the movements and distribution of antelope in various areas -- if at all?

(2) a. How successful are the mother-young behavioral characteristics in reducing neonate mortality?

b. Apparently inadequate defensive behavior by adults in the presence of a high density of coyotes on fawning grounds with sparse hiding cover (4-6-inch grass cover, no browse or tall forb component).

(3) a. Management as it relates to pronghorn behavior and physical obstructions, such as fences, etc.

b. There are indications that antelope may learn, over time, to jump some fences. Perhaps they may, to some extent, adapt to fences.

(4) Is trophy hunting selecting for smaller, less vigorous, and nonterritorial bucks?

(5) Do territorial bucks compete for preferred habitat areas as well as for females?

(6) a. Antelope seem adaptable to human activity and often concentrate near populated rural areas or at the edge of town, making adequate harvest difficult or impossible and unpopular.

b. Can antelope from dominant grassland habitat types and milder climate adapt behaviorally and physiologically to shrub-grassland types and harsher climates?

(7) Has aggressive behavior been noted and/or documented between feral horses and antelope at watering sites on ranges where water availability is low?

Attention to the first of these subject areas occupied virtually all of the time allotted to consideration of the relation of behavior to management. A summary of the two-hour discussion is given below.

CHAIRMAN'S RATIONALE FOR THE SUMMARY FORMAT

Summarizing the tape-recorded discussion, rather than giving a verbatim transcription, seems advisable for the following reasons: (1) Several participants are neither identified nor their voices identifiable; (2) there was considerable reference to diagrams, etc., on the blackboard, in which instances much of the taped dialogue becomes meaningless; (3) there was frequent repetition; (4) many words are unintelligible; (5) some exchanges were not relevant to the subject under consideration; and (6) a complete transcription, typed single-space, would fill 19 pages.

I have tried to avoid letting my own bias color the summary. However, in an effort to help clarify and/or emphasize certain points and to correlate the many views and observations reported, I have added some annotations and questions; such additions are enclosed in brackets. Direct quotations from the tape recording are marked as such. Any errors in transcription, interpretation, or conclusions are exclusively mine.

The addition of references also seems appropriate.

<u>To what extent are normal seasonal movements of pronghorns influenced by tradition as opposed to environmental conditions.</u>

[Migration and tradition.

The terms migration and migratory classically allude to the periodic departure from and return to a given region or area (Cockrum 1955:86). The question first considered by this panel referred to seasonal migrations, i.e., regular seasonal movements between summer range and winter range.

"The distinctive feature of tradition is its dependence on learning by new generations from their predecessors" (Wynne-Edwards 1962:464). Therefore, it appears to be incorrect to characterize a "traditional movement" (migration) as "behaviorally innate"; rather, it is the capacity to learn, and thereby behave traditionally, that is innate. Probably all such learning on the part of young animals is by imitation, sometimes attributed, probably inappropriately, to parental instruction. "Traditions . . . . grow in power with repetition" and "local traditions . . . can survive for hundreds and even thousands of years" (Wynne-Edwards 1962:464). Eisenberg (1972:196) has written of the elephant: "The cow herd in which the young grow up serves as a repository of traditional knowledge vital for survival," including that which makes possible "the seasonal movements."]

Brought into focus by consideration of this question was the fact that seasonal migrations of pronghorns are markedly variable, even locally within what might be looked upon as "a population." [("Normality," in this context, is another variable!) Such findings are in keeping with the view that geographic differences are characteristic of the behavior of pronghorns, and that such differences might more appropriately be labeled ecologic, if for no other reason than that they are expressed in widely separated regions of the species' geographic range (see the Proceedings of the Fifth Antelope States Workshop, p. 223). However, the fact that differences in seasonal moves are found within relatively short distances of each other, as reported below, calls for further refinement

of our view of the variability of behavior.] It also became apparent that certain features of pronghorn groups, e.g., spacing of individuals within a group, the spacing of groups, and group integrity (fidelity of individuals to the group) influence the expression of migration in this species.

Observations on neck-banded pronghorn does in central Montana were reported as showing that herds and doe bands are "traditional social units." [Apparently exclusive in this characterization and the discourse relative to it is the behavioral phenomenon of social attachment or bonding.] Perhaps also functioning here is "fidelity to [an] . . . area" [= "attachment to place" (Mason 1972:384) which is perhaps most dramatically expressed by an animal annually returning to the same breeding area and even site. In the pronghorn this may be expressed by integrated summering groups spending the winter together, then reestablishing their integrity upon returning to summer range. Attachment to place may also account for traditional migratory <u>routes</u>.]

Studies in Alberta have revealed the tendency in pronghorns to form "increased [larger?] social aggregations" at a rather constant time of year. There is also evidence of the animals' being "rather traditional" in annually returning to specific ranges [showing attachment to place?]. However, a number of instances have been noted in which individuals "shifted ranges" by moving permanently from a "sedentary" population, i.e., one whose summer-winter moves are about 4-5 miles in extent, to a migratory population, the seasonal moves of which cover 30 miles or so. [Is this evidence of mature pronghorns learning a "new" tradition? Does such a shift also suggest that attachment to place may at times be overridden by subsequent social attachment? On the other hand, the

presence of apparently nonmigratory individuals in the lower Pahsimeroi valley of Idaho (see below) suggests (a) individual variation in "traditional knowledge" and/or (b) that attachment to place may prevail over social attachment as expressed in following migratory members of wintering groups upvalley in the spring.]

Movements of pronghorns up and down a particular valley that is about 12-14 miles long have been observed in Wyoming. However, the animals move up the valley to winter into a "rolling, break type habitat," and "during the summer they move down onto the open benches above the river." There is "probably . . . not 100 feet difference" in elevation between the two habitats.

Three migratory patterns in Idaho were described:

(1) In the Pahsimeroi River drainage, the pronghorn population that is dispersed throughout all or most of the available range -- as high as 10,000 feet above sea level -- during the summer, is "telescoped" during the winter into the lower two-thirds or so of the valley floor -- about 5000-7000 feet elevation. The longest moves here probably extend at least 10 miles. This pattern of "compression" -- and especially the fact that fawns are dropped in the lower portions of the valley -- strongly suggest that some of the animals not only do not migrate, but are in wintering bands with migratory individuals.

(2) On the basis of marked animals, it is known that most if not all of the pronghorns summering in Copper Basin (high in the Big Lost River drainage) spend much of the winter about 1000 to 2000 feet lower on the southwest side of the valley and about 35 miles down the drainage; however, the migration route, rather than following the loop of the

valley, extends only about 12 miles across foothill country which furnishes continuous pronghorn habitat.

(3) Some of the pronghorns wintering on the Snake River plain summer on the Horse Prairie in Montana. The migration route extends, at most, about 150 miles by way of Birch Creek valley, Gilmore Summit, the upper end of the Lemhi River drainage, Railroad Canyon, and Bannock Pass in the Beaverhead Mountain range.

One of several, current, research projects -- under the aegis of the Idaho National Engineering Laboratory Site Ecology Studies -- may involve some of the pronghorns that participate in this remarkably long migration: With the cooperation of the Idaho Fish and Game Department, Reed Hoskinson, graduate student at the University of Minnesota, has put radio-collars on a considerable number of pronghorns in the Little Lost, Birch Creek, and Crooked Creek drainages. Transmitters will also be placed on neonates at birth sites in the Birch Creek valley. Special attention will be given to various aspects of migration and relevant environmental factors. Findings to date (latter half of February 1976) indicate: (1) There is "mixing among . . . groups" on some winter ranges; the groups "are not spatially isolated." Accompanying these movements of individuals between groups, there are expressed varying degrees of social attachment between [among?] individuals. (Observations on summering pronghorns in the Pahsimeroi valley over the last 20 years have revealed that exchanges of individuals between groups and coalescences and separations of groups are frequent, and suggest that "groups as we generally think of them are pretty fluid," and that "we are dealing with subgroups that are parts of a larger organized [integrated?] combination of individuals." In this connection, it was pointed out that studies in East Africa have

shown that fluidity and intermingling of groups [in part] characterizes the social organization of animals living in open plains.") (2) While what we call subgrouping is occurring in one valley, in the adjacent valley "the antelope that we are following right now are in one large herd" -- about 160 head; they are "always together . . . . never separating into small groups" [subgroups?]. Significant physiological differences between these two populations have been found (see paper by Les Trout, p. 122). The two valleys show "some extreme habitat differences and there are probably some differences in the distances" the animals in the two populations migrate.

CONCLUSIONS

1. It seems clear that:
   a. Tradition and environmental conditions are both involved in the seasonal migrations of pronghorns -- that they are not mutually exclusive, i.e., "opposed," as characterized in the question.
   b. Environmental factors (changes) influence, and perhaps trigger, the traditional moves; the timing of migration is, thereby, a variable.
   c. A seasonal migration, although traditional, may be "conditioned" [modified] by the availability of forage along the route.
   d. Traditional routes are influenced and, in some places, dictated by topography.
2. It is also conceivable that, rather than the act of migration, i.e., making overland moves, being traditional, it is places, i.e., winter and summer ranges and the routes to and from such areas, that are the traditional entities.

3. It is further conceivable that a tradition for migrating can be absent in a given population, as in at least one area in Montana where they "do not have migratory antelope," and even in some individuals of a population.

4. Rather than pronghorns "responding to . . . an instinct to move somewhere," innateness is apparently involved only in their capacity (a) to learn and remember [the neuronal basis of traditions], and (b) to respond to environmental conditions (changes = stimuli), principally weather (atmospheric conditions), snow-depth (a function of weather), and plant phenology. That weather can in and of itself elicit migration in pronghorns is evidenced by movements from winter range onto or toward summer range in response to "a warming trend in the middle of the winter," as reported for one area in Wyoming.

5. The discussion was characterized by considerable speculation [one of the tools of science] and justifiable caution; e.g., "it looks like most of their [migrational] movements are pretty much traditional," "rather traditional," "probably traditional," "it is my feeling," "the antelope do seem to follow . . . the first green-up," "I would assume," "I am not sure," "you might well have an intermediate stage," etc. [In other words, the discussion demonstrated the paucity of reliable data on behavior of pronghorns relative to management of the animals throughout the species' geographic range -- and/or the failure up to this time to recognize such relationships in the information already gathered. The need for long-term, deep-digging research, both "pure" (academic) and "applied," is obvious. Promoting and coordinating such research

and correlating the findings seem to be within the province of the Antelope States Workshop. Promotion in this context will include securing support, both administrative and financial.

Applied ("practical") research must be local, or at least regional, because of variations in the pronghorn's behavior from place to place, but it will require an understanding of some ethological principles and the basic patterns of the animal's complex behavior. The discussion raised many problems that are subject to research.] It was held that, in this context, the objectives of research should be to (1) establish the existence of [describe on the basis of rigorous and systematic observation] a given behavior pattern and (2) try to measure some of the abiotic parameters which correlate with it, to the end that we know what causes the behavior. With predictability thus secured, manipulation of relevant and controllable environmental factors can be undertaken in an effort to "use the behavior" to achieve whatever end is wanted in management, e.g., better distribution or higher reproductive success.

Can seasonal distribution of pronghorns be significantly influenced by isolated habitat improvements such as areas ungrazed by livestock, fertilized fields, greenfeed, etc.?

["Behavior is intrinsic to the ecology of an animal" (Smith 1966:485).] Obviously, behavior develops (phylogenetically and ontogenetically) and takes place in an ecological setting, i.e., a habitat. We cannot alter behavior, but we can alter (manipulate) habitat with a view to allowing, facilitating, increasing, and/or eliciting behavioral responses that may contribute to the improvement of management. [This is in keeping with the objectives of research stated at the end of

the preceding summary.]

Three kinds of vegetational manipulation were briefly considered:

(1) Within an area where the rest-rotation system is being practiced and where pronghorn doe bands show fidelity to an area, a "rest pasture" may not be used by a doe band if it is outside the "doe-band area" [home range?]. Somewhat countering this position was the view that pronghorns are "opportunistic" and that, therefore, "we can influence their movements where they are going to summer and winter" -- that pronghorns "can be moved by vegetative manipulation." These two opinions were perhaps reconciled by the observation that "it takes them [pronghorns] a long time to adjust."

(2) It was suggested that pronghorns can be induced to use a new area for fawning and as summer range in two to three years by reseeding "with high forb content or high vegetative content that antelope prefer."

(3) Where pronghorn does prefer islands of sagebrush for parturition (see paper by Bob Autenrieth, p. 127), such fawning sites ("ideal" in terms of spacing and cover requirements) might be artifically produced by selective clearing. It was speculated that such a clump of vegetation would act as a "releaser [sign stimulus (Klopfer and Hailman 1967:40) might be a more appropriate term] in the absence of any alternatives." This suggestion was tempered by the view that (a) we must keep in mind the [behavioral] "requirement for isolation among the parturient does," and (b) unless large pieces of country were

used (perhaps too large to be practical), the manipulation might result in a concentration of fawning which would be detrimental in terms of predation. [Alcock (1975:313) has written: "When prey are clumped they are often more vulnerable to their enemies than if they are dispersed. . . . This is particularly true of prey that are relatively defenseless against attack . . ."]

The problem of transplanted pronghorns moving out of areas where they are expected to stay was brought up. It was suggested that exploratory behavior might account for such moves, some of which might take the form of dispersal. Exploratory behavior occurs in many kinds of animals and is considered highly important in contributing to survival. [Upon being placed in new surroundings, the individual immediately or very soon moves around in a way that expedites learning about features of the new environment, e.g., hiding places, escape routes, etc. I do not know if pronghorns would ever exhibit exploratory behavior as a group.] The behavioral question raised here concerning pronghorns is somewhat complicated by the fact that some do stay where they are transplanted: of 143 pronghorns trapped in December, half were released in the "northern end of the state" [not identified on tape] and the other half released in a valley located centrally in the state; one "herd dispersed . . . went in all directions," the other "stayed in one close, compact group." The "ecological barriers to dispersal" are "about the same" in the two areas, whereas "habitat and forage situations are considerably different." In the language of the question under discussion: what was, in effect, seasonal distribution of pronghorns may have been influenced by the nature and/or condition of the range in these situations.

Two testimonials on the adaptability of pronghorns were offered: (1) "I think the antelope are very adaptive and I think through habitat manipulation or these types of management practices [reseeding, fencing, etc.] we can change their behavior." (2) "I think these animals are more adaptive than we give them credit for." These statements and relevant dialogue later elicited the following concern: The willingness or hopefulness of some [resource management] agencies "to use the fact that pronghorns or any other wildlife species can adapt to the things [practices?] they are trying to justify on a particular range." Workshop members were urged not to accept adaptiveness as an excuse for justifying practices "that we all know are detrimental to the population on that range at that time."

<u>How do high rates of predation affect the movements and distribution of antelope in various areas -- if at all?</u>

[Because two accounts (from Alberta and Arizona) given in response to the following and last question are somewhat more instructive regarding this question, I have taken the liberty of including them here.]

This question was, in effect, considered in two contexts -- predation on fawns and predation on adults (yearlings and older).

That coyotes prey heavily on pronghorn fawns, under certain circumstances, appears to have been amply demonstrated. For example:

(1) In the early 1950s, an outbreak of rabies in Alberta led to an extensive poisoning campaign which effectively reduced the

numbers of predators. Following that reduction, "previously unreached" high population values were recorded for pronghorns and survival indices were regularly in excess of 100 fawns per 100 does. In the last five years "we have not averaged" 50F/100D "in our Alberta study areas . . . where we have had a significant increase in coyotes at the same time."

(2) Does of the Yellowstone pronghorn herd give birth on "a restricted winter range. . . . they cannot fawn any place else." That range was dominated by big sagebrush 35 years ago but is now grassland because of utilization "by all kinds of big game." The does come through the winter "in fine shape," carrying twins to parturition. "But they lose about 80 per cent of the fawns in the first three weeks" in the presence of a "high coyote population" where "a lot of cover" has been removed by elk. (Concurring with that report is the assertion that, in Idaho, predation on pronghorn fawns by coyotes -- and Golden Eagles -- "could be a significant factor without sufficient fawn concealment".)

(3) In northern Arizona, where there is a relatively high density of coyotes, "one herd" of pronghorns remains at "a relatively low density." During the "period of high vulnerability" of neonates, "there is a high concentration of coyote activity upon this . . . animal with the result that we apparently have a very high impact of the coyote on the antelope herd." That the coyote is, therefore, "a major limiting factor . . . seems to be the situation. With the same behavior, the same habitat, [but] with five or six times more antelope on that same range

(which we used to have 15 or 20 years ago), it is thought the "relative impact" of the coyote "would be totally different."

The following information suggests -- perhaps only tentatively -- that the presence of and/or predation by coyotes can influence the local distribution of pronghorns: When there "were no coyotes" on the National Bison Range, all of the pronghorns there used large, open mesas on the north side of the tract -- the best part of the range as regards soil and vegetation. They would move to the south side, where slopes are steep and the soils thin and rocky, only when there was "quite a heavy snowfall." In relatively recent years, three changes have come about: (1) "Coyotes have built up to pretty good numbers," denning and hunting primarily in the northern portion, (2) the range on the north side is now "almost all bunch grass and few forbs," and (3) about half of the pronghorns now fawn on the south side and spend the entire winter there. One biologist considers the "movement" of the pronghorns a "response to coyote predation"; another feels "that it is a movement in response to range conditions." [If indeed this shift was made in response to predation by coyotes, the question remains as to whether the critical predation pressure was on fawns or on adults.] In this connection, it was stated that, "in the summertime, a coyote poses essentially no threat to a grown antelope," but "in the wintertime . . . . coyotes immediately become a threat" -- [at least in some places.]

The belief was expressed "that originally, predators played a fairly important part in dispersal of individuals or maybe even small micropopulations [groups?] of pronghorns on the local level." Now, as in the Yellowstone example, "emphasis of predation on pronghorns has changed from being a beneficial dispersal mechanism to one" which is "far more

than just a culling mechanism, but is actually a serious threat" because the pronghorns are no longer able to disperse due to restrictive ranges. Today, dispersal -- considered "beneficial to population survival. . . . may or may not be effected, depending on the size of the range available to the [prey] animals. . . . predation would have a detrimental effect on confined populations and could, in fact, easily become a limiting factor to population growth."

How successful are mother-young behavioral characteristics in reducing neonate mortality?

This question calls for a quantitative answer; such data were not offered.

The pronghorn as a species has survived [prehistorically and historically] and, therefore, mother-young behavior must be effective in reducing neonate mortality, "otherwise it would never have become evolved and incorporated into" the behavioral repertoire of the animal. However, maternal defense against a predator is not always successful.

Attention was again drawn to the coyote as one of the predators confronting pronghorns by the following thoughts: Pronghorns probably did not evolve in the immediate presence of the densities of coyotes they now face, but rather with wolves which hunted the prairies while coyotes hunted the river bottoms. Areas with wolf populations generally do not have high coyote populations. The elimination of wolves by the white man allowed coyotes to move onto the pronghorn ranges -- but once the wolves were eliminated, bureaucratic control measures were turned against coyotes which were held at relatively low numbers for a long time. So, prehistorically, pronghorns may never have had to cope with the density of

coyotes confronting them now -- at least, in some places. Furthermore, because wolves hunt in packs, they would have disturbed a pronghorn population far less than the same number of coyotes which typically hunt singly or in pairs and, therefore, more dispersed than wolves over a given area.

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BUSINESS SESSION

0900 26 February, 1976
Robert Autenrieth, Chairman

Voting Delegates

Duane Pyrah, Montana
Edson Fichter, Idaho State Univ.
Bob Sherwood, Idaho
Karl Menzel, Nebraska
Don Beale, Utah
Morley Barrett, Alberta
Don Neff, Arizona
Jim Yoakum, BLM
Robert Hauk, South Dakota
Dave Lockman, Wyoming
Earl Wiltse, Saskatchewan
Bart O'Gara, U.S.F. & W.S.

Others in Attendance

Wayne Anderson, Arizona
Kent Jackson, Arizona
Chuck Jensen, Idaho
ElRoy Taylor, Wyoming

Following is an edited record of the Seventh Workshop Business Meeting. Most of the discussion is included to benefit those states unable to attend.

Autenrieth: After yesterday, there can be no question regarding our mission here this morning. We have been challenged to provide guidelines for pronghorn antelope management. We must establish committees and team leaders for writing all sections of the guidelines.

Before we proceed with the guidelines, we have a few other items of business. I declare our business session officially open for the Seventh Workshop. The Workshop was sanctioned on July 13, 1973, by the Western and our obligation, as Bob Salter indicated in his opening remarks, is to provide a written summary of our Business Sessions with an agenda of our meetings. The next Western Meeting is in July at Sun Valley.

I have a letter from Robert Streeter who is a coal research manager for the Department of Interior, Fish and Wildlife Service, Fort Collins. Excerpts of his letter follow:

"Western coal deposits are primarily in the Northern Great Plains and Rocky Mountain provinces (North and South Dakota, Nebraska, Montana, Wyoming, Idaho, Utah, Colorado, Arizona and New Mexico). The distribution of coal resources is clearly overlain with the distribution of pronghorn antelope. The effects of strip-mining on antelope populations will be two-fold: the direct effects of mining-related activities, and the effects of increased human population pressures on the antelope populations.

The Northern Great Plains Resources Program developed three coal development profiles for energy activities in the Northern Great Plains provinces (North and South Dakota, Nebraska, eastern Montana, northeastern Wyoming, eastern Colorado and northeastern New Mexico). Their estimates were that by the year 2000 the human population of the area would increase by 74,000 to

515,000 persons and from 100,000 to 400,000 acres would be directly affected by coal development, plus an equally substantial area indirectly affected. Over half of that acreage is some of the finest antelope habitat that exists in North America.

It, therefore, seems essential that the biologists responsible for the management and research on the pronghorn antelope immediately organize an effort that will address the cumulative effects, with both regional and local perspectives, of the effects of coal development-related activities on the movements, population productivity, survival, distribution, hunting, demand, etc., on the pronghorn. Realizing that energy development will occur, it is also necessary that post-mining land use planning include stipulation for reclaiming the strip-mine lands for antelope production. This will require further research and management actions to develop and implement stipulations for reshaping the land surface; water developments, revegetation strategies and post-mining management of disturbed lands.

It would seem appropriate that a special working session would be called for prior to the next Biennial Pronghorn Antelope Workshop. The U.S. Fish and Wildlife Service, Western Energy and Land Use Team, would be available to assist in the planning, organization and support of such a working session should the pronghorn antelope workshop attendees vie for such an option."

This is a timely letter and mining impacts should be one of our considerations this morning.

Committee reports: Don Beale, do you have a report on the fencing guidelines?

Beale: As you all know, fencing has been a problem on antelope range for a long time. There has been considerable time, effort and money spent trying to find a solution to problems. We addressed ourselves to this prior to and during the last antelope workshop. About the same time, the BLM called a fencing workshop which was held in Cheyenne, Wyoming, to address the fencing problems on their lands. They called this meeting for input from agencies and the public. We sent our views and representative to the meeting. The BLM now has a new policy on fencing. From our experience and the experiences of other states, there is a favorable response to this policy. It is divided into five sections: planning, coordination, construction, modification and maintenance. Under this policy, all aspects of fencing, fence construction or modification, must be addressed and subject to the Bureau's Planning Process. No fence construction or modification of existing fences will be permitted except in emergency situations until inventories, unit resources analysis, management framework plans and environmental analysis have been made. Each fence project is to be considered on a case-by-case basis. This is important because of how fences affect any antelope herd depends on the situations there, i.e. whether it's summer range, whether it separates habitat use areas in summer and winter, whether it disrupts access to water or whether it is on migration routes. All of these will have an affect on whether that fence will serve livestock needs and still permit the passing of antelope. If the planning process indicates that fencing would adversely affect wildlife, their migrations or result in the loss of other aesthetic values, the following alternatives must be considered: livestock class conversion, adjust-

ment in allotment areas, establishment of dual use common areas, herding, exclusion of domestic livestock entirely, no fence areas, supplemental control of livestock and seasonal use change.

I will not review the whole policy. It is available for anyone who wants it. All agencies should have it. There is a section on coordination that discusses fences along highway right of ways as well as those fences within the livestock units. Under the construction section, a series of fence designs are listed to meet the various needs. The three types include the three strand wire, two top strands being barbed wire and the bottom strand being smooth wire, spaced 16" above the ground, the total height of the fence then being 38". This is considered adequate for holding cattle. For sheep, four strand barbed wire fence is recommended on antelope range. The bottom wire is smooth and 10" above the ground. The top strand is 32" high. Adult antelope are expected to go over or under and fawns would pass underneath. A fence for both cattle and sheep will have four strands of wire. The first strand is smooth wire and 10" above the ground. The top wire is 38" above the ground. During the planning and inventory stages, existing fences requiring modification will be pointed out and brought into line with the recommendations. In our area, particularly the Richfield unit where we have had some fencing problems, 14 miles have already been modified. This is a small amount of fence compared to what may be involved in Wyoming or Montana, but in our area this is a high percentage. As long as we work with the BLM, participate in the planning stage, and get our needs known, we will find this BLM policy definitely beneficial to antelope. If there are any questions, I'll try to answer them.

Jackson: Have you shown these guidelines to the Forest Service and have you had any response to them?

Beale: No, I haven't. We have virtually no forest range in Utah antelope areas. I can only think of two areas and the Forest Service has modified their fences similar to BLM guidelines. Wyoming probably has lots of fences on forest land, doesn't it?

Taylor: Not that directly affects antelope that I know of.

Beale: Maybe someone else can comment on the Forest Service and their policy regarding fencing on antelope habitat.

Autenrieth: We have only directed our efforts toward BLM.

Pyrah: Montana has a fair amount of antelope habitat on Forest Service land and they should be made aware of the fencing guidelines.

Autenrieth: It would be good to have these incorporated in the Forest Service handbooks.

Beale: Forest Service personnel in our state said there may be a policy but they were just modifying fences where there were antelope on their land in accordance with these general designs.

Autenrieth: Is the BLM in any of the states resurveying existing fences to determine if they qualify under the new fencing policy? Do you know anything on that, Jim?

Yoakum: I know several states that began modifying fences last year in connection with these guidelines.

Autenrieth: Is this an ongoing program?

Yoakum: Yes, but it's not going as fast as it should be. Last fall, one outfit really caught the devil because they weren't going as fast as they should. Some areas aren't going as fast as others.

Autenrieth: It seems this is the type of activity that should be encouraged by a resolution from the Western.

Menzel: How about interstate highway fences? Have you had any problems within the state getting adequate passes?

Taylor: I don't think they have modified any highway fences or intend to in the future. The BLM, in some districts, have modified fences and they have plans to do more. What they would like to do is remove fences that divide sheep pastures. As the money becomes available, they will continue to do this.

Menzel: I was thinking of the state itself. We have far less problems with the Forest Service. However, the state is reluctant to make any modifications in fences.

Taylor: I don't think we have asked the state to modify highway fences.

Yoakum: Karl has a good point. I know one state that has what it calls a legal fence for the purpose of holding livestock. It ignores the effects on antelope or other wildlife species. Our group should be on record regarding fencing. It might make some of the policy makers realize they must consider wildlife as well as livestock. In some areas, it is really a problem. They build the fence regardless of the wildlife effects. They are going by the "legal fence" specifications.

Lockman: We don't have any trouble with new fences. But I have never tried to get the highway department to modify fences that are already in. I don't know if that is possible.

Beale: The proceedings of the fencing workshop are probably available aren't they, Jim? Our biggest problem regarding fencing in Utah has been on state lands. Of all publicly owned lands, the state lands in Utah are the worst managed.

Pyrah: I'd like to see a little more discussion on interstate fences. Pronghorns in Idaho are very seriously affected by interstate fences. I am sure that some of those in Wyoming must be affected. What is the attitude of the group? Is there nothing we can do? Livestock are only against those fences for a certain time, but they are the only consideration. Surely there is some kind of compromise we can reach regarding fencing impact. Letting them down or leaving gates open every half mile would allow animals to cross. When we have fences modified for antelope crossing, motorists can be made aware that there may be antelope crossing in the area. The speed limits are down to 55 and the hazards from animals are reduced on the roads. I would like to know if everyone thinks we are in a stalemate? Is it really our business to work for

concessions on these interstate fences?

Sherwood: Have we had any luck in getting an interstate fence modified near Snowville, Utah?

Autenrieth: Yes, we have. It is a problem similar to Duane's except with mule deer. Discussions have lasted several years, regarding overpasses, underpasses and let-down panels. We currently are using let-down panels in one or two areas and the highway department has built deer-proof fence to funnel the migrating deer into these areas. How effective it's been--we are not sure yet.

Sherwood: I know there is a great reluctance by state agencies to make concessions for antelope. Would it carry any weight if we made a push for states to reevaluate present planning steps? Would they accept our imput? If they are going to build a new fence, we should comment on it. They usually go along with us if we have something we can justify. They seem reluctant to consider old fence modifications.

Autenrieth: I think we have been too silent on this matter during the last few years. As Duane points out, with the change in the speed limit, it might be well to reopen the problem.

Sherwood: We've tried underpasses. They don't seem to work. Probably no more than three antelope in the last 18 years have used those underpasses.

Autenrieth: The simplistic approach is let-down panels. Little expense and limited manpower is required for maintenance.

Beale: Motorists' response to signs, in the research I've read and done on this, is not very favorable. We've found very little reduced speed using warning signs. In Colorado, they used the flashing animated sign and got poor results in reducing the motorists' speed and improving the safety of the animal at a crossing. It seems the signs only fulfill an obligation to warn motorists to the hazards. Reducing deer mortality by placing warning signs hasn't shown much promise.

Autenrieth: We have discussed three points on fencing: 1) to reconsider the policy on interstate fences and its effect on migrations of pronghorns, 2) direct the fact that we have guidelines to the Forest Service and to every state land board. Maybe they should be backed by a resolution from the Western supporting the value of the guidelines and recommending acceptance by those agencies, and 3) the BLM, Forest Service and state land boards should reevaluate their existing fences and modify them where a problem exists.

Before we finalize whether we want a resolution, has everyone seen the fencing guidelines we formulated in 1974? Are there any recommendations for changes?

Yoakum: I saw some fence specifications that were being considered in the conference last summer. They put the top wire 42" in height. The top wire is not the most important thing from an antelope standpoint but the guidelines do say that you should make it 32" because there is occasionally an antelope that jumps over. There are photos where antelope have died by

getting caught in the top wire. I suggest we add that the top wire be no higher than necessary, preferably 38" maximum. The tradition was to make that 42" high? There's no basis for it. Every inch that you can get that top wire down, you're saving that many more lives of wildlife.

Autenrieth: I think it would be appropriate, at this time, to recommend a resolution to the Western.

Beale: I think we need something more active than a resolution. What do resolutions do?

Autenrieth: They support the copies we would send to the agencies. Having the sanction of the Western often helps, particularly with Federal Agencies.

Beale: In order to get the highway department's cooperation we need something more active than a resolution. The highway department will not take down panels and put them back again just because you have a resolution.

Autenrieth: It's a starting point.

O'Gara: I think it's going to take some real aggressive person in each state pushing to get something done, but it gives support to have a resolution from the Western.

Taylor: Are you asking for one resolution to cover all areas?

O'Gara: I think the fencing committee is best suited to bring this together. I would like to have this group give the fencing committee the authority to draft a resolution for us.

Yoakum: It seems we are only agency oriented. I know of fences being built on military reservations that affect antelope. I know of fences on refuges that affect antelope. I have a letter from the Mexican government asking for suggestions on fencing. It seems we should be concerned about fencing that affect antelope on all lands. These guidelines should be for any and all, including the Forest Service, BLM, Mexican government, Canadian government or private.

O'Gara: It would probably be best to write a general resolution that would apply to all fencing on antelope ranges including a list of people we feel should get it, including highway departments, state land departments, Forest Service, BLM, etc.

It's good to have a general resolution that fits all cases, but if somebody has a specific problem, and they have a specific resolution dealing with that problem, it would carry more weight than the general one does. There are values to both.

Lockman: Well it is only general in that you don't name specific people it applies to.

Anderson: How can Don or his committee make a resolution when we don't know where the specific problems are right now, whther it will be with the Forest Service or with the State Land Department in Arizona. We can't have a resolution from the Western saying we have a problem here, unless

you want separate resolutions on every possible problem.

Lockman: I think the best way to word it is to designate that all fences on antelope range go under these guidelines.

Autenrieth: The Sage Grouse Guidelines are general as is the resolution from the Western supporting it, but where you don't have better information they are indispensable. The BLM, at least in Idaho, has been including those recommendations into their management plans. However, managing sage grouse requires on the ground analysis of all circumstances.

A general resolution is a starting point. It is not going to answer all our problems. It shows that antelope are recognized as being important and must have consideration.

Jackson: It has been my experience with resolutions that groups, like the Western, carry a lot of weight. They have more impact than just you or me.

Autenrieth: Would you like to recommend a resolution, Kent?

Jackson: I move that the resolution be that all livestock fences within the antelope range conform to the Workshop Guidelines.

Beale: In all the work of the committee, it was almost unanimous that they wanted to stay away from putting out an exact type of fence. Allow the flexibility to have a fence that meets the needs of the particular area.

Pyrah: How about including in this the fact that we don't want a fence that is any more restrictive than our recommendations but certainly may be less restrictive. I personally don't like 16" for the bottom strand of fence. I like 18" and would be more satisfied with 20".

Lockman: You should also speak to reevaluation of the current fencing within antelope range.

Beale: As far as policy on fencing, the one the Bureau has out is the best of anything I've seen and I think it considers all the values. You see, it doesn't say there has to be a fence at all. If the aesthetic values are great, a no fence alternative will be considered.

Autenrieth: Paraphrasing the resolution, we will accept the Antelope Fencing Workshop Guidelines and include our management guidelines with a paragraph regarding reevaluating of existing fences on all public, private and state lands. Is this correct? Do we have a second on this motion? Karl Menzel seconded it. Further discussion?

Lockman: Will we still have the fencing committee retain the responsibility for rewording this resolution?

Autenrieth: Before voting, we should reestablish the fence committee members. It was a 1974 committee with Don Beale, Chairman, and ElRoy Taylor

myself, Buck Compton from Montana and Jim Johnson from New Mexico as committee members. Are there any comments or suggestions on the committee? All those in favor of accepting the fencing committee as it is, signify by saying aye. Opposed? We have the fence committee reestablished. Are we ready for the question on the resolution? All those in favor of the resolution as stated and amended, signify by saying aye. Opposed? The resolution passed. The Fence Committee will draft the resolution for consideration of the Western.

Do you all have a copy of the by-laws? They were revised following the meeting in Salt Lake but in a minor way. Are there any comments on the revision?

I tried to follow the by-laws as closely as possible for this meeting, including the invitations. The initial announcements were sent to everybody on the list. Those that aren't here are those who chose not to be. The mailing list included over 100 different addresses. I move we once again accept the by-laws as revised in June, 1974. Do we have a second?

Yoakum: I'll second it.

Autenrieth: I have a second from Jim Yoakum. Any discussion on accepting these by-laws as they are? All in favor, signify by saying aye. Opposition? The ayes have it.

The floor is open for the topic of inviting other groups to our meetings.

Pyrah: I wonder if it would be a more reasonable approach to invite others to participate in our next workshop. It would give us the benefit of their position and make them aware they are a part of antelope management.

Autenrieth: Your proposal would allow for invitations to these groups rather than have them as official members of our organization.

Barrett: What types of groups did you have in mind?

Pyrah: Wool growers or cattlemen.

Taylor: We are talking about inviting them to our workshop as participants. Yet, the goal of the workshop as stated in the by-laws is to provide information on antelope management. I think it is good to invite them for mutual information, but we can over do it in a hurry. We must not end up with so many special interest groups that we loose the workshop objectives of sharing and assimilating information gained by our scientific research. The primary goal of the workshop is not public relations.

Autenrieth: I agree with ElRoy. The workshop should maintain a blinders-eye view for the pronghorns' best interest and present the strongest statements necessary for the best management of the species.

Beale: We should have representatives from the National Cattlemen's Assoc., the Wool Growers, and the National Wildlife Federation. I don't think they should be voting representatives.

Taylor: The purpose of our workshop is to get something done. I would even like to restrict our workshop. I think we must have people who are actively doing research or working with antelope. Assembling the information can be a separate vehicle. It is not a part of the workshop process.

Autenrieth: Thinking back over the comments and observations we have made as a group in the last two days, I suspect we would have further alienated other groups by their attendance at our meeting. I think we would talk less freely. It is tremendously important that we speak our mind without concern for alienating other interest groups.

Fichter: I agree with that point of view. Basically, I don't like the idea of exclusiveness but I think we should keep this situation as pure as possible. It is primarily a workshop. Bob has made a good point here about speaking freely. I think it would cramp your style.

Autenrieth: Maybe we should work toward further dissemination of information to these groups.

Fichter: Public relations come under the individual worker in the field who is part of the workshop or who receives assembled material. I would hate to see this orgainzation become a PR group.

Beale: Whether we have the men working on antelope at the workshop is going to be a function of the chairman of that particular workshop. By swinging toward state representatives, we get away from those who are doing the work attending the meeting.

Autenrieth: Voting delegates provide continuity. The idea of sending a person to the workshop because he has not previously attended seems to be a problem. This is not to imply we don't want new people. Certainly we do and particularly those involved in research and management. We also need state representatives who have attended prior workshops and have a feel for past problems. We need their past experience.

Beale: I think you can have the best of both with the Chairman bringing in those doing research.

Autenrieth: We really don't have a problem, do we?

Beale: We haven't, but I have seen it in the Interstate Workshop and it could arise here.

Autenrieth: The way our by-laws read, we will go both routes.

Yoakum: We should, at least, send a copy of the transactions to the various organizations.

Fichter: If you want to make that a motion, I will second it.

Yoakum: I so move.

Autenrieth: This will come under Section E in the By-laws--the mailing list of the pronghorn antelope workshop shall be . . .

Is there further discussion of who should be included, We have Wool Growers, Range Society, National Wildlife Federation, Sierra Club, National Cattlemen's Assoc., and Library Reference Service.

Taylor: I am in favor of disseminating what we do here. I just wonder what the best vehicle is for us to do that.

Anderson: It might be best to consult with the Western Association regarding this matter.

Yoakum: It does not have to be the Proceedings. We could have a news release. We need to communicate to others than just ourselves.

Autenrieth: We need the backing of the Workshop but the implementation must be through the individual.

Yoakum: The professional societies should all receive a copy of the Proceedings and the Wildlife Society news letter should receive notice of our publication to include in their list of new literature.

Taylor: We are in general agreement about the need. Maybe two or three people should have a PR responsibility.

Autenrieth: This could easily be done by the Workshop Chairman.

Yoakum: I move the Chairman consider an appropriate means of communicating with various other groups regarding the results of our meeting.

Fichter: I second the motion.

Autenrieth: Is there any further discussion? All those in favor say aye. Those opposed? The motion passes.

Before we discuss management guidelines, is there any other business?

Beale: Are we going to keep the By-Laws Committee active?

Autenrieth: It seems to me, the state representatives should compose the By-Laws Committee. We will provide the opportunity for amendments from session to session. The Chairman would establish a committee if he feels the need.

Following is a list of topics Workshop participants felt should be included in the Pronghorn Antelope Management Guidelines: exchange sheep use for cattle use on antelope range, predator control policy and off-road vehicles during hunting season.

Yoakum: Following is a comment I received. "Be sure to stress the urgency of BLM's need for antelope-livestock habitat recommendations for implementations into AMP's. For example the Boise, Idaho district will be required to develop 30 plans covering 3.5 million acres between now and the next antelope workshop in 1978. It is extremely important that state Fish and Game Departments realize that they might consider our AMP effort of

highest priority and imput would bring them greater benefits than any other activity."

I don't know if the group realizes that the BLM is under a court order stating in so many years it has to do so much work. BLM is going through E.I.S.'s and they need our imput. The point is, two years from now we will have missed many opportunities. I encourage this group to provide guidelines for all agencies.

Beale: We need guidelines now, not two years from now.

Autenrieth: The voting delegates we have now will continue until the next workshop. Following topics writing, we can send out copies to delegates for approval. It is feasible to distribute guidelines long before the next workshop if you are willing to provide the time and effort. We will assign the topics to the experts we agree on today and set a six month deadline. The rough draft will be sent to voting delegates for their review. A revised copy will then be sent for final approval.

The following assignments were made:

Introduction and History:

Jim Yoakum
Bureau of Land Management
Nevada State Office
Room 3008 Federal Building
300 Booth Street
Reno, Nevada 89502

Life History and Current Knowledge:

Bart O'Gara (Team Leader)
Montana Coop. Wildlife Research Unit
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Route 6
Missoula, Montana 59801

Morley Barrett
Dept. of Zoology
University of Alberta
Edmonton, Alberta
Canada

Behavior and Management:

Edson Fichter (Team Leader)
Idaho State University
Department of Biology
Pocatello, Idaho 83209

C. David Simpson
Texas Tech. University
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Lubbuck, Texas 79409

Robert Autenrieth
Idaho Dept. of Fish and Game
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Jerome, Idaho 83338

Livestock Management on Pronghorn Range:

ElRoy Taylor (Team Leader)
Wyoming Game and Fish Dept.
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Duane Pyrah
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Bureau of Land Management
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Bob Sherwood
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Idaho Falls, Idaho 83401

Predators:

Wayne A. Anderson (Team Leader)
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Flagstaff, Arizona 86001

Don Beale
Utah Wildlife Resources
P. O. Box 606
Cedar City, Utah 84702

Mining:

Bob Streeter
U. S. F. & W. S.
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Fort Collins, Colorado 80521

Dave Lockman (Team Leader)
Wyoming Game and Fish Dept.
180 West Flaming Gorge
Green River, Wyoming 82935

Roger Wilson
Wyoming Game and Fish Dept.
307 West Mountain View Drive
Sheridan, Wyoming 82801

Fencing:

Don Beale (Chairman Fence Committee)
Utah Wildlife Resources
P. O. Box 606
Cedar City, Utah 84702

Off-Road Vehicles:

Kent Jackson
Arizona Game and Fish Dept.
1709 Atlantic Avenue
Kingman, Arizona 86401

Autenrieth: the next item of business is appointing a new host state or province for the 8th Biennial Pronghorn Antelope Workshop in 1978. Those states and provinces who have not hosted a Workshop are: Alberta, Arizona, California, Kansas, Mexico, Nevada, North Dakota, Oregon, Saskatchewan, South Dakota, Texas, and Washington.

Morley Barrett of Alberta agreed to accept Chairmanship of the next workshop. Wyoming volunteered as alternate host. The group indicated a winter meeting would be easiest for all to attend.

The business session adjourned at 11:15 am.

RESOLUTION NO: _____

FENCE CONSTRUCTION ON RANGE LANDS USED BY PRONGHORN ANTELOPE

WHEREAS, considerable research has shown that many types of livestock fencing used on pronghorn antelope range are detrimental to the movement of pronghorns; and

WHEREAS, additional research has shown that fences can be designed to adequately control livestock and still permit the passage of all age classes of pronghorn antelope; and

WHEREAS, some state and federal public land management agencies have not in the past adequately considered the requirements of pronghorns when implementing fence construction,

NOW, THEREFORE, BE IT RESOLVED, that the Western Association of Game and Fish Commissioners urge all state and federal public land management agencies and state highway departments to include pronghorn antelope in their land use plans where suitable habitat occurs; and where fencing is deemed necessary, that it be constructed in accordance with the guidelines established by the Regional Fencing Workshop held in Cheyenne, Wyoming on March 22-23, 1974.