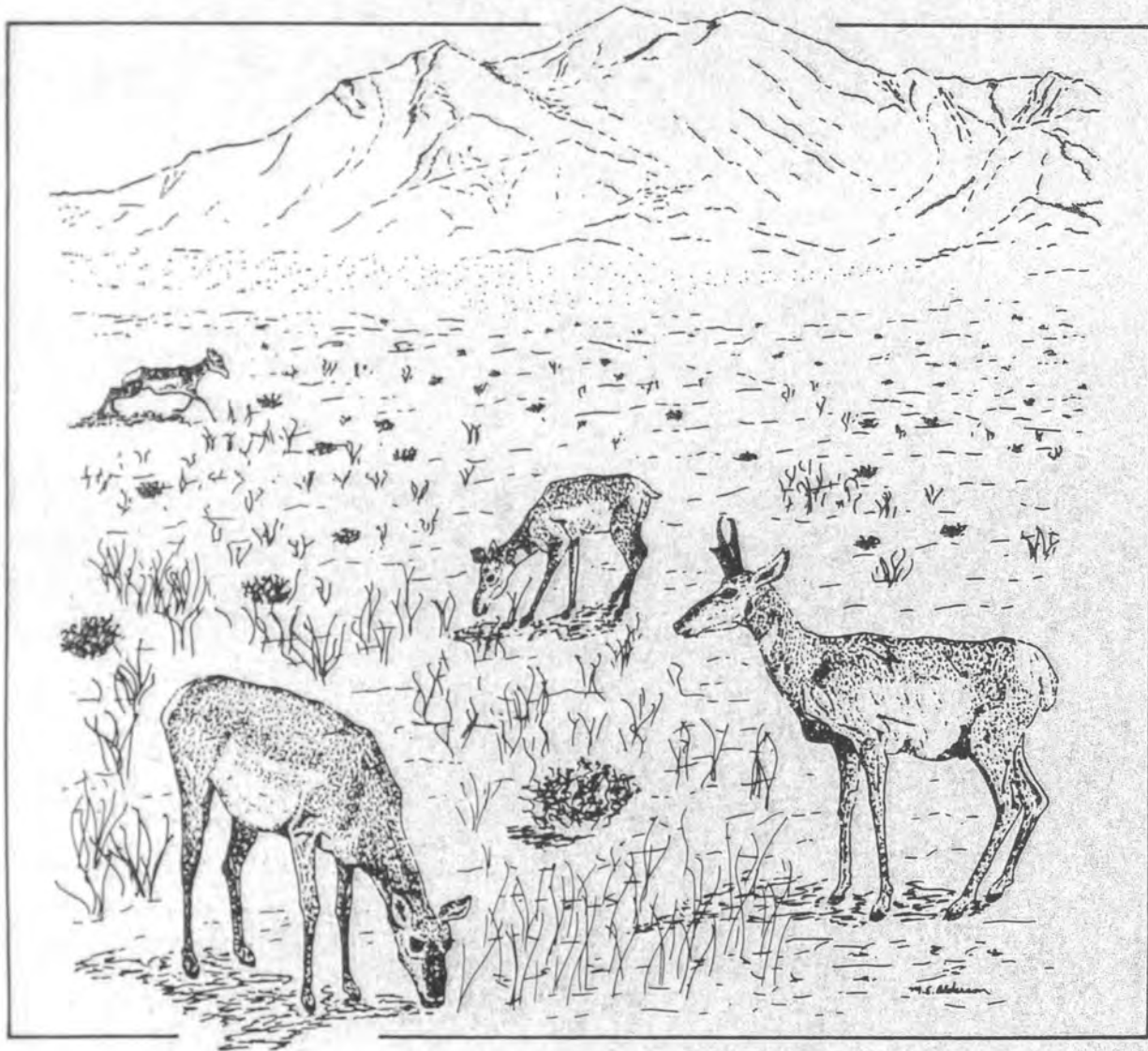


Proceedings of the Ninth Biennial Pronghorn Antelope Workshop



April 7-10, 1980 Rio Rico, Arizona



PROCEEDINGS
of the
NINTH PRONGHORN ANTELOPE WORKSHOP

RIO RICO, ARIZONA, U.S.A.

April 8-10, 1980

CHAIRMAN
JOHN S. PHELPS

PREFACE

The Ninth Biennial Pronghorn Antelope Workshop was held at Rio Rico, Arizona on April 8-10, 1980. The Workshop was hosted by the Arizona Game and Fish Department.

Sixty-four delegates participated in the Workshop. All states or provinces containing pronghorn antelope submitted status reports. Mexico also submitted a status report for the 3 native populations of pronghorn antelope occurring in Mexico.

All technical session papers presented are included and 1 paper submitted without a presenter is also included. As all papers were retyped, the Workshop Chairman accepts responsibility for typographical errors and omissions.

The business meeting resulted in amendment of the By-Laws, which are included as amended. Follow up, resulting from discussion of the business meeting, has resulted in the establishment of a source for papers contained in past Workshop proceedings. Complete details follow the amended By-Laws.

The State of North Dakota has agreed to host the Tenth Biennial Pronghorn Antelope Workshop in 1982.

John S. Phelps

Workshop Chairman

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ORGANIZATION and FUNCTION
of the
PRONGHORN ANTELOPE WORKSHOP
BY-LAWS

I. Designation

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

II. Goal

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

III. Objectives

- A. To provide an opportunity for all persons interested in pronghorn antelope to meet and discuss current research and management of the species and its habitat.
- B. To provide a vehicle for disseminating research and management findings to the various agencies and organizations concerned with pronghorn antelope management.
- C. To promote species-oriented research for development of new information on all aspects of pronghorn antelope ecology, life history, and management on western ranges.
- D. To identify particular problems associated with pronghorn antelope management and to formulate recommendations and resolutions directed to the appropriate agency or organization including the Western Association of State Game and Fish Commissioners.
- E. To promote cooperation among all agencies and organizations concerned with pronghorn antelope management and research, particularly among the various provincial, state, and federal agencies with the primary responsibilities of managing this species and its habitat.

IV. Organization

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

B. Voting

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

1. State, provinces, and countries.

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

2. Federal Agencies.

Bureau of Land Management, Forest Service, Soil Conservation Service, U. S. Fish and Wildlife Service, National Park Service, Parks Canada, and the Dirección General de Fauna Silvestre.

3. Universities and Colleges.

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

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

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

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

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

1. To serve as chairman for the two year period following his appointment.
2. To call for papers and prepare an agenda for the Workshop and assemble and distribute any recommendations or resolutions made or passed at the Workshop.
3. To prepare and distribute the transactions of the Pronghorn Antelope Workshop for which he has been responsible.
4. To organize and conduct the meeting and business of the Workshop.

5. To appoint committees as necessary.
 6. To maintain the goals and objectives of the Workshop.
 7. To prepare and make a formal report to the Western Association of State Game and Fish Commissioners.
- D. The new host state, province, or country shall be selected and announced at the business meeting of the Workshop. It is the intent of the Workshop that host state, province, or country will be volunteered on a rotating basis among the actively participating member states, provinces, and countries.
- E. The mailing list of the Pronghorn Antelope Workshop shall be:
1. The Western Association of State Game and Fish Commissioners.
 2. The Director and Game Chief of every member state, province, and country.
 3. All biologists known to be conducting antelope research.
 4. All state BLM offices and BLM Regional Service Centers in the western United States.
 5. All Regional Forest Offices of the western United States.
 6. All regional offices of the U.S. F. & W.S. in the western United States.
 7. All regional offices of the S.C.S. in the western United States.
 8. All Cooperative Wildlife Research Units in the western United States.
 9. All persons attending the Workshop.
 10. Any person or organization requesting a copy of the Proceedings.
- F. The chairman shall forward the mailing list and any other pertinent material to the new Workshop chairman upon completion of his responsibilities as chairman of the current Workshop.

As amended April 10, 1980 at Rio Rico, Arizona.

The Denver Wildlife Research Center Library,
U. S. Fish and Wildlife Service, has a complete set
of Antelope Workshop proceedings. Anyone wishing to
borrow all or part of the set must have his/her
library request the materials through inter-library
loan. Any library can provide this service, so if
there is no research library available, you may use
whatever library is convenient. The loan period
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Summary of Pronghorn Workshops held to date.

MEETING DATES AND LOCATIONS	NUMBER ATTENDEES	PROCEEDINGS	CHAIRMAN	HOST AGENCY
April 14-15, 1965 Santa Fe, New Mexico	18	1st Proceedings 103 pages	W. Huey	New Mexico Department Fish and Game
February 16-17, 1966 Denver, Colorado	32	2nd Proceedings 85 pages	G. D. Bear	Colorado Game, Fish and Parks Department
February 5-6, 1968 Casper, Wyoming	97	3rd Proceedings 117 pages	J. L. Newman	Wyoming Game and Fish Commission
January 27-28, 1970 Scottsbluff, Nebraska	85	4th Proceedings 139 pages	K. E. Menzel	Nebraska Game and Parks Commission
June 19-22, 1972 Billings, Montana	85	5th Proceedings 293 pages	O. V. Compton	Montana Fish and Game Department
February 19-21, 1974 Salt Lake City, Utah	52	6th Proceedings 183 pages	D. M. Beale	Utah Division of Wildlife Resources
February 24-26, 1976 Twin Falls, Idaho	68	7th Proceedings 222 pages	R. Authenrieth	Idaho Department Fish and Game
May 2-4, 1978 Jasper, Alberta	84	8th Proceedings 532 pages	M. W. Barrett	Alberta Fish and Wildlife Division
April 8-10, 1980 Rio Rico, Arizona	64	9th Proceedings 294 pages	J. S. Phelps	Arizona Game and Fish Department

PROVINCIAL AND STATE REPORTS

ALBERTA PROVINCIAL REPORT

MORLEY W. BARRETT, Alberta Environmental Centre, Vegreville, Alberta

1. The 1979 population estimate for Alberta was 15,500 antelope.
2. Major changes in habitat or population status.

The extremely severe winter of 1977-78 resulted in both extensive mortality of pronghorns over most of their range and abnormal winter distribution. The July 1978 survey estimated the population at 11,000 animals, down from the 18,000 estimated in 1977. Winter mortality in some areas reached 50-65%. Winter surveys indicated that upwards of 60% of the animals were located off their normal winter ranges. The 1979 summer population was estimated at 15,500 antelope. Fawn recruitment was abnormally high (93 fawns per 100 does compared to 71 fawns per 100 does for 1978). Pronghorn populations in the northern half of pronghorn range more than doubled and in certain areas increased 3 to 4 times. It is speculated that such increases were the result of:

- a. Movement of pronghorns back into normal ranges following the extensive dispersal of animals during the previous winter.
 - b. Dry range conditions in 1979 which concentrated pronghorns near prairie sloughs and thus made the animals more easily observed.
 - c. Above average survival of pronghorn following the winter of 1977-78.
3. Hunting season dates and estimated harvest.

In 1978, 1,000 permits were issued for a 6-day hunt beginning the last week of October. Hunters were restricted to trophy bucks only (minimum horn size 12.5 cm or 5 ins.). The hunter success rate was estimated at 67%. In 1979, 1,200 trophy buck permits were issued for a 6-day season beginning the last week in October. Hunter success for the 1979 season was estimated at 85%. Buck populations in certain areas had not recovered from mortality experienced in the winter of 1977-78. Buck ratios in some zones in 1979 were 30 bucks/100 does; down from the 9-year average of 50. The 1979-80 winter has been exceptionally mild and this coming fall we expect to issue female permits in addition to trophy buck permits for most hunting areas. There is currently no archery season for pronghorns.

4. Research Programs

- a. There is no ongoing field research program on pronghorns in Alberta. Current emphasis is on data analysis and completion of reports on research conducted between 1970 and 1978.

ARIZONA STATE REPORT

JOHN O'NEIL, Arizona Game and Fish Department, Pinetop, Arizona

Arizona's antelope population is estimated at roughly 8,000 animals, the majority of which are located in north-central Arizona. Of this number, approximately 150 are of the Sonoran subspecies, and found along the Mexican border west of Ajo. A few antelope of the Mexicana subspecies are believed to be present on the eastern and western borders of the state.

In general, the state antelope population is believed to be on a slight downward trend, mainly as a result of past and present overgrazing of the ranges by livestock, heavy fawn predation by coyotes, and habitat degradation by energy developments and rural subdivision expansion. Most of the major antelope herds in the Little Colorado River Basin have not recovered from the decimating winter of 1967-68, having been suppressed in a large part by these factors.

The 1980 general antelope proposed season dates are from September 26 to the 28, 1980, although several hunt areas will be open for an additional 3 days. Hunter success during the past 2 years has averaged about 50% with a little over 400 antelope harvested.

Five archery antelope seasons have been recommended for 1980, 4 buck only hunts and 1 combined unit any antelope hunt. Hunter success for the past 2 archery seasons has averaged 10%, with 13 and 19 antelope taken respectively. The 1980 harvest for firearms and archery is not expected to differ significantly from those of the previous 2 years.

Arizona has an antelope fawn survival research study ongoing near Flagstaff, which will be discussed in depth later during the program by Don Neff.

Arizona's management strategies concerning antelope basically involve a short range goal of increasing fawn survival by reducing local coyote populations immediately prior to and during the fawn drop, and a longer range program of improving antelope habitat. Antelope reintroductions, such as the Arizona Strip project, to be presented later, are also part of the strategy.

The Arizona Game and Fish Department has sponsored a bill in the Arizona Legislature which would allow the taking of coyotes from aircraft, giving the Department the most effective means at hand to efficiently and timely remove coyotes in problem antelope areas. Passage of the bill appears good.

CALIFORNIA STATE REPORT

DOUGLAS J. THAYER, California Department of Game and Fish

1. Herd Surveys

a. Annual Census

The northeastern California annual aerial census of antelope was conducted January 20, 21, 22, and 23, 1980. Winter ranges were snow free, with a few minor exceptions. Counting conditions were excellent, with very little interference from cloud cover or haze. Antelope were well scattered on winter ranges in numerous groups. Good coverage of all winter ranges was achieved.

Six thousand nine hundred ten (6,910) antelope were counted in the basic California population. The 1980 count is the highest on record and is 1,812 animals or 36% higher than the 1979 count. The 1980 population is 5,130 animals or 288% higher than the low of 1,780 antelope in the 1960 census. The 1980 count is 1,939 animals or 39% higher than the previous 5-year average of 4,971 antelope.

b. Buck-Doe Ratio

The annual aerial herd composition survey in northeastern California was conducted on July 23, 24, 25, 26, and 27, 1979. Survey techniques were basically the same as used in past years. A modified sampling method which eliminates specified locations that consistently show low or zero counts was again used in 1979 (see 1977 report). This method was used in 1977 and 1978.

During the 1979 survey 3,024 antelope were classified. The buck ratio was 29 bucks per 100 does. This ratio was down 3 bucks per 100 does from the 1978 ration and is 1 buck per 100 does above the previous 5-year average ratio.

c. Production

The 1979 kid ratio, obtained during the summer herd composition counts, was 37 kids per 100 does. This ratio was down 2 kids per 100 does below the 1978 count and 6 kids per 100 does below the previous 5-year average. The 1979 kid ratio is the lowest on record for California. This was the third consecutive year of very low kid production. Kid production has been declining or low since 1975.

d. Harvest

The sixteenth consecutive hunt was held in northeastern California from August 25 through September 3, 1979. Three hundred seventy four permits were issued on a statewide drawing basis. Adult bucks only were legal. Permit fee was \$35. The hunt area was again divided into 7 zones. All hunters were required to report on the success of their hunt through the tag and report card system.

Hunters reported taking 329 antelope for a success ratio of 88%. The hunter success ratio for 1979 was the same as occurred in 1978 which was the highest recorded for California. Hunter success has averaged 80% for the previous 5 years.

The percent of yearlings in the kill decreased from 22% in 1978 to 2% in 1979. During the previous 12 hunts the percent of yearlings in the kill ranged from 12 to 36%. The percent of 4 years and older age class animals in the 1979 kill was 47%. This was up from the 31% recorded in 1978 and was just below the record 48% recorded in 1976.

The ninth annual hunter orientation session was held in Alturas the day before the hunt began. There were 180 people in attendance. Of these, 99 were permit holders. The 99 permit holders represent 26% of the hunters. Attendance at the session is on a voluntary basis.

During the past 16 years, California has issued 5,099 antelope permits. Hunters have taken 3,913 antelope for a success ratio of 77%. Antelope numbers are 164% higher than they were in 1964 when the series of hunts began.

The California Department of Fish and Game has requested a special antelope hunt for 1980. The request calls for 450 adult male antelope permits and 20 doe permits. The doe permits are being requested as a means of relieving a depredation problem.

2. Range Surveys

a. Weather Conditions

Seasonal precipitation for 1978-79 was below normal. Summer water supplies were good. Seasonal precipitation through February 1980 is above normal for the first time in several years.

b. Range Modification

None specifically for antelope. Lot splitting on antelope range is a problem.

c. Range Conditions

Spring rains in 1979 produced excellent forage growth.

3. Miscellaneous

a. Disease

No disease outbreaks were reported in 1979.

b. Tagging and Marking

No tagging and marking programs were conducted in 1979.

4. Summary

The 1980 census showed the basic California antelope population to be 6,910. This count is the highest on record for California and is 1,812 animals or 36% higher than the 1979 count. California antelope population has increased 288% since 1960.

The 1979 buck ratio was 29 bucks per 100 does. This was down 3 bucks per 100 does from 1978, but was 1 buck per 100 does higher than the previous 5-year average.

The 1979 kid ratio was 37 kids per 100 does, down 2 kids per 100 does below the 1978 ratio and down 6 kids per 100 does below the previous 5-year average. This was the third consecutive year of very low kid production. Kid production has been low or declining since 1975.

The sixteenth consecutive hunt was held in 1979. Three hundred seventy four were issued. Hunters reported killing 329 antelope for a success ratio of 88%. Hunter success average 80% for the previous 5 years.

Range conditions for 1979 were considered excellent despite below normal seasonal precipitation.

TABLE I

*Winter Aerial Census in Northeastern California

Year	Total Counted	**Erratic Winter Population	Basic California Populations
1975	4,109	0	4,109
1976	4,987	118	4,869
1977	4,908	0	4,908
1978	5,872	0	5,872
1979	5,098	Not Counted	5,098
1980	6,910	0	6,910

*See 1977 report for years prior to 1975.

**Erratic winter populations occupying interstate ranges east of the Warner Mountains subtracted from total, leaves the basic California population.

TABLE II

*Antelope Herd Composition Summary

Year	Population	Ratio Bucks:Does:Kids			No. Classified
1974	4,747	34	100	42	2,769
1975	4,109	26	100	41	2,711
1976	4,869	28	100	51	2,844
1977	4,908	26	100	48	2,886
1978	5,872	29	100	38	2,873
1979	5,098	32	100	39	2,557

*See 1977 report for years prior to 1974.

TABLE III

*Buck Antelope Kill by Season

Year	Permits Issued	Reported Kill	Hunter Success Ratio
1974	410	284	.69
1975	225	170	.76
1976	375	306	.82
1977	325	271	.83
1978	400	352	.88
1979	374	329	.88

*See 1977 report for years prior to 1974.

COLORADO STATE REPORT

THOMAS POJAR, Colorado Division of Wildlife, Ft. Collins, Colorado

The post season 1979 population estimate of pronghorn antelope in Colorado was 33,100. This estimate is derived from our computer population simulations which are based on herd structure, trend count and harvest data. The state is divided into 4 administrative regions and the number of pronghorn in each region are as follows: NE, 9,930; SE, 12,144; SW, 1,831; and NW, 9,195. Some trends are evident in the observed fawn:doe ratios of the 4 regions. The NW has remained high in recent years, the NE stable, but low, the SW shows an increase; the SE generally shows a decline (Fig. 1) with 1 SE population in particular exhibiting a rather steep decline in recent years (Fig. 2).

All permits to hunt pronghorn with a rifle are limited. In 1979 there were 21,787 applicants for the 6,199 licenses available. The total rifle harvest was estimated to be 4,696 based on a 50% sample of the license holders. The rifle hunters success rate was 75.7%. The success rate of archery hunters is generally in the range of 15 to 20%.

Population modeling is playing an ever increasing role in pronghorn management. Not only is it used to explore management possibilities in terms of numbers of permits issued but it has also been used to evaluate the effects of trapping and transplant operations.

Colorado has just initiated a pronghorn research project. It is designed to investigate low and declining reproductive rates. Some topics that will be approached during the study area are: nutrition, disease, genetics, hunting disturbance during the rut, and predation.

The incidence of Leptospira hardjo in pronghorn antelope populations is monitored by collecting blood samples from hunter-killed animals. In 1979 blood collection kits were sent to 5,510 hunters. Of the samples tested, 9.54% were positive for Leptospira hardjo with the heaviest concentration in the southeast region, followed by the northwest, northeast, and southwest regions respectively (State-Federal Brucellosis Laboratory, Colorado Department of Agriculture, 2331 West 31st Avenue, Denver, CO 82011).

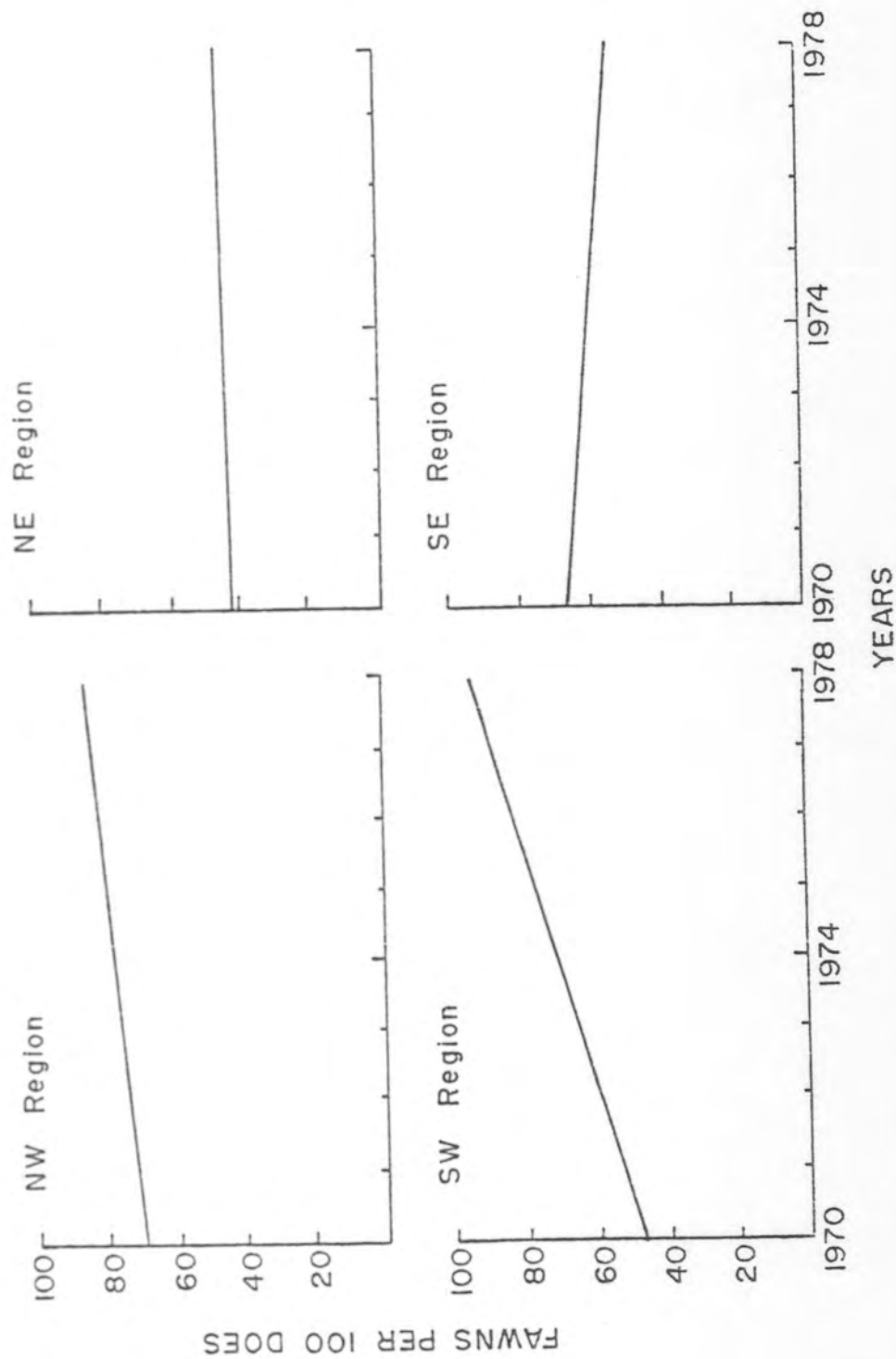


Fig. 1. Fawn:doe ratio trends of the 4 regions of Colorado.

THATCHER - SE REGION

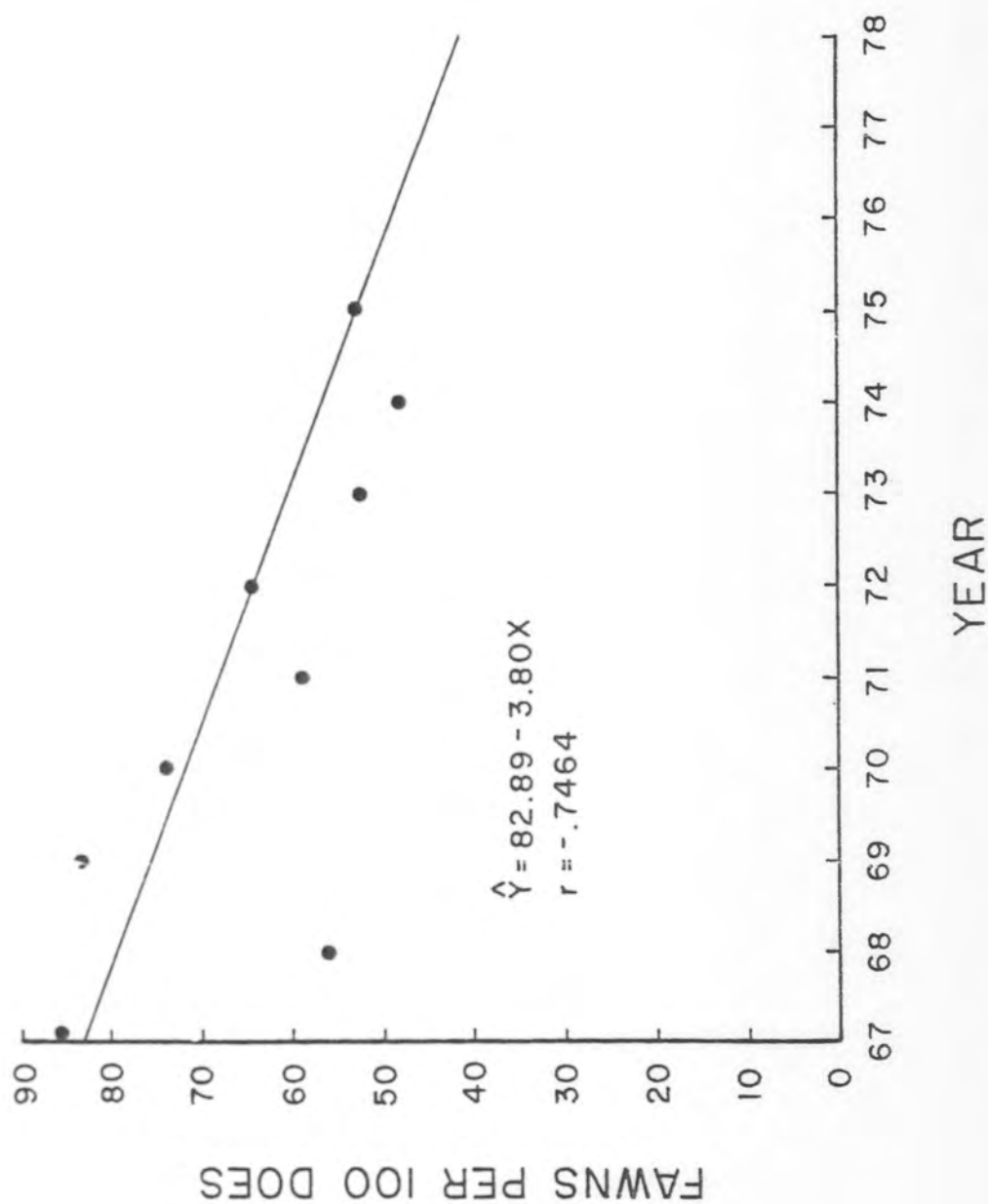


Fig. 2. Fawn:doe ratio trend of the Thatcher pronghorn population in Southeastern Colorado.

IDAHO STATE REPORT

ROBERT AUTENRIETH, Idaho Department of Fish and Game, Jerome, Idaho

Most Idaho antelope populations are stable or increasing with an estimated 15,000 pronghorns found in the state. This estimate is 5,000 more than 10 years ago. A relatively conservative harvest is allowing populations to increase as provided for in the Management Plans. A total of 1,500 to 1,800 center fire permits are issued and 200 muzzleloader only. The controlled hunt season opens the third weekend in September and closes 16 days later. In addition, a general archery season runs from early August (5 units) or September to mid-September in 11 of the 28 units. In 1979 there were 25,071 applicants for the 1,745 permits. The Commission has indicated we will soon go to an application system similar to that in Wyoming where the permit fee will be required with all controlled hunt applications. It is felt the number of applications will decline by 50% compared with our current free application system.

Harvest success was 67% in 1978. Buck harvest was 70%. In addition, 44 antelope were taken by 1,019 archers with a 55% buck harvest.

Based on the new data currently being presented by graduate student Gary Copeland, we are considering delaying the center fire hunt until after the rut. Hunter related harassment and the removal of territorial bucks prior to breeding may be important in the long-term welfare of pronghorn populations. Other findings of Copeland's 3-year study indicate importance of antelope-livestock competition and disruption of summer distribution caused by turning-off BLM water sources.

A post-doctorate research study is in the completion stage on the Idaho National Engineering Lab site west of Idaho Falls. Tim Reynolds has been documenting antelope migration routes and winter habitat use on the INEL. Recent publications based on INEL and Fish and Game research include: Metabolic Indicators of Habitat Condition and Capture Stress in Pronghorns, Migration Behavior of Pronghorn Antelope in Southeastern Idaho, A Seroepidemiologic Survey of Three Southeastern Idaho Pronghorn Populations, 1975-1977, Plutonium in Pronghorn Antelope Lungs Near a Nuclear Fuel Reprocessing Plant, Iodine-131 Concentrations in Air, Milk, and Antelope Thyroids in Southeastern Idaho, Strontium-90 Concentrations in Pronghorn Antelope Bones Near a Nuclear Fuel Reprocessing Plant, Radionuclides in Pronghorn Resulting from Nuclear Fuel Reprocessing and Worldwide Fallout and Capturing Pronghorn Antelope Using a Helicopter and M-99.

Research objectives through 1984 include: completing the antelope population analysis to provide wildlife managers with a summary of individual unit production and constraints; completing the birth and bed site vegetation studies (2 populations are yet to be done); determining what, if any, conflicts exist between wild horses and antelope and conducting another 3 years of production census to complete the 10-year trend objective. Trapping and transplanting pronghorns to historic ranges will also be conducted when winter conditions permit.

KANSAS STATE REPORT

TERRY L. FUNK, Kansas Fish and Game

Winter surveys indicate that Kansas now has an antelope population level near 1,700. Five new herds have been established over the past 2 winters, sites 2,3,5,7, and 8 (See Fig. 1) as a result of trapping activities in Wyoming. Two of these sites, 2 and 8, are doing well and showing some reproduction. One site, 5, experienced heavy winter losses. The remaining 2 sites, 4 and 7, are questionable at best.

Productivity survey, aerial surveillance accounted for 345 antelope classified according to sex and age compared to 241 in 1978.

The percent of fawns 31.9 was compared to 36.5% in 1978 and the past 3 years average of 31.0%. Bucks accounted for 22.9% of the classified antelope and does for 45.2%. This compares with 22.0% and 41.5% respectively in 1978. There were 71 fawns and 51 bucks for every 100 does. This compares with 88 fawns and 53 bucks per 100 does in 1978.

Kansas Pronghorn Antelope Herd Sex And Age Composition, 1978 - 1979

<u>BUCKS</u>		<u>DOES</u>		<u>FAWNS</u>		<u>BUCKS:DOES:FAWNS</u>	
78	79	78	79	78	79	78	79
53	79	100	156	88	110	53:100:88	51:100:71

A record high of 1,149 pronghorn antelope were counted in the area open to hunting (See Fig. 2). This amounts to a 36.0% increase over the 845 counted in 1978. This year the average herd size was 57 while in 1978 it was 11. The prolonged winter weather in western Kansas accounted for the antelope being in larger herds. Herds of 41 and 36 were observed in 1978 while the largest herds this year numbered 247 and 147. Additional herds were observed during the survey period by 2 reliable individuals, but were not included in the tabulations.

Firearm antelope hunters this past October harvested 91 animals (76 bucks and 15 does). Three permit holders reported that they did not hunt, 3 hunters were unsuccessful. Hunter success was 96.8% (of active hunters).

Archery antelope hunters found that it wasn't easy to harvest an antelope with a bow, only 2 hunters were successful. Seven permit holders did not hunt. Hunter success was at an all time low of 2.7% (of active hunters).

The 1980 antelope season will again be held during the last week of September and the first week of October. Permit quotas have been increased in Unit 1 to 120 firearm and 80 archery. A new unit, 2, will be opened this year with 40 archery and 40 firearm permits available (See Fig. 3).

Research on Kansas antelope food preference was just completed by Mark Sexson, a Fort Hays graduate student. Work is now under way on a research project to determine the movement and reproduction of the antelope transplanted in the Flint Hills.

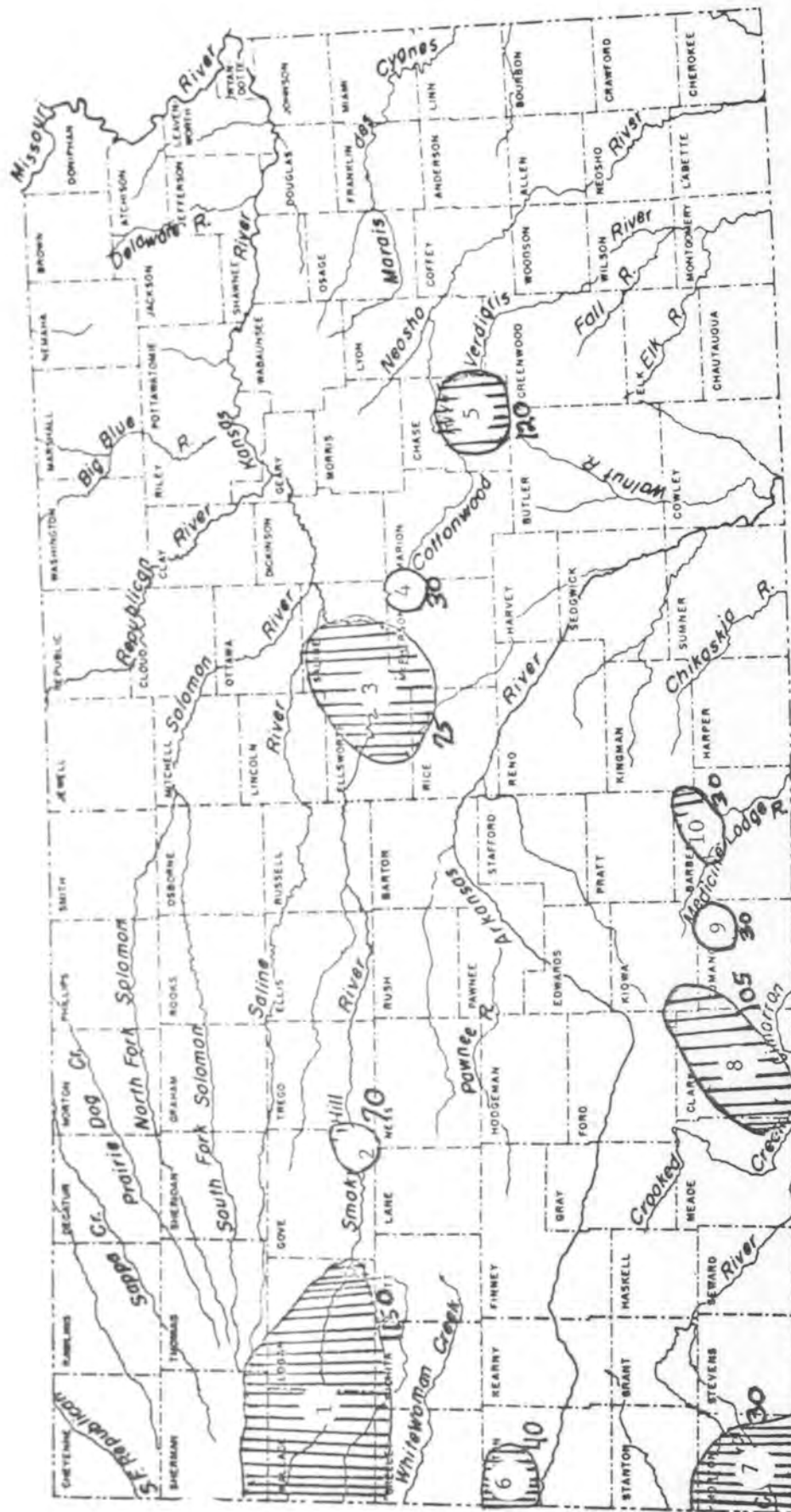


Fig. 1. Current antelope populations in the state.

- Herd number

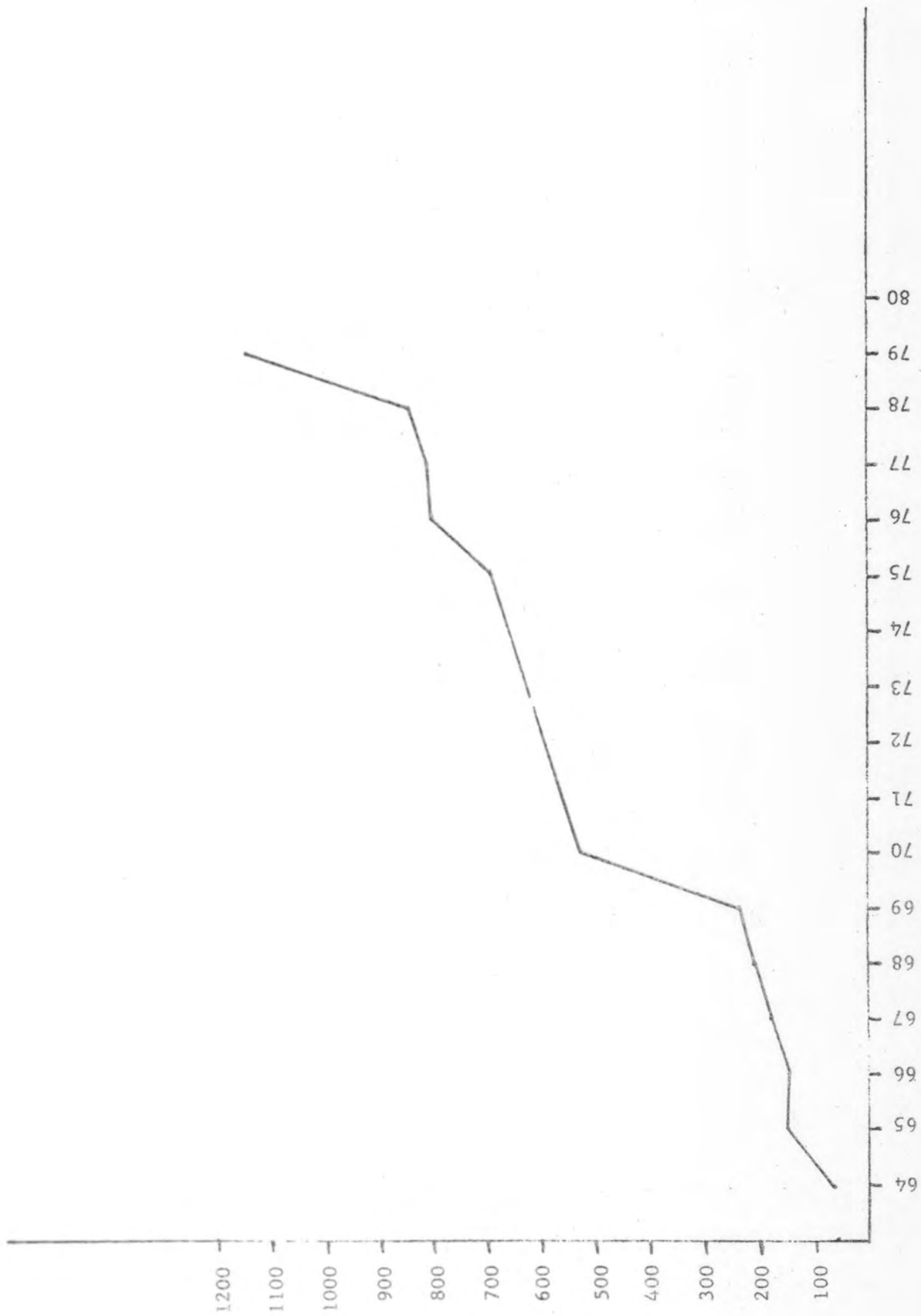


Fig. 2. Pronghorn antelope winter population data
Sherman, Wallace and Logan Counties.

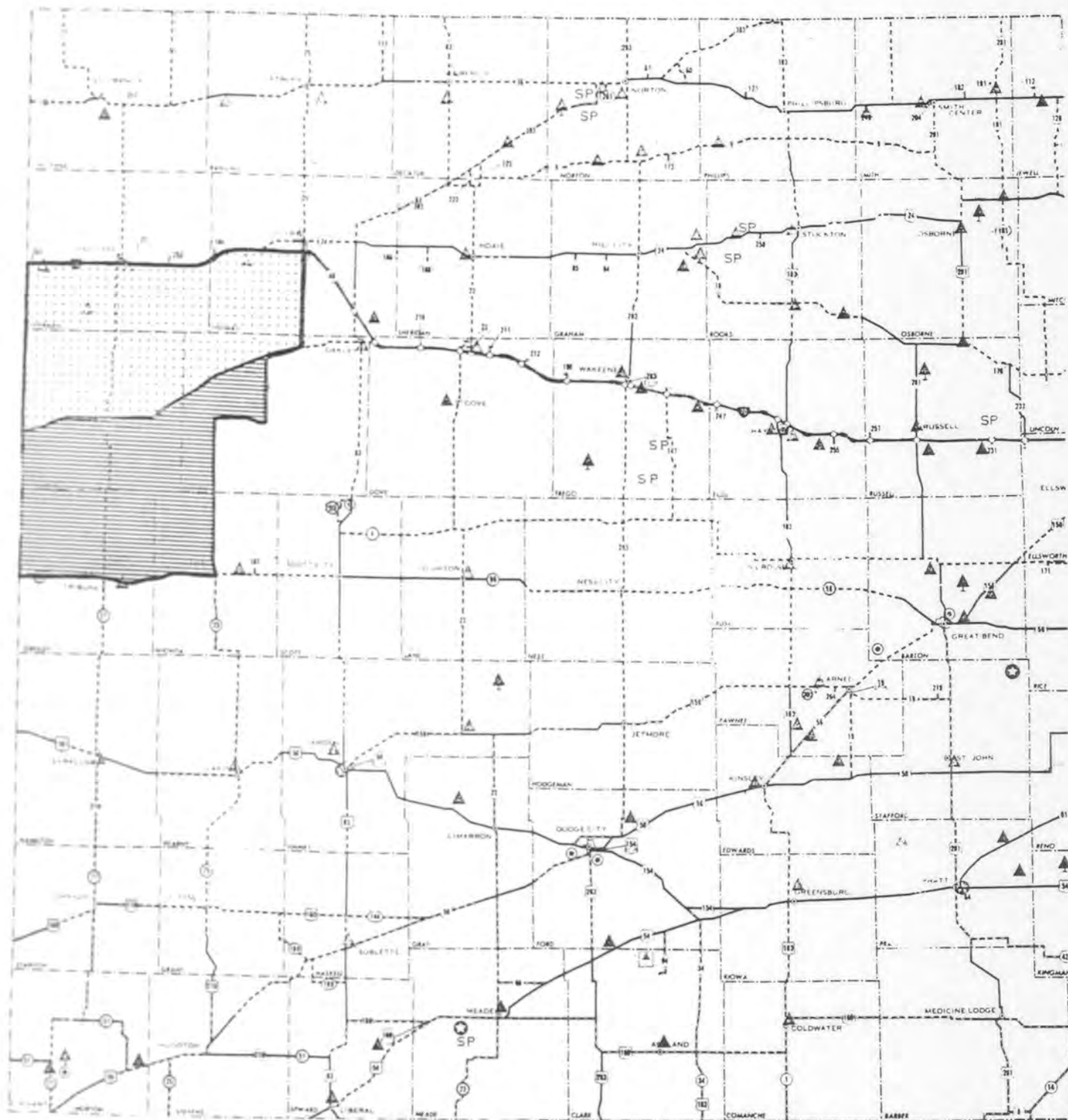


Fig. 3. 1980 Antelope season units.



THE PRONGHORN ANTELOPE IN MEXICO

MIGUEL ANGEL HERNANDEZ G., Biologist, Mexican Wildlife Department
Translated by TERRY ENFIELD

The data analyzed here are the result of the efforts of a group of wildlife biologists and technicians directed by biologist Margarito Rodriguez R., who form part of the task force commissioned by the Director General of the Fauna Silvestre to take a census of game animals in the states of North and South Baja California, Sonora, and Chihuahua during 1978.

Also, other data taken into consideration were obtained by technicians of the same agency, Orihuela (1977), Sanchez and Alcerreca, unpublished reports (1977), and Trevino (1978), who show similarity of sampling methods.

Four subspecies of antelope exist in Mexico: Antilocapra americana peninsularis in South Baja California; Antilocapra americana sonoriensis in Sonora; Antilocapra americana mexicana in Chihuahua, and Antilocapra americana americana in San Luis Potosí, the latter recently introduced from the U. S. A.

Leopold (1977) reports that in 1540 (based on Torquemada's story, written in 1723) that a great hunt took place in the area of Hidalgo, Mexico in honor of the first viceroy Don Antonio de Mendoza, in which the Indians killed 600 specimens of deer and antelope.

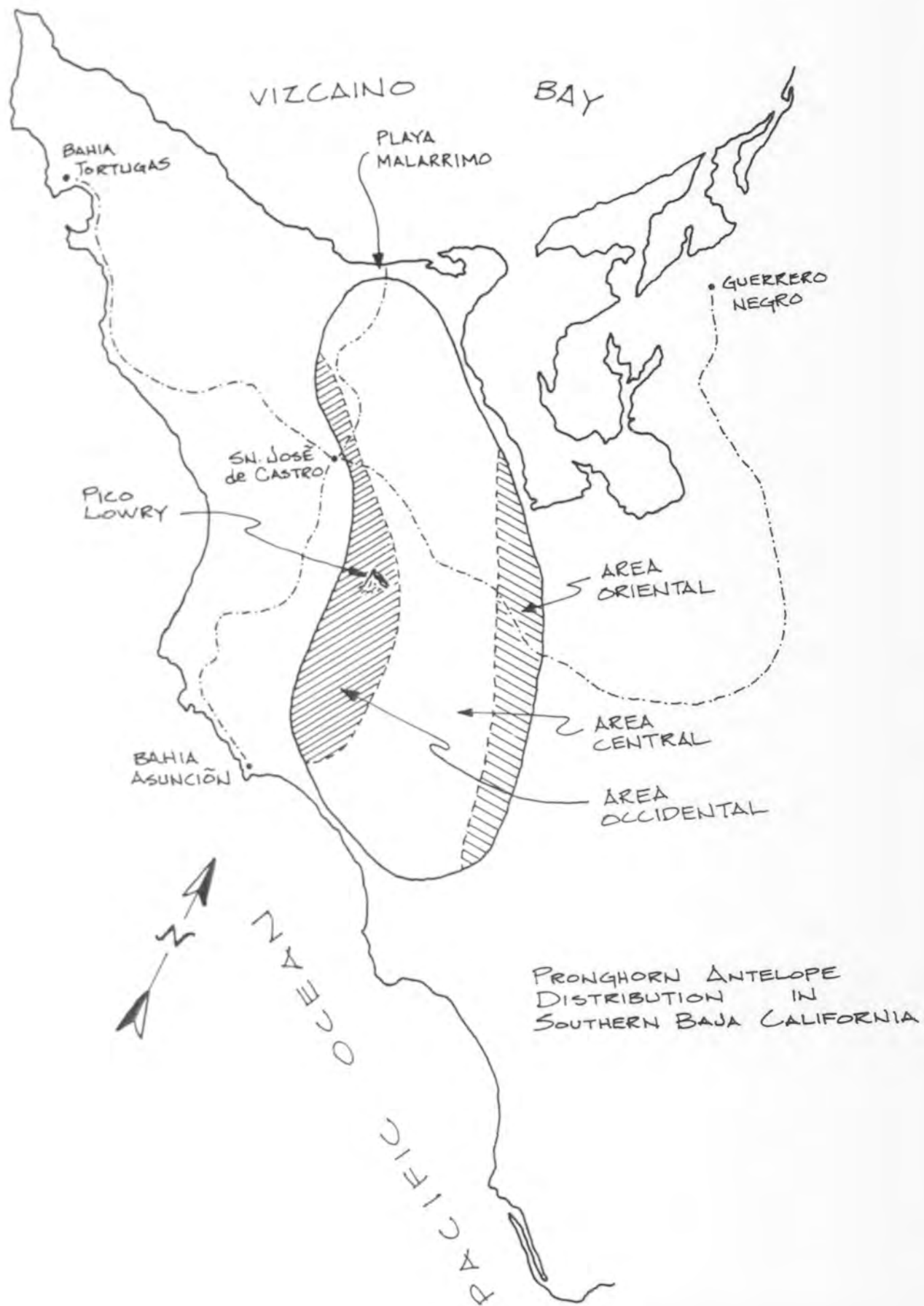
About 1882 Mearns considered there to be thousands of pronghorn in northwest Mexico. In 1925 it was estimated that the pronghorn population numbered 2,395. Despite the fact that since 1922 there was a moratorium on pronghorn hunting which has never been lifted, the population has decreased lamentably, despite various projects which have tried to protect the species.

Since the Washington convention in 1973, the 3 subspecies of Mexican pronghorn have been listed in Appendix I (International Convention on the commerce of endangered species of wild flora and fauna) with which our country is in agreement having ratified this position in previous conventions such as the one which took place in Costa Rica in 1979.

Prior to the field work, maps were obtained of the states of reference, dividing them into areas and the areas into quadrants of 800 kilometers each.

Based on surveys taken on levels of hunters and settlements, the distribution of the pronghorn was theoretically delimited. Prior to this, the verification of these data was determined by surveys in specific areas.

In these surveys the transect method was used principally to estimate the populations and the compositions of the population in a given location. Another method utilized was a direct count of the groups (by aerial census) using a helicopter with a minimum of 2 observers.



STATUS OF THE PRONGHORN ANTELOPE IN SOUTH BAJA CALIFORNIA
(Antilocapra americana peninsularis)

Table 1. Results of 1977 and 1978 pronghorn surveys in Baja, California

Locality	Rancho San Jose de Castro y Los Volarores Arroyo San Jose y San Jose de Castro	
Date	February 22-28 1977	June 7-13 1978
Does	30 (36.1%)	45 (56.2%)
Bucks	29 (34.9%)	27 (33.7%)
Juveniles	13 (15.6%)	8 (10.0%)
	<u>11</u> (13.2%)	<u>0</u>
TOTAL	80 (99.8%)	80 (99.9%)

COMPOSITION OF THE ANTELOPE POPULATION
(Antilocapra americana peninsularis) SOUTH BAJA CALIFORNIA

During the 1977 and 1978 the area of the Vizcaino Desert was surveyed particularly the locations of Arroyo San Jose, Rancho San Jose de Castro and Los Voladores south of the Ojo de Liebra lagoon, the principal areas of antelope distribution.

The transect method was used in dry washes and dunes with 2 task forces, covering 849 kilometers the first year and 107 kilometers the second, at average speeds of between 8-10 kilometers per hour with the aid of binoculars and spotting scopes for classification.

The results of the survey (Table 1) indicate a slight variation in the composition of the population; manifested in the 36.1% does in 1977 and the 56.2% in 1978, the proportion of bucks remained practically the same, about 34%, the juveniles 15.6% in 1977 and 10% in 1978, and a group of unclassified in 1977 with 13.2%. The minimum population is estimated at 83 specimens in 1977 and 80 antelope in 1978.

PRONGHORN ANTELOPE POPULATION IN SONORA
(Antilocapra americana sonoriensis)

From March 16 to April 5, 1978, surveys were done in the previously established areas, mentioning only the principal localities which we group in the following:

Area 1: Rancho Santa Rosa, Puerto Lobos, Los Alamos, and Sierra el Marmol.

Area 2: Estacion Sahuaro, Ejido Juan Alvarez, Rancho Noche Buena Nueva, Sierra Pachequeñas, Sierra San Francisco y Sierra San Emeterio.

Area 3: Sierra del Pinacate

The distribution circumscribes the 3 areas already designated apparently as isolated groups.

The composition of the population was classified in the following way:

unclassified observations	41	80.3%
does	5	9.8%
bucks	2	3.9%
juvelines	<u>3</u>	<u>5.9%</u>
TOTAL	51	99.9%

In this way a minimum population of 51 antelope was estimated, the very high percentage of unclassified specimens being due to the difficulty of differentiation from the helicopter.

ESTIMATED POPULATION OF ANTELOPE IN CHICHUAHUA
(Antilocapra americana mexicana)

The surveys of this subspecies were carried out between July 25 and October 11, 1978, which yielded the following data:

does	52	36.3%
bucks	42	29.3%
juveniles	12	8.4%
unclassified	<u>37</u>	<u>25.9%</u>
TOTAL	143	99.9%

It is thought that the minimum estimated population for the state is 143 antelope and the maximum population is 533, the last datum based on a paper by Jose Trevino (biologist) in 1978.

The distribution corresponds to 4 large areas: in the northern region in the localities of Palos Blancos and Rancho el 24; northwest region, in the localities of El Berrendo, Cuervo and Ejido 12 de Octubre; central region, localities el Gregoria and El Sueco; and the eastern region, localities of Rancho el John, Rancho el Ford and Tres Castillos, the vegetation being thicket and pasture.

CONCLUSION AND RECOMMENDATIONS

For the investigations to date we can conclude that:

1. It is a species which has weakened with human activities such as: opening of roads, oil wells, tourists, hunting and fishing, to such an extent that we consider it little adaptable to modern development.

2. Its distribution has been reduced to such an extent that presently it is limited to very restricted areas in the states of South Baja California, Sonora, and Chihuahua.

3. The estimated population for said states is 650-700 individuals. This is extremely low, for which reason the species has been placed on Appendix I of the Endangered Species List. Thus the species that is in the most critical situation is the Sonoran subspecies.

4. Of the areas that the antelope inhabit, 2 have been declared wildlife refuges and preserves, the Desierto Vizcaino and Sierra del Pinacate, respectively, as well as the few groups which are found on private ranches which offer them a degree of protection.

5. Poaching is still practiced in some areas despite vigilance and despite the sanctions of the federal hunting laws.

6. With the creation of regional fauna coordination, more attention is given to wildlife and especially to species in critical situations, watching their areas of distribution. Presently technical studies are continuing in the Sierra del Pinacate and the Desierto Vizcaino and in areas of the state of Chihuahua.

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MONTANA STATE REPORT

DUANE PYRAH, Montana Department of Fish and Game

Prolonged cold and deep snow characterized winter conditions during 1977-78 and 1978-79. Severe winters back to back have not occurred during recent years. These 2 severe winters caused high antelope mortality in eastern Montana. Some hunting districts in southeastern Montana lost 85% of their antelope. Regionwide surveys are down 62%. Winter losses were much less in southwestern Montana and recent surveys indicate populations above 1977 levels.

Fawn survival during summer of 1979 was generally good throughout the state and many populations made a good recovery from the high winter mortality. In central Montana, fawn survival was the highest since 1968.

Stable habitat conditions exist on most antelope range on public land; however, habitat deterioration and destruction continue on private land. Much of Montana's private land antelope range is being converted to cultivated dryland agriculture. Two regions, southeastern and southwestern, indicate that plowing on private land is their most serious habitat problem, much more serious than habitat deterioration from coal development, which is the activity receiving the most attention. Some of the antelope winter range is being destroyed by plowing, adding to the problem of winter mortality.

The statewide hunter questionnaire for 1978 reported 13,471 antelope killed by 18,393 hunters during 55,179 hunting days. Antelope harvests in Montana have been reduced by: 1) not issuing permits for antelope on land closed to hunting, and 2) population losses from winter mortality.

Hunting dates vary somewhat; however, most hunting districts were open in 1978 from October 8 to October 25 or November 5. All hunting districts were open to archery hunting (September 9 to October 7). Archers must have an archery stamp (\$6.00) in addition to their antelope permit (5.00).

The biologists in the Billings region initiated a slightly different management strategy during 1980. They attempted to issue hunting permits more on the basis of the area's ability to produce antelope. Each hunting district was analyzed for production, harvest, and sex ratio from 1960's to 1978. They fell into the following classes:

<u>Class</u>	<u>Fawns/100 does</u>	<u>Bucks/100 does</u>	<u>Hunter Success</u>	<u>Permit Level</u>
High	80 - +	50 - +	70% - +	50-55%
Medium	70 - 80	40 - 50	60 - 70%	35-45%
Low	60 - 70	30 - 40	50 - 60%	25%

Antelope research in central Montana, which was part of the Sagebrush Ecology Project, is being prepared for publication. Tentatively, it will be printed about this fall. No new research is underway by the Montana Department of Fish, Wildlife and Parks.

NEBRASKA STATE REPORT

KARL MENZEL, Nebraska Game and Parks Commission

The Eighth Pronghorn Antelope Workshop, held at Jasper in May, 1978, included an interesting session on effects of the severe winter of 77-78 on pronghorn populations. To me it was primarily of academic interest, since Nebraska had no similar history of losses except for probable mortalities during the notorious 1949 blizzard.

It did not take long to awaken. Between December 1 and 3, from 10 to 25 inches of snow hit most of Nebraska's antelope range north of the North Platte and Platte rivers. With periodic decreases and periodic increases, snow depths generally exceeded 12 inches through mid-February, with average depths of about 18 inches for most of the period. A weather station near Hemingford, close to one area of heavy antelope losses, had 23 days in January with sub-zero temperatures.

The Sandhills, which is secondary or worse antelope range, was hardest hit. The lowest known mortality in this area was 50% (36 of 72) - several areas probably had a 100% wipeout. In the Garden Unit, which includes the southwest portion of the Sandhills, about 60% of the pronghorn population moved to the North Platte Valley where snow conditions were less adverse, and consequently survival was better.

The greatest documented numerical loss in one area was 130 out of about 350 east of Hemingford. Since losses continued following dispersal from the primary wintering site, the 130 is undoubtedly minimal. The buck:doe:fawn ratio from 85 carcasses examined was 36:100:82, compared to the preceding July ratio of 22:100:36 in a closely adjoining area. Age composition of adult does was distorted to older animals, with 21 of 39 does (54%) 6½ years or older, compared to an average of about 12% of the harvest in this same age group.

Fortunately the primary antelope range - the Panhandle west of the Sandhills - fared considerably better and no mortalities were found. This is not explainable based on weather and snow depths alone.

Three areas were covered by aerial surveys in July, 1979. The North Sioux (our best range) generally had the most favorable winter conditions, with snow depths normally less than 6 inches. Here the population estimate was 20% higher than in 1978. The Box Butte, with intermediate conditions, showed a decline of 16%. The Garden, where conditions were worst but about 60% of the population wintered in the North Platte Valley, had an indicated decline of 43%. Unfortunately, statistical analysis for past years has shown that our estimates are not particularly reliable, and any of these apparent changes would normally constitute no significant change.

Estimates of fawn:doe ratios are more reliable, and could reasonably be expected to reflect changes in production as a result of the winter. All 3 areas, including the North Sioux, had poorer production indicated. The North Sioux showed 64 fawns to 100 does, the lowest on record and 14% below

the preceding 4-year average; only one other year of 24 preceding showed lower than 71:100. The Box Butte, with 31:100, was 14% below its preceding 4-year average and was also a record low. Garden, with 36:100, did not set a record but was 37% below the preceding 4-years mean.

Even where we had no known losses (North Sioux and Box Butte) production was comparatively lousy. It was probably worse further east, where major losses occurred.

Hunting seasons in 1979 were adjusted accordingly. The Sandhills (excluding Garden) were closed; even with an optimistic 20% annual increase it would take 5 years to reach pre-1979 levels in the lower (50%) mortality areas. Average permit cut in the North Sioux, Box Butte, and Garden was 53%; based on comparatively poor hunter success, reductions in permits were not excessive. Three units, where snow almost missed, were unchanged and success remained good.

NEVADA STATE REPORT

GEORGE TSUKAMOTO, Nevada Department of Wildlife, Reno, Nevada

The current estimated antelope population for Nevada is 7,000 animals scattered throughout the northern two thirds of the state. The largest concentration and significant increases in recent years have occurred in northwestern Nevada in Humboldt and Washoe counties. Here some populations have experienced 20-25% increases over the last 2 years. The mid-winter census conducted in February, 1980 resulted in the largest sample (5,518) since the census was initiated in 1949. This sample is comparable to those obtained in 1949-1952 period.

Mild winter conditions during the past 5 years is thought to be partially responsible for buildup in populations. With the exception of several drought years during the past 5 years, range conditions have improved.

The annual hunting seasons are held in August and September. The archery hunt begins in early August and remains open for approximately 3 weeks. Archery hunting success has increased significantly in recent years with increased numbers of more experienced hunters and the use of the more efficient compound bow. In 1979 the archery hunting success was reported at 18% statewide.

The general rifle hunt is held for 9 days through the Labor Day weekend in September. Hunters have enjoyed high hunter success averaging 87% in 1979. The demand for tags is increasing yearly with only 394 permits issued from 3,309 applicants in 1979.

Hunters average approximately 2.4 days in the field, while successful hunters averaged 2.2 days of effort.

The MX missile proposed defense system to be built in Nevada and western Utah will have significant adverse impacts on the pronghorn resource. In the event that the MX system is actually built, some mitigating measures should be requested to offset the damage that is anticipated. This mitigation could come in the form of development of potential habitat and initiation of a vigorous reintroduction program on these developed sites. The MX project is presently viewed as the most significant event in this century which could significantly alter the pronghorn resources. A very close second is the Bureau of Land Management Environmental Statements on livestock grazing and its effects on pronghorn habitat management for the future.

NEW MEXICO STATE REPORT

BRUCE MORRISON, N. M. Department of Game and Fish, Roswell, New Mexico 88201

Current population estimates for New Mexico give us approximately 27,000 pronghorns. The eastern half of our state supports the majority of the pronghorns with approximately 22,000 ranging in that area. The remaining 5,000 are spread thinly over suitable habitat in the western half of New Mexico.

During the last 2 years there have been no major changes in population status or habitat availability. The notable exception has been the construction of a net wire fence along a State Highway in the Claunuch area. This fence divided our antelope range, in that area, in half and trapped most of the pronghorns on their summer range. Negotiations are currently underway with the State Highway Department in an attempt to correct the situation.

The pronghorn hunts are split in New Mexico, with the west half and southeast quarter of the state open around the end of September for a 2-day weekend hunt. The northeast quarter is usually open for a Saturday through Monday hunt towards the end of August. These hunts are buck only except for a few areas that are designated either-sex. Success during these hunts averages around 60 to 70%. During the 1979 hunts, 3,879 hunters harvested 2,758 pronghorns for a 71.1% success rate. There are 2 bow hunts held in the state with a very low success rate. Last year, 157 bow hunters harvested 20 animals for a success rate of 12.7%. These bow hunts have an either-sex bag limit. In 1979 we held our first muzzleloader hunt with 75 hunters participating. This was a buck only hunt with 29 animals harvested for a success rate of 38.6%.

Our antelope hunts are set up on a management unit basis. Each designated pronghorn management unit is allocated a number of permits, based on results of spring and early summer surveys. The permits allocated for each unit are then divided among the ranches within the unit, according to antelope populations and acreage. The permits for each ranch are next divided according to the amount of patented land and public lease land contained within the ranch. Those permits assigned to the public land are issued to the lucky applicants whose names are drawn with a computer selection system. Those permits assigned to patented land are issued out of our main office in Santa Fe, to those people who submit a special application, on a first come, first served basis. This is a major change from the system in effect a few years ago, in that the individual landowner can no longer designate whom the private land permits are sold to. Each person that receives a landowner permit is required to have, in his possession while hunting, written permission from the landowner allowing him to hunt on that ranch. This system allows the landowner to retain some control over who hunts on his private land permits, while giving the general public an opportunity to obtain these permits. Most ranchers charge trespass fees, to the private land permit holders, ranging from \$50.00 to \$1,000.00.

Current research in New Mexico includes the Antelope Habitat Study being conducted in the Roswell area. This study is being carried out by New Mexico State University, under contract with the Bureau of Land Management. An upcoming paper at this workshop will cover the study in detail.

The only other pronghorn research being conducted in New Mexico is a chromosome banding study being carried out by Dr. Terry Yates of the University of New Mexico. The technique being used by Dr. Yates is called electrophoresis and involves the use of electricity in mapping the location of genes on chromosomes. The results of this study should enable us to determine the genetic differences or similarities in different pronghorn populations. Electrophoresis should assist us in determining the feasibility of transplanting animals from various locations and to genetically match the pronghorns of the areas where we wish to reinforce the population.

NORTH DAKOTA STATE REPORT

JIM MCKENZIE, North Dakota Game and Fish Department

A brief history of antelope in North Dakota:

Vernon Bailey in his "Biological Survey of North Dakota," reported that antelope originally ranged over nearly all the open country of North Dakota. He also presents many records from early explorers (1800's) that attest to the abundance of this animal on the prairies of North Dakota.

Antelope declines coincide with the early filling up of each section of their range by settlers. In 1915, it is doubtful if any antelope remained north and east of the Missouri River and by 1925 there was only 5 herds of antelope with an aggregate of about 225 animals left in the state, these being located in the badlands of southwestern North Dakota.

It was about this period in time when human concerns for wildlife and the initiation of wildlife management practices were beginning.

The low of 225 pronghorns in 1925 increased to a high of 14,245 in 1964 (a span of 40+ years); with distribution occurring over the western half of North Dakota. This increase and distribution was augmented with trap and transplant projects in the 1950's, involving 8 release areas.

North Dakota is noted for its winters and for the past 15 to 20 years we've had some "dillies." Three winters, in particular, were real "goodies"--winter of 1964-65, which reduced our 1964 high population of 14,245 to 6,150 (57%)--from this (6,150) the population increased to 9,245 pronghorns in 1977 (this 13 year period involved a couple - 3 moderate winter kills)--then the consecutive winters of 1977-78 and 1978-79 took their toll--1977-78 winter reduced the population of 9,245 to 2,615 (72%)--the winter of 1978-79 reduced the 2,615 to 1,245 (52%) which brings us to the present (see attached figure).

Besides having been blessed with extraordinary winter seasons, North Dakota has recently (past 10 years) again been blessed with furnishing the world's energy needs (we're going to produce all the gas, oil, and coal--so everyone can relax, as regards the "camel rider" problems of the Middle East).

I guess what we're saying is that with the loss of antelope habitat (winter and summer ranges), due to increases in the agriculture, oil, gas, and coal industries and our periodic winter kills, North Dakota's pronghorns are having a bad time. Consequently, the North Dakota Game and Fish Department is in the process of developing a "Recovery Plan for Pronghorn Antelope in North Dakota": The major goal of this recovery plan is to "provide recreational hunting/harvest on a sustained annual basis and to reach a pronghorn population of 7,000 (6,500-7,500) animals by 1995."

A copy of our preliminary "Recovery Plan" flow chart is attached and what we're looking for is a critical review with suggestions for additions or deletions and implementation of needed studies.

At present we've put together a data package to be used at the next legislative session in an effort to get control of the harvest (as it stands now, landowners receive a permit on request if they live in an open hunting unit).

This past winter we conducted a winter concentration survey utilizing enforcement personnel - so we do have information on winter distribution and numbers.

We've investigated the possibility of using available satellite, high altitude, and infra-red photography for land use information but have found it too expensive or incomplete for our needs.

Our plans are to intensify our July pronghorn aerial survey - we have been flying half of our 50 pronghorn management units at 1/3 coverage. Will attempt to do approximately a third of the units each year at a 100% coverage which will provide us with more accurate population data.

Except as a last resort, we'd like to stay away from a trap and transplant program.

So, with that, I guess we're ready for your solutions to our pronghorn problems.

TABLE I
Pronghorn ♂:♀:K Ratios From Past Reports

Year	Pronghorn #	♂:♀:K Survey in first 1/2 of April	Harvest #	% ♂:♀:K	Hunter Success
1951	3878	.66:1:99	913	54.0-32.5-13.5	96.0
1952	3820	.58:1:69	986	48.7-34.8-16.2	91.5
1953	4815	.61:1:87	No Season		
1954	6854	.66:1:99	1,794	51.3-31.6-17.1	96.9
1955	5790	.62:1:92	1,494	51.1-32.5-16.4	95.7
1956	6792	.60:1:77	1,151	52.2-31.3-16.5	94.6
1957	7480	.47:1:95	1,381	54.0-24.0-22.0	97.0
1958	8801	.53:1:116	1,771	52.0-33.0-15.0	97.0
1959	9518	.41:1:98	2,101	52.3-32.3-15.4	94.4
1960	9336	.40:1:103	2,085	54.5-31.4-14.1	97.0
1961	10,332	.42:1:94	2,948	52.8-32.5-14.7	96.8
1962	11,366	.35:1:84	2,634	51.2-32.8-16.0	91.9
1963	10,000	.60:1:97	2,378	47.0-29.3-23.7	91.8
1964	14,244	.46:1:78	3,502	47.0-29.3-23.7	91.8
1965	6151	.39:1:62	1,211	47.0-29.3-23.7	85.6
1966	6152	.31:1:92	1,153	54.5-24.0-21.2	87.6
1967	7600	.39:1:78	1,728	58.0-24.0-18.0	90.3
1968	8560	.43:1:92	2,030	52.7-26.6-20.7	90.0
1969	6933	.48:1:90	1,031	51.6-27.2-21.0	86.4
1970	7522	.42:1:88	1,807	56.6-24.7-18.7	89.0
1971	7455	.49:1:72	1,486	62.0-23.0-15.0	89.2
1972	6916	.42:1:84	1,132	61.0-24.0-15.0	91.0
1973	7066	.37:1:73	1,378	63.0-23.0-14.0	93.0
1974	9334	.27:1:81	1,816	61.0-25.0-14.0	90.0
1975	7733	.47:1:62	1,683	64.0-24.0-12.0	84.0
1976	8123	.43:1:73	1,225	65.0-23.0-12.0	74.0
1977	9244	.36:1:69	1,194	69.0-18.0-13.0	78.0
1978	2617	.36:1:64	No Season		
1979	4246	.12:1:59	No Season		
1980	----	----	No Season		

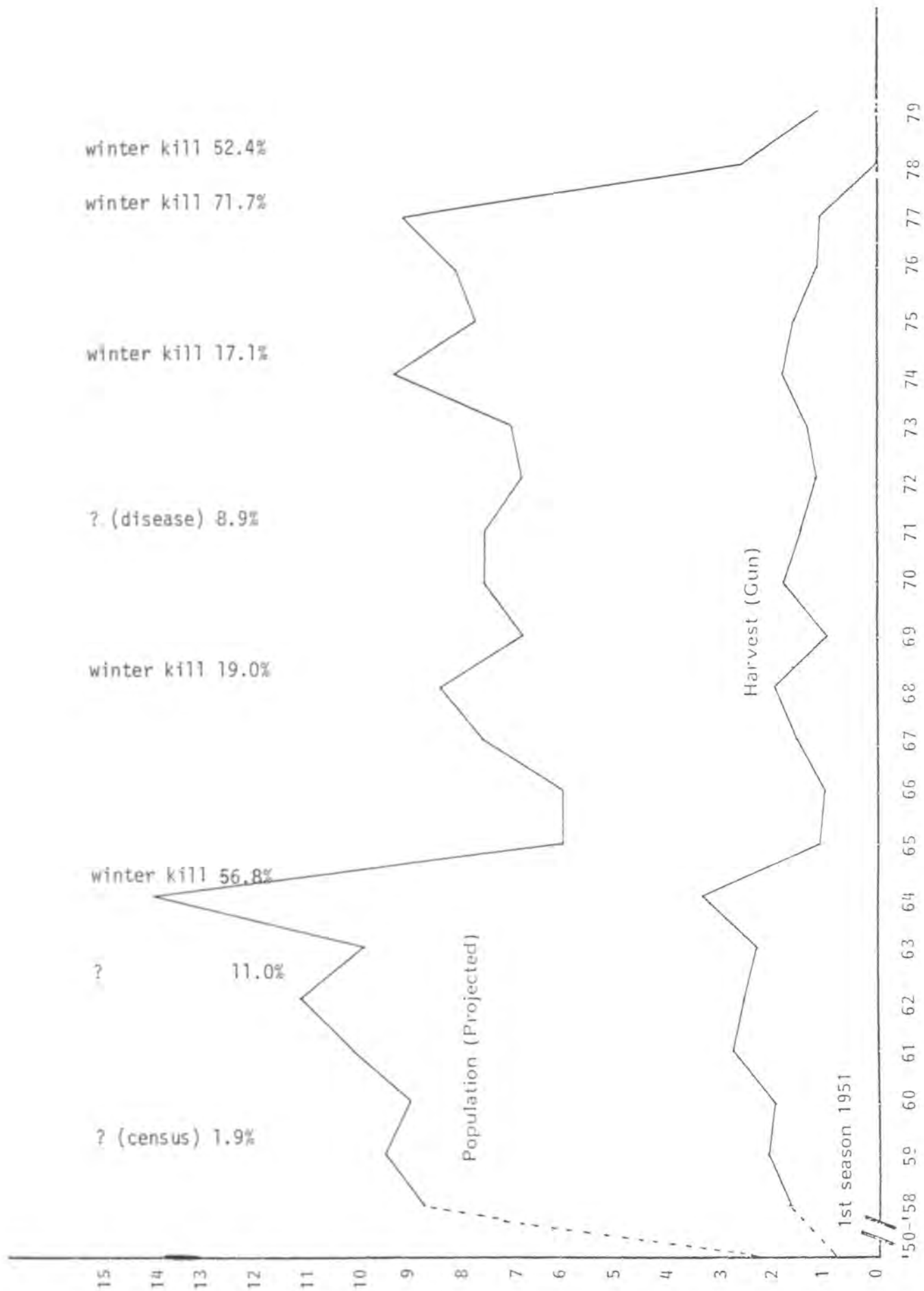


Fig. 1. Antelope population and harvest in thousands.

OKLAHOMA STATE REPORT

D. T. SANDERS, Assistant Chief, Game Division (Research)
Oklahoma Department of Wildlife Conservation

The pronghorn antelope in Oklahoma is confined primarily to the short-grass high plains and sandsage brush vegetation types of Cimarron and Texas Counties with small remnant herds occasionally reported in Ellis and Beaver Counties. Although, accurate population estimates are not available, the antelope population in Oklahoma is thought to be declining. Results of aerial spring surveys in Texas and Cimarron Counties reveal a steady population decline from estimates of 450 in 1971 to a low of 150 in 1978. However, personal interviews by Department personnel with large landowners during June of 1979 produced an estimate of 322 for the 2 county area.

The total antelope population in Oklahoma is probably less than 350 with approximately 280 in Cimarron County, 45 in Texas County, and the remaining 25 scattered in Beaver, Ellis, and possibly Harper Counties. These estimates are considered maximal.

As of this workshop, the actual amount of antelope habitat available or the amount of habitat occupied is not known. In 1972, the shortgrass prairie and sandsage brush vegetation types comprised 52.7% (622,042 ac) and 39.6% (518,692 ac) of the total land area in Cimarron and Texas Counties, respectively, (Moser, 1976. Final Report, Oklahoma, Pittman-Robertson Project W-82-R, Study 7, Job 1). However the portion of this vegetation type that is suitable antelope range is not known. In addition, a portion of the shortgrass prairie and sandsage brush habitat is being converted annually to cropland; thus, further reducing the habitat available to antelope.

Oklahoma has not had an antelope hunting season since 1972 when 34 were harvested during a 3-day September hunt in Texas and Cimarron Counties.

There are no new or ongoing pronghorn research programs at this time nor have there been any recently terminated. No new management strategies have been initiated. Present management consists of protection and annual monitoring of populations in Texas and Cimarron Counties.

An item of interest was an unusual hail storm that passed through a portion of south central Cimarron County on the evening of June 3, 1978. Hail size in a portion of the area hit by the storm was reported to have been as large as 6 inches in diameter. Department personnel found 4 dead pronghorns following the storm with reliable reports of 3 additional ones killed by the storm. Total pronghorn range involved in the storm was from 8 to 15 square miles. A herd of 17 were known to occur in this area.

OREGON STATE REPORT

PAUL W. EBERT, Oregon Department of Fish and Wildlife

1. Estimate 12,000 antelope in Oregon.

2. Changes in population

1976 - 1.8 antelope per mile

1977 - 2.2 " " "

1978 - 2.5 " " "

1979 - 2.4 " " "

1980 - 2.4 " " "

Changes in habitat - no significant changes have occurred in recent years.

3. 1979 Hunting Season:

August 18 through August 22

1,235 buck tags - harvested 748 antelope

30 doe tags - harvested 23 antelope

4. Gerber Reservoir Bow Antelope Season

Two hunt periods allowed:

August 4 through August 12

September 1 through September 9

Permits allowed:

No limit on the number of permits but a hunter was allowed to hunt in only 1 time period. Bowhunters purchased 475 buck permits and harvested 3 antelope.

5 & 6. Antelope Research

A new study will be started in the spring of 1981 to determine fawn survival rates on different ranges and the causes of mortalities. Kids will be monitored for 2 months after birth with telemetry. Habitat will be surveyed to correlate mortality rates with habitat types.

7. New Management Strategies:

Increase doe harvest around agricultural area to control damage.

SASKATCHEWAN PROVINCIAL REPORT

EARL WILTSE, Department of Tourism and Renewable Resources
Regina, Saskatchewan

1. The 1979 population estimate: 6,200 antelope inhabit about 92,000 km² of habitat in Saskatchewan.

2. Major changes in habitat or population status.

Dramatic population increases in our southern ranges have excelled the provincial population level to the highest recorded since 1971. In 1979 an overall population density of 1.77 animals per sq. km. was recorded. Excellent fawn production combined with good yearling recruitment into the population have been primary factors for the increase.

The province-wide fawn production average for 1979 was 90 fawns per 100 does, highest recorded since 1965.

3. Hunting season dates and harvest.

In 1979, 4,009 applicants applied for 2,300 either-sex antelope licenses issued for a 6-day season beginning on October 29. The estimated harvest was 1,723 animals for a 87.2% hunter success.

4. Archery Season.

Archery antelope hunts have been held annually on a quota basis since 1976. In 1979, 150 licenses were issued for a 4-week season beginning on September 10. Estimated hunter success was 18%.

5. The Saskatchewan Fish and Wildlife Branch has no ongoing antelope research project.

6. Management Strategies.

We have just completed a document detailing direction and guideline for big game management in Saskatchewan up to the mid 1980's. The 5-year management plan calls for increasing antelope population to 8,500 which will allow us to provide 5,000 sport hunting days and a harvest of 2,500 animals. Our basic management goal is to provide maximum sustained hunting and viewing opportunity while total harvests are kept in balance with harvestable antelope populations.

SOUTH DAKOTA STATE REPORT

TED SCHENCK, South Dakota Department of Game, Fish, and Parks
Assistant Regional Supervisor

In the short time since the last workshop, the antelope population in South Dakota has changed a great deal. Back-to-back severe winters have driven the population from nearly 40,000 to a summer population in 1979 of 18,300. The prime antelope range of northwest South Dakota was hardest hit by both winters. Winter stress did affect reproduction as well. Doe:kid ratios dropped from 100:97 in 1977 to 100:65 in 1978, and 100:71 in 1979.

Adult antelope are counted starting 1 May using a 1/3 sample of large units. Small units are completely counted. Doe:kid counts are flown in late June-early July.

In 1979 we issued 3,128 resident licenses for a 9-day rifle season. The traditional opening date is the first Saturday in October. Our projected kill was 2,473 antelope for a hunter success of 79%. Sixty-six percent of the harvest were bucks. Landowners are given preference for $\frac{1}{2}$ of the licenses each year. Non-landowners are allowed to hunt antelope every third year.

Archery antelope permits are not limited in number and are sold to residents and non-residents. The season is open from 1 September to 31 October except during the 9-day rifle season. Archery licenses totaled 400 in 1979. Projected success was 10% with 44 antelope killed.

Presently, there are no antelope research projects being constructed or planned for the near future in the Department.

TEXAS STATE REPORT

H. G. KOTHMANN, Texas Parks and Wildlife Department, Big Spring, Texas
CHARLES K. WINKLER, Texas Parks and Wildlife Department, Austin, Texas

The Texas antelope population was estimated to be slightly in excess of 18,000 animals during the late summer of 1979. Populations are roughly similar to the previous peak level attained in 1973. Two-thirds of the Texas antelope are located in the Trans-Pecos region (west of the Pecos River). The remaining 1/3 of the antelope are located in the Panhandle and Rolling Plains areas.

Gradual population increases during recent years were supplemented with releases of broodstock obtained from other states. During March of 1979, 87 antelope were trapped near Cheyenne, Wyoming and released at 4 sites in north Texas. In January of 1980, a shipment of 100 antelope from Colorado were released at 4 additional sites, 3 in north Texas and 1 in south Texas. In addition to broodstock received from other states, a total of 94 antelope were trapped in the Trans-Pecos and released at 3 nearby sites during November of 1979.

All antelope taken by hunters in Texas are harvested on private land through a system whereby the Department provides the concerned landowners with permits for surplus animals. Hunters must generally pay a sizeable trespass fee to the landowner in order to obtain a permit and be granted access to the privately owned antelope game ranges. During 1978 the Department issued 1,168 buck antelope permits to 337 landowners who in turn allowed 833 hunters to harvest 748 buck antelope. Hunter success was 90% and 64% of the permits were utilized. During 1979, a total of 1,398 buck and 23 doe antelope permits were issued to 352 landowners. An estimated 1,007 hunters harvested 897 buck and 1 doe antelope for a 89% hunter success and 63% permit utilization. An estimated 20% of the adult buck population was harvested by hunters during each of these years.

Due to the limited number of antelope permits made available to hunters, fees being charged for trespass privileges are becoming excessive; averaging near \$400 during the 1979 hunting season. Private landowners are certainly due some consideration for providing room and board for resident wildlife populations; however a question of ethics arises when hunters are charged exorbitant fees for access to state-owned wildlife resources. Commercial leasing systems have been the saviour of big game populations on privately owned game ranges in Texas. Without the incentive of financial rewards from wildlife populations, many landowners would have long ago converted game ranges to other land uses not conducive to those populations. At present, ever increasing consideration is being given to wildlife populations by ranchers as evidenced by recent population increases. The hunting lease system in Texas is a one-on-one agreement between the landowner and the sportsman and, at present, charges approximate what the market will bear. No state regulation of leasing costs is planned at this time.

It is estimated that future antelope populations in Texas will remain generally static at 18,000 animals with occasional decreases to 8,000 animals following periods of drought and/or severe winters. Expansion of antelope populations is limited by availability of suitable habitat. Much of the historic antelope range in the northern part of Texas has been permanently lost to cropland and urbanization. Sheep ranching with the associated net wire fences had in the past extirpated antelope from historic ranges in the lower rolling plains and parts of the Trans-Pecos. Excessive depredation by coyotes has caused many of these ranchers to discontinue raising sheep. In such areas, as net wire fencing deteriorates or is altered, some acreage of historic range is once again becoming available to antelope. Coyote predation of antelope fawns is a definite problem in the Trans-Pecos region, but is accepted as a lesser evil in view of the alternative of sheep ranching.

UTAH STATE REPORT

DONALD M. BEALE, Utah Division of Wildlife Resources, Cedar City, Utah

There are roughly 3,500 pronghorn antelope in small scattered bands on 15 different areas or herd units within the State of Utah. About $\frac{1}{2}$ of these occupy the western desert areas and the remainder are in the northeast corner and in the south-central part of the state. Populations in some herd units have increased over the past 2 years, largely as a result of improved fawn survival.

Pronghorn habitat has not changed significantly during recent years, but in some areas there has been a shift from winter grazing by sheep to winter grazing by cattle and as a result, there is less competition for forage between antelope and livestock in these areas. One of the greatest and most recent threats to pronghorn habitat is the MX Missile in its present proposed racetrack design. This system would disrupt vast areas of antelope habitat in western Utah.

Pronghorn antelope are hunted in Utah on a permit basis, usually in early September. Applicants are allowed no more than 1 permit every 3 years. Over the past 10 years the interest in antelope hunting in Utah has increased significantly. For example, 1,078 persons applied for 152 permits issued in 1968 and harvested 114 bucks. By 1978, the number of applicants had increased to 5,163 for a total of 320 permits and the harvest increased to 276 bucks.

Management data obtained annually in Utah include late summer fawn to doe ratio counts, winter trend counts, and harvest information. August fawn to doe ratios have improved on some herd units the past 2 years. The statewide average ratio in 1979 for 15 units was 48 fawns per 100 does with 4 units showing over 70 fawns per 100 does.

Research programs with pronghorn antelope in Utah, which have been active in previous years, have been completed and no additional studies are planned at this time. Some phases of the research that have been completed are yet to be published.

The Utah Division of Wildlife Resources is continuing efforts to expand pronghorn populations by trapping and moving animals into new areas where habitat is suitable. In 1978 and 1979, a total of 77 and 73 antelope, respectively, were trapped from Awapa Plateau and were released into other areas of the state.

Previous research at the Desert Experimental Range indicated that available drinking water was an important factor in pronghorn habitat. In fact, it was concluded that antelope could not survive without drinking water during hot summer months in the Atriplex-Eurotia vegetation types found at lower elevations on the desert areas of western Utah, even when above average forage succulence occurred. As a result of this work, "guzzlers" or rain catchment systems have been placed in antelope habitat in 3 different areas of southwestern Utah in an attempt to apply research

findings to management. These watering systems were distributed through the better antelope habitat at 2 or 3 mile intervals. Antelope are making extensive use of most of these watering systems and the population will be watched for several years to determine if increases result.

Another management strategy that has considerable merit in Utah is to adjust class, season and intensity of livestock use to reduce competition with antelope. The Division of Wildlife Resources works closely with the Bureau of Land Management and the U. S. Forest Service to achieve better patterns of livestock use and to maintain and improve pronghorn antelope habitat in Utah.

WASHINGTON STATE REPORT

LOWELL D. PARSON, Washington Department of Game

An estimated 60 pronghorn antelope occur in the State of Washington. The pronghorn is thought to be an exotic in Washington and attempted introductions have not been successful. No hunts are conducted.

WYOMING STATE REPORT

WALT GASSON, Wyoming Game and Fish Department

1. Current population estimates.

a. Forty-nine herd units totaling approximately 217,000 (post-season 1979).

2. Major changes in habitat or population status.

a. Habitat losses due to energy development and industrialization.

1) Eastern Powder River Basin--85,000 acres lost to coal development by 1990.

2) Southcentral--9,000 acres lost to coal and uranium development.

3) Southwest-14,000 acres lost to coal, uranium, and petroleum development.

b. Human population increase associated with industrial development.

1) Wyoming is fastest growing state in U. S.--at least 25-30% increase in next 10 years.

a) Urbanization--urban sprawl, subdivisions, new towns.

b) Facilities that accompany growth--highways, railroads, fences.

c) Increased illegal kills in rapidly growing areas.

3. Hunting season dates and harvest.

a. 1979--53,000 licenses (27,000 resident licenses; 26,000 nonresident licenses).

b. Seasons vary in 104 hunt areas.

1) Generally open Sept. 1 - Oct. 1; average 15-20 days in length.

c. Estimated 1979 harvest--44,630.

1) Average hunter success--91.5%.

2) Average days per animal harvested--2.5.

3) Forty-five of 104 hunt areas had additional doe/fawn licenses available.

4) Antelope hunters spent \$12 million in Wyoming in 1979.

4. 1979 Antelope archery hunting season.
 - a. Many areas--late August, early September pre-season.
 - b. Most areas--15 day pre-season.
5. New and ongoing pronghorn research programs.
 - a. Trend toward site-specific, problem-solving approach, away from large-scale studies.
 - 1) Effects of coal development on antelope--Red Rim.
 - 2) Effects of experimental wind energy development--Medicine Bow.
6. New management strategies, other topics of interest.
 - a. BLM coal leasing in pronghorn habitat.
 - 1) Application of Unsuitability Criteria.
 - a) Failure by decision-makers to adequately consider wildlife resource.
 - b) Criterion #15 pushed aside whenever it conflicts with leasing.
 - 2) Unsure of our real role in leasing, BLM planning process.
 - b. Population modeling
 - 1) Simulation model ONEPOP developed by Jack Gross (USFWS)
 - a) Utilizes data most gathered by field biologists.
 - b) Depends on identification of discrete populations.
 - 2) Usage
 - a) Make model mimic historic data.
 - b) Project trend into future.
 - c) Use options to evaluate potential management strategies.
 - 3) Pros and cons
 - a) Pros--evaluate potential management strategies, point out data gaps.
 - b) Cons--tendency to put too much faith in modeling, may be baffled by technology.

- c. Damage to crops on private lands.
 - 1) Wyoming continues to pay for antelope damage to crops.
 - a) Forced to manage antelope on damage-control basis.
 - b) No solution in sight.
- d. The winter of 1978-79.
 - 1) Extremely severe winter.
 - a) Began early, deep snow, high winds, extreme cold, did not lessen until late February.
 - 2) Physiological and distributional effects on antelope.
 - a) Extreme stress, high mortality.
 - b) Movement into unfavorable habitat.
 - 3) Effects on management.
 - a) New spatial distribution, reduced fawn survival, inadequacy of mortality estimates.
- e. 1980 license fee increase in Wyoming.
 - 1) Financial crunch.
 - a) License sales--81% of Department income
 - b) Increasing challenges plus inflation exhausted funding.
 - c) Opted for fee increase, not sales increase, severance tax, etc.
 - 2) Problems
 - a) Backlash--decreased demand for licenses
 - b) Crunch continues--will need increase again by 1986.

TECHNICAL SESSION

A DESCRIPTION OF "WEAK FAWN SYNDROME" IN PRONGHORN ANTELOPE

WALTER L. BRODIE, Idaho Department of Fish and Game, Salmon, Idaho 83467

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University of Montana, Missoula, Montana 59812

Abstract: Radiotelemetry was used to determine factors affecting pronghorn (*Antilocapra americana*) fawn mortality in central Idaho. Six of 19 pronghorns collared during the 1976, 1977, and 1978 fawning season exhibited similar symptoms: (1) general weakness; (2) susceptibility to hypothermia; (3) early mortality; (4) secondary enteritis; (5) swollen livers and spleens; (6) edema, fibrin, and hemorrhaging in hock joints; (7) enlarged and edematous suprascapular and prefemoral lymph nodes; (8) rough and dry coats; (9) atrophic thymus glands; and (10) impaired suckling response. Symptoms observed in pronghorns were similar to those described for weak calf syndrome in domestic livestock. Weak fawn syndrome appeared to be related to the nutritional condition of the dam and can be affected by added cold stress. A possible link between selenium deficiency and fawn survival is suggested.

Pronghorns are Idaho's most numerous trophy species, and are normally hunted through special permit drawings. These hunts are heavily over-subscribed. In 1979, 25,071 hunters applied for 1,745 either-sex permits. High hunter demand and the need to manage pronghorn populations to reduce depredations on agricultural crops necessitates intensive management programs; these programs rely heavily on adequate population data.

Pronghorns are subject to high mortality during early life (Vriend and Barrett 1978), especially during the first 30 days post partum (Fichter and Nielson 1964). Recent radiotelemetry studies have shown that predation

*The U. S. Fish and Wildlife Service; Montana Department of Fish, Wildlife, and Parks; University of Montana; and the Wildlife Management Institute cooperating.

is responsible for most early mortality (Beale and Smith 1973, Barrett 1978, Von Guten 1978, Bodie 1979, Corneli 1979). Other causes of mortality, such as disease, starvation, abandonment, or accidents, have also been reported. In some instances, no specific cause of death could be determined (Beale and Smith 1973, Reichel 1976, Barrett 1978, Bodie 1979).

The objective of this study was to quantify and qualify the unknown loss category.

We thank Dr. W. Foreyt of Washington State University and Drs. M. Stoszek and E. Stauber of the University of Idaho for field assistance and laboratory analyses.

STUDY AREA

This study was conducted in the upper Pahsimeroi River valley of central Idaho about 60 km southeast of Challis, Idaho. The upper Pahsimeroi valley is a relatively flat valley surrounded by high, steep hills, and mountains. Elevations range from 2,000 m in the northern portion to 2,700 m along the southern boundary of the study area. Mt. Borah (3,857 m) is the dominant topographic feature. Precipitation averages 36 cm/year and most falls as snow or spring showers. Snow and cold temperatures, less than 0°C, are common during the fawning period of late May and early June (Bodie 1979).

Plant community types consist largely of the various phases of the sagebrush/grass habitat type. Sagebrush (*Artemesia* spp.) is the most common overstory vegetation. At least 5 species and subspecies of *Artemesia* occur: Wyoming big sagebrush (*A. tridentata wyomingensis*), low sagebrush (*A. arbuscula*); fringed sagebrush (*A. frigida*); threetip sagebrush (*A. tripartita*); and mountain big sagebrush (*A. tridentata vaseyana*).

Two plant community types characterize a major portion of the study area. The short sage/flat type consists largely of low sagebrush with an understory of bluebunch wheatgrass (Agropyron spicatum) and Sandberg bluegrass (Poa sandbergii). This type is found on the flat portion of the study area. Along the base of hills, and in the draws leading into the hills, a second major type is found. The second type, tall sage/foothill, is largely composed of Wyoming big sagebrush with an understory similar to that of the low sage/flat type.

About 69% of the study area is managed by the Bureau of Land Management, 24% by the United States Forest Service, 5% by private individuals, and 2% by the Idaho Department of Lands. A more detailed description of the study area was given by Bodie (1979).

METHODS AND MATERIALS

Newborn pronghorn fawns were captured during the 1976, 1977, and 1978 fawning seasons and equipped with miniaturized radio transmitters. The techniques of capture and fitting of transmitters were described by Bodie (1978). An attempt was made to capture fawns less than 48 hours of age. Fawns were weighed and measured, and general body condition was recorded. Anal, throat, and nasal cultures were taken during 1977 and 1978. Fawns were monitored daily except for periods of severe weather conditions.

Dead fawns were photographed, examined for external wounds, weighed, and collected. The kill sites were searched and predator signs recorded. Fawns were monitored until they died, the transmitter fell off, or until 1 August.

During 1976, fawn carcasses were frozen and saved for a later laboratory necropsy. Field necropsies were performed in 1977 and 1978. Punctures, lacerations, and signs of feeding by predators were recorded and photographed.

Indications of disease, starvation, general body condition, and the stomach contents of fawns were noted. Wound and feeding patterns as described by Cowan and Korstad (1969), Henne (1975), and O'Gara (1978) were used to determine the species of predator involved in killing or feeding on a fawn.

Tissue samples were collected from 7 fawns for histopathological and trace mineral analyses. Samples for histopathological analysis were collected from the lungs, heart, thymus gland, liver, spleen, kidneys, small intestine, and mesenteric lymph nodes and preserved in 10% buffered formalin. Samples for trace mineral analyses were collected and frozen from the heart, lungs, liver, kidneys, diaphragm, and brain.

Hunter-killed pronghorns were sampled on the opening days of the 1975 through 1978 hunting seasons. Animals were checked for condition and ovulation rates. Carcasses were weighed and measured. Data on kidney fat, general body condition, and ovulation rates were recorded. Tissue samples from the kidneys, liver, heart, lungs, and muscle tissue were collected and frozen for later trace mineral analyses.

RESULTS

Neonatal histories were gathered for 42 fawns during the 3 years of the study. Ninety-two percent of all mortality occurred during the first 2 weeks after birth. Predation accounted for 15 (35.7%) deaths of marked fawns, starvation-disease 9 (21.4%), and other causes 2 (4.8%) (Table 1).

The relatively high rates of starvation-disease losses in 1976 (25%) and in 1977 (30%) contrasted with the low rate of 1978 (8%). A combination of factors including disease, starvation, and abandonment accounted for these high rates.

Table 1. Fates of transmitter-equipped fawns by year

Year	N	Predation				Disease- starvation	Other	Survived
		Coyote	Eagle	Bobcat	Small raptor			
1976	12	2	2	1	2	3	0	2
1977	17	0	2	0	0	5	1	9
1978	<u>13</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>1</u>	<u>5</u>
Total	42	4	7	2	2	9	2	16
Percent	100	<u>9.5</u>	<u>16.7</u>	<u>4.8</u>	<u>4.8</u>	21.4	4.8	38.1
35.7								

Determining the direct cause of mortality was difficult because fawns affected by disease often showed evidence of starvation and the reverse may also have been true. The number of fawns affected by starvation and disease may have been higher than recorded if fawns taken by predators during the first 5 days of life had survived. Some symptoms of disease were probably missed, especially during the first year of the study, due to the inexperience of the observers and the freezing of carcasses before necropsy.

Length of time from marking, the presence or absence of the doe, the presence of mild curd in the rumen, and the presence of serous atrophy of fat were indicators used to determine abandonment losses. Three of 9 starvation-disease losses had no significant symptoms of disease and were listed as abandonment losses.

In 6 of 9 case histories, sufficient symptoms were observed to indicate that disease was at least contributory to death. In one case, a systemic infection was apparently caused by an infected umbilical cord.

Five nonpredator-related losses and 1 eagle-killed fawn showed similar symptoms upon necropsy. In all 6 cases, mild to severe enteritis was evident. The livers and spleens were typically swollen and edematous and the livers were reddish-black. In 3 of 6 cases, at least 1 of the hock joints had pinkish-colored synovial fluid. In 1 case, all 4 hock joints were edematous and had large amounts of fibrinous material. Typically, these animals had rough dry coats, empty rumens, and enlarged and edematous prefemoral, suprascapular, and mesenteric lymph nodes. Two fawns picked up alive, but in an obvious weakened condition, had rectal temperatures of 29.4°C (85°F), or less, and impaired suckling responses.

Histopathology provided little conclusive data on disease losses. Anomalies such as mild congestion, edema, and cell degeneration were observed, but the conditions were not severe enough to have caused death. Two thymus glands collected from weak-acting fawns showed indications of poor fetal development but the sample size was too small to draw a reliable conclusion. The mean weights of 15 thymus glands, collected from fawns, increased during the 3 years of the study from 0.582 to 0.799 to 2.31 g. Thymus weights were highest during 1978 when losses to starvation-disease were the lowest.

Table 2 presents data on rectal and nasal cultures taken from newborn fawns during 1977. Data are lacking on basic flora and fauna of newborn pronghorn fawns and these data are included in the hope they will be useful to subsequent researchers.

Four of 5 blood samples taken from newborn fawns had positive detectable antibody titers for para-influenza 3, indicating a possible high rate of exposure in adult Pahsimeroi pronghorns. The 5 samples had no detectable antibodies for infectious bovine rhinotracheitis, blue tongue, or bovine diarrhea.

Table 2. Results of nasal and rectal cultures for 1977

Fawn no.	Date	Nasal	Rectal	Fate
1	5/31/77 6/1/77*	Bacillus subtilis Bacillus subtilis Pseudomonas spp.	Negative Pseudomonas spp.	Trauma
2	5/31/77	Pseudomonas spp.	Pseudomonas spp. Staph. epidermitis	Predation
3	6/1/77 6/1/77*	Pseudomonas spp. Pseudomonas spp. Bacillus subtilis	Pseudomonas spp. Pseudomonas spp.	Disease
4	6/1/77	Pseudomonas spp.	Staph. epidermitis	Survived
5	6/1/77	Negative	No sample	Survived
6	6/1/77	Negative	Negative	Survived
7	6/1/77 6/3/77*	Pseudomonas spp. Pseudomonas spp.	Staph. epidermitis Staph. epidermitis	Starvation-disease
8	6/1/77	Pseudomonas spp. Staph. epidermitis Bacillus subtilis	Negative	Survived
9	6/1/77	Negative	Negative	Survived
10	6/6/77	Bacillus spp.	Bacillus subtilis	Starvation-disease
11	6/6/77	Bacillus subtilis	Negative	Predation
12	6/6/77	Bacillus subtilis	Staph. epidermitis	Survived
13	6/6/77	Bacillus subtilis	Pseudomonas spp.	Survived
14	6/6/77 6/10/77*	Bacillus subtilis Pseudomonas spp.	Negative Pseudomonas spp.	Disease
15	6/6/77	Pseudomonas spp.	Negative	Survived
16	6/10/77 6/20/77*	Negative Not done	Negative Not done	Disease
17	6/10/77	Bacillus spp.	Negative	Survived

*Post mortem.

Fawns were weaker, less precocious, easier to catch, and more docile when handled in 1976 and 1977 than in 1978. Kidney fat and serous atrophy of fat were almost absent in 1976, increased somewhat in 1977, and were significantly greater in 1978. During 1978, fawn kidneys had approximately 30% of their surfaces covered with fat.

Seventeen liver samples collected from pronghorns killed by hunters in the Pahsimeroi were analyzed for trace mineral levels by the neutron activation technique (Stoszek et al. 1978). She considered the selenium levels deficient when compared with levels found in Montana pronghorns. Individual pronghorns from the Pahsimeroi had liver selenium levels as low as those of selenium-deficient farm livestock suffering from clinical signs of white muscle disease.

Possible Causes of Weak Fawn Syndrome

Ward (pers. comm.) and Card et al. (1973) recognized and described symptoms of weak calf syndrome in cattle. Affected animals showed 1 or more of the following symptoms: hemorrhages, edema or fibrinous material in the leg joints; atrophic thymus glands; enlarged and edematous suprascapular and prefemoral lymph nodes; and susceptibility to secondary bacterial enteritis leading to diarrhea. Calves sometimes died of hypothermia in rather mild winter weather (4.4°C). Calves and lambs were born in a weakened condition and many died within a few days after birth. Domestic lambs suffering from the syndrome often had minor infections and swollen spleens and livers. In most cases, the abnormalities are not severe enough to have been the direct cause of mortality.

Causes of the weak calf problem are not well known. Bull et al. (1974) found a relationship between the nutritional state of pregnant cattle in Lemhi and Custer Counties, Idaho, and subsequent calf survival. Januszewski

(1972) reported a causal relationship between weak calf-lamb syndrome and a virus in Montana. Epidemiology also suggests that the syndrome is caused by an infectious organism. In Montana, the syndrome appeared to be restricted to the first calves of infected cows, and the problem was first noted in a herd of cattle brought in from out of state. Bull et al. (1978) was able to produce symptoms of weak calf syndrome in domestic cattle by subjecting newborn calves to cold stress. Ushijima (pers. comm.) successfully treated weak calves with injections of thymus-gland extract.

The symptoms described for weak calf syndrome were very similar to those observed in Pahsimeroi pronghorns. In general, the symptoms were less severe in pronghorns than those reported for domestic cattle. We suspect that pronghorn fawns are more susceptible to hypothermia than domestic calves due to their smaller size and greater potential to lose body heat. Pronghorn fawns suffering from weak fawn syndrome (WFS) probably die before the symptoms become as severe as those observed in domestic cattle.

The relationship of viral infections to WFS is not known. The relationship of viral infections reported by Januszewski (1972) indicates a possible cause in pronghorns. Because the thymus gland is involved in the immunological response, the small and underdeveloped thymus glands observed during the first 2 years of the study may have been, at least partially, responsible for the secondary enteritis and other indications of mild infections observed in Pahsimeroi fawns. Minor infections could cause death if they are severe enough to weaken the fawn and impair its ability to nurse. The loss of heat derived from the milk could lower body temperature, further weakening a fawn. Hypothermia would be the result and the final direct cause of mortality. During periods of severe weather conditions,

cold stress would make hypothermia even more likely.

Pahsimeroi fawns come from does that have been nutritionally stressed during the previous summer (Bodie 1979). Kidney fat indices show that Pahsimeroi does have low fat reserves during September in comparison to other populations. Carcass weights of hunter-killed does were also lower during some years than for other populations.

Ozaga and Verme (1978) reported that thymus weights in white-tailed deer were related to nutritional plane on a seasonal and regional basis and suggested a negative correlation between general vitality and size of thymus in young fawns. Pahsimeroi fawn thymus weights also appeared to be related to the nutritional condition of the doe (Bodie 1979). Although sample sizes were small, fawn losses appeared to be less during a spring following a hunting season when does were in good nutritional condition than during springs after the does were in poor condition. Fichter and Nielson (1964) hypothesized that fawn survival was directly related to the amount of precipitation the previous summer in the upper Pahsimeroi. Better forage conditions allow better doe condition and apparently better fawn survival the following year.

The low level of selenium in liver samples indicates the possibility of nutritional muscular dystrophy (NMD) or white muscle disease in Pahsimeroi pronghorns. We did not suspect NMD during 1976 and 1977; consequently, we did not check for symptoms. However, at least 2 fawns had very pale muscle tissues, an indication of the presence of NMD. Domestic lambs affected by moderate selenium deficiencies were listless, unthrifty, and weak (Paulson et al. 1968). We suspect selenium deficiency is also implicated in WFS.

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NATURAL TRACE MINERAL DEFICIENCY IN NATIVE PRONGHORN ANTELOPE POPULATIONS

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In the upper Pahsimeroi Valley of central Idaho, the survival of newborn pronghorn antelope fawns is considerably lower than in nearby Montana. In addition, the rate of fawn survival in the Pahsimeroi Valley declined considerably during the last 20 years. While the average August doe/fawn ratios in 1957 to 1960 ranged from 62 to 95 fawns/100 does, in 1973 to 1975 these ratios averaged only 43/100 does (Autenrieth 1976). The newborn fawns often exhibit signs similar to those found in the "weak calf syndrome" (Card et al. 1973), such as bloody discoloration of synovial fluid and fibrin in tarsal joints, subcutaneous hemorrhages and edema, absence of suckling reflex, and general weakness combined with lowered body temperature. Secondary bacterial infections are often found shortly after birth.

In the fall of 1977, tissue samples were collected from 55 hunter-killed pronghorn antelope in the Pahsimeroi River, Little Lost River, and Birch Creek drainages of central Idaho, and from an area some 30 miles east of Bozeman in Montana. All samples were transported frozen to the laboratory and analyzed by neutron activation and atomic absorption techniques for content of iron, zinc, cobalt, selenium, chromium, copper, rubidium, and scandium. Tissue samples collected from pronghorn antelope killed in the Little Lost River, Birch Creek, and Pahsimeroi River drainages of Idaho contained significantly lower levels of selenium ($P < .001$), zinc ($P < .05$), iron ($P < .05$), cobalt ($P < .01$), and scandium ($P < .05$) than similar samples from Montana antelope. When compared with similar trace-mineral levels found in domestic livestock and in Montana pronghorn tissues, all Idaho pronghorn antelope had

severely reduced tissue concentrations of selenium. Liver selenium found in Idaho pronghorn averaged $0.52 \pm .16$ ppm (dry weight), with individual levels of 0.35 ppm being similar to levels found in livestock suffering from white muscle disease. Compared with liver selenium levels from "normal" Montana pronghorn, which averaged $1.21 \pm .20$ ppm, and with healthy pigs and sheep averaging 1.2 to 1.8 ppm, Idaho pronghorn can be considered severely deficient in selenium. Less severe reductions of zinc, iron, cobalt, and scandium found in Idaho pronghorn tissues also deserve attention.

In Europe, gradual removal of trace-minerals from marginally low soils through livestock grazing, logging, and cropping activities resulted in depletion of minerals and increasing trace-mineral deficiencies in plants and animals. Marginal deficiencies of critical minerals became progressively more severe, and, had it not been for proper trace-mineral supplementation, the soils would have eventually become unable to support plant and animal life. Low birthrate and increasing fawn mortality in pronghorn antelope populations in Idaho over the last 20 years may also result from such trace-mineral depletion. Annual variation in soil moisture, reflected in varying amounts of available minerals (Underwood 1977), may be directly correlated with variation in pronghorn mortality.

The results of analyses of pronghorn tissue samples indicate that deficiency of selenium, combined with reduced levels of several other trace-minerals, may be one of the factors responsible for the decline of eastern Idaho pronghorn herds. If so, correct trace-mineral supplementation would improve survival rates dramatically. Under existing land management practices and without supplementation, however, the eastern Idaho pronghorn populations may continue in their steady decline.

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COMMENTS AND QUESTIONS

AMSTRUP: You said the other day when we were talking that effluents from certain kinds of power plants could be tying-up certain minerals. Would you like to repeat that?

STOSZEK: Yes, by all means. Industrial pollution definitely is part of man's influence on the soil. If we add an element, whichever element it is, there is interaction among elements. One element can influence as many as half a dozen, which in turn influence others. So really all the trace elements are influencing each other. For example, copper. If you have a normal level of copper, say 6 to 8 parts per million and you have normal levels of molybdenum, you have normal animals. You do not change the level of copper, you keep that the same. And you decrease the level of molybdenum and you create copper toxicity. Again, with the same level of copper, you increase the molybdenum level; perhaps through industrial pollution, you create severe copper deficiency. The same for zinc and selenium--all the trace minerals are influenced by others. Not only adding or removal but tying-up the

ability of animals to absorb these elements and that definitely speeds up the whole process.

McKENZIE: North Dakota is in an area indicated as having no particular problem. As a matter of fact, it's almost the other end of the spectrum. In many areas of North Dakota they have this selenium poisoning or alkali disease as they call it. Very recently and these occurring downwind of the coal fire generating plants, we're running into selenium deficiency in livestock primarily. We have a veterinarian down there studying this. Is sulphur tying-up the selenium?

STOSZEK: Yes, sulphur is very much so. Sulphur ties up just about anything. That has been really one of the large problems. There is a whole list of papers from industrial nations in Europe, for example, when they are in the shadow of a large plant. That goes for hundreds of kilometers, and they have probably no livestock.

AUTENRIETH: All the way through on your tables you were relating to livestock in terms of the pronghorn being efficient. Are we really justified in saying that because pronghorns have a lower level of these trace elements that they are, in fact, deficient as compared to livestock?

STOSZEK: That we really don't know at the moment. There is no normal level established for pronghorn or for any other wild ruminant. We have studied these animals to actually establish what is normal, that we can start judging these levels. However, I have looked through literature and collected all the data available on other animals. It starts from mouse through rat through domestic livestock, monkey, human and all these levels are almost identical. There is very little difference among them. No, I am not saying that pronghorn antelope

cannot have different levels. However, since our Montana herd which has a normal reproductive rate and looks very vigorous and healthy is approaching the normal levels found in all the other animals. I am presuming that Idaho sites are deficient and Idaho animals are deficient.

AUTENRIETH: Birch Creek is our most productive population and we're running 90 fawns per 100 does there.

STOSZEK: Right. And Birch Creek is also somewhat higher than 2 other areas, both Pahsimeroi and Little Lost Rivers. There is a slight difference among the samples. Now this slight difference could be sufficient to keep reproductive rates at high level. However, drought, for example, if you have a really dry year which slows down absorption from the soil to the plant of this critical element, could produce very same symptoms one year and next year it could be gone because of better rain conditions or better moisture conditions. So what I'm saying is that these sites definitely are on the borderline level or below it. Now again keep in mind that the samples were collected from animals that were killed by hunters. These were not does just about ready to give birth to a fawn. In my opinion, those would be lower yet than the animals we have seen here. And the newborn levels of course would be lower also because of increased demand for the fetus developing in the doe.

BARRETT: Have you done, or would you recommend, soil and vegetative analysis in those specific study areas to see what contrasts might exist from year to year and area to area?

STOSZEK: It really depends on the amount of funding. Quite frankly, the study that I just reported on was not funded by anybody and it was done by volunteers. At the moment we are not able to secure funds even for trace mineral salt blocks to distribute to these animals to see if we can improve the weak fawn syndrome through selenium-cobalt supplementation. In my opinion, it is a lot more feasible to start analyzing tissues of the animal, primarily because, as I mentioned earlier, of very large interactions among minerals. You may know that the plants that the animals are consuming have such and such levels of trace minerals, but as to the actual interaction among them in the body of the animal we really can't be sure unless we go directly into the product of these interactions and that's the animal. We are analyzing at times some enzyme. All the trace minerals are needed for enzymatic activity. So if we analyze the enzyme, we know that if activity is normal an animal's trace minerals are at normal levels. If activity goes down to zero or very low, we know that the animal is deficient.

BARRETT: I guess what I'm really looking for is large areas associated with energy development where we may be changing what is available in soil. What are the types of indicators we might look at in terms of seeing what's going on before we get to the point where there is a serious problem?

STOSZEK: You can start analyzing plants and soil samples. I would advise that, however, you should have now established some baseline level of what is available before this process of development occurs-- something to compare it to. I have seen too many samples analyzed and nobody being able to interpret them once they are finished with the analysis. So yes, I think it can be prevented, at least to some extent.

VULNERABILITY OF PRONGHORN FAWNS TO PREDATION

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Abstract: While the importance of pronghorn fawn predation during the first 3 weeks subsequent to birth have been well documented, the differences in recruitment rates between populations have not been fully addressed. This paper presents data indicating Idaho antelope populations can be classified by the birth and bed site vegetative cover. Recruitment rate is directly related to fawn vulnerability to predation during the period of lying secluded.

The measurement of vegetation at 63 birth sites and 366 bed sites combined with 7 years of August population trend data and a 2 year transmitted fawn mortality study near the east fork of the Salmon River were the basis for determining vulnerability relationships.

The mean birth site vegetation coverage for the 5 populations studied ranged from 49.5% to 30.1% while the bed site coverage ranged from 59.1% to 23.6%. The average recruitment rate for the 59.1% bed site cover was 76 fawns/100 does while 24 fawns/100 does were recorded in the 23.6% cover.

Vulnerability to both avian and mammalian predators increases when vegetation cover decreases. Avian predators (golden eagles, Aquila chrysaetus) seem to be more successful where vegetative cover is low. Mammalian predators (principally coyotes, Canis latrans) are more successful where cover is not homogeneous and vegetation clumps are used for bedding.

In spite of annual differences in predator and primary prey species levels and other variables, the most important population constraint on marginal rangelands appears to be predator vulnerability during the first 3 weeks after birth. While a predator control program may not be feasible

or desired, an understanding of this principle is important in dealing with range rehabilitation programs, stocking rates and planning realistic harvest levels.

COMMENTS AND QUESTIONS

STOSZEK: Would you possibly consider a link between mineral content of the range and the number and density of the plant cover?

AUTENRIETH: It certainly seems reasonable. I have to admit I haven't considered that. I've been listening to your presentation and the implications. I understand the importance of the problem we are dealing with here. I'm a little frustrated--I haven't seen more of the problem with selenium deficiency. I've observed maybe 150 fawns born, and to be sure we had 4 here with unknown causes of death which we weren't able to document in the lab. Maybe that related to the way I handled the processing too. I think it could very well be a problem particularly in the Chalice area. Of course another problem that I left you hanging on was the wild horses and I'll tell you about that in 2 years. One of the problems associated with the conflict between horses and animals in the Chalice is abuse of the range, and that has certainly been a problem which leaves the fawns more vulnerable during the critical period.

QUESTION: When you mention cover, are you talking about total cover or just overstory?

AUTENRIETH: I should have gone into the other aspects on the slide and I think I would have made that more clear. But I was talking about the total coverage including the grass and forbs. Where you have a layering effect, not just sage with bare ground, it appears that the safety of those fawns is dramatically greater.

BALL: Did you approach the study from the direction of range condition?

AUTENRIETH: No. All I'm doing is documenting what is being used at this point. Whether in fact we can do anything about what we observe here is certainly a point, the next step. At this point the best we can do is recognize what some of the constraints are and adjust our management programs, realizing that the Chalice will probably never be producing 90 fawns per 100 does if they continue to fawn under existing conditions.

YOAKUM: All of the sites that you have shown look to me like they were sagebrush sites. Do you have any of your pronghorns dropping young that are not in a sagebrush site or a dominant sagebrush site, so you could be making some comparisons?

AUTENRIETH: You've spent enough time in south Idaho to know what our habitat is there. It's very unusual to have fawning occur outside of the sagebrush areas, although I know of one case where a doe had fawns in an alfalfa field. Those things do happen, but of the study areas I gave you, no. I'd say they're not very adaptive.

COYOTE PREDATION ON NEONATAL FAWNS ON ANDERSON MESA, ARIZONA

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Abstract: Anderson Mesa is a 7,000-foot high plateau south of Flagstaff which is the spring-summer range for a pronghorn herd which winters on saltbush-short grass plains to the east. This herd numbered perhaps 3,000 head for a short period in the 1930s. Aerial surveys begun in 1944 show a peak of over 1,800 head in 1950, followed by a general decline. Since a severe winter die-off in 1967-68 this population has remained stabilized at 250 to 400 head. Fawn survival has been consistently low except in years when coyotes were controlled with 1080. Fawn survival has averaged 28 fawns per 100 does in July aerial surveys since this study began in 1974.

Six years of observation of fawning activity indicate a normal birth rate, excellent health and vigor in fawns, and normal maternal care. Malnutrition, disease, and parasites thus do not appear to be significant factors in low fawn survival.

There is abundant evidence of coyote predation on neonatal fawns, including direct observation of killing and feeding behavior, location of fawn remains with dogs, and coyote scat and stomach analysis. This evidence confirms earlier research and management experience in coyote control on this area going back over 30 years. It must be concluded that coyote predation on neonatal fawns is the most important single factor and is largely responsible for the decline of the herd. An experiment is now underway to determine the feasibility, costs and benefits of coyote control by sport-hunting and steel trapping (the only control methods now available to us).

INTRODUCTION

The Anderson Mesa pronghorn antelope herd was once the largest and most productive in Arizona. Total numbers were estimated to be at least 2,200 head in the early 1930s and 1940s (McGregor 1935a, 1935b; Knipe 1944). The trend in numbers has been generally downward since about 1950 (Fig. 1), except for short-lived resurgences in 1959 and 1967. For the past 10 years antelope numbers in this herd have been only about 20% of the numbers counted in 1950. Fawn survival has been chronically low. In the 23 years since 1957 there have been 12 years of less than 40 fawns per 100 does, and only 5 years when fawn survival exceeded 57 per 100 does (the minimum for the 1950-56 period).

Predation by coyotes was identified as a major fawn mortality factor in the 1940s (Arrington and Edwards 1951). Game management personnel over the years have made local investigations of various problems, including range condition and drought, predation, disease and parasitism, storms during fawn drop, and illegal kills. However, no intensive research on pronghorn antelope has been conducted since 1949 (Edwards 1950).

The questions to be addressed in the present study are related directly to the causes of the low fawn:doe ratios observed in the annual aerial surveys: Is the birth rate normal? Is the physical condition of does and fawns adequate? When is fawn mortality occurring? What mortality factors are involved?

DESCRIPTION OF STUDY AREA

Anderson Mesa is a basalt-capped plateau extending south and eastward from Flagstaff for about 40 miles. Elevation is around 7,000 feet and terrain is gently rolling with numerous ephemeral lake basins. Vegetation is ponderosa pine forest on the west, mountain meadow grassland in the center, and pinyon-juniper woodland along the east side. Off the east side of the mesa a steep pinyon-juniper slope drops 800 feet onto shortgrass-saltbush plains. Large

areas of pinyon-juniper control in the 1950s and 1960s narrowed this belt of woodland. The spring-summer range on top of the mesa totals about 225 mi² but open grassland range has been significantly reduced by invasion by both pine second-growth and pinyon-juniper woodland. Approximately 3/4 of the herd is migratory, wintering on the plains, but moving up onto the mesa in early spring. Consequently, the majority of the fawning activity occurs on the mesa. This high range is weedy grassland with numerous palatable forb species but almost no shrub layer. Forage production for antelope is excellent, but hiding cover for the fawns in May and June is very poor. Thanks to water development efforts over many years by the local ranchers, there is now abundant water on what was originally a very dry range.

Anderson Mesa lies entirely within the Coconino National Forest and is grazed by cattle under permit. The winter range east of the mesa is checker-boarded by private and state lands which are grazed by the Raymond Buffalo Ranch (AG&F) and 3 large cattle ranches. Portions of the winter range still show the marks of early day overgrazing but present range management is vigorously progressive.

METHODS

Aerial surveys are conducted annually in July by game management personnel in light fixed-wing aircraft. Coverage of the mesa top has been quite consistent since about 1944, but coverage of the winter range to the east has varied somewhat from year to year.

Field work on the fawning grounds on the mesa top began in May 1974. The classic methods of collecting does for necropsy (Larsen 1970) and putting radio mortality collars on neonatal fawns (Beale and Smith 1973) were considered but were rejected on the grounds of excessive impact on an already threatened population. It was decided that information on fawn production

and survival would be obtained if possible entirely by unobtrusive observation. During the first 3 years fawning observations were conducted by stalking and watching antelope at close range. In conjunction with this work carcass searches were made using black-and-tan hounds who worked on leash and were encouraged to lead the observers to any interesting smells they detected. During the past 3 years most observations have been made by spotting scope from a tower on 300-foot Pine Hill. This system has proved highly efficient in numbers of both antelope and coyotes observed and also offers a degree of standardization which permits comparison among years in numbers of observations per hour. Coyote food habits have been determined by stomach and scat analysis.

RESULTS AND DISCUSSION

Aerial Surveys

Annual aerial surveys have been reasonably uniform on top of Anderson Mesa. The flight areas originally outlined (Arrington and Edwards 1951) are still in use. However, the low winter range where approximately 25% of the herd is resident has usually received less intense coverage and sometimes has not been flown at all.

The overall trend in population during the past 11 years is more stable than in previous years. During the 11 year period since the 1967 winter die-off, the adult population count (excluding fawns) has varied from 175 to 347 with a mean of 281 and a coefficient of variation of only 17%. The average annual loss was 8% of the bucks (excluding legal kill) and 13% of the does. Including legal kill the total population turnover has averaged 19.8% per year. This is much lower than the 37% turnover calculated by Ellis (1972) from Bear's northwest Colorado data. Thus it seems that the adult population has stabilized at a low density level with low mortality and low recruitment.

Natality

Winter-killed does necropsied east of Anderson Mesa after the 1967 blizzard were almost all carrying fawns and 85% had twins, or about 175 fetuses per 100 does (Wayne Anderson, in Arizona Game and Fish Dept. 1968). A major goal of the present study was to supplement this finding by direct observation of does and their neonatal fawns. This required observation of nursing and grooming activity which clearly established the maternal relationship. During the 6 years of work to date the verified fawn:doe ratios were as follows:

	Fawns	Does	Fawns per 100 Does
1974	73	56	130
1975	50	36	139
1976	41	25	164
1977	260	174	149
1978	123	93	132
1979	<u>51</u>	<u>39</u>	<u>131</u>
	598	423	141

Fetal rate for pronghorn antelope is commonly in excess of 180 per 100 does (Ellis 1970). Thus the fetal rate in the winter-killed does was close to the normal range. Since many of our fawns were 2 to 4 weeks only when observed and much of the early mortality must have already occurred, it seems likely that fawn:doe ratios of 130 to 164 also reflect normal birth rates. We therefore tentatively conclude that our problem is largely, if not entirely, postnatal.

Mortality

During the on-the-ground work of the first 3 years we located with the hounds 39 neonatal fawns killed and/or eaten by coyotes (Table 1). One September fawn kill and 6 spring adult kills by coyotes were also located.

Only one fawn carcass was found which showed no evidence of predation.

Poaching and illegal kill during the hunt accounted for 1 fawn and 5 adults.

During this 3-year period aerial surveys in July counted a total of 224 does and 98 fawns on the Pine Hill study area. If we assume a birth rate of 175 fawns per 100 does we can estimate that a total of 392 fawns were born on the study area during these 3 years. Only 98 fawns survived to be counted; 294 were presumed dead, a 75% mortality rate. We were able to find the remains of 40 neonatal fawns, or 13.6% of those presumed lost.

During the 3 years of observation from Pine Hill we were only occasionally able to verify a coyote kill or feeding site on the ground. However, observation of coyote and mother doe behavior provided presumptive evidence of 30 more fawn deaths. In 16 cases the coyote(s) were observed feeding, and in 14 more cases no predator was seen but highly agitated behavior by the doe indicated the loss of a fawn or fawns. In 2 cases the actual kill of a fawn by a coyote was observed.

During this 6 year study 192 coyote observations were tallied, no foxes or bobcats were observed, 1 eagle was seen on the ground and 2 more flying overhead. Observations of tracks and scats and catches in steel traps in the area supported the assumption that coyotes were numerous but other predators were scarce on the fawning grounds.

Mortality factors such as malnutrition, disease, parasites, injuries and abandonment cannot be ruled out by the methods employed here. However, in 865 fawn observations to date we have never seen one that was sick, weak, injured or otherwise abnormal. We feel that if there were a significant occurrence of such slow-acting mortality factors we would have seen some sign of it. We therefore conclude that predation by coyotes is the predominant cause of death in neonatal fawns on the Anderson Mesa study area.

Fawning Observations.

Observations from Pine Hill tower based on numbers of antelope and coyotes seen per hour (Table 2) have produced some dramatic trends in the past 3 years:

1. Fawn antelope per hour decreased by 90% from 1977 to 1979.
2. Coyotes per hour increased by 700% from 1977 to 1979.
3. The predator-prey ratio (fawns per coyote in observations per hour) in 1979 was less than 2% of the 1977 ratio.
4. During this period the adult antelope herd apparently remained stable; however, numbers using the study area in 1979 were low because of unusually good forage production on the winter range.
5. There was no difference between morning and evening observations of adult antelope and very little difference for fawns, but coyotes were clearly more active in the morning. Coyotes hunt before dawn; several feeding coyotes were observed at first light.

Fawn Survival and Coyote Control

There is in the Anderson Mesa area considerable circumstantial evidence linking high fawn survival to coyote control work. Steel trapping alone from January to June 1946 north of Canyon Diablo produced a July aerial survey ratio of 50 fawns per 100 does, while a similar but untrapped area south of Diablo produced only 17 fawns per 100 does (Arrington and Edwards 1951). Further work in this same area and other northern Arizona antelope ranges with various toxicants produced similar results from 1946 through 1950.

Management experience over the 34 year period from 1946 to 1979 has been compiled by Unit 5B Wildlife Manager Wayne Anderson (Table 3). The control work was done by compound 1080 from 1948 through 1970. In Table 3 there are 3 categories: 11 years when control was done the previous winter just before

fawn drop; 6 years when control work was done a year earlier; and 17 years with no control work during the preceeding 2 or more winters. Fawn survival immediately after control work was consistently high (mean = 76 fawns per 100 does), but dropped rapidly when control was discontinued.

Coyote Food Habits by Scat Analysis

A total of 65 winter and 102 spring-summer coyote scats have been analyzed (Table 6). Results show that cottontails and jackrabbits are the most important food items on the winter range, followed by cattle (probably mostly carrion, but possibly including some calves), and rodents. Antelope and mule deer material showed up in 9 and 12% of the scats respectively, and probably included both kills and carrion. Insects, reptiles, and birds were rare, while juniper berries and other vegetation were common items.

On the spring fawning grounds scats were mostly collected during fawning observations and kill searches. It is not surprising that 63% of the scats contained antelope remains. Cattle and other big game were minor elements, as were rabbits. Rodent material was found in 28% of the scats, indicating considerable time spent mouse-hunting. Birds were also a major item, largely nesting horned larks and meadowlarks. Insects were present in 25% of the scats, and again juniper berries and other vegetation were common.

CONCLUSIONS

Based on direct observation of antelope and coyote behavior and on carcass searches and scat analyses over the past 6 fawning seasons we have reached the following tentative conclusions:

1. Birth rate in this antelope herd is in or near the normal range.
2. Fawns are strong and vigorous with no indication of any significant occurrence of physical debility. Maternal care is normal and abandonment is insignificant.

3. Coyotes are common to abundant on the fawning grounds and are actively hunting fawns. Scat analysis and feeding site examination indicates a high impact of coyote predation on neonatal fawns. No other predator has been implicated to a significant degree.

From these conclusions and from past management experience in this area we have formulated the hypothesis that coyote predation is the primary cause of low fawn survival on Anderson Mesa. We now are engaged in a 5-year test of the efficiency, costs and benefits of winter and spring coyote control by steel trapping and sport hunting. No other coyote management techniques are available to us at present, although a proposal for controlled use of aerial gunning is now before the state legislature.

We are investigating home ranges and movements of coyotes to aid in future management. We also are beginning to study range forage production in hopes that the herd will increase and concern will shift from survival to range carrying capacity.

Total Antelope Count

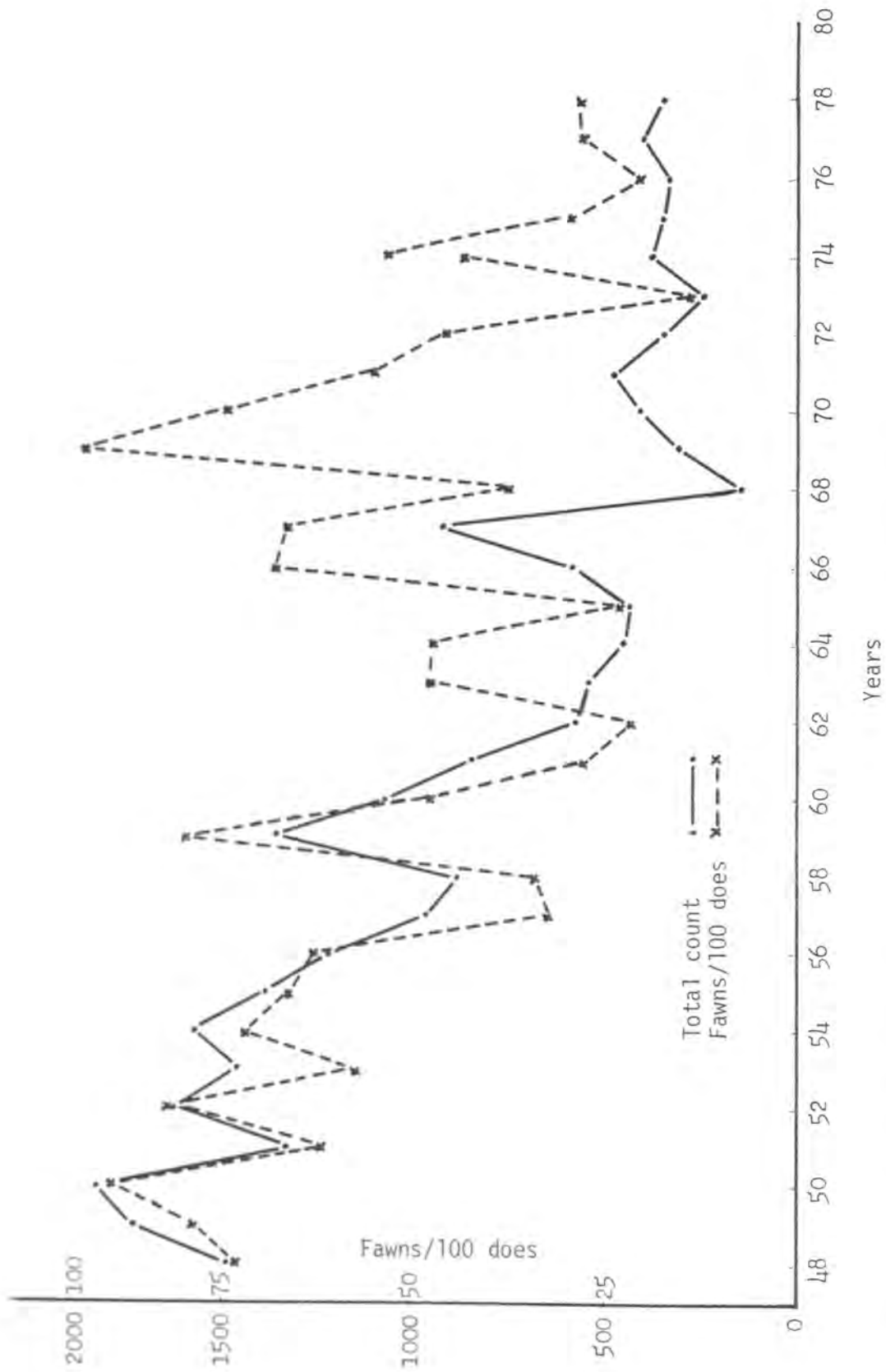


Fig. 1. Antelope population trends and fawn survival on Anderson Mesa. Data from aerial surveys, Arizona Fed. Aid Project W-53-R.

Table 1. Observed pronghorn antelope mortality, Pine Hill-Ashurst Lake study area on Anderson Mesa, Unit 5B. 1974-76

	Spring 1974	Fall 1974	Spring 1975	Fall 1975	Spring 1976	Totals
Fawns:						
Coyote kill/feed	4	1	18	--	17	40
Illegal kill in season	--	--	--	1	--	1
Cause of death unknown	1	--	--	--	--	1
	<u>5</u>	<u>1</u>	<u>18</u>	<u>1</u>	<u>17</u>	<u>42</u>
Adults:						
Coyote kills	2	1	--	--	2	5
Lion kill	--	--	1	--	--	1
Bear kill?/feed	--	--	1	--	--	1
Poached, out of season	--	1	1	--	--	2
Illegal kill in season	--	--	--	2	--	2
Crippling loss, legal buck	--	1	--	--	--	1
Cause of death unknown	1	--	1	--	2	4
Date and cause of death unknown	--	--	--	--	--	--
	<u>3</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>16</u>

Table 2. Summary of pronghorn antelope and coyote observations from Pine Hill Tower, Anderson Mesa, Arizona

Observation	Year	Total Hours	Adult Antelope per Hr.	Fawn Antelope per Hr.	Coyotes per Hour	Fawns per Coyote
Morning	1977	38.67	17.33	4.55	0.18	25.3
	1978	48.18	18.80	2.03	0.60	3.4
	1979	62.00	10.34	0.48	1.06	0.5
Evening	1977	25.67	18.35	4.99	0.04	124.8
	1978	39.30	18.07	1.70	0.23	7.4
	1979	44.31	11.67	0.47	0.56	0.8
Total	1977	64.33	17.74	4.73	0.12	39.4
	1978	87.48	18.47	1.89	0.43	4.4
	1979	106.31	10.92	0.48	0.86	0.6

Table 3. Relationship of pronghorn antelope fawn survival to coyote control in the Anderson Mesa-Canyon Diablo area, 1944 to 1979. Data are fawns per 100 does counted in June or July aerial censuses

Control work during preceding winter	One year since last control work	Two or more years since last control work
1946 - 62	1947 - 66	1944 - 30
1948 - 74	1951 - 62	1945 - 39
1949 - 79	1953 - 57	1956 - 62
1950 - 90	1955 - 66	1957 - 32
1952 - 81	1960 - 48	1958 - 34
1954 - 71	1971 - 55	1961 - 28
1959 - 80		1962 - 22
1966 - 69		1963 - 48
1967 - 67		1964 - 48
1969 - 93		1965 - 23
1970 - 74		1972 - 46
		1974 - 44
		1975 - 30
		1976 - 21
		1977 - 28
		1978 - 28
		1979 - 14
Number of Years	11	17
Mean	76.4	59.0
Range	62-93	48-66
		14-62

Note: Two years (1968 and 1973) were excluded from this table because of severe winter weather which probably affected subsequent fawn survival.

Coyote control work consisted of 1080 poison baits from 1948 to 1970. Intensive steel trapping and strychnine baits were used in 1946.

Table 4. Analysis of coyote food habits by scat analysis, Anderson Mesa spring-summer range and Canyon Diablo winter range, Unit 5B. Determinations by Norman Woolsey

Taxa	Winter		Spring-Summer	
	Occur. %	Volume %	Occur. %	Volume %
Cattle	15.4	30.4	6.9	51.4
Antelope (<u>Antilocapra americana</u>)	9.2	65.8	62.7	66.6
Mule deer (<u>Odocoileus hemionus</u>)	12.3	59.1	2.0	8.0
Elk (<u>Cervus canadensis</u>)	1.5	85.0	1.0	2.0
Blacktailed Jackrabbit (<u>Lepus californicus</u>)	30.8	66.8	3.9	22.5
Cottontail (<u>Sylvilagus</u> sp.)	26.2	62.6		
Rodentia, species unknown	15.4	26.9	28.4	46.3
Wood Rat (<u>Neotoma</u> sp.)	13.8	70.6	3.9	71.0
Deer Mouse (<u>Peromyscus</u> sp.)	13.8	49.1	5.9	65.8
Birds (<u>Aves</u>)	1.5	Tr.	34.3	23.1
Lizards (<u>Reptilia</u>)	1.5	10.0		
Insects (<u>Insecta</u>)	1.5	20.0	24.5	10.7
Juniper berries (<u>Juniperus</u> sp.)	40.0	22.8	35.3	17.7
Grass (<u>Graminae</u>)	40.0	5.2	58.8	7.1
Other vegetation	18.5	18.7	24.5	9.0
	n = 65		n = 102	

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COMMENTS AND QUESTIONS

AMSTRUP: I have 2 questions. The first one pertains to the range conditions you showed of what amounted to essentially bare soil and you made the remark that you thought the range wasn't being overgrazed. It seemed to me that if there hadn't been as much removal of the previous year's vegetation, that there would be some dried vegetation remaining after the snow went off, which would be better than the bare soil situation.

NEFF: That's probably true. I suspect that it would not really be significant however.

BRITT: Don, I'd like to speak on that for a second. The grass is primarily Agropyron smithii and that stuff evidently just packs down flat. There is just nothing left.

NEFF: We do have 2 situations which do provide a little better cover than that. Thistles invaded back in the 1930s, and we have patches of thistles in the area which seems to be able to resist the snow packing. I have yet to see any indication that the fawns were selecting for thistle patches for their bed sites. We also have a great deal of the rocky, bouldery kind of situation that you saw in Bob's slides just a few minutes ago. Again, I don't see any significant indication that the fawns are selecting for that. I want to look at that some more, but at the present time they don't seem to particularly care. They'll just go out there like that one spot with the cover board and just lay right down there.

AMSTRUP: The other question I had pertained to the shrinkage of that range. You made the comment that the mesa had been invaded substantially by timber. Do you think that what you're seeing in the way of increased

coyote predation might have something to do with a less than normal concentration of fawning activity, and therefore a little bit easier hunting regime for the coyotes? Have you considered that all in your hypothesis?

NEFF: Well, we have lost considerable range. The reports that we get from the old military expedition back in the 1850's was that they saw antelope all across the mountain. It was a very wide open, large mature forest of ponderosa pine and antelope just scattered everywhere. The little parks and openings and actually in the timber itself. That has changed considerably. We had a big seed year in 1919 and it just sprang up seedlings all over the place. So our ponderosa pine forest is quite different from what it used to be and is no longer antelope range. So we've lost all of that. Then, too, we had a lot of invasion by pinyon-juniper. On the other hand we are also down at the very low density, the very low total numbers of antelope in this herd. So one can do a mental juggling act and come up with some kind of guess that maybe density is not a whole lot different now than what it was back in the old days. It is just a pure guess. We certainly don't have what you could call a concentration up on that mountain grassland. They're pretty thin up there at the present total number. It's a pretty big area, 225 square miles roughly. And we can't have more than about 300-350 head fawning up there. So they're pretty thin.

AUTENRIETH: Did you observe the birth sites? I assume you did.

NEFF: Just that one.

AUTENRIETH: So you really didn't know whether the birth site cover was similar to what the fawns were using for beds?

NEFF: That piece of bare ground there in front of that one photo, that was the actual spot where the doe laid. I've just been reading your monograph and I got all excited and spent 3 days watching that 1 doe and I finally got to see the action and that's the spot she picked, and it was wide open--no cover of any kind anywhere around.

AUTENRIETH: So probably the fawns aren't using anything much different than what they're being brought into.

NEFF: Not a whole lot. We haven't tried to qualify it the way you've been doing it, but this is the pattern. Most of the cover is just like that with the exception of a few rock patches and the thistle patches, but they sure don't seem to select for those.

AUTENRIETH: Is there a tower on what you would call a fawning area?

NEFF: It's right on the edge of one of the main study areas there. It's about a 35 square mile area of opening which we could see about 3/4 of from the tower. We can see fawns when they're up and moving as far as 4 miles away.

AUTENRIETH: Would you speculate you'd had an influx of coyotes even under a trapping program? I seem to have a gut feeling that they're coming into the fawning areas in my study area even though we might have a low density if you ran a survey.

NEFF: Well, we've got a very heavy coyote population off east and we've got a pretty good population up on top. What we don't know yet is how much movement there is back and forth. Do they migrate with the antelope? Certainly we have some coyotes up on top all winter and we don't yet know whether they're residents on territories or what. That's something we hope to do starting right now. As I said when I started, our direction has turned from a purely antelope study into pretty much of a coyote study.

We need to really pursue that and understand the coyotes and what they're doing in order to evaluate the impact upon the antelope.

LAPLANTE: Doesn't the State of Arizona have an agreement with the Fish and Wildlife Service to carry out any predator control programs and use aerial gunning?

ANSWER: We have such an agreement with the ADC, but at the present time we have several state laws which forbid the shooting of any wildlife from a motor vehicle or from an aircraft. We have to get those changed, and that's in the Legislature right now. We think aerial gunning might work very nicely. We could go on top in the winter before the antelope come up and knock those coyotes back and get the job done real quick and easy just before fawning season and maybe we could get that fawn survival figure up. If we're going to manage coyotes, that's probably about the only way we can do it.

CAPTURE METHODS FOR FREE-RANGING PRONGHORNS

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Abstract: Since the mid 1930s, thousands of pronghorns (Antilocapra americana) have been captured in large corral-type traps. Corral traps are very effective tools for trapping pronghorns, but they are difficult and time consuming to set up and cumbersome for back-country use. Linear tangle nets lack efficiency of corral traps but are less cumbersome. They are easier to assemble, disassemble, and transport to remote areas. Baiting of pronghorns has been notably unsuccessful. Although they can be captured in a cannon net with the right bait, latent mortality is excessive. Capture of pronghorn fawns is highly selective, and capture-induced mortality can be low. However, it is time consuming, and many study objectives cannot be met by capture of fawns. Drug immobilization of pronghorns is limited by effectiveness of available drugs and imprecisions in delivery systems. Overall, drive trapping with either corrals or tangle nets is the most acceptable pronghorn capture method currently available.

¹ The U. S. Fish and Wildlife Service; Montana Department of Fish, Wildlife and Parks; the University of Montana; and the Wildlife Management Institute cooperating.

INTRODUCTION

The first article about pronghorns in the Journal of Wildlife Management dealt with live trapping. In that article, Fisher (1942) credited Barker and Russell of New Mexico with the first successful pronghorn live trapping and transplanting operation. Since then, thousands of pronghorns have been captured and transplanted to facilitate their rapid comeback in North America (McLucas 1976).

Translocations continue, but many pronghorn captures today are for research purposes. More than 100 animals are often taken from wintering herds for translocation, but a few pronghorns from each of several locations may be desired for marking, radio-tagging, taking measurements, or other research purposes. The large drive traps used during translocations are expensive to build and difficult and time consuming to transport and erect. Because animals desired for research are sometimes inaccessible except by light vehicles or on foot, researchers should consider other procedures before deciding how to capture pronghorns.

Capturing methods should be evaluated relative to each researcher's goals. Parameters to consider as they are dictated by those goals and realities of the field situation include: number, age, and sex of animals needed; density of animals in the trapping area; terrain and proximity to roads; whether pronghorns are accustomed to fences; how wary the animals are; the possibility and acceptability of mortalities; and the cost (in time as well as money) per captured or marked animal. This paper draws on the literature, the authors' personal experiences, and the advice of other workers in an attempt to provide a useful guide to capturing methods for novice pronghorn investigators.

ACKNOWLEDGEMENTS

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METHODS USING AIRCRAFT TO DRIVE PRONGHORNS

Type of Aircraft

Fisher (1942) drove pronghorns into traps with fixed-wing aircraft, and McLucas (unpubl.) has captured more pronghorns with fixed-wing aircraft than with helicopters. Although pronghorns can be driven with fixed-wing craft, a helicopter is more suitable. The capability for slow flight and the great maneuverability of helicopters allow more precise direction of animal movements. Fixed-wing aircraft must apply great pressure in bursts separated by periods of little or no pressure. Helicopters can apply steady, controlled pressure and drive animals at essentially their own pace. Since metabolic acidosis is less severe in animals captured after casual pursuit (Harthoorn and Van Der Walt 1974), helicopter driving ought to be less stressful to the animals than driving by fixed-wing. Therefore, we recommend use of helicopters rather than fixed-wing aircraft wherever possible.

Corral-type Drive Traps

McLucas designed and constructed the corral trap we use. The woven wire wings of the trap are set in the shape of a straight-legged "Y" to funnel the

animals into a lane that leads into a suspended net corral. A fence that pronghorns are accustomed to crossing is covered with woven wire and used as a wing. When they realize they cannot cross it, pronghorns line up along the wing and are driven over the crest of a hill or around some other geographic feature into the lane. Approaching the wing at an acute angle usually prevents pronghorns from going through it. Three or four people hide outside the mouth of the lane. As soon as pronghorns enter the lane, a long strip of burlap or canvas hidden near the fence is pulled across the lane to haze them into the corral. One hazer closes the corral gate after pronghorns enter. Several groups of pronghorns can be "stacked" into the corral prior to handling any of them. With pronghorns in the corral, hazers resume their positions and one additional person stands motionless by the gate. When additional pronghorns are deep in the lane and hazers are advancing behind them, the gate guard swings the gate open. Upon seeing the previously captured animals, the new group usually runs to join them and the gate is closed. Over 400 pronghorns have been "stacked" into the corral in this manner.

Pronghorns should be left in the corral overnight to settle down before handling them. A canvas curtain that can be drawn across the center of the corral is used to hide workers from the animals. Pronghorns are cut into the working side of the corral two or three at a time and hazed into a catch pen where they are physically restrained. Hay is scattered in the holding pen to provide food and bedding and to settle dust or mud during catching and handling. Hoover et al. (1959) provide additional information and illustrations of drive trapping methods.

During an Alberta study, Chalmers and Barrett (1977) captured 594 pronghorns in a corral-type drive trap. They documented fates of 475 animals handled in different ways and recommended the following to reduce

trauma and mortality: use less intense aircraft pursuit; minimize handling; use darkened trailers for transportation; and trap during cold weather. These are sensible precautions to take during any attempt to capture adult pronghorns. Litton (1975) noted that a mild tranquilizer (acepromazine) and antibiotics injected upon first handling reduced mortality after capture of Texas pronghorns.

Chalmers and Barrett (1977) lost 27 percent of pronghorns that were drive trapped and transported to holding facilities. Most of those died with clinical signs of capture myopathy. Capture myopathy is a condition associated with the capture of wildlife. It is characterized externally by muscular stiffness, weakness, tremors and paralysis, and often results in death. This suggests pronghorns may not be able to withstand transportation and holding stresses, but our evidence indicates lower mortality rates are possible.

In November 1959, 85 pronghorns were drive trapped near Malta, Montana, and transported 480 km in a livestock truck to Helena, Montana. They were released into the enclosure under the grandstand at the old fairgrounds. The enclosure measured approximately 25 m X 50 m, had a soft earthen floor, and was relatively dark. Throughout their stay, pronghorns were given water, second-cutting alfalfa (Medicago sativa), grain, and freshly clipped sagebrush (Artemisia sp.), ad libitum. After 2 weeks, they were individually loaded into 1.2 m X 1.2 m X 2.4 m plywood crates equipped with feeding and watering facilities and trucked to Seattle, Washington. Then they spent 6½ days at sea before arriving in Honolulu, Hawaii, where they were dipped in a livestock pesticide and quarantined for 1 day. The following morning they were flown to the Island of Lanai, again loaded onto trucks, and hauled several miles to their release site. Throughout the entire ordeal, only one pronghorn died. During the early 1960's, several smaller groups of pronghorns

were held and shipped in a similar manner with very few losses. Comparable survival cannot be predicted for similar operations. However, these experiences verify that, under some circumstances, pronghorns can withstand holding and shipping stresses.

Our observations suggest that pronghorn populations differ in their behavioral responses to humans. Some differences may be associated with habituation to various stimuli. For example, Wyoming pronghorns we have worked with seem far less excitable and are more approachable than those in southeastern Montana. Oregon and Nevada pronghorns seemed even more excitable than those in Montana. These observations may correlate with exposure to humans and their concomitants. Such exposure was greatest in Wyoming and least in Oregon and Nevada. Perhaps other behavioral differences between populations result from natural evolutionary pressures. In any event, areal and perhaps temporal variations in capture and handling success may be partly explained by such differences between populations.

Thousands of pronghorns have been captured in corral-type drive traps (Spillett and ZoBell 1967, McLucas 1976, Chalmers and Barrett 1977, Hoskinson and Tester 1980). Corral trapping is the most efficient and cost-effective method we know for capturing large numbers of pronghorns. It is also a relatively safe method with which we have experienced less than 5 percent trap-related mortality.

On the other hand, corral traps are difficult and time consuming to assemble and disassemble making capture of fewer animals expensive. Repeated trap relocation and assembly to catch groups in different areas are cost and time prohibitive for many studies. Also, because corral traps must be hauled in a large truck or trailer, they may be difficult or too expensive to erect at sites optimum for research-related captures.

Tangle Nets

Linear tangle nets have been used to catch caribou (Rangifer tarandus) in Canada and small and medium sized African antelope (Miller et al. 1971, Young 1973). A long net (20-300 m) 2-3 m high with a large mesh is suspended vertically by notched wooden sticks leaning against each other in an A-frame configuration or simply draped in tall vegetation (Fig. 1). Occasional steel fence posts may add stability in rough terrain, or where wind is a factor. Division of nets into panels 30-70 m long facilitates mobility and assembly. Animals are driven into the net by aircraft, land vehicles, or people on foot and manually restrained after becoming entangled when it collapses. Recently, workers in Florida, Montana, Texas, New Mexico, and Arizona have successfully captured mule deer (Odocoileus hemionus), whitetails (O. virginianus), desert bighorn sheep (Ovis canadensis nelsoni), and even elk (Cervus elaphus) with linear nets (Silvy et al. 1975, Beasom et al. 1980). Because most ungulates run to cover when pursued, linear nets can be hidden by vegetation. However, pronghorns usually run to flat, open habitat when chased, and their excellent eyesight makes camouflaging nets difficult.

Our first attempts at netting pronghorns took place in southern Oregon. Because few fences were available to guide driving and the vegetation was short and sparse, we attempted to drive pronghorns into a net suspended in a big sagebrush (A. tridentata) community by 2.4-m notched wooden stakes. At first, for economic reasons, a fixed-wing aircraft was used. When the net was placed along routes commonly used by pronghorns, they were easily herded almost to the net. However, about 2 m in front of the net, the herd would perform an about-face and run directly under the aircraft.

Oregon pronghorns were finally captured by setting the net as a cul-de-sac below a pass through rimrocks and driving them with a

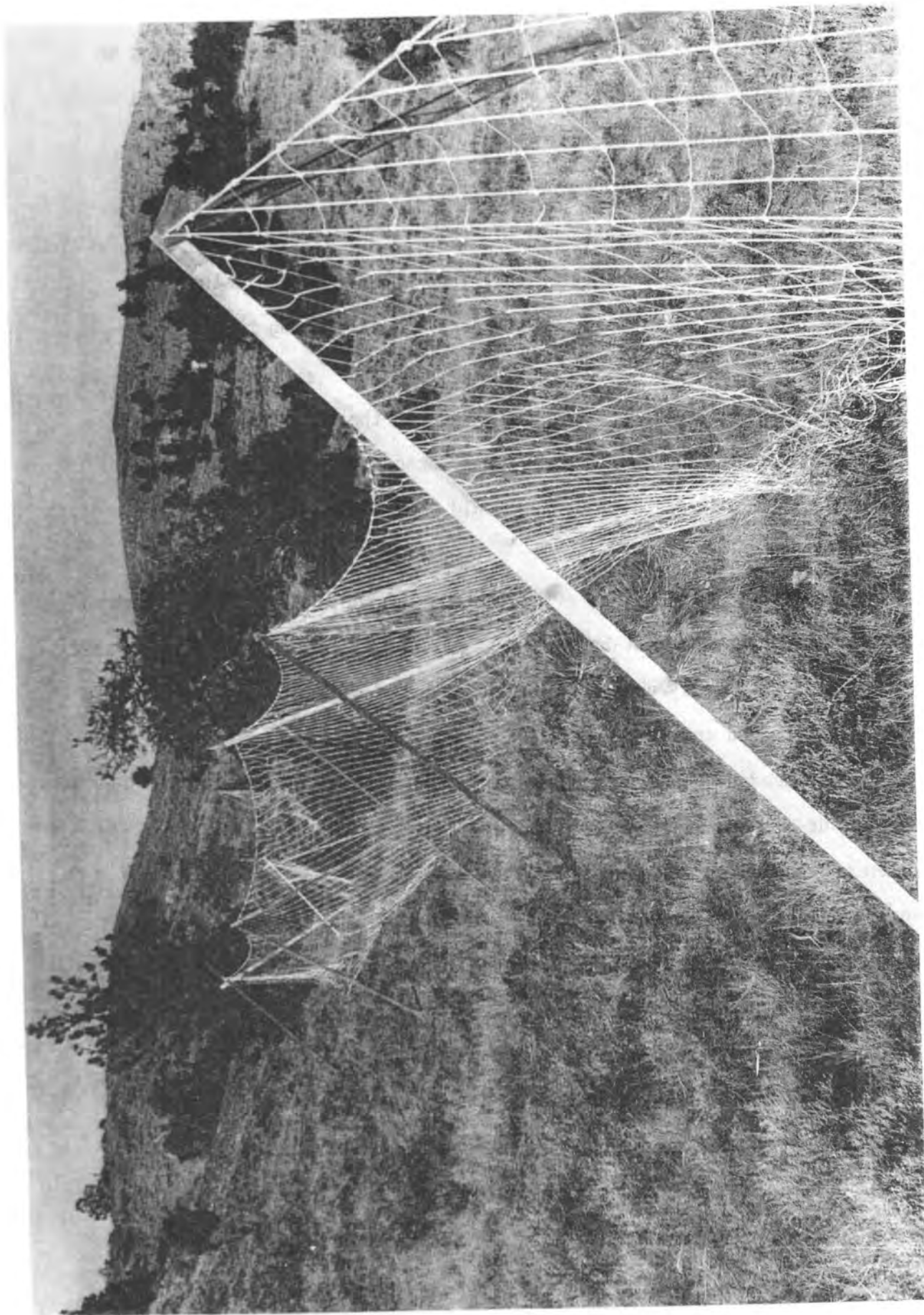


Fig. 1. Illustration of nylon net suspended by notched wooden stakes

helicopter (Fig. 2). The pass was frequently used by pronghorns going to and from a playa, and the net was not in view until pronghorns cleared the pass. Pronghorns did not go directly into the net even with the helicopter almost on the ground behind them. They would have gone back up the pass had several workers not blocked it, and several animals attempted to jump or climb a sheer rock face about 4 m high rather than challenge the net. One female broke a back leg attempting to climb the rock.

Once antelope decided to try going through the net, they drove into it low as if going under a fence. Several pronghorns would hit the net and tangle, and the rest of the herd would jump the downed portion of net and escape.

In Nevada we learned that even a helicopter could not drive pronghorns through a pass they had not been using. However, a successful set was made at the head of a grassy draw that pronghorns used regularly while traveling between a lake and surrounding sagebrush-covered hills. At this site, few stakes were needed. The net was draped on the tall sagebrush in the form of a cul-de-sac and was not very visible (Fig. 3). Pronghorns were easily driven up the grassy draw and scattered somewhat after entering the sagebrush inside the cul-de-sac. We were lying in the sagebrush to block the entrance, but the precaution was unnecessary since the helicopter drove the animals right into the net. We did jump up and split a large herd so we would not catch more animals than needed.

"Natural traps" like those used in Oregon and Nevada were not available in the smoother topography and shorter vegetation of Campbell County, Wyoming. However, drainage patterns and existing fences helped direct Wyoming pronghorns into a net. At the first trap site, observations indicated pronghorns had a natural tendency to move back and forth along a

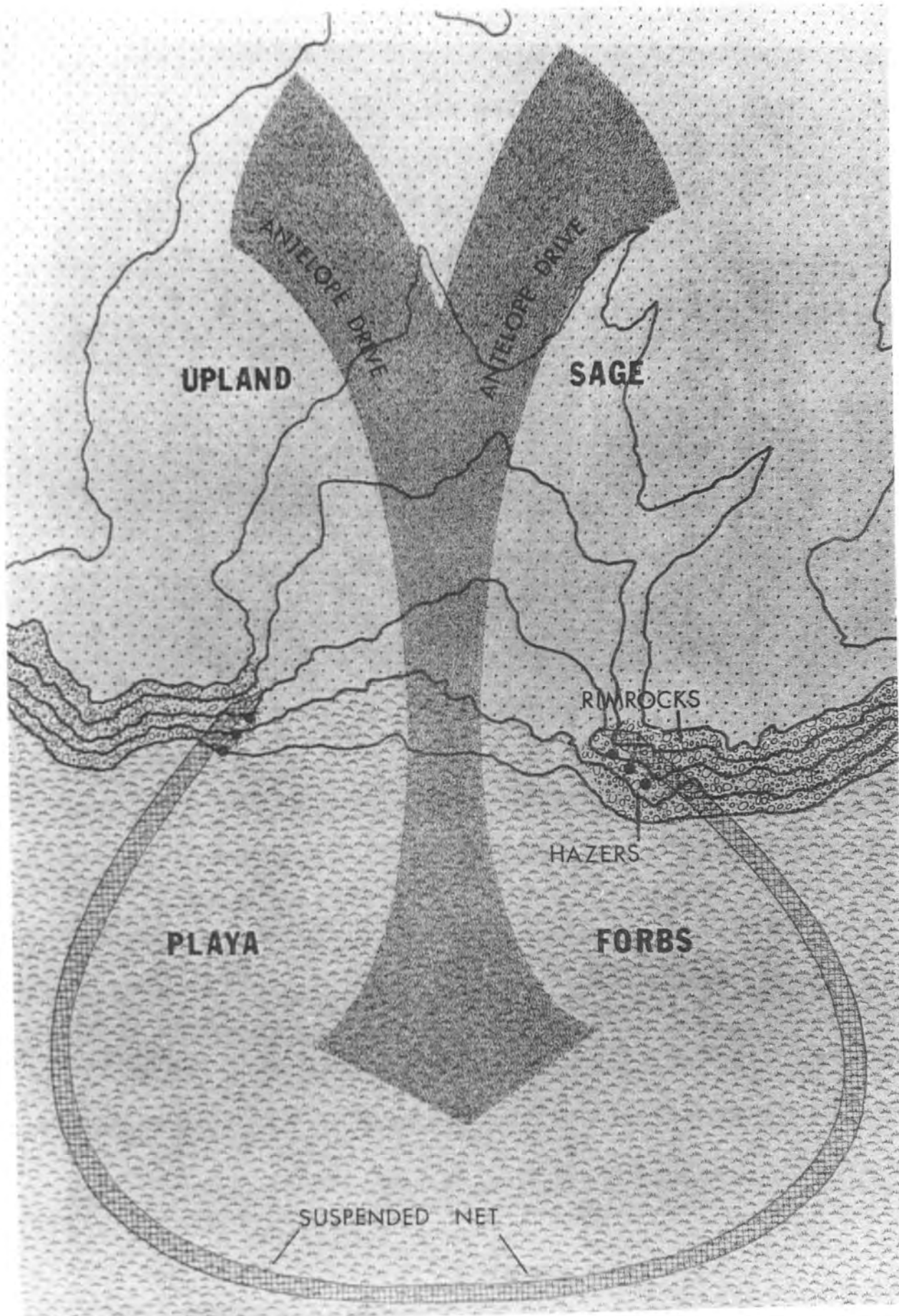


Fig. 2. Illustration of trap set used in Oregon. Pronghorns were driven from uplands through a gap in the rimrocks and onto the edge of the playa

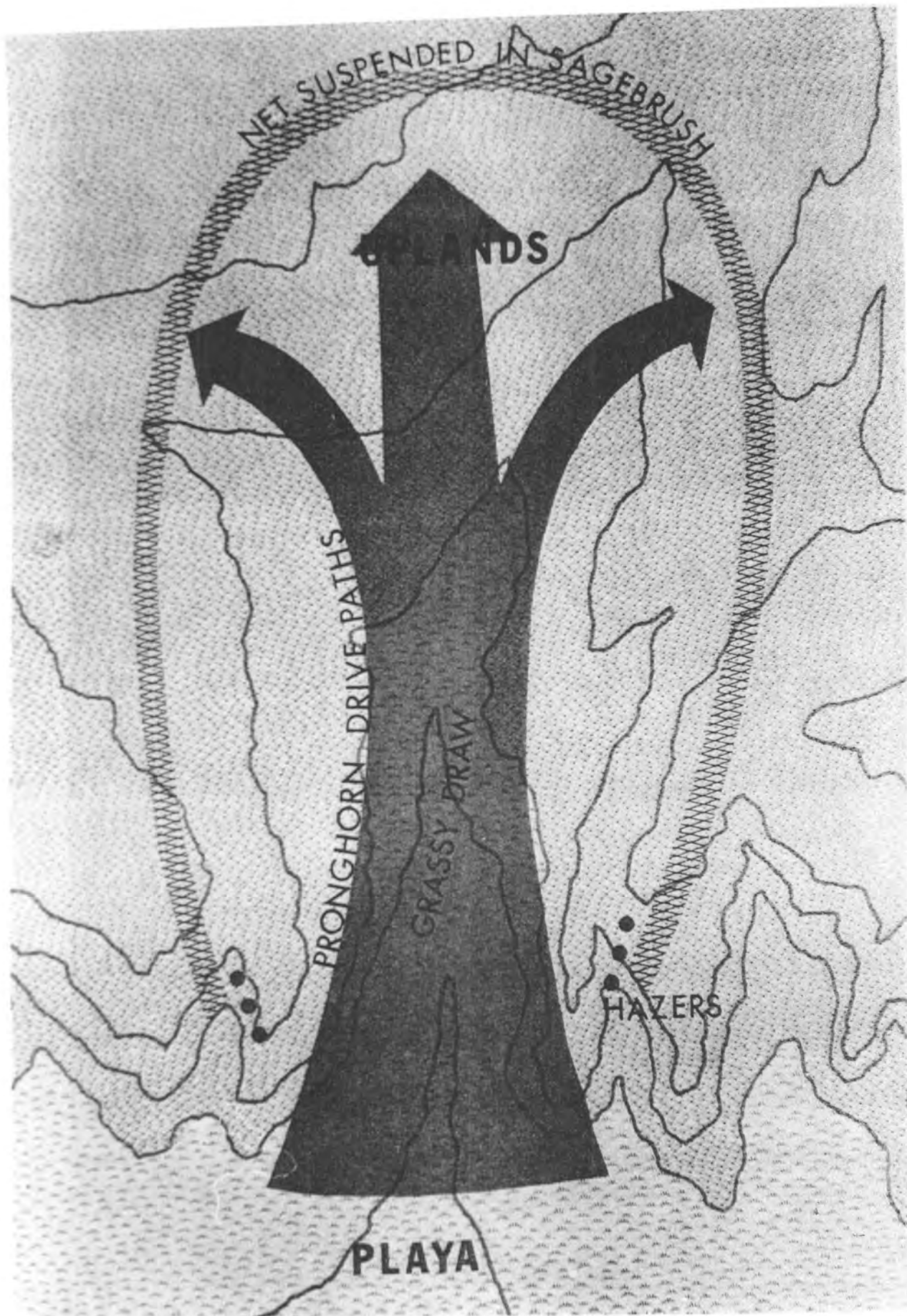


Fig. 3. Illustration of trap set used in Nevada. Pronghorns were driven off the playa up a grassy draw and scattered when they entered the tall sagebrush

particular ridge. Before dropping to lower country, the ridge terminated in a high conical hill. Pronghorns frequently moved along the crest of the ridge but dropped into a swale to circumvent the hill rather than go over it. We placed a net cul-de-sac in that swale and a loosely strung woven wire wing up the swale and across the ridge. Our strategy was to drive pronghorns by helicopter along the ridge in the direction they had been observed to travel on their own; then, redirect their movement into the net at the point where they usually dropped off the ridge to circumvent the higher hill (Fig. 4). This allowed the net to be hidden from view until pronghorns were nearly in the cul-de-sac.

Our second strategy relied upon existing fences to direct pronghorn flow into the net. We placed woven wire against a fence through which frequent pronghorn movement had been observed. Pronghorns were driven against the fence at an acute angle and then parallel to it. A cul-de-sac of net was placed on the downhill side of a rise crossed by the fence, and pronghorns ran right into it (Fig. 5). Hazers stationed at the mouth of the cul-de-sac climbed the fence after pronghorns were driven past and created a human barrier to return of animals unwilling to challenge the net. In all capture attempts, entangled pronghorns were securely held to prevent self-induced injury; then age and sex were determined, and animals were marked and released.

We caught 19 of 90 Oregon pronghorns driven to our nets by helicopter. Despite human barriers and the presence of the helicopter, many animals turned and escaped the way they approached the net. Others escaped by jumping portions of the net pulled down by captured pronghorns. Approximately 85 Nevada pronghorns were driven to our net in two groups. Seven of the first group of 10 were caught. About 50 pronghorns were split from the second group and prevented from entering the net cul-de-sac, and

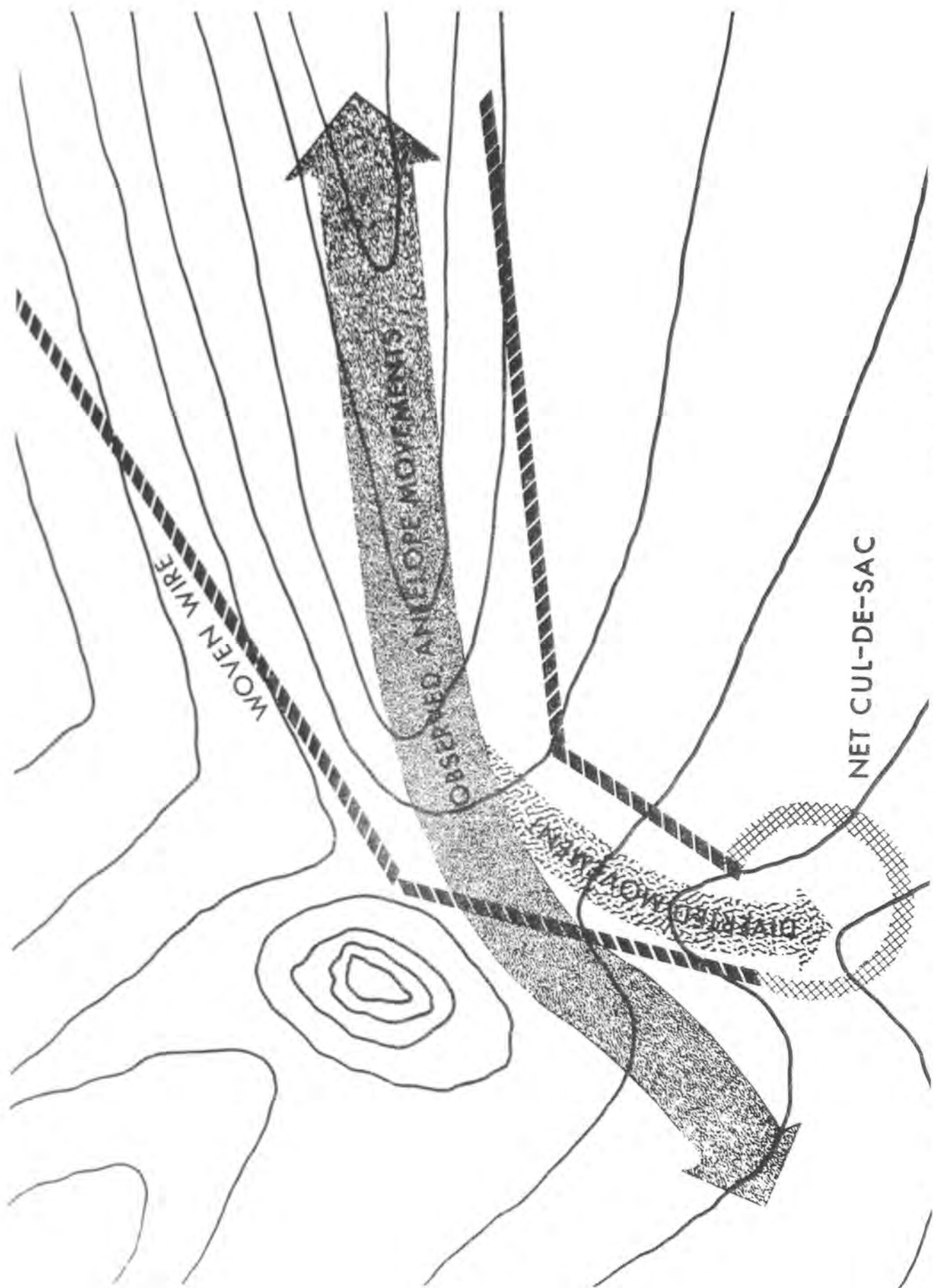


Fig. 4. First trap set used in Wyoming. Pronghorns were driven eastward along a natural pathway and diverted, by woven wire, into the net

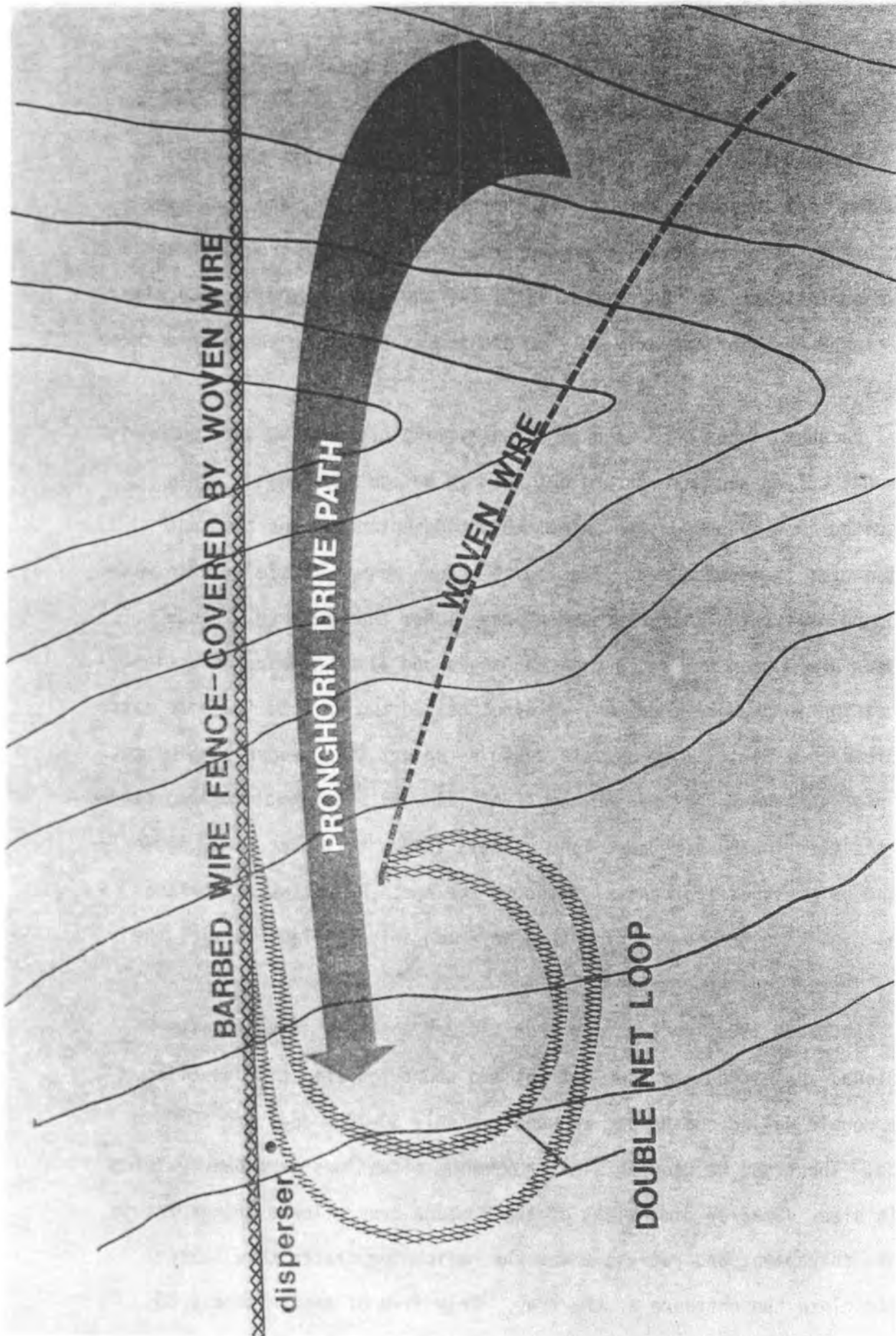


Fig. 5. Illustration of second trap set used in Wyoming. Pronghorns were driven along the top fence and over the hill into the cul-de-sac. The second loop of netting and the dispenser were added for later trapping in Montana only, and the lower wing of woven wire was removed

15 of those entering the net were caught. Total escapement at the Nevada site was over downed portions of the net.

The first group of 30 pronghorns driven to the first trap site in Wyoming went through a hole created in the net by wind, and none were captured. Four pronghorns were captured from two other groups of about 20 each that were driven to that site. At the second Wyoming trap site, we caught three of approximately 40 pronghorns driven to the net in three waves.

Because fences were used to align Wyoming pronghorns, they entered the net cul-de-sac more strung out than in Nevada and Oregon. This resulted in only one or two animals becoming entangled and the rest going over the downed net. Thus, even though we had little trouble with pronghorns turning back, escapement was higher than desired. Since fences are common on many pronghorn ranges and allow greater directional precision in pronghorn drives, we hypothesized two ways to increase catch efficiency. First, more animals could be caught if a second loop of net is placed a few meters behind the first (Fig. 5). Second, a person hidden at the turn in the net where lead animals tended to impact could suddenly stand before the first animal impacted the net. Resultant scattering would increase the number of points at which animals might contact the net, increasing the catch.

In March 1980, we tried to test those hypotheses in southeastern Montana. Unfortunately, our net was too short for effective doubling. The double walled cul-de-sac we used was only 30-35 m deep and 20-25 m wide. The traps we used in similar Wyoming situations were nearly twice this size. Smaller dimensions of the Montana trap allowed pronghorns to sense entrapment and retreat under the helicopter faster than hazers could close the entrance of the trap. Only five of approximately 35

pronghorns that entered the mouth of the trap were caught. The rest turned and escaped. Pronghorns neither reached the person stationed to disperse them nor the second net. This corroborated our earlier observations that minimum visibility of the net is essential but prohibited our tests of hypotheses. We feel those hypotheses retain merit but must be tested with sections of net allowing a larger cul-de-sac.

We have captured 55 pronghorns in linear nets during the last 8 months with only two mortalities due to acute trauma at the trap site. One mortality occurred when an Oregon pronghorn broke its leg on rocks trying to escape the trap. The second animal broke its neck diving under the woven wire covered guide fence in Montana. Also, of the 29 animals we instrumented, only one died after release. Chalmers and Barrett (1977) reported a high incidence of capture myopathy in pronghorns subjected to certain kinds of stress, and we were concerned that capture myopathy might plague tangle-netted pronghorns. Our low mortality rate is especially noteworthy because of high ambient temperatures during trapping (Chalmers and Barrett 1977). The Oregon and Nevada netting took place during hot weather in August. Temperatures were 5-10⁰ C during the November trapping in Wyoming and the March trapping in Montana.

Although this is the first reported application of linear nets to pronghorn capture, we feel it is an appropriate method for capturing small numbers of pronghorns in selected areas. Keys to successful linear netting seem to be: positioning the net so pronghorns cannot realize they are trapped until it is too late; dispersed impact with the net; availability of enough people to physically restrain every animal caught (excess animals must be released immediately); and systematic procedures for handling to assure rapid release of captured animals.

Portability of the linear net allows it to be set up almost anywhere. It can be reassembled several times in a day if necessary for a particular

sampling regime, and it appears to be relatively safe. However, costs (largely flying time and labor) escalate rapidly with attempts to increase sample size. So, if a large sample is needed, a corral trap will usually be a better bet.

CAPTURING FAWNS

Low recruitment in many pronghorn populations despite consistently high conception rates (Vriend and Barrett 1978) has resulted in a proliferation of studies that begin with the capture of fawns. Instrumentation and subsequent monitoring are the only ways to ascertain fates of neonates.

The behavior of parturient and lactating females signals presence of fawns to careful observers (Nichol 1942, Autenrieth and Fichter 1975). Once fawns are located, an observer can keep them in view with a telescope while directing a capture team with gestures or by two-way radio. One team member can attract the fawn's attention while the second sneaks up behind it. Very young fawns are easily caught by hand. However, covering them with a 1-m diameter, long-handled salmon net assures capture of some older fawns without a chase. Fawns too wary for daylight capture can be caught with spotlights at night (Brownlee and Hailey 1970). Observations of single females at dusk often indicate presence of fawns, and a spotlight search should begin in that locality after dark (Tucker 1979). Wearing surgical gloves while handling fawns minimizes transmittal of human scent. Returning fawns to their original position and gently rubbing their tails reduce their tendency to run after release. Newborn fawns should not be handled until the female voluntarily leaves the site or for at least 3 hours after birth.

Mortalities caused directly by handling fawns can be low. Of 136 fawns captured by students from the University of Montana (in Montana,

Idaho, and Nevada) and by Amstrup (in Wyoming), only four that were abandoned by their mothers were considered capture-related mortalities. Many fawns were killed by predators or died of other causes within a month of marking. However, marked fawns were not significantly more vulnerable to these fates than unmarked fawns. Information on these and other fawns can be found in Beale and Smith (1973), Reichel (1976), Barrett (1978), Von Gunten (1978), Bodie (1979), Corneli (1979), and McNay (in prep.).

If marking of fawns is the only way to obtain survival data, it can also provide additional information. Summer and fall movement patterns progressively approach those of adults. So, properly designed (expandable) radio-attachments (Steigers and Flinders 1980) can provide insights into migrations and other behavioral features of pronghorns marked as fawns.

Although Nichol (1942) captured fawns for translocation, their capture is primarily useful for research. Capturing fawns is highly selective for area and individuals; it is inexpensive in terms of capital outlay; and sample size obtained depends solely on patience of the investigator. However, obtaining a large sample requires monumental expenditures of time. Any markers applied must grow with the fawns. Life of radio transmitters may be limited because of miniaturization to match the size of fawns. Mortality rates of fawns are normally higher than for other population segments so mark attrition will usually be high.

METHODS USING BAIT

Many species of North American ungulates have been enticed to bait for purposes of trapping and marking (Clover 1954, Knight 1966, Hawkins et al. 1968, Rideout 1974, Schmidt et al. 1978). Beale (1966) used a self-marking device on pronghorns at water sources in arid portions of

Utah, but we are unaware of other successful attempts at baiting pronghorns.

Although it is an effective bait for mule deer and white-tailed deer in many areas, we could not consistently attract pronghorns to alfalfa hay. Also, abundant free water precluded use of water-baited stations. However, observations of pronghorns utilizing mineral salt and protein blocks placed on the range for cattle suggested they might be successfully baited for trapping.

Four stations baited with salt and protein blocks were subsequently monitored for pronghorn use. Observations indicated that, although pronghorns took the bait, they did so only if they happened to be passing by it. They were not attracted to blocks on a regular or predictable basis desirable for trapping, and none entered Clover (1954) type traps set up nearby. Frequency of appearance at bait sites increased markedly when apple pomace (Schmidt et al. 1978) was placed alongside salt blocks. Although pronghorns still did not enter Clover traps, they consumed large quantities of apple pomace, alternated feeding bouts between salt and pomace, and bedded down immediately adjacent to the bait.

The attractive qualities of apple pomace plus successes of cannon netting white-tailed and mule deer (Hawkins et al. 1968, Biggins 1976) prompted attempts to capture pronghorns the same way. Pronghorns were baited to the cannon net site with a combination of mineral salt and apple pomace. Rockets were fired whenever a desired number of animals were feeding on the bait. Captured animals were marked and released from the net as soon as possible. No individuals were held in the net longer than 30 minutes, and usually they were released in 5-10 minutes.

Thirteen pronghorns were captured on four netting occasions during winter and early spring 1977-78 (Table 1), but only five of those were

Table 1. Summary of 1977-78 cannon netting results

Date	Sex	Age	Mark	Comment
12/12/77	F	Fawn	Radio	Radio fell off; never seen again.
12/12/77	F	Fawn	Neckband	Observed twice; then disappeared.
12/12/77	F	1½	N/A	Broke neck in trap.
12/20/77	F	Fawn	Radio	Found dead 01/06/78.
12/20/77	F	Adult	Radio	Found dead 01/06/78.
12/20/77	F	Fawn	Radio	Found dead 01/06/78.
12/20/77	M	Adult	Radio	Tracked throughout summer.
12/20/77	M	Adult	Radio	Coyote kill 01/03/78; had acted sick and stayed alone since capture.
12/27/77	M	Adult	Radio	Tracked throughout summer.
12/27/77	F	Adult	Radio	Tracked throughout summer.
12/27/77	F	Adult	Radio	Tracked throughout summer.
03/26/78	F	Adult	Radio	Tracked throughout summer.
03/26/78	F	Adult	Radio	Died about 04/01/78; no predation evident.

known to survive. One female broke her neck on impact with the net; the remaining seven either died, were killed by coyotes, or disappeared within 2 weeks of capture.

Captured animals that were observed before their death or disappearance showed external symptoms of capture myopathy. Although causes of capture myopathy are not completely understood, it clearly is related to capture stress. We hypothesized that stress from driving by helicopter, collection in a corral, and processing in a several hour long ordeal would exceed that resulting from 10 or 15 minutes under a net. However, mortality rates after release from corral traps were far fewer than after release from cannon nets. Compared to deer, pronghorns became more entangled in cannon nets. Further, whereas deer were relatively patient after becoming tangled, pronghorns fought the net during the entire period of their restraint. Only when they reached apparent total exhaustion did entangled pronghorns cease struggling. Because pronghorns are adapted for running, the stress and exertion of drive trapping may not be as damaging as the surprise firing of rockets followed by concentrated isometric exercise resulting from cannon netting.

Because individuals to be captured are observed before firing the net, cannon netting can be selective for sex and age class as well as for individuals occupying a specified area. Since pronghorns loiter in the vicinity of apple pomace bait, trap sites can be checked periodically in the course of other field activities and nets fired if animals are present. This reduces time spent waiting and watching for trap attendance. On the other hand, our 62-percent latent mortality of cannon netted animals is ethically objectionable and prohibits realization of any advantages of cannon netting. In the absence of additional data to the contrary, cannon netting and other baiting procedures involving entanglement must be considered unacceptable for capturing pronghorns.

METHODS USING DRUGS

Over 60 chemicals have been used to aid capture of wild animals although only a relative few have achieved great popularity in North America. As detailed reviews of many drugs and their applications are beyond the scope of this paper, readers are referred to the works of Harthoorn (1965), Denney and Gill (1970), Young (1973), Savarie (1976), and Hugie (1977).

Drugs commonly used for immobilizing wild animals are either paralyzing or centrally acting. Paralyzing drugs simply interfere with reactions at ganglia or neuromuscular junctions (Savarie 1976, Hugie 1977). Sedation and analgesia are not achieved by use of these drugs alone. Paralyzed subjects are keenly aware of ambient stimuli, including pain; they simply cannot react to them. Advantages of paralyzing drugs include: relatively low cost, simplicity in use, clear paralytic symptoms, and short induction and recovery times (Harthoorn 1965, Hugie 1977). Their main disadvantages are: lack of sedation and analgesia resulting in greater potential physical and psychological trauma, narrow tolerance ranges in many species, and difficulty in resuscitation (Harthoorn 1965, Savarie 1976, Hugie 1977). Succinylcholine chloride (SCC) and gallamine triethiodide are two of the most commonly used paralyzing drugs.

By altering central nervous system activity in a variety of ways, centrally acting drugs can immobilize, tranquilize, and anesthetize subjects (Harthoorn 1965, Savarie 1976, Hugie 1977). They can be used singly or in combination to achieve a desired effect. Subjects immobilized with some centrally acting drugs can often maintain an upright posture or even walk, yet remain completely tractable. Effective antagonists exist for some centrally acting drugs, allowing rapid recovery from the immobilized state. Disadvantages of some centrally acting drugs include: high price, restrictive regulations, more complicated use, and persistent residual effects that may affect survival of drugged subjects after release. Common

centrally acting drugs include: acepromazine, chlorpromazine, morphine, M99-etorphine, ketamine hydrochloride, phencyclidine hydrochloride, and xylazine (Savarie 1976).

Distances of several meters or more between investigators and potential subjects require delivery of drugs to free-ranging mammals with projectile syringes. Most drugs are used in liquid form, and Clark et al. (1979) provide detailed descriptions of equipment and procedures for remote delivery of liquid drugs. SCC is readily available in powdered form, and Liscinsky et al. (1969) described an innovative delivery system for it.

Numerous wildlife species have been immobilized with a variety of chemicals. However, drug immobilization of pronghorns has been very limited. SCC, which acts by producing persistent depolarization of muscle sole plates at neuromuscular junctions (Talbot and Lamprey 1961, Harthoorn 1965), is the only paralyzing drug reported for use on pronghorns. Thomas (1961) and Beale and Smith (1967) recorded 11 successful immobilizations of 10 captive pronghorns with SCC. Hepworth and Blunt (1966) mentioned successful use of SCC on pronghorns but provided no data.

Although evidence gathered from captive animals suggested SCC may be useful for capturing wild pronghorns, no field studies had been reported until recently. The custom of simultaneously capturing many pronghorns in corral traps, coupled with difficulties in approaching free-ranging pronghorns within safe range of heavy liquid-filled projectile syringes, may have stifled immobilization attempts. However, dry darts facilitate delivery of SCC to pronghorn sized targets. Liscinsky et al. (1969) reported effective use of darts delivering powdered SCC on 101 white-tailed deer, but application of dry darts to field immobilizations of pronghorns has been less successful. Amstrup and Segerstrom (in press) injected 46 free-ranging pronghorns with darts containing powdered SCC (Pneu-Dart, Inc.,

Williamsport, PA). Thirty-four injections of 3l pronghorns elicited little or no observable reaction to the drug. Ten pronghorns were successfully captured and released with powdered SCC, but two of those had to be resuscitated when spontaneous respiration ceased, and five animals died as a direct result of capture (Table 2). Amstrup and Segerstrom (in press) experienced difficulty in resuscitating SCC overdosed pronghorns, corroborating conclusions of Talbot and Lamprey (1961) and Harthorn (1965) and conflicting with evidence presented by Day et al. (1965).

Paralytic reactions of pronghorns to powdered SCC, as expected, increased with increasing dose. However, mortality rates were not directly related to increasing dose. Variations in sensitivity of pronghorns to SCC were so large that some animals were killed by doses inadequate to affect others. Harthorn (1965) reported similar reactions to SCC among giraffes (Giraffa camelopardalis). For those species with high tolerances, SCC has been a very effective field immobilizer (Talbot and Lamprey 1961, Flook et al. 1962). For species with narrow ranges of effective doses, however, risks with SCC probably outweigh any advantages (Hugie 1977). We feel SCC is ineffective for immobilizing free-ranging pronghorns and should not be used in that context.

Use of centrally acting drugs for pronghorn immobilization has been as limited as that of paralyzers. Autenrieth et al. (in prep.) have immobilized pronghorns from a helicopter with M99. Accidental and drug-related mortalities were exceedingly heavy when this method was first used (Copeland et al. 1978). However, they have lost only four of the last 29 animals captured. Procedures they used to minimize mortalities include: using lower powder charges in their guns and restricting shots to 5 m or less, administering adequate drug dosages, administering the anti-inflammatory drug dexamethasone to prevent shock (10-100 mg depending on symptoms),

Table 2. Responses of 15 pronghorns immobilized with powdered succinylcholine chloride

Date	Sex	Age	Repro. status	Dose (mg)	Reaction time (min)	Duration paralysis (min)	Area hit	Remarks
03/28/77	M	2	--	9	6	--	Hip	Respiratory failure--could not be revived.
05/31/77	F	A	Pregnant	10	8	14	Hip	Perfect response.
06/14/77	F	A	Lactating	10	3-5 (not seen)	33	Hip	Very slow pulse and irregular breathing for 10 minutes of paralysis.
06/15/77	F	2	Barren	10	.3	38	Ribs	Respiratory failure--resuscitated with ambulance bag in 24 minutes.
08/16/77	F	A	Lactating	8	15	41	Hip	Euthanatized 3 days after capture.
05/21/78	F	2	Pregnant	11	4	19	Hip	Oxygen administered due to irregular, labored breathing.
05/22/78	M	3	--	11	4	35	Hip	Very slow pulse, respiratory failure--revived with oxygen and manual resuscitation.
07/05/78	F	1	Barren	9	7	31	Hip	Oxygen administered because of labored breathing.
05/31/79	F	2	Lactating	9	10	16	Hip	Perfect response.
06/01/79	F	2	Pregnant	9	6	--	Hip	Respiratory failure--could not be revived.
06/02/79	F	2	Lactating	9	5	25	Hip	
06/04/79	M	2	--	9	3	--	Hip	Respiratory failure--could not be revived.
06/26/79	F	7	Lactating	9	12	13	Flank	
06/28/79	M	7	--	9	16	9	Hip	
07/14/79	M	3	--	9	12	--	Hip	Cardiac arrest--could not be revived.

administering sodium bicarbonate (1.8 g per kg body weight) to neutralize metabolic acidosis, and injecting up to three times as much of the antagonist M50-50 as M99. Autenrieth et al. (in prep.) suggested their drug-related mortalities were largely a result of underdosing rather than overdosing pronghorns, and they recommend 7-9 mg M99 be administered to adult males and 4 mg for all females. The diluted solutions of M99 currently available and the practical limits on sizes of projectile syringes mandate multiple injections of adult males to assure adequate dosage. Although multiple darting attempts and close range pursuit by helicopter are not optimal, this procedure is superior to use of SCC and may be considered an acceptable approach to certain study objectives.

The most promising drug for the immobilization and handling of pronghorns has, unfortunately, been removed from the market. Tiletamine is a cataleptoid anesthetic with marked central nervous system depressant properties. Its convulsant tendencies are neutralized by a 1:1 mixture with the tranquilizer zolazepam and the combination is called CI-744 (Savarie 1976). Harry Goreman (Colorado State Univ., Dept. Vet. Sci., pers. commun.) has used this drug on nearly all North American ruminants and found it superior to any other available drug.

Dr. Goreman found characteristics of this drug included: rapid immobilization, duration of immobilization and degree of anesthesia were solely dependent upon dose administered, and a very wide safety margin. Pronghorns required very high doses of tiletamine (10-15 mg/lb vs. 2 mg/lb in elk), but because the drug came in powdered form and was very highly soluble in distilled water or physiological saline, this created no problems. Unfortunately, the Food and Drug Administration has refused to approve production of tiletamine for commercial use, and Parke-Davis and Company (Detroit, MI) has ceased production. There are rumors that

Parke-Davis may negotiate sale of its patent on the drug, but for the present that seems unlikely. We are unaware of use of any other centrally acting drugs for pronghorn immobilization.

The objectives of many biological investigations mandate selectivity for individuals or groups of animals in specific areas. Because an investigator must locate an animal before darting it, such selectivity is assured with drug immobilization. Another advantage of drug immobilization is that it can be achieved at any time of year, further augmenting selectivity of capture. Finally, drug immobilization permits handling of animals without physical restraint. This is potentially valuable for delicate, high-strung animals like pronghorns, which may be prone to injury and capture myopathy (Chalmers and Barrett 1977). The absence of constant fighting in immobilized animals also facilitates taking measurements and other biological information.

However, disadvantages to chemical capture of pronghorns exist. Present delivery systems are usually not precise enough to assure safe injection at usually encountered distances. Tissue damage alters chemical absorption and subsequent survival of immobilized subjects (Harthoorn 1965). Therefore, intramuscular injections of wild animals "must produce little or no tissue damage at the site of injection" (Cowan et al. 1962:57). Since they have thin skin, small muscle masses, and slender, fragile bones, risks of tissue damage resulting from injecting pronghorns with heavy liquid-filled projectile syringes are high. Our experience suggests liquid-filled projectile syringes cannot be precisely delivered beyond 20 m. Copeland et al. (1978) and O'Gara (unpubl.) reported precision problems which resulted in five pronghorn fatalities. Although "dry darts" can achieve requisite precision, they are currently manufactured with SCC only. Because SCC provides an inadequate safety margin for pronghorns, use of "dry darts" is not a viable option.

CONCLUSIONS

Capturing pronghorns with drugs, catching and marking neonatal pronghorns, bait trapping, and two methods of drive trapping pronghorns were discussed.

Immobilization of pronghorns with currently available drugs and equipment is not generally practical. Dry darts (Liscinsky et al. 1969) can be precisely delivered but are not available with drugs useful on pronghorns. When animals are darted from a helicopter, liquid drugs can be safely delivered with low powered charges (Autenrieth et al., in prep.). However, imprecisions in delivery and the potential for injury reduce the utility of liquid-filled darts projected from the ground.

Fawn survival can best be assessed by capture and marking of neonatal pronghorns. With expandable radio-collars, this procedure can provide information from fawns long after they join the general pronghorn population. However, obtaining reasonably large sample sizes can be very time consuming, and attrition of marked fawns will usually be high.

Although pronghorns were attracted to apple pomace, they could not be lured into confined traps. They were captured with pomace-baited cannon nets, but latent mortality was prohibitively high. It may be possible to bait pronghorns into a spacious corral-type trap. Also, a self-marking device (Beale 1966) might work with apple pomace as bait. However, the latter techniques have not been tested. Overall, the potential for effectively trapping pronghorns with bait seems low.

The effectiveness of corral trapping for catching pronghorns has been proven over a period of about 45 years. This is still the most efficient and cost-effective procedure for catching large numbers of pronghorns under most conditions. However, because they are relatively immobile and designed to catch large numbers of animals in one place, they may not always be suited to particular research goals. Because linear tangle nets are

portable and can be assembled and disassembled easily, they lend themselves to many situations where corral traps are not suited. Linear nets are more suitable for catching fewer animals or individuals in selected locations while corral trapping excels when many pronghorns must be caught. Both linear netting and corral trapping are relatively safe for the animal subjects, and we feel these procedures are best suited to most situations where pronghorns must be captured.

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ANTELOPE STUDIES IN SOUTHEASTERN NEW MEXICO

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ABSTRACT: A brief review of the history of the antelope (Antilocapra americana) decline in southeastern New Mexico in the past 40 years is presented. Current BLM policy of multiple use and the steps undertaken to achieve this goal to determine if antelope increases are feasible and warranted on BLM Lands in the Roswell District are outlined. Preliminary data on numbers transplanted into 18 study pastures of 3 sizes, fawn production and survival, adult mortality, and distribution of antelope throughout some of the pastures during June-December, 1979, are discussed.

INTRODUCTION

No one seriously questions the fact that antelope (Antilocapra americana) populations have declined in southeastern New Mexico. In an area of 1.5 million acres, the antelope habitat study area - defined on Fig. 1, located west of Roswell, New Mexico, antelope populations which had been estimated at 3,000 in 1940 by the New Mexico Department of Game and Fish (NMDG&F) has dropped to roughly 300 by 1977 (Walt Snyder, Chief, of Game Management, NMDG&F). As documented in the publication Antelope of New Mexico (Russell 1964) and other NMDG&F records, antelope were so abundant that several hundred were trapped in this area during 1938 and used to establish herds elsewhere in the state and on the Wichita Mountains National Wildlife Refuge in Oklahoma. Declines in antelope populations caused by woven-wire fences

have been described and documented by Bear (1969) in Colorado, Russell (1951) in New Mexico, and Hailey et al. (1966) in west Texas.

This antelope problem also exists in other western states where the Bureau of Land Management, as one of its multiple-use responsibilities, has adopted a policy of fence-modification programs on public lands which are being applied to antelope areas throughout the west. About 300 miles of net-wire fences have been modified already within major sheep and cattle-producing areas in New Mexico and 4 other western states. The purpose of this paper is to present the history, objectives, methodology, and preliminary results of antelope reproduction and survival for the Bureau of Land Management's southeastern New Mexico study of antelope after 8 months.

HISTORY

The Bureau of Land Management's (BLM's) Roswell District first became involved with the program of modifying fences for antelope in 1975 when antelope fencing directives were issued by the Bureau. Having determined that antelope populations were declining on public lands in southeastern New Mexico, steps were initiated through the Bureau Planning System, in conjunction with Bureau fencing policies to begin a program to mitigate the impacts of the net-wire complex located west of Roswell. The announcement that the Bureau was studying the degree of fence modifications which would be required to comply with the Bureau's antelope policy, drew immediate opposition from the livestock community, primarily in southeastern New Mexico. The opposition of this area's stockmen was increased by the BLM's announcement that viable herds of antelope would be re-established in historic habitat west of Roswell to comply with federal mandates which impose standards for multiple-use management on public lands. During 1976, several meetings were held to obtain the views and recommendations of local interest groups. As a

result, an "antelope task force" was formed in the summer of 1977, consisting of 2 area ranchers and 2 representatives each from the BLM, the NMDG&F, and the U. S. Fish and Wildlife Service. The primary function of this committee was to develop a study proposal which would provide the facts and information necessary to properly assess the effects of expanding antelope habitat and to study alternative measures to accomplish these objectives. With these objectives in mind, the committee proposed that an independent study be conducted to: 1. Analyze movement of livestock and antelope through different types of fence modifications, and 2. Determine the size of an area and other habitat requirements needed to support a viable herd of antelope on public lands in the Roswell District.

DESCRIPTION OF THE AREA

The 4-year study is being carried out in an area west of Roswell, New Mexico (Fig. 1). This area is characterized as a shortgrass prairie with principal grass species consisting of gramas (Bouteloua spp.) muhlys (Muhlenbergia spp.), dropseeds (Sporobolus spp.), buffalograss (Buchloe dactyloides), tobosa (Hilaria mutica), windmill grasses (Chloris spp.), and threeawn grasses (Aristida spp.). Woody plants found in the area include catclaw (Acacia greggii), mesquite (Prosopis glandulosa), skunkbush (Rhus aromatica), oaks (Quercus spp.), cholla (Opunia imbricata), and snakeweed (Gutierrezia spp.). From east to west, the topographic features are flat-to-rolling terrain containing intermittent swales of varying widths, progressing to rugged limestone hill and canyon country. The climate is mild but semi-arid, with precipitation averaging 12 inches with most falling from July through September. Winter temperatures seldom reach 0 degrees Fahrenheit, while summer temperatures rarely exceed 100 degrees.

METHODOLOGY

To accomplish Task 1 of the study, which involves the observation and documentation of antelope and livestock movement through specially designed fence panels, the following procedures will be undertaken on the Task 1 pastures shown on Fig. 1.

1. A complete soil/vegetation inventory will be carried out the first year in the 10 pastures which have existing fence modifications. The inventory used in this study will be the Soil-Vegetation Inventory Method (SVIM) which is the BLM's method for conducting basic soil and vegetation inventories. This procedure is described in detail in BLM Manual 1731.
2. Aerial surveys will accomplish visual observations of antelope, sheep, and cattle each month in those 10 pastures.
3. Movements of antelope, sheep, and cattle through existing fence modifications will be monitored monthly by taking track counts and through periodic use of time-lapse cameras.
4. Actual use figures (numbers of animals in each pasture) for antelope and livestock will be collected each month.
5. The control and movement of livestock (sheep and cattle) through 8-10 types of fence panels and passes will be monitored and documented at New Mexico State University campus. Livestock will be placed on each side of the test panel or pass and placed under various stress conditions to entice them to move through the test panel. The test panels and passes will be evaluated and rated as to those which are best able to control livestock. Two of the panels or passes having the best ratings will be field-tested in Task I pastures, to determine their effectiveness in the movement of antelope.

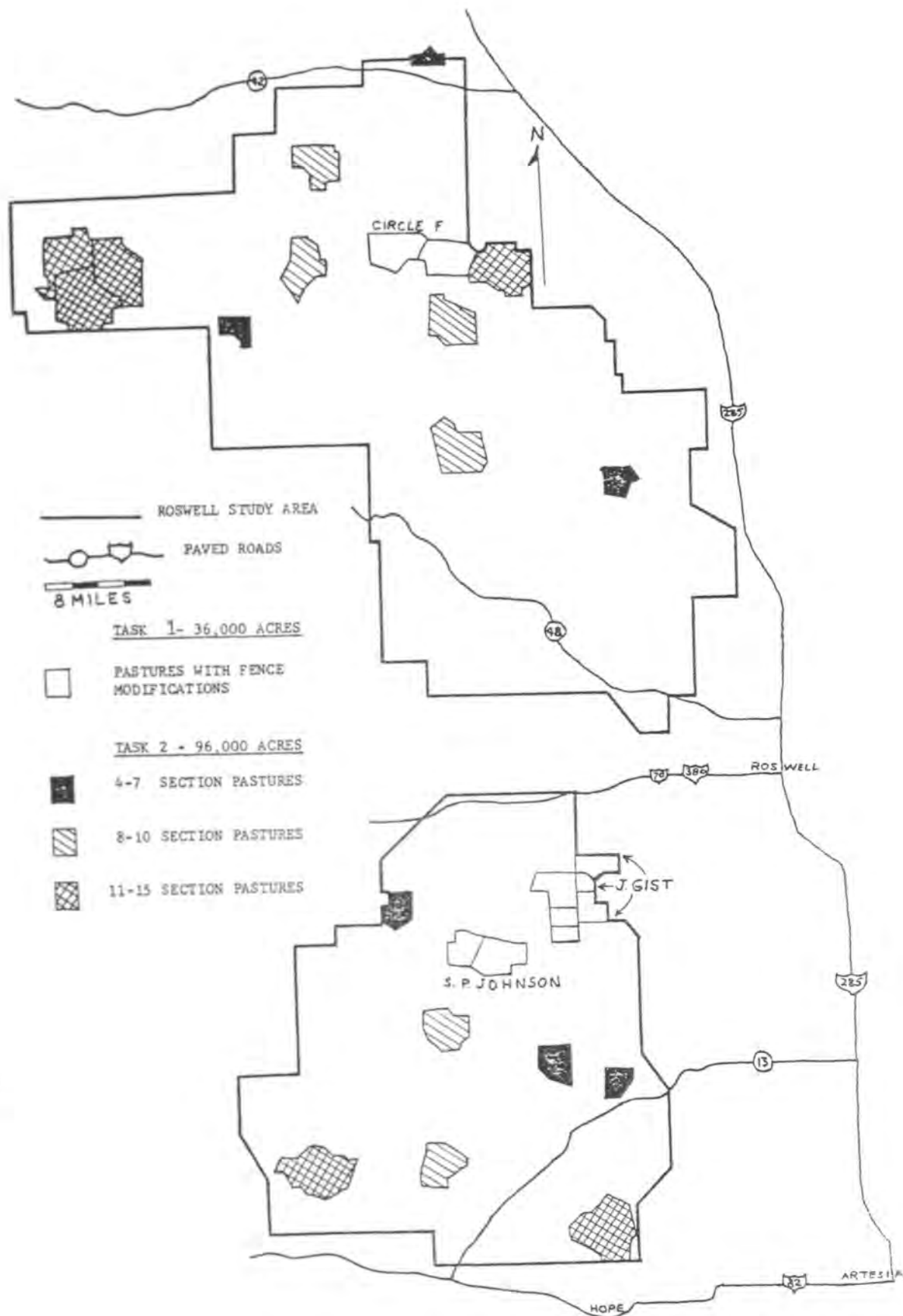


FIG. 1

The Task 1 ranches for this study are the J. Gist Ranch, the Circle-F Ranch, and the S. P. Johnson Ranch. The J. Gist Ranch has approximately 250-300 native antelope, with 10 antelope passes consisting of 4-strand barbed wire panels which are 50 yards long and 43 inches high. The bottom strand is approximately 18 inches above the ground. The Circle-F Ranch has approximately 52 antelope with 2 antelope passes available. These passes are also the 4-strand barbed wire type. They are 50 yards long and 40 inches high, with the bottom strand 12 inches above the ground. The S. P. Johnson Ranch has 40 antelope with a "Paul's Pass" in operation between the 2 study pastures (Russell 1951).

In order to meet the objectives of Task 2 of this study, the observation and documentation of antelope population changes in specified locations, as related to vegetative and climatic determinations and pasture size in the same areas, the following procedures will be carried out on the Task 2 pastures as shown on Fig. 1.

1. A complete soil/vegetation inventory, using the Bureau's SVIM method, will be carried out in the 18 pastures during the first year (1979). Additional vegetation inventories will be conducted in conjunction with the fecal collections 4 times a year. The purpose of these seasonal studies will be to provide data on vegetation availability to be correlated with the fecal analysis. The procedure will include the use of data from ten 4.8 sq. ft. plots along an extended transect line within each range site in each pasture. Data collected will include plant composition, phenology, availability and estimated weight for annual production.
2. Aerial surveys will be taken monthly to inventory antelope populations in all 18 pastures to assess reproduction, mortality and possible immigration or emigration.

3. The following discussion and procedures as outlined by Beasom (1979) will be followed in conjunction with the fecal collection and analysis portion of this study. The fecal analysis will be carried out by the U. S. Forest Service's Great Plains Wildlife Research Laboratory, Lubbock Texas. Research is needed to determine the interrelationships between pasture size (since this feature influences uniformity of grazing use) and dietary overlap between domestic livestock and pronghorn antelope.

Fecal collections will be made seasonally (September, January, March, and June) from a sample size of 12 each cattle, sheep, and pronghorns in all Task 2 pastures where they occur for a total of 800-900 per year per species. Species identification of fecal groups will be by observation for cattle and by observation and pH reading for sheep and pronghorns. Each sample will be comprised of approximately 20 ml for cattle and 20 - 30 pellets for the other species. The pH readings will be conducted by Forest Service personnel by subsampling on all samples identified as sheep or pronghorn. Samples with pH values 8.3 or greater will be considered pronghorn, and those of 8.0 or lower will be considered sheep. Microhistological examination of all fecal samples will be conducted by the Food Habits Laboratory at Texas Tech. University, Lubbock Texas. Importance Values will be derived for each food-stuff for the 3 species by multiplying the number of animals within a species using a plant by the relative frequency of occurrence of that particular plant. From the Importance Value lists an R index of similarity will be used to compare overall similarity between the diets of the cattle, sheep, and pronghorns. The subsequent indices then will be related to the large, medium, and small pasture sizes.

4. Actual-use figures will be collected each month for livestock in each of the 18 pastures.

5. A computer model will be developed using the collected information to enable a wildlife manager to estimate the minimum area and conditions necessary to sustain a viable antelope population within a given set of environmental parameters. The term "viable" as used in this study, refers to a population of any size which meets the following criteria.

a. The population is self-supporting in that survival is not dependent upon any form of artificial propagation.

b. The natural recruitment rate into the adult class equals or exceeds the mortality rate of the adult age class.

The environmental ingredients of the model must be restricted to those measurements routinely collected by BLM field personnel such as topography indices, vegetative composition, productivity and cover, seasonal rainfall data, and livestock grazing pressures. Additional data may be used if records are available for the entire problem area or can be collected within the manpower and financial resources normally available to BLM. Throughout the model development, regardless of the model's quality, it will not meet the objectives of this study unless it can be applied from the practical standpoint throughout the problem area.

The 18 pastures included in Task 2 were selected by the following method. Twenty-seven grazing allotments, within the proposed antelope study area, were considered for inclusion in the study because of the operators agreement to cooperate in supplying water, maintaining fences, and furnishing livestock actual use records. These 27 allotments contained 81 pastures that were evaluated for diversity and suitability of topography, and production and variety of grasses, forbs and browse. These pastures were categorized into 3 groups (Table 3) based on size; group I, 4-7 sections, group II, 8-10 sections and group III, 11-14 sections. Six pastures within each group were

selected through the use of a random selection procedure and used in the study.

Before this study began, 309 antelope (including 9 animals to replace those which died during transporting) were trapped and transported into the 18 Task 2 pastures (Table 3) by the New Mexico Department of Game and Fish, using capture techniques described by Russell (1964). Trapping operations began on January 15, 1979, and the last animals were released on March 10, 1979.

Animals were stocked in each pasture at a rate of 2 animals per section. The sex ratio was 1 male per 3 females. All of the transplanted antelope were fitted with vinyl-coated nylon collars. Females received orange collars, while males were fitted with blue collars. Red, yellow, and black numbers identified the pasture and group designation (Table 3). Aerial surveys were flown within 1 week after the pastures were stocked with antelope in an effort to locate any dead or injured animals, so these could be replaced. All animals found dead were field examined by State and BLM biologists to determine the probable cause of death.

No changes are required in the normal ranching operations where the antelope study pastures are located. Livestock numbers, supplemental feeding, water availability, vehicle and human disturbance are not required to be adjusted in any manner.

RESULTS

The remainder of this paper will address only the findings for those 18 pastures included in Task 2. Data presented includes census, fawn production and survival and seasonal distribution. Data pertaining to vegetation, food habits of livestock and antelope, topography, etc., have not been analyzed.

Antelope Census

Initially the antelope in each pasture were censused from the ground and from an aircraft once each month. Exceptions to this schedule included the months when ewes were lambing (March-May depending upon the individual ranch) and during the peak of fawning for antelope (June). Ground surveys were discontinued in October due to the large discrepancies in both total counts, and sex and age ratios when these numbers were compared to those obtained from the aerial surveys. All data presented in this paper are taken from monthly aerial surveys between July and December, 1979 (Table 1).

Fawn Production

The percentages of fawns born were relatively high for all but 2 of the 18 pastures (Table 1). Considering the stresses of capturing, marking, transporting and releasing the does into new ranges, an 89% fawn crop was higher than we expected. In addition, all antelope does, including yearlings which probably had not bred, were included, in these calculations.

It is interesting to note that the highest percentage of fawns were produced in the smaller pastures, followed by the large and medium pastures, respectively. This phenomenon could be a result of either one or a combination of several factors. Some of these include: (1) Smaller pastures are more accurately counted, (2) there were fewer yearling does transplanted into the smaller pastures, and (3) the antelope transplanted into these pastures came from an area with better forage conditions and had a higher tendency for twinning. Size of pastures probably did not play a major role in production since previous research indicates the number of fawns produced is highly correlated to rainfall and forage conditions of the previous season.

Antelope Survival

Twelve of the original adult male antelope have disappeared from the study including 4 and 8 from medium and large pastures, respectively. Twenty-three females, including 5, 7, and 16 from small, medium, and large pastures, respectively, have also disappeared. Average loss of adult antelope has been 17% for males and 13% for females.

Fawn survival has varied greatly among pastures and between sizes of pastures, ranging from 40 to 100%. Small and large pastures averaged 90% survival while medium pastures averaged 81% (Table 2). Since the range of survival percentages is great, these percentages probably are not significant. There were pastures within each size class which had 100% fawn survival for the period ending December 1979 (Table 2). Predation was not known to be a factor in any of the pastures; therefore, fawn survival was probably related to weather, vegetational differences or other factors in the pastures. These data have not been analyzed and correlated with fawn survival.

Distribution

Antelope generally tended to move throughout most pastures which have uniform, moderately undulating terrain. No seasonal preferences have become obvious within any of the pastures, regardless of size. Antelope have avoided areas of rough, broken terrain wherever it occurs within the pastures. Most antelope left 1 pasture (2-4) which is mostly rough limestone hills with narrow valleys and moved to an adjacent pasture which has less rugged terrain. The few animals that remained in pasture 2-4 are utilizing a single valley which has relatively gentle slopes. Those animals that moved to the adjoining pasture apparently jumped a standard metal cattleguard in a road connecting these 2 pastures.

CONCLUSION

Preliminary results indicate the antelope transplanted into the 18 study pastures are generally doing well. All pastures had moderate to high fawn production and survival. Only 2 pastures have not had a net increase in antelope. Pasture 1-4 ended the year with the same number of antelope as were transplanted and pasture 2-4 had the majority of the antelope move to an adjacent pasture.

Table 1. Maximum numbers of pronghorns counted from aerial surveys in the study pastures from July-December, 1979

Pasture Number	Number Sections	Antelope Numbers			% Fawns
		♂	♀	Fawn	
1-1	6	3	9	13	144
1-2	4	1	6	7	117
1-3	4	2	6	7	117
1-4	5	2	5	4	80
1-5	4	2	6	4	67
1-6	4	<u>2</u>	<u>6</u>	<u>7</u>	117
		12	38	42	(111)
2-1	9	4	14	9	64
2-2	8	4	12	12	100
2-3	8	3	11	12	109
2-4	8	3	12	5	42
2-5	8	4	12	6	50
2-6	9	<u>4</u>	<u>13</u>	<u>9</u>	69
		22	74	53	(72)
3-1	11	5	18	14	78
3-2	13	6	19	20	105
3-3	11	5	17	20	118
3-4	13	7	20	13	65
3-5	14	7	20	16	80
3-6	11	<u>5</u>	<u>17</u>	<u>21</u>	124
		35	111	104	(94)

Table 2. Numbers of antelope remaining in the 18 pastures in December, 1979

Pasture Number	Antelope			% Fawns remaining
	♂	♀	Fawn	
1-1	3	9	12	92
1-2	1	4	7	100
1-3	2	6	6	86
1-4	2	3	3	75
1-5	2	5	3	75
1-6	<u>2</u>	<u>6</u>	<u>7</u>	100
	12	33	38	(90)
2-1	4	13	9	100
2-2	2	10	10	83
2-3	2	11	11	92
2-4	3	12	2	40
2-5	3	10	4	67
2-6	<u>4</u>	<u>11</u>	<u>7</u>	78
	18	67	43	(81)
3-1	4	16	11	79
3-2	1	15	19	95
3-3	5	17	17	85
3-4	5	14	13	100
3-5	7	16	13	81
3-6	<u>5</u>	<u>17</u>	<u>21</u>	100
	27	95	94	(90)

Table 3. Group I (4-7 sections) - black numbers on collar

Habitat Type: A					
Name	Pasture	Area	Sec.	Acres	No. of Antelope
David McGee (South)	B (East Turner)	S	6	3,840	12
Francis Corn	A (North)	S	4	2,560	8
David McGee (South)	E (Felix)	S	4	2,560	8
Habitat Type: B					
Ron Merritt	B (Simpson)	N	5	3,200	10
Tom Corn	A (West)	N	4	2,560	8
Mrs. C. H. Richards	F (South)	N	4	2,560	8

Group II (8-10 sections) - yellow numbers on collar

Habitat Type: A					
Name	Pasture	Area	Sec.	Acres	No. of Antelope
W. E. Corn	M (South)	N	9	5,760	18
Truman Pierce (Yoder)	N (Plate)	N	8	5,120	16
Bill Bogle (Gallo)	B (Mesa)	N	8	5,120	16
Habitat Type: B					
James Corn	B (East)	S	8	5,120	16
Lloyd Treat	A (North)	S	8	5,120	16
Irwin Corn	A (West Brown Lake)	N	9	5,760	18

Group III (11-14 sections) - red numbers on collar

Habitat Type: A					
Name	Pasture	Area	Sec.	Acres	No. of Antelope
Herbert Corn (North)	B (North)	N	11	7,040	22
Bill Bogle (West)	B (Hines)	N	13	8,320	26
Hal McCall, Jr.	B (Eagle Draw)	S	11	7,040	22
Habitat Type: B					
Flying H	H (Ox Yoke)	S	13	8,320	26
Bill Bogle (West)	F (Middle Well)	N	14	8,960	28
Bill Bogle (West)	A (North Elrod)	N	11	7,040	22
TOTALS - HABITAT TYPE A			74	47,360	148
HABITAT TYPE B			76	48,640	152

TOTAL ACRES: 96,000

TOTAL NUMBER OF ANTELOPE: 300

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COMMENTS AND QUESTIONS

QUESTION: Are there sheep in all the pastures and what is the grazing system?

HOWARD: At one time of the year or another most all pastures do have sheep in them. Now not all of them have sheep yearlong and there are all kinds of mixes between cattle and sheep present. It depends upon what the rancher does. There is nothing in the management scheme that the rancher was currently operating in that he was asked to alter in order to go in this study. When he volunteered to let some of the pastures in his grazing allotment be used, we told him that everything that he normally did, continue to do it. The one thing that we have done from this plan that we have modified, we do not do aerial surveys in the months when he is lambing so that we do not harass his sheep and cause abandonment of lambs by the ewes. We were earlier doing ground counts.

And to correlate 4 months of data to aerial surveys, there was such a discrepancy in some of these larger pastures that we discontinued doing ground counts. We could not come up with approximately the same numbers. We could not come up with even the same sex ratio using marked animals that we were getting out of our aerial surveys. Since we have that fuel crunch and so many miles to drive, we figured it was a waste of the BLM's money and our time to try to do it. So we quit, and we're doing more intensive aerial surveys. Some of the pastures that we feel like we've missed an animal we may turn around and completely do the survey over again from scratch just for 1 animal. So we spend a lot of money on fixed-wing time.

AMSTRUP: I'm a little confused about the ownership of this land. You started out talking about BLM doing fence modifications and then the rest of the time you talk about private ranches. Who owns this land you're talking about?

HOWARD: It can be anywhere from 15% BLM to 88% BLM within the grazing allotment.

AMSTRUP: A checkerboard type?

HOWARD: Yes it is a checkerboard type. And the places where the fences are to be modified are all on BLM land, not private.

SCHEMNITZ: Would you care to comment on some recent mortality since you've written your paper that has occurred in the area?

HOWARD: Yes we have 2 pastures up in the northern portion of the area where, as I mentioned earlier, we had one of those late snows in New Mexico. For us pretty severe. We had 10-12 inches of snow on the ground for approximately 2 weeks. It is apparent these pastures have been grazed heavily in the past by both sheep and cattle, forb species from the past

growing season had been eliminated. As a result of this we were experiencing animals which were in a very high state of malnutrition, and we lost in one pasture from 33 head down to about 6 head in a period of 2 months. Ten of those carcasses, or was it 12 Alex, 12 of those carcasses have been located.

Now we went up there about 2 ½ weeks ago and collected pronghorn from each pasture and had Bob Lang, the veterinarian from Game and Fish New Mexico, with us and did a complete field necropsy on them. Both of the animals were in extreme states of malnutrition, neither had any body fat remaining anywhere. One little buck had begun to metabolize muscle tissue. Estimated total body weight was less than 55 pounds. You could pour the bone marrow out like melted jello. So those animals probably, the few that are remaining, will not be considered a viable herd. Because in one pasture we have no males left to breed the few females that are left. If we do not reintroduce, which as far as I know we don't intend to, there'll be a few pronghorn that may make it after this severe condition (the combination of weather and overgrazing). But that herd will probably no longer be considered viable in either of those 2 fashions.

POJAR: Are the sheep herded in New Mexico?

HOWARD: Okay maybe I should go into that. We have no sheep herding in the State of New Mexico. Herding went out when the bracero program went out and cheap labor went down the drain. All of our sheep in that portion of the state are what they call range sheep and they're all under net wire fence and all they do is move them from pasture to pasture. Some of them they graze yearlong in a single pasture. It just depends upon what the operation is. This is supposedly a result of an economic problem not

of not being able to afford to pay the additional personnel to herd sheep. We have a total range lambing situation in the State of New Mexico.

QUESTION: Had predation loss been a factor?

HOWARD: Well maybe Larry can correct me if I'm wrong, but as I understand it, between the State Department of Agriculture and ADC program, there is some 39 or 43 trappers in the State of New Mexico. There is about 27 of them concentrated in this immediate area. There is no self-respecting coyote that can survive over about 3 days of any of this country.

THE DISTRIBUTION AND MOVEMENT OF PRONGHORN ANTELOPE IN THE RED DESERT OF
WYOMING

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ABSTRACT: Patterns of distribution and movement of pronghorn antelope (*Antilocapra americana*) in the Red Desert of Wyoming were determined by systematic aerial surveys. Flights were conducted biweekly from September 1979 to the present. The group size and location of pronghorn, domestic livestock, and other wildlife species were recorded for each flight. Changes in pronghorn distribution and group size were first observed in November, prior to snowfall. The general winter pattern of movement was south and east into a longitudinal band of reduced snow cover in the central portion of the study area. This distribution pattern was consistent through the winter (November-March). Range use by domestic livestock reflected grazing allocations and schedules. The distribution of feral horses appeared unrelated to snow cover and depth.

Ground measurements were made at 6 pronghorn winter concentration areas from January to April 1980. Snow depth and support quality were measured with a compaction gauge. Vegetation availability, type, and utilization were also recorded for each area. Analysis of winter data was initiated in April. Quantitative results of these analyses are not presently available. cursory examination of winter data however, suggest that snow support quality is an important determinant of winter area use. Future study plans are also presented.

INTRODUCTION

The distribution and movement of pronghorn antelope in the Red Desert were described by Riddle and Oakley (1972) and Sundstrom et al. (1973). Characteristics of pronghorn habitat in this region have also been examined (Taylor 1975). Since publication of these reports the Red Desert has been subject to alterations from energy resource exploration and development. Habitat changes have occurred that may have affected patterns of pronghorn movement and habitat use. Previous studies were fundamentally important in the design of this study. However, these studies did not address the comprehensive effects on pronghorn of resource development, fences, roads, and rapid influx of human population presently occurring in the Red Desert of Wyoming.

The purpose of this study is to define pronghorn distribution and movement through a detailed, systematic aerial survey of antelope in the Red Desert and a comprehensive study of their summer and winter habitats.

The principle objectives of this study are to:

1. Determine the movement and distribution patterns of pronghorn in the Red Desert Herd Unit through systematic aerial surveys with supplemental ground observations.
2. Describe and quantify characteristics of essential pronghorn habitats (summer and winter).
3. Evaluate techniques used in geographic, meteorological and vegetational quantification of pronghorn habitats.
4. Establish causes for distribution and movement.
5. Determine potential impacts of resource development on pronghorn distribution, movement, and habitat use.

6. Determine impacts of a specific uranium milling and mining operation on pronghorn distribution and activity.
7. Propose recommendations for impact mitigation and future management of pronghorn.

We would like to recognize the assistance and support of Minerals Exploration Company, who is funding this study. This project is a cooperative endeavor between them, Colorado State University, the U. S. Bureau of Land Management, and the Wyoming Game and Fish Department. Aerial surveys were flown by Dwight H. France, France Flying Service, whose dedication and skill have greatly enhanced this project. We also extend special thanks to Larry Saslaw, U. S. Bureau of Land Management, and Jim Ellis, Colorado State University, for invaluable assistance in this study.

STUDY AREA

The study area, located in southcentral Wyoming, encompasses approximately 9,200 square kilometers. The eastern boundary is formed by U. S. Highway 287 from Rawlins to Muddy Gap (64 km). The Crooks and Green Mountains and the Sweetwater River border the northern edge of the area. The western boundary extends from Continental Peak south to Point of Rocks. The southern edge of the study area is formed by Interstate 80 from Rawlins to Point of Rocks (110 km).

The Red Desert region has a semiarid climate with mean annual precipitation of between 14.7 to 24.1 cm. Surface water is available in the form of intermittent streams and in isolated lakes and reservoirs. Additional water is also available as runoff from stock wells. Altitude varies from approximately 1,900 m to 2,200 m. The average annual temperature varies widely with season. Vegetation has been divided into 7 major types: sage, grass, greasewood, saltbush, meadow, mountain shrub and waste (U. S. Bureau

of Land Management Seven Lakes ES 1978). This area is recognized as the Red Desert Herd Unit by the Wyoming Game and Fish Department and is a complete recognizable ecological unit with respect to its pronghorn herd.

The study is divided into 3 interrelated sections--aerial surveys, intensive study of pronghorn summer habitat and characterization of winter concentration areas.

AERIAL SURVEYS

Aerial transect routes were established in August 1979 with a consideration of flight expense and time, topographical features and prior knowledge of pronghorn distribution (Sundstrom et al. 1973). Flights are conducted on 2 consecutive mornings (weather permitting) every 2 weeks using a Cessna 206 occupied by a pilot, navigator and 2 observers. The plane is flown approximately 100 m above ground at a speed of 130 km.p.h. A transect width of 0.8 km is defined by a cord attached to the wing strut and a taped line on the plane window. The location of pronghorn groups along transects is recorded by the navigator on reduced topographical maps. Observations on groups size, habitat condition and type, and percent snow cover (if applicable) are made by each observer using portable tape recorders. Pronghorn groups of 10 or more animals are photographed to verify estimated counts of group size. Other domestic and wildlife species observed along the transect are also counted and plotted. Fifteen flights have been made to date. Four representative flights which illustrate major changes in pronghorn distribution and group size will be discussed in detail.

The first selected flight was conducted on 21, 22 September 1979, prior to any significant change in mean summer precipitation or temperature. Pronghorn groups of both size categories were scattered throughout the area (Fig. 1). Mean group size was 5 animals. The distribution of cattle and feral horses has also been plotted (Figs. 2 and 3.).

The second flight was flown on 2, 3 November 1979 immediately following a light snow that covered the area with a continuous but shallow snow layer. A southward shift in the distribution of pronghorn groups is evident (Fig. 4). The shift is especially apparent along transects 1 through 5. The reason for this extreme southward movement in this portion of the study area is unknown. The number of small groups decreased to 13 compared to the previous flight total of 162. A mean groups size of 17 animals was recorded. Increased group size is probably the result of an amalgamation of smaller groups evidenced by the significant reduction in the number of small groups. In addition, since this flight was conducted immediately following new snow, changes in distribution and group size may have occurred prior to snowfall.

A southward shift in the distribution of cattle was observed (Fig. 5). Only 2 groups were recorded along the upper east-west transects compared to 35 groups observed along these transects on 21, 22 September. Cattle remained clustered about Siberia Ridge (transect 5) and the Mahoney Ranch (transect 9). Light snow did not appear to affect the distribution of feral horses (Fig. 6). Twenty-five horse groups were observed on 21, 22 September; 2 of these groups were present along the upper east-west transects. A total of 45 groups of feral horses were counted on this flight. Five of the groups were found in the northern portion of the study area.

The flight of 31 January, 1 February was made when estimated snow cover in the northern and southern third of the study area was 80-100%. Snow cover of 60-80% was observed in the central portion. Snow was described as deep (ca. 20-50 cm) throughout the area with only the tops of sage and greasewood appearing above snow. Distribution of pronghorn shifted further south and east into the narrow band of reduced snow cover (Fig. 7). Twenty-four groups containing 1982 pronghorn were counted during this flight. Seventy-one

percent of the groups (17 groups) were found where snow cover was estimated to be 60-80%. Group size ranged from 50 to 855 animals with a mean of 83 animals. A total of 4 small groups were observed along transects 9 and 10.

A southward shift in cattle distribution was noted (Fig. 8). All groups (7) were confined to the lower third of the study area. Feral horse distribution also shifted south (Fig. 9). This movement was especially apparent along transects 1 through 7. This change in distribution, however, was significantly less relative to that observed in pronghorn and cattle.

The fourth flight was conducted on 21, 23 March 1980. Snow melt was occurring at a rapid rate with large areas of bare ground and vegetation visible. Pronghorn distribution showed a shift north and west (Fig. 10). An extreme example of this northward movement was the presence of 2 pronghorn at the northern boundary of the study area between transects 5 and 6. These animals were observed in an area of continuous and relatively deep (ca 15-30 cm) snow cover. No explanation is available for their appearance in this region under the aforementioned conditions. There was a twofold increase in the number of small groups (from 4 to 8 groups). Mean group size decreased dramatically to 17 animals.

Cattle groups appeared concentrated south of Battle Springs Flat (transect 6) (Fig. 11). Movement north was observed only in this area. Feral horse distribution was also shifted north (Fig. 12) particularly along transects 1 and 3. In the eastern section of the area (transects 5 through 10), feral horses were found only along transect 7. No additional significant changes in distribution were observed.

SNOW COVER

A distinct pattern of snow cover was observed with proportionately greater amounts occurring in the northern and southern extremes of the study

area. This pattern remained unchanged although changes in total snow cover and depth were observed throughout the winter. Snow accumulation occurred later and to a lesser degree in a longitudinal band extending through the middle of the study area. Consequently snow free areas appeared sooner in this band than in areas to the north and south. This pattern of snow distribution likely influenced the movement and distribution of pronghorn in the Red Desert.

PRONGHORN DISTRIBUTION

The winter distribution of pronghorn (November-March) appeared to follow a general pattern of movement south and east (Fig. 13). A split may occur in the southward movement between transects 2 and 4. The habitat type in this region consists of extensive areas of greasewood, saltbush, and sand dunes which may inhibit a straight course south between these 2 transects.

Changes in group size over time were also evident (Fig. 15). A steady increase in the mean number of pronghorn/group was observed from November to January. Mean group size appeared at least partially correlated with estimated snow cover and depth. For example, mean group size was greatest in January (83 animals) when snow cover and depth were also at their highest values.

Shifts in distribution are clearly shown from plots of the most northern pronghorn group observed/transect for 3 of the 4 aerial surveys discussed (Fig. 14). The most northern groups for the flight of 21, 22 September occur along the boundary of the study area. Progressive southward movement is shown for the second flight (2, 3 November). A proportionately greater shift south was observed for the flight of 31 January, 1 February in association with extremes of snow cover and depth.

CATTLE AND FERAL HORSE DISTRIBUTION

Cattle and feral horse distributions were concentrated on the western section of the study area (transects 1-4). Cattle distribution was likely influenced by grazing allocations and management schedules. The pattern of feral horse distribution appeared consistent throughout the winter irrespective of snow cover and depth. Horses were often observed in the northern portions of the area where little or no vegetation seemed immediately available above the snow.

WINTER DATA COLLECTION

Measurements of various snow parameters were made at areas selected with a consideration of area utilization by pronghorn and accessibility considering existing snow conditions. Pronghorn groups studied were often located during aerial flights. Snow and vegetation were measured in areas of historic pronghorn use and areas of current pronghorn use. This division was necessary as a result of snow patterns which may have influenced pronghorn use of certain historic ranges. Random line transects were established in each area. Measurements were made with a modified compaction gauge (Hepburn 1978). Data collected included snow depth and support quality, pronghorn tract position and sinking depth, and plant availability and utilization. Vegetation samples were collected along random transects for future proximate analysis. Fresh pronghorn feces were also collected whenever possible for dietary analysis.

Data collected this winter have not as yet been analyzed. However, certain subjective observations can be made. During the winter of 1979-80, pronghorn were rarely if ever, observed in areas of historic winter use. Snow depth in these areas was comparable to that in areas of current pronghorn use. However, snow support (hardness) in historic use areas was as much as

30 times as great as in areas receiving continuous use. This has important implications with respect to energy expenditure by pronghorn and forage availability. Snow support may be a major factor that influences the degree of area use.

CONCLUSIONS

Pronghorn group size and habitat selection appeared to be influenced by percent snow cover, depth and support quality. Observed shifts in distribution south and east (November-March) may be the result of snow accumulation or consolidation in the northern and southern extremes of the study area. Consideration (increased snow hardness) occurred more rapidly in these regions where snow had existed for longer periods of time. The importance of snow support quality as a determinant of area use has been suggested of this parameter in pronghorn wintering areas.

Domestic cattle and feral horse distribution were concentrated on the western section of the study area (transects 1-4). The pattern of feral horse distribution did not appear significantly affected by changes in snow cover and depth.

FUTURE WORK

Aerial surveys will continue bi-weekly throughout the summer (May-September 1980). Intensive summer field work will begin in May. This work will involve direct ground observations of pronghorn with reference to group size and composition, activity and habitat. In addition, measurements of vegetation (composition and productivity), temperature and water availability will be made in predetermined summer use areas. Winter field techniques will be re-evaluated. Results of this evaluation should produce refined data collection procedures for use during the winter of 1980-81. A trapping and marking effort on pronghorn in the Red Desert Herd Unit will be conducted

in the fall (1980). Radio collars will be applied to select animals at this time. The use of radio telemetry will provide for greater specification of patterns of movement, habitat use types and response to environmental stimuli. The results of such research efforts will lead to a comprehensive understanding of the ecology and future of pronghorn in the Red Desert of Wyoming.

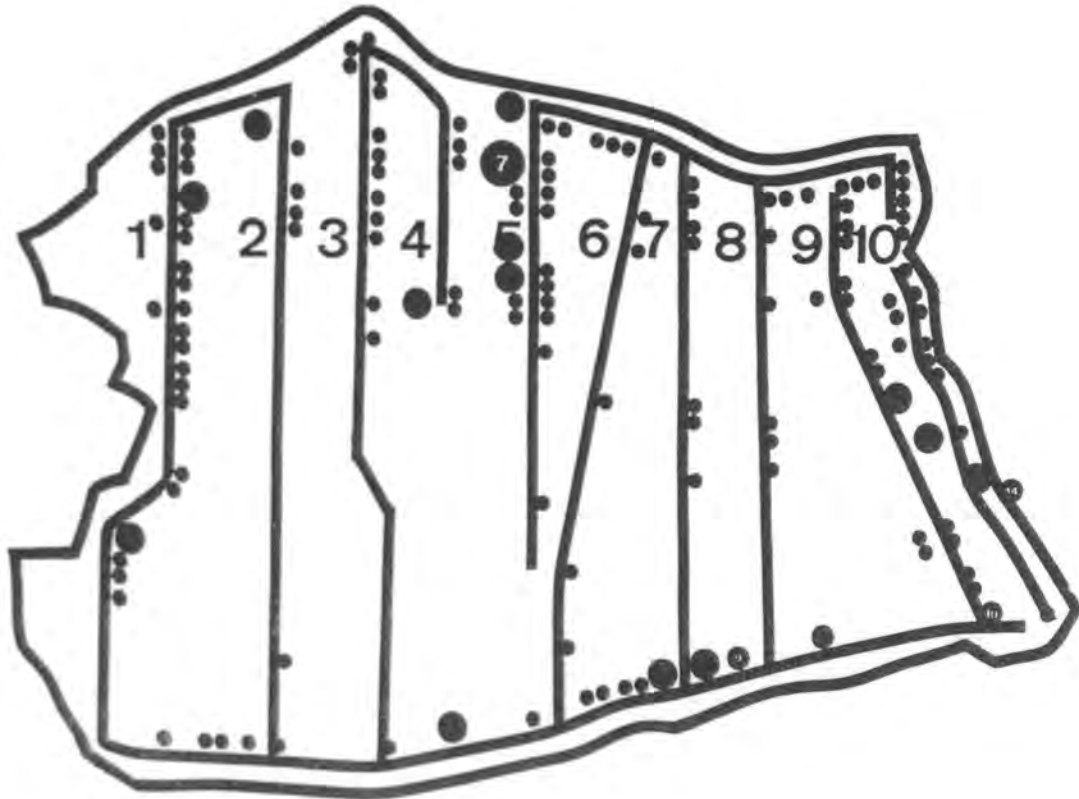


Fig. 1. Pronghorn distribution obtained from aerial surveys over the Red Desert Herd Unit 21, 22 September 1979. Transect routes are sequentially numbered with the exception of upper and lower east-west transects. Numbers within dots represent the number of groups in that region that are not plotted due to space limitations. Small dots represent pronghorn groups of fewer than 11 animals. Larger dots show the position of groups of more than 10 animals.

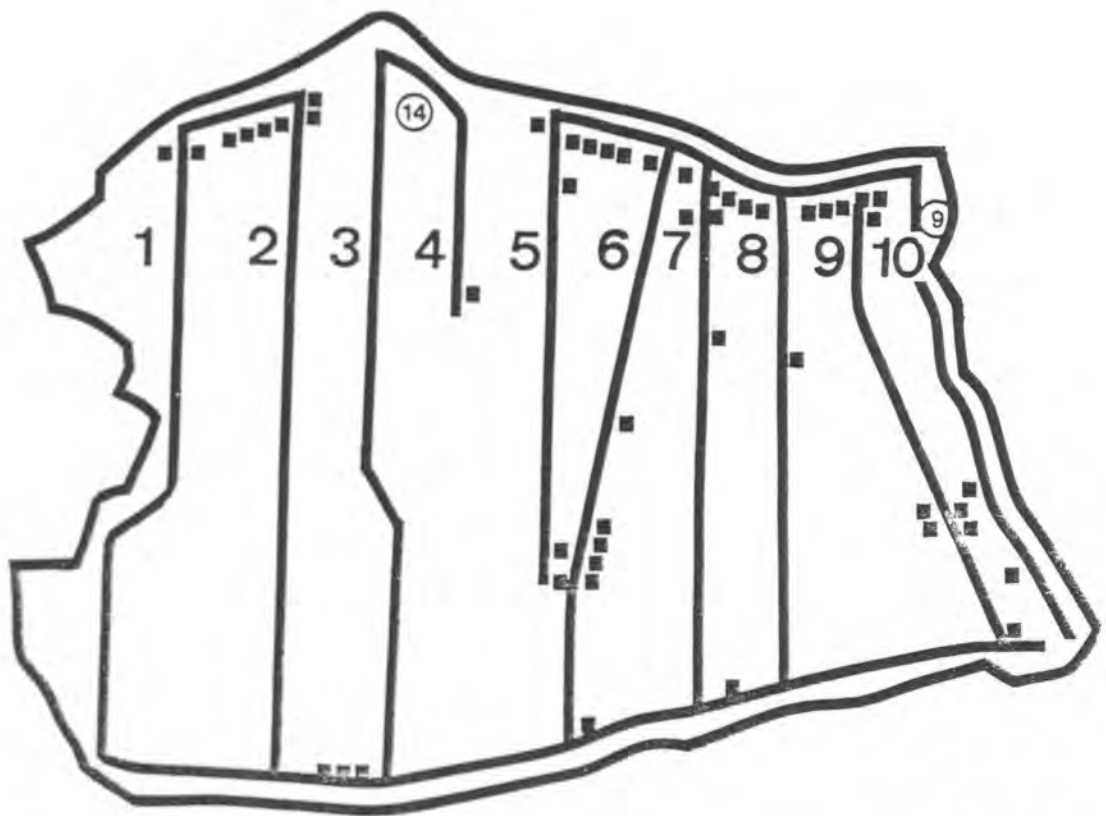


Fig. 2. Distribution of cattle obtained from aerial surveys over the Red Desert Herd Unit 21, 22 September 1979. Each square represents a discrete cattle group. Circled numbers represent number of cattle groups observed in that region.

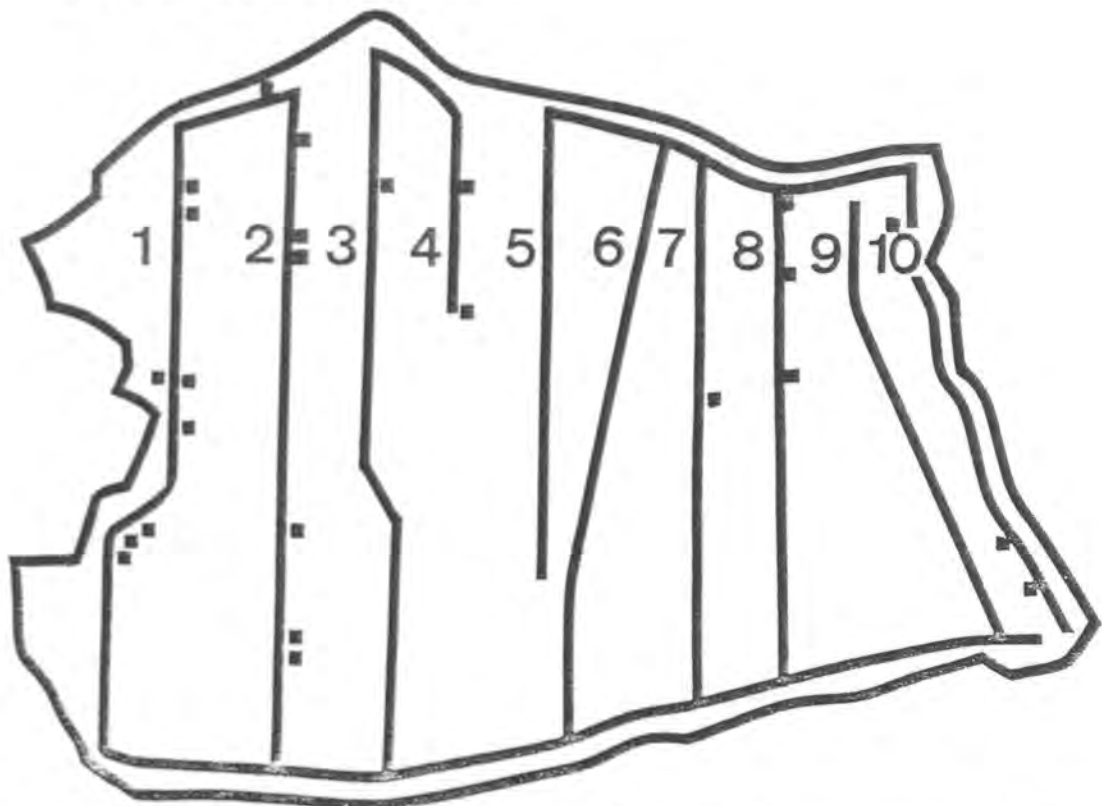


Fig. 3. Feral horse distribution obtained from aerial surveys over the Red Desert Herd Unit 21, 22 September 1979. Each square represents a discrete group of horses.

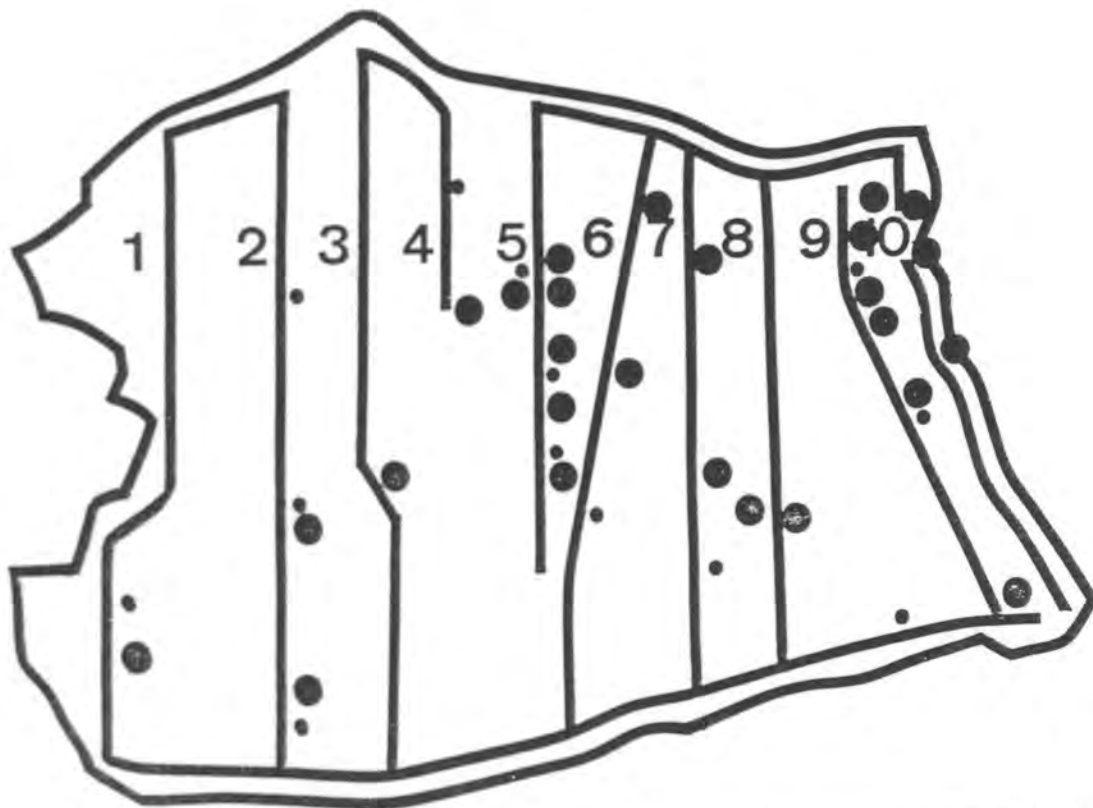


Fig. 4. Pronghorn distribution obtained from aerial surveys over the Red Desert Herd Unit 2, 3 November 1979.

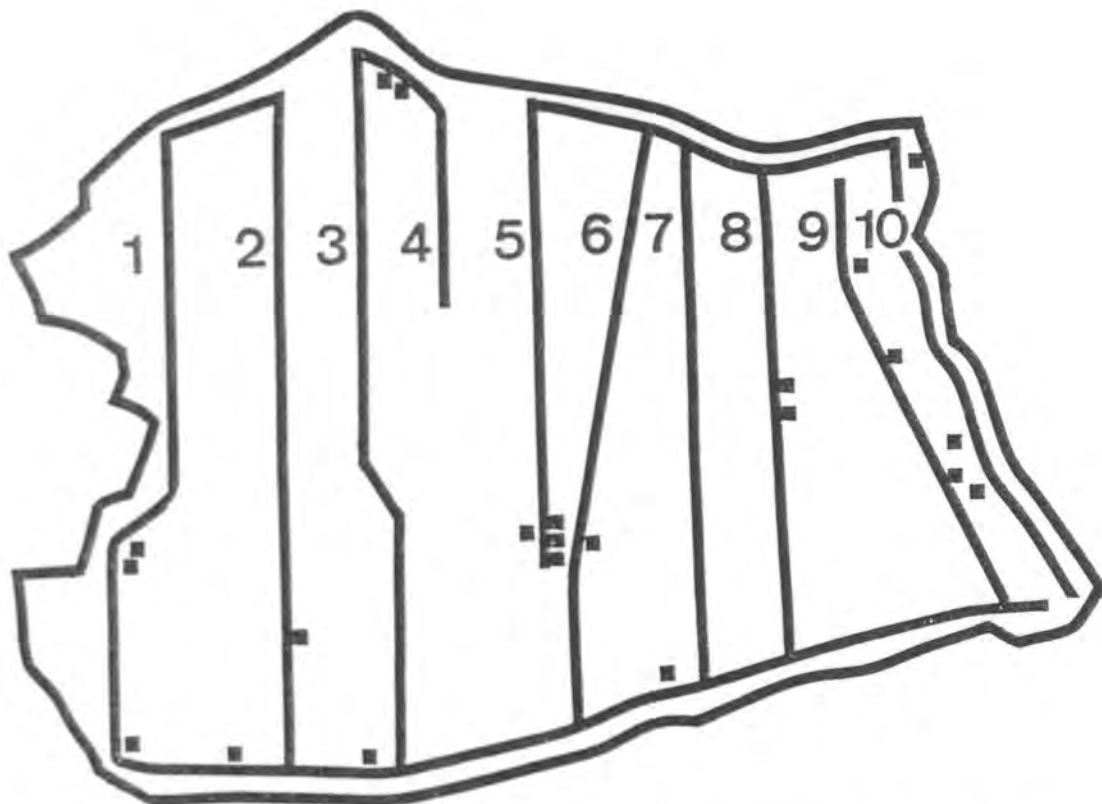


Fig. 5. Cattle distribution obtained from aerial surveys over the Red Desert Herd Unit 2, 3 November 1979.

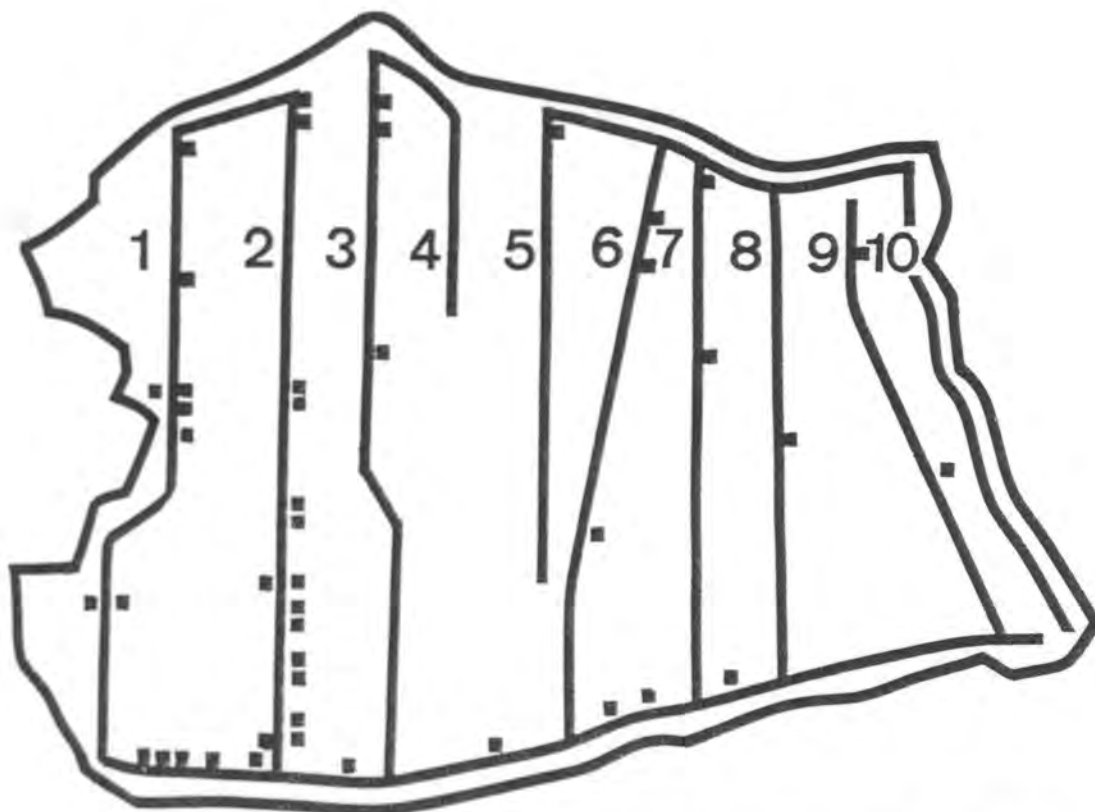


Fig. 6. Feral horse distribution obtained from aerial surveys over the Red Desert Herd Unit 2, 3 November 1979.

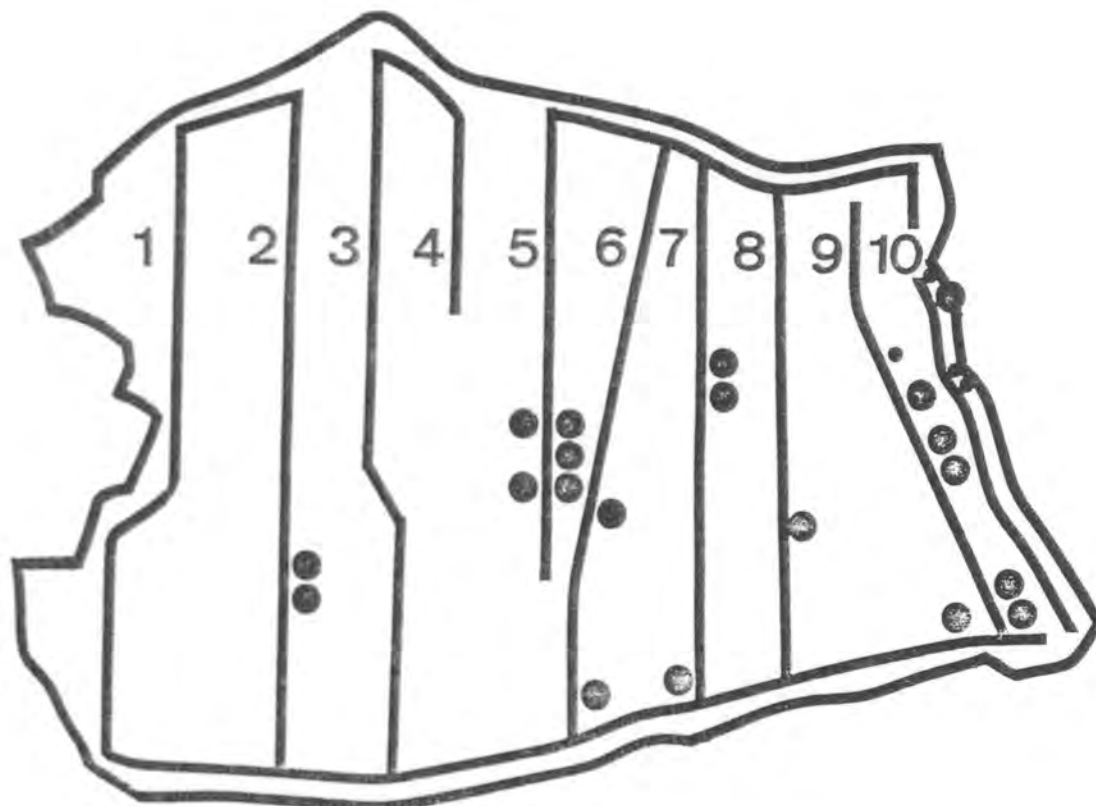


Fig. 7. Pronghorn distribution obtained from aerial surveys over the Red Desert Herd Unit 31 January, 1 February 1980.

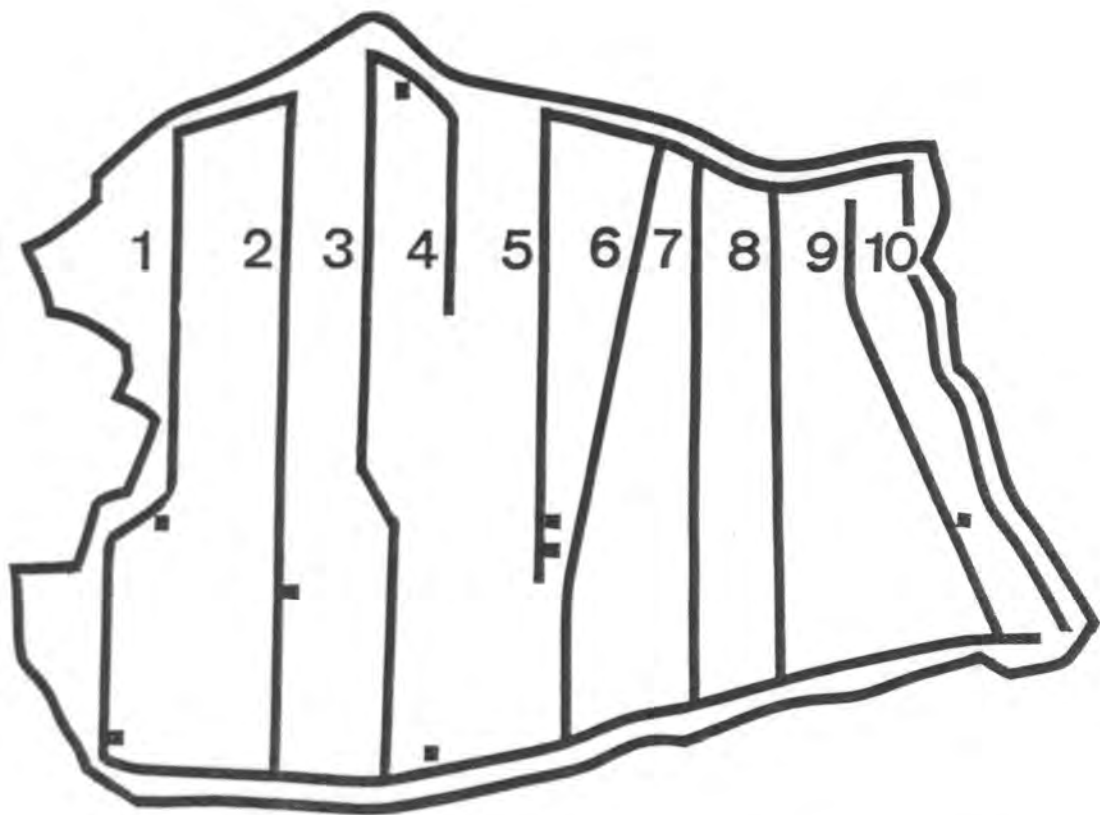


Fig. 8. Cattle distribution obtained from aerial surveys over the Red Desert Herd Unit 31 January, 1 February 1980.

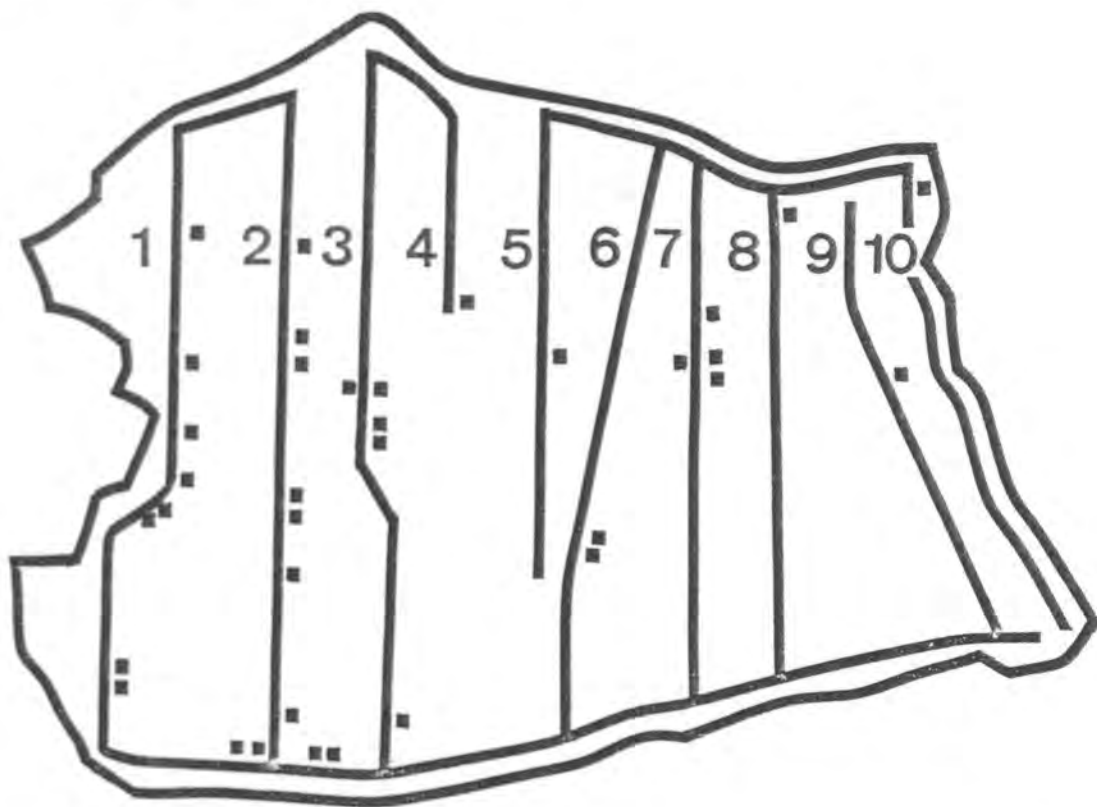


Fig. 9. Feral horse distribution obtained from aerial surveys over the Red Desert Herd Unit 31 January, 1 February 1980.

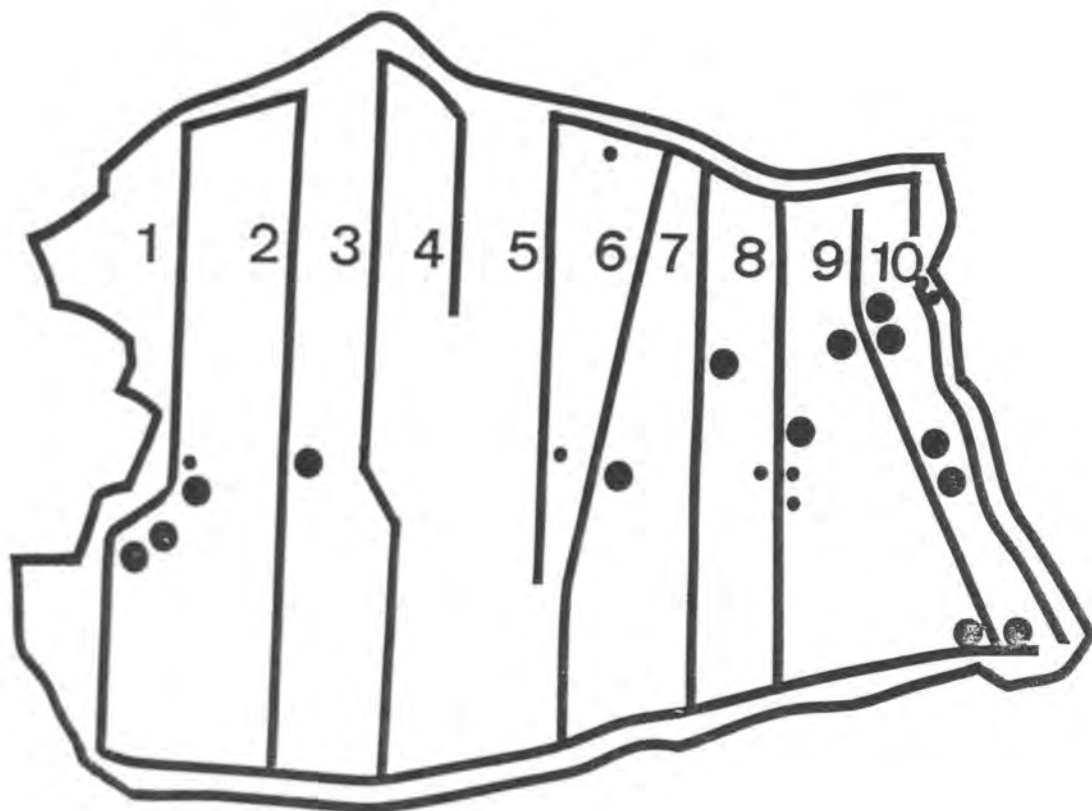


Fig. 10. Pronghorn distribution obtained from aerial surveys over the Red Desert Herd Unit 21, 23 March 1980.

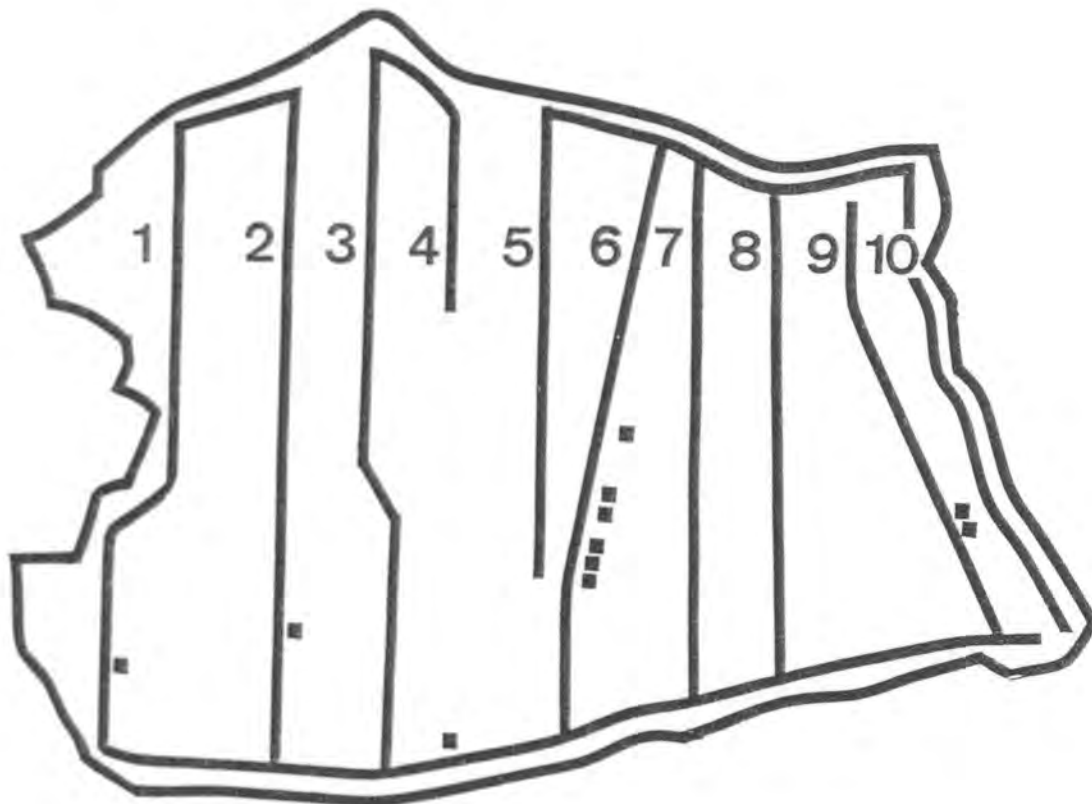


Fig. 11. Cattle distribution obtained from aerial surveys over the Red Desert Herd Unit 21, 23 March 1980.

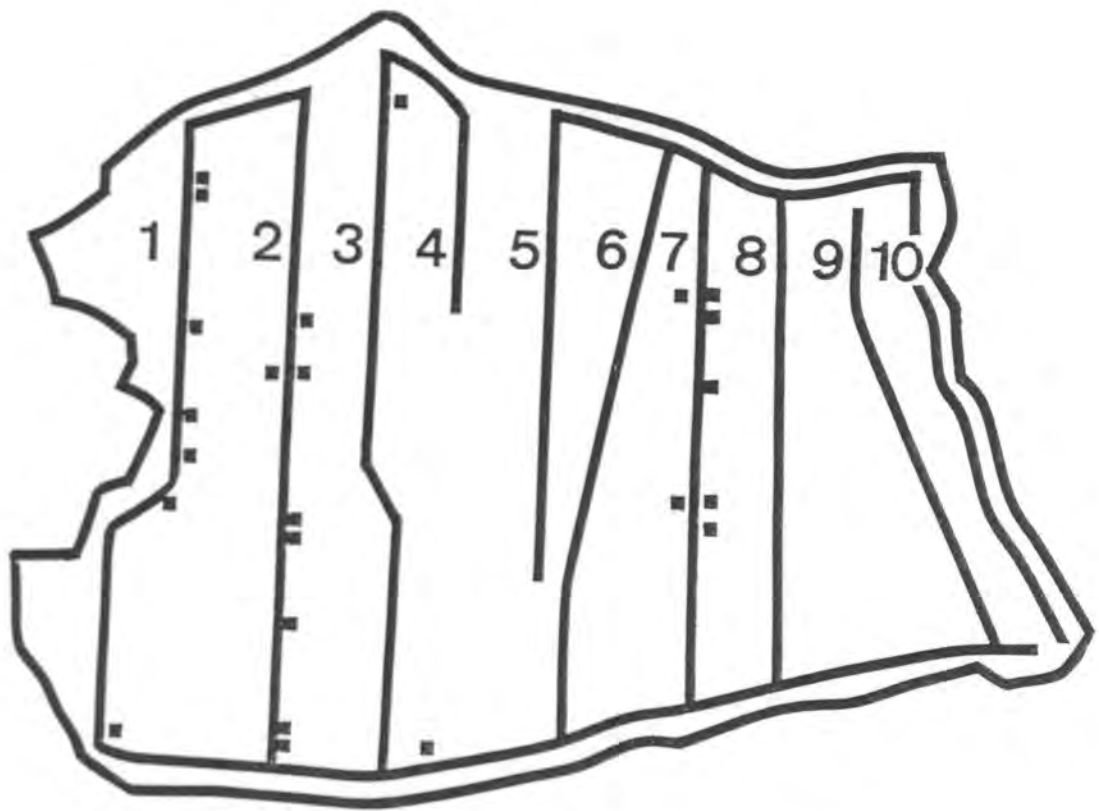


Fig. 12. Feral horse distribution obtained from aerial surveys over the Red Desert Herd Unit 21, 23 March 1980.

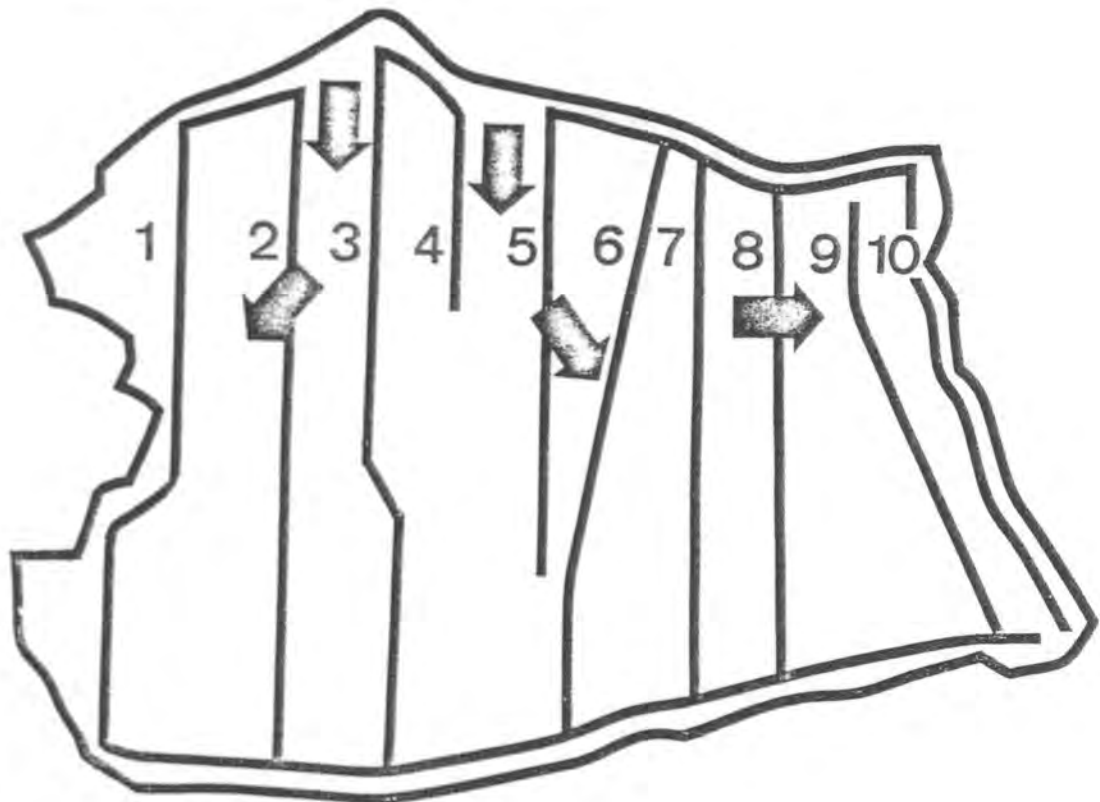


Fig. 13. General pattern of pronghorn movement obtained from aerial surveys (September-March).

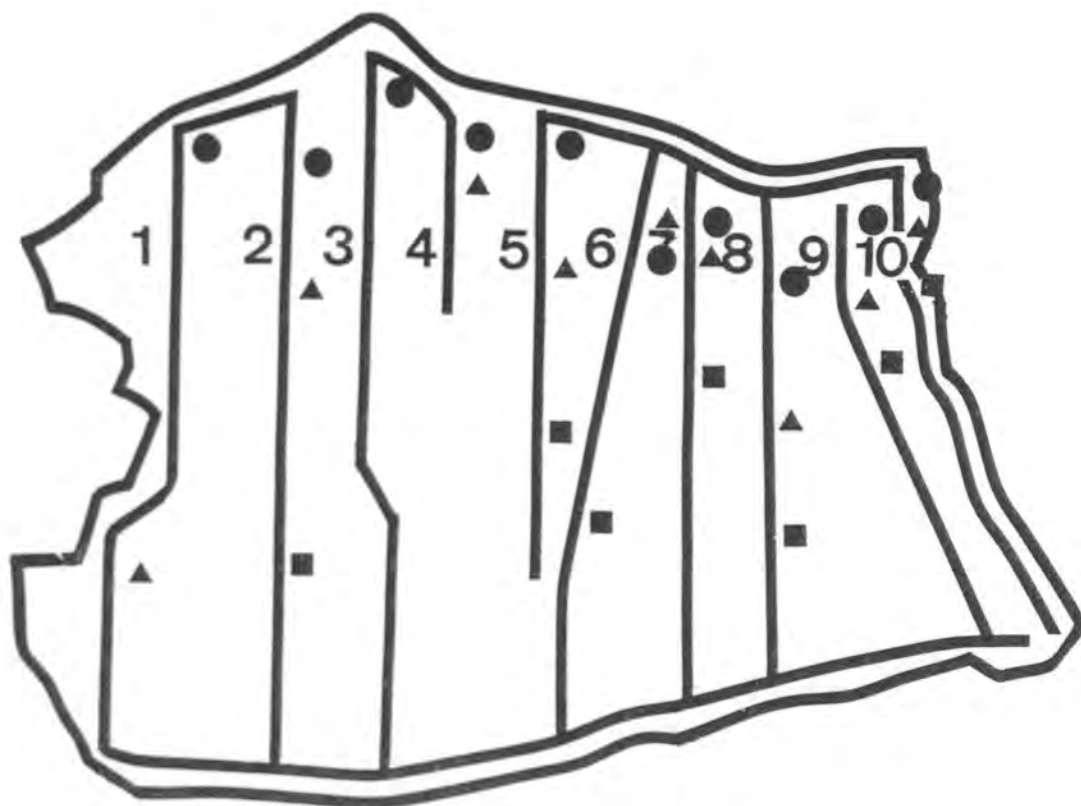


Fig. 14. Pronghorn distribution pattern from plots of the most northern pronghorn group/transect. Circles represent the flight of 21, 22 September 1979, triangles are the most northern groups of 2, 3 November 1979 and squares represent the flight of 31 January, 1 February 1980.

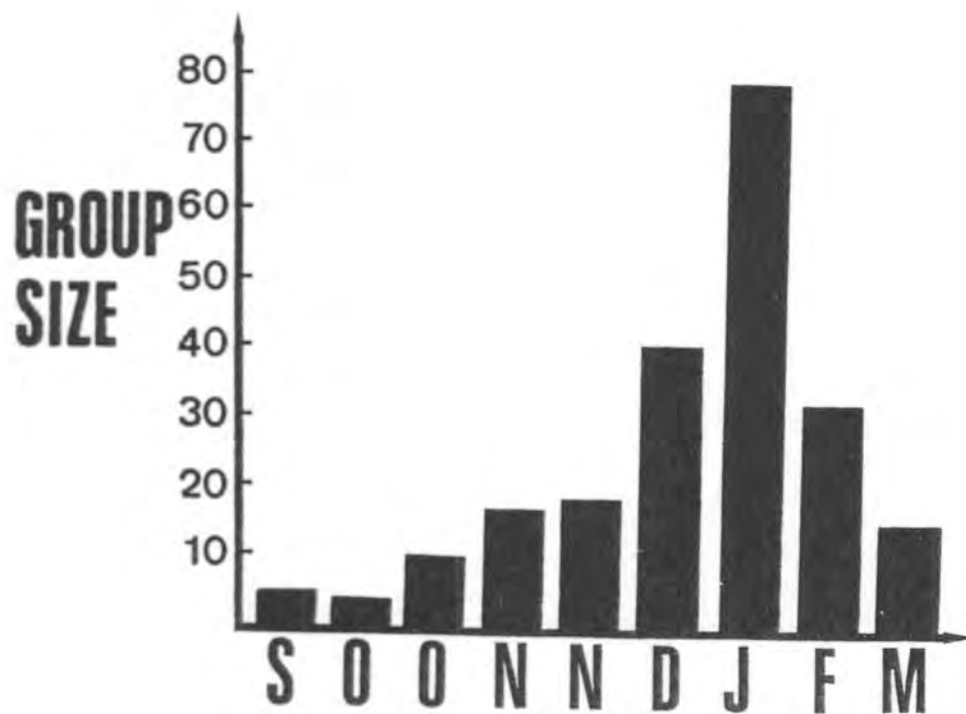


Fig. 15. Bar diagram of changes in pronghorn group size over time. Letters along the horizontal axis represent months.

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COMMENTS AND QUESTIONS

AUTENRIETH: I missed why the energy expenditure would be greater. Was it the snow support?

ROSENDALE: The snow. In other words it required 17 to 30 times as much pressure to break through the crust than it did in areas where pronghorn were found. There would be an equivalent amount of vegetation but in order to get to subsurface vegetation, or sub-snow level vegetation would require much more effort on the part of the pronghorn.

AUTENRIETH: Was the movement south lower gradient movement, from high to low?

ROSENDALE: Yes, essentially it was, but not totally. The area in which they moved is called the great basin, and there are smaller mountain ranges

both to the north on the very northern margin of the study area and along the very southern margin. So they are in sort of a great basin. But the altitude only changes from about 6,300 feet to 7,200 feet and that's the range and altitude.

AUTENRIETH: Are they moving from a higher snow depth then to a lower? What I'm trying to get at is, are they being forced to move under the greater snow conditions?

ROSENDALE: That is something which we're still trying to determine. If it is snow that's causing their movement, why should there be an increase in pronghorn herd size with the shift beginning prior to any snowfall? And that's what we've observed. But snow depth and snow support does play a major factor. Another thing we notice too is that pronghorn move no further south than they absolutely have to.

AUTENRIETH: That's what we see. Their moves are forced and some winters have an open winter and almost a summer distribution.

ROSENDALE: This winter I've been told that it's been a moderate winter compared to last winter and they are quite scattered throughout the central portions. But that's also the area where there is less snow too.

BEALE: With Sundstrom's work in the Red Desert in the 60's and Taylor's in the 70's is some of this information available?

ROSENDALE: The work of Taylor in particular is what we use to design the aerial transects in terms of percent cover of aerial transects and percent concentration of pronghorn in particular areas. The need for this study became apparent when we realized that Sundstrom's work was done in 1960's and Taylor published a report in 1975. Since that time the Red Desert is undergoing increasing pressure for mineral development.

I've seen a great deal of development just in the last year that I've been there. So their work was very important in the design of the study and in consideration for the statistical design itself. But we felt there was a need for the study in addition.

POJAR: Gail is this a fairly discrete population?

ROSENDALE: Yes it is. It's called the Red Desert herd unit because it's defined as such by the Wyoming Game and Fish Department, and for the most part there doesn't seem to be a substantial movement into or out of the area--probably because of the highways that bound it.

POJAR: You've made several counts using the same sampling design, have you calculated a variance between those counts?

ROSENDALE: No, we haven't done anything statistical with it yet. In fact that's what we're doing right now. It appears that we always see between 1,000 and 1,200 per flight with a 19% cover by the aerial transects.

POJAR: It would be of interest for those of us who use the same general technique in estimating population numbers and trends to know what sort of variation there would be amongst the counts. We rely on just one count, and maybe if we went out just the next week we might count twice as many animals, but we pretty much go with that one count because that's all we can afford to do. It's really advantageous to know what sort of variation you might begin with.

ROSENDALE: I'm quite sure that will be done.

QUESTION: I was just wondering what kind of fencing was used in the study area?

ROSENDALE: The southern portion of the area up to 20 miles north of I-80 is called a checkerboard area with every other section owned publicly and the alternate section owned by landowners. There is a great deal of

fencing in that area. A lot of it however is barbed wire fence. Also we have a large amount of net wire fence going up. That's principally used by cattle owners rather than sheep owners. And there has been a great move in the past to convert, for sheep owners to convert to cattle owners. But there is some hesitancy for those to do that because of the conversion factor for sheep owners to cattle owners where 7 sheep equal 1 cow, and that's the conversion that they're given. So there are still some sheep herders.

SEASONAL HABITAT ASSOCIATIONS OF PRONGHORNS IN ALBERTA

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ABSTRACT: Habitat associations and herd size of pronghorns (Antilocapra americana) in Alberta were determined over a 6-year period. Largest herd sizes and a heavy utilization of ranges containing silver sagebrush (Artemisia cana) were documented in winter. The major habitat types occurring in the key wintering areas of pronghorns are presented. The distribution of pronghorns within winter ranges demonstrated that areas containing sagebrush were utilized more consistently over a period of years. Pronghorn utilization of sagebrush was determined over 4 winters within a 200 ha enclosure and provided a regression ($r^2 = 0.97$) for estimating average winter densities of pronghorns from browse analysis. Length - weight relationships of sagebrush leaders were measured. Reduced growth of sagebrush leaders may result as a consequence of heavy winter browsing by pronghorns.

INTRODUCTION

Numerous researchers have investigated the food habits of pronghorns on specific study areas in northern ranges (Dirschl 1963; Bayless 1969, Mitchell and Smoljak 1971, Barrett 1974). Collectively, these studies indicated that forbs were consumed year round by pronghorns and that browse primarily sagebrush (Artemisia spp.), was heavily utilized during winter. The seasonal distribution of pronghorns, described by Barrett and Vriend (1980), revealed the existence and location of key winter ranges. Little information is available on the important seasonal habitat relationships of pronghorns on northern ranges. Utilization of sagebrush by pronghorns on open ranges has

been presented by Barrett (1974) and Wiltse (1978). Measurements of the use of sagebrush by a known density of pronghorns under controlled conditions, however, has not been reported previously.

This study provides a broad perspective of habitat associations of pronghorns with particular emphasis on vegetative cover available on winter ranges. This information should facilitate recognition of habitat deemed critical to pronghorns in Alberta and presumably other northern ranges. The specific objectives of this study were to describe: (1) The seasonal habitat associations and herd structure of pronghorns; (2) the habitat types within winter ranges; and (3) some of the relationships between pronghorn density and the utilization and growth of sagebrush.

Portions of this study were conducted over the entire pronghorn range within Alberta. This area conforms largely to brown and dark brown soil zones. General descriptions of the area have been presented by Coupland (1950; 1961) and Mitchell and Smoliak (1971). Pronghorn range within Alberta is part of the mixed-grass prairie region (Webb et al. 1967). The relationship between the density of pronghorns and the utilization of sagebrush were investigated within an enclosure in southeastern Alberta; the vegetation within this enclosure has been described previously by Barrett (1979).

METHODS

While conducting a variety of investigations, project personnel spent in excess of 2,000 man-days throughout the range of pronghorns in Alberta from 1971 and 1976, inclusive. When pronghorns were observed, the herd size, herd composition, predominant activity and habitat association of each group were recorded. Habitat associations were separated into 4 major classifications of vegetation namely: (1) Native grass prairie (NGP); (2) NGP with light sagebrush cover (3 - 10 sagebrush plants per 60 - m linear transect); (3) NGP

with heavy sagebrush cover (10 sagebrush plants per 60 - m linear transect); and (4) cultivated lands (includes summerfallow, cereal crops and tame pasture).

The key wintering areas in Alberta as described by Barrett and Vriend (1980) were examined using aerial photography to determine the major vegetation types present; the vegetation types in all areas were ground truthed. The distribution of pronghorns in winter was recorded relative to these vegetation types. Nine vegetation cover types were identified within the winter ranges. NGP was divided into 4 categories based on the number of sagebrush plants intercepted by a randomly selected 60 - m linear transect. The 4 categories, NGP, NGP - light sagebrush, NGP - medium sagebrush and NGP - heavy sagebrush reflected densities of <3 , 3 - 10, 11 - 25 and >25 plants per transect, respectively. Cultivated land was divided into forage or tame pasture areas and lands used to produce cereal crops. Treed areas included lands covered by stands of trees such as aspen (Populus tremulorides) and willow (Salix spp.) and covering more than one half hectare in area. Brushland included lands covered with low browse species other than sagebrush and were usually dominated by snowberry (Symphoricarpos occidentalis), rose (Rosa spp.) and silverberry (Eleagnus commutata). Water bodies referred to areas covered year round by water.

The names for the winter ranges follow those presented by Barrett and Vriend (1980). The distribution of pronghorns relative to major habitat types is presented for the Walsh winter range and is generally representative of findings on the remaining wintering areas.

Habitat mapping of all winter ranges was accomplished initially using aerial photography. Habitat types mapped were confirmed by extensive ground truthing in each winter range. Mapping was completed on a 1:50,000 map scale. Areas of the winter ranges and the habitat types were calculated using both a planimeter and a 1:50,000 scale dot grid. Calculations were done in duplicate

and results were replicable to within a 4% error factor. The entire range of pronghorns in Alberta was examined using 1970 aerial photographs and the percentage of the area in native rangeland and area under some form of cultivation was determined.

Pronghorn use of sagebrush was investigated within a 200 ha enclosure where winter densities of pronghorns were maintained between 4.4 and 13.0 per km². With the exception of an occasional mule deer (Odocoileus hemionus), pronghorns were the only large herbivore to use the enclosure. The enclosure was within the brown soil zone. Habitat mapping followed the procedure used for the winter ranges. Random browse transects were established within the sagebrush areas of the enclosure and the percentage of leaders browsed during winter was determined in April of each year (Cole 1963). A linear regression was calculated for the density of pronghorns based on the percent of sagebrush stems clipped.

The length of unbrowsed sagebrush leaders was examined in relation to 3 previous grazing regimes, namely, (1) spring and summer use by cattle, (2) year-round use by pronghorns, and (3) no-use. The no-use areas were within exclosures and the cattle-use area was outside the pronghorn enclosure. The length - weight relationships for sagebrush stems was determined using the current year's growth on unbrowsed sagebrush plants within the pronghorn enclosure.

RESULTS

Herd Size and Habitat Associations

The mean herd size of pronghorns was markedly lower in the 7 month period from April to October and higher during the winter months (Fig. 1). Pronghorns were more widely distributed and occurred in smaller herds during the month of May than at any other time of the year; that time period coincides

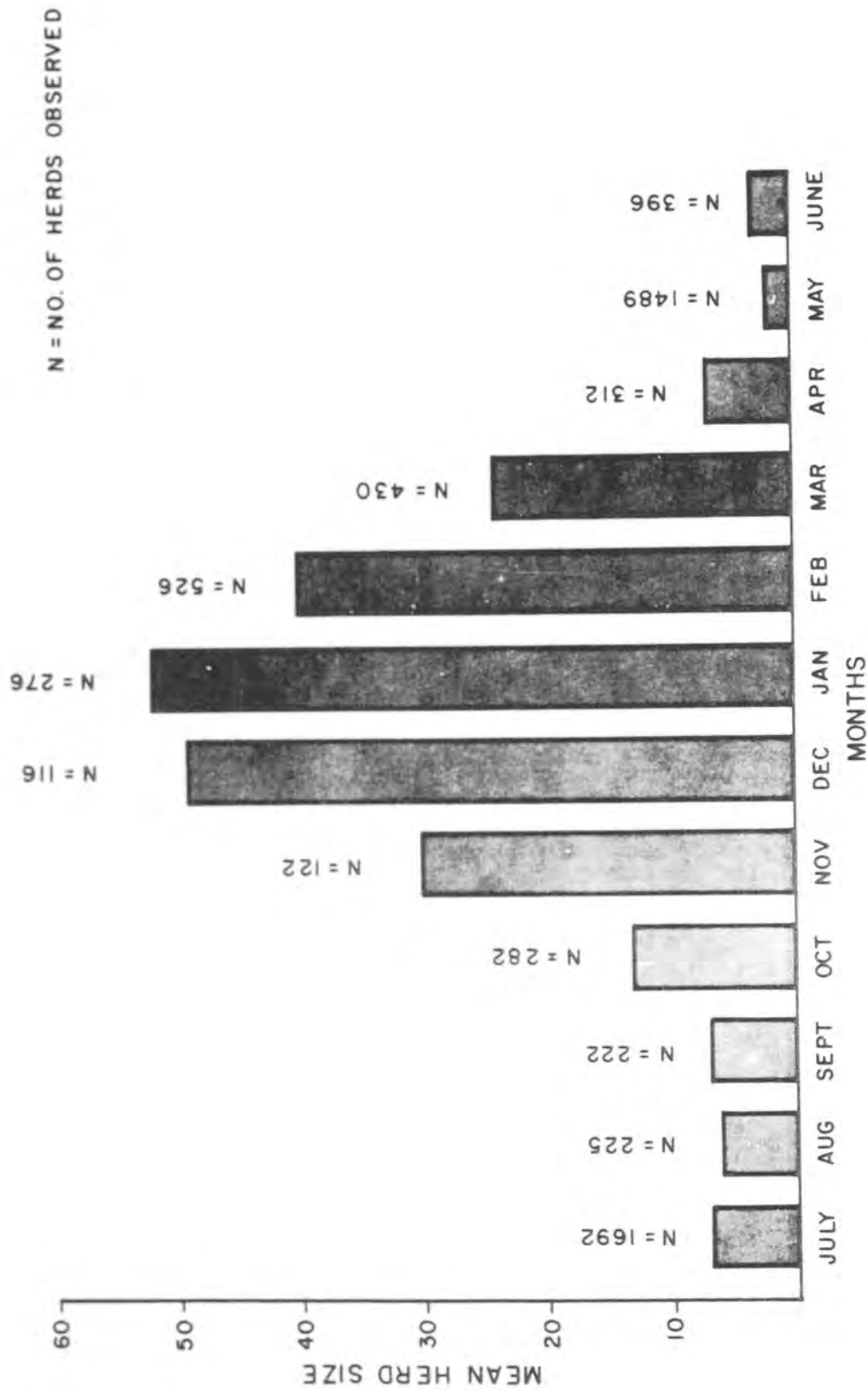


FIG. 1. MEAN MONTHLY HERD SIZE FOR 80,866 PRONGHORNS OBSERVED IN ALBERTA FROM 1971 - 1976, INCLUSIVE

with the parturition period for pronghorns in Alberta. During December and January, the mean herd size's were largest and pronghorns typically occupied their winter ranges.

At all seasons of the year, approximately 25% of pronghorns occurred on NGP - light sagebrush rangelands (Fig. 2). Heavy sagebrush cover was used most extensively during the winter months from December to March. Conversely, during the winter months, the proportion of pronghorns using NGP rangelands diminished sharply. Use of cultivated lands was moderate in all months but increased in October and November. The increase in use of cultivated lands in the fall reflected greater use by pronghorns of fall seeded crops and stubble fields.

Increased use of sagebrush communities in late fall, coincided with the dramatic increase in mean herd size (Fig. 1). During this time period pronghorns moved from their summer to winter ranges. Conversely, in late winter the process reverses, as pronghorns disperse from their wintering areas, separate into small groups and increase their use of NGP (Fig. 2). Occupation of predominately grassland ranges during the summer months does not imply that pronghorn are consuming primarily grasses but rather that their forage was selected from a grassland community.

Vegetation Types in Winter Ranges

The key winter ranges for pronghorns as presented by Barrett and Vriend (1980) are outlined in Figure 3. Detailed habitat mapping was conducted on all winter ranges except the Suffield, Murray Lake, and Canal Creek areas. Native grasslands represented the largest single land use type (42.5%) while grasslands with light sagebrush was the next most abundant type (30.1%) (Table 1). Heavy sagebrush communities, while exceedingly important to wintering pronghorns, represented only 9.2% of the area of the winter ranges.

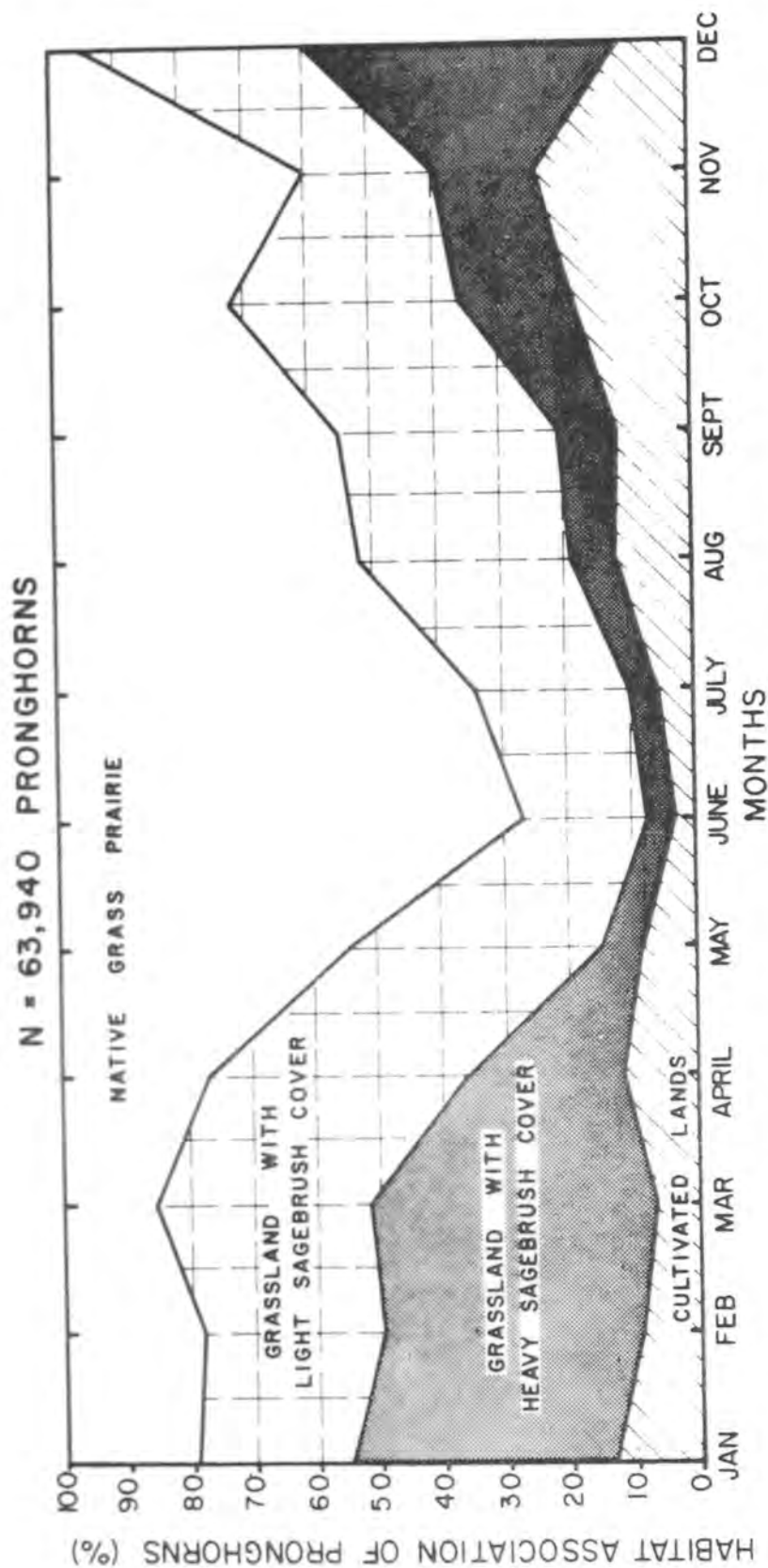


FIG. 2. MONTHLY DISTRIBUTION OF PRONGHORNS WITH RESPECT TO AVAILABLE HABITAT TYPES AS RECORDED FROM 1972 TO 1976, INCLUSIVE

Table 1. Summary of habitat occurring on the 9 identified pronghorn winter ranges in Alberta

Habitat Type	Total Area (km ²)	Proportion of Winter Range (%)
Native Grass Prairie (NGP)	1,251.5	42.5
NGP - Light Sagebrush	885.9	30.1
NGP - Medium Sagebrush	161.2	5.5
NGP - Heavy Sagebrush	108.5	3.7
Cultivation - Forage	23.8	0.8
Cultivation - Cereal	338.4	11.4
Treed Areas	72.2	2.5
Brushland	51.6	1.7
Water Bodies	<u>54.0</u>	<u>1.8</u>
Total	2,947.3	100.0

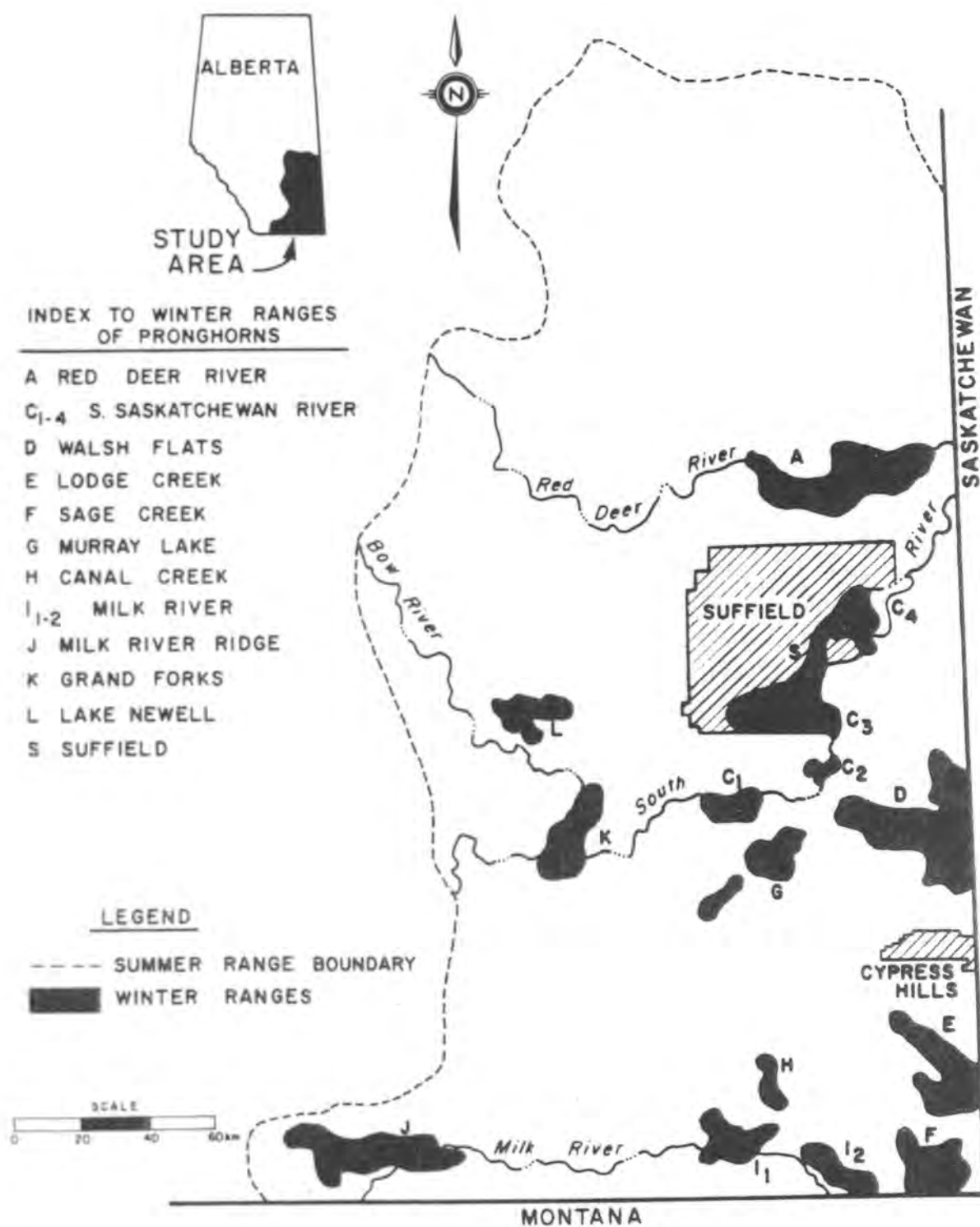


FIG. 3. DELINEATION OF THE SUMMER DISTRIBUTION AND WINTERING AREAS OF PRONGHORNS IN ALBERTA

Cultivated lands represented 12.2% of the area of the winter ranges (Table 1) but 29.6% of the area within the total pronghorn range in Alberta.

The major habitat types and the areas of the different winter ranges are summarized in Table 2. Cultivation was virtually absent in the Lodge Creek wintering area but represented a high of 21.4% of the Walsh wintering area. Sagebrush rangelands varied from a low of 4.6% in the Milk River Ridge wintering area to a high of 56.5% in the Lake Newell wintering area.

The Walsh winter range illustrates the importance of the different habitat types. The distribution of pronghorns during winter was determined over a 5-year period and specific high use areas identified (Fig. 4). Habitat mapping of the same area revealed that the high use areas contained a high proportion of sagebrush rangelands and a moderate proportion of grassland range (Fig. 5). Areas which were predominately under cultivation were seldom reported as high use areas within a winter range. Furthermore, no areas of the province with more than 25% of the land area in cultivation were consistently used as wintering areas by pronghorns.

Pronghorn - Sagebrush Relationships

The relationship between pronghorn density and the utilization of sagebrush was determined within a 200 ha enclosure constructed on a portion of the Lodge Creek winter range (Fig. 6). Habitat mapping revealed that 40% of the area was native grassland, and 23, 17, and 19% was NGP - light, NGP - medium, and NGP - heavy sagebrush, respectively. Mean over-winter-densities of pronghorns varied from 4.4 to 13.0 per km². The percentage of leaders browsed during winter ranged between 24.1 and 80.4% (Table 3). A significant ($r^2 = 0.97$) linear regression of mean over-winter density of pronghorns and utilization of sagebrush leaders was developed (Fig. 7).

Table 2. Summary of major classifications of vegetation within identified pronghorn winter ranges in Alberta

Winter Range	Area of Range (km ²)	Percentage of Area Vegetated by		
		Sagebrush ^a Rangelands	Grasslands	Cultivated Lands
Red Deer River	456.7	31.5	41.3	11.5
South Saskatchewan River	205.4	36.5	54.6	5.8
Walsh Flats	593.8	18.3	52.3	21.4
Lodge Creek	235.7	39.1	55.8	0.5
Sage Creek	283.6	39.9	50.0	7.2
Milk River Valley	336.3	11.9	75.8	8.9
Milk River Ridge	337.5	4.6	73.9	19.9
Grand Forks	151.8	47.1	43.2	7.6
Lake Newell	202.5	56.5	29.3	11.3
Mean	311.5	31.8	52.9	10.5

^aSagebrush rangelands includes all areas where sagebrush plants occurred more than 3 times per 60m linear transect

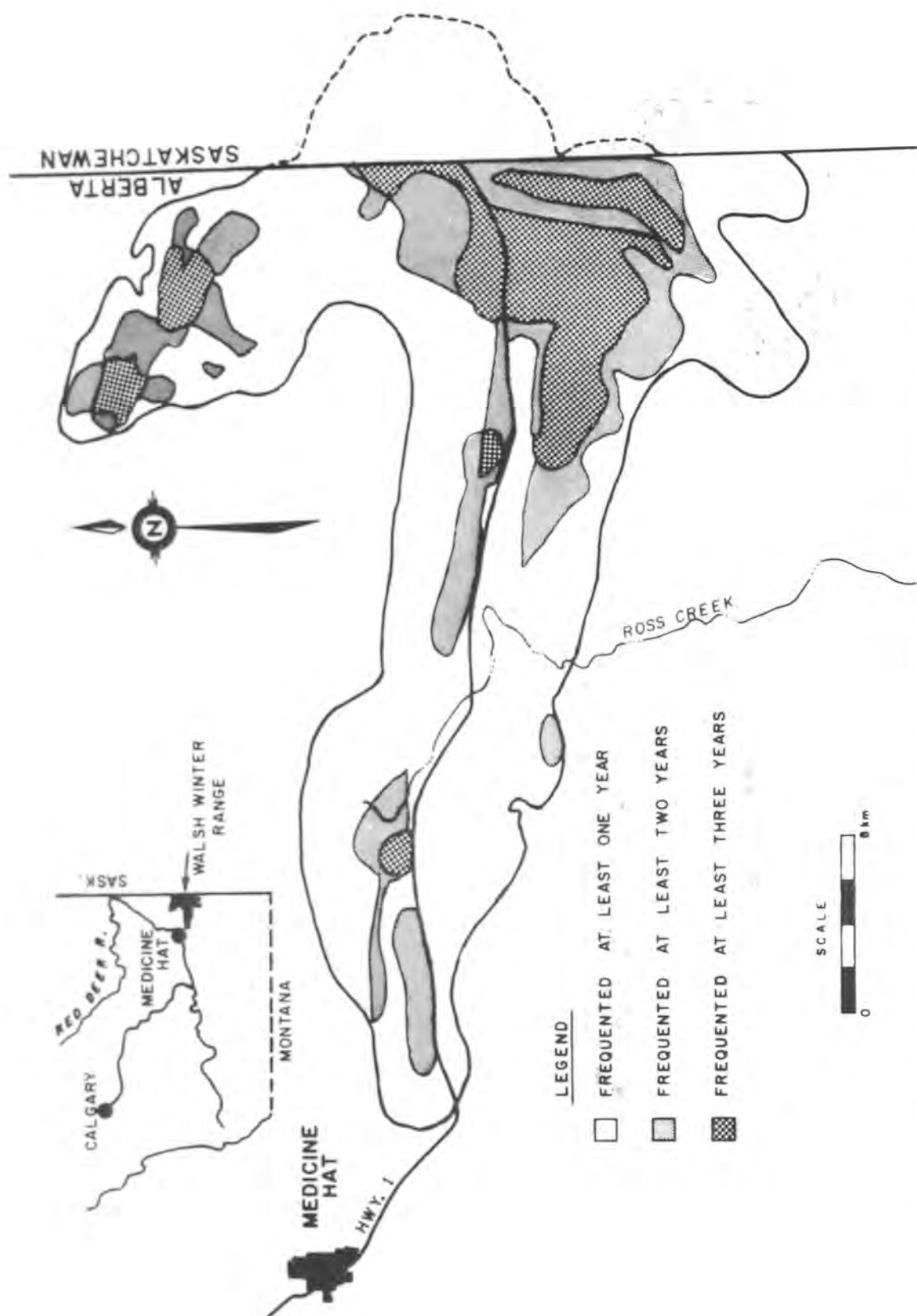


FIG. 4. OUTLINE OF WALSH WINTER RANGE OF PRONGHORNS SHOWING THE FREQUENCY OF OCCUPATION DURING A 5 YEAR MONITORING PERIOD

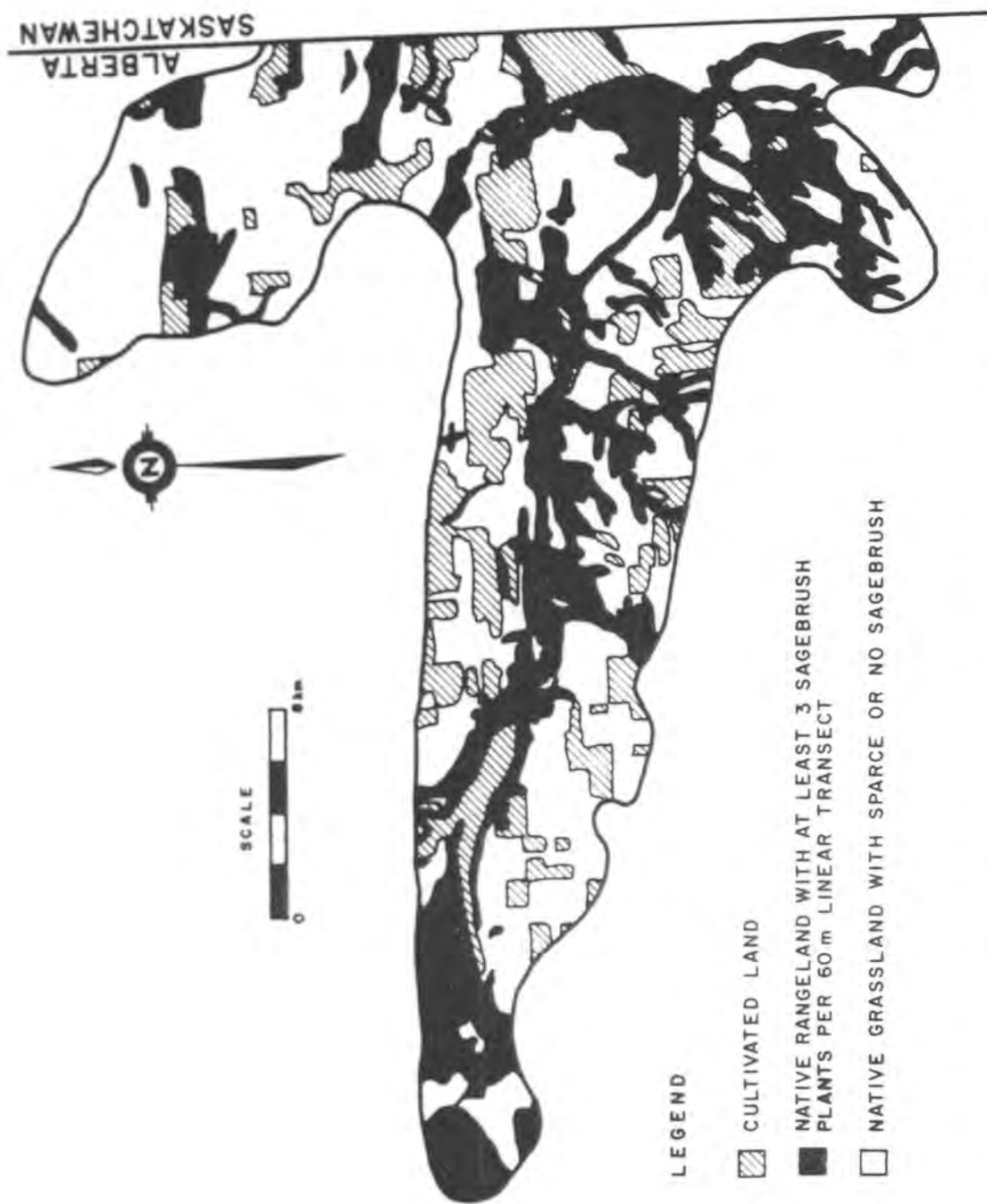


FIG. 5. DISTRIBUTION OF THREE MAJOR TYPES OF LAND CLASSIFICATION ON THE WALSH WINTER RANGE OF PRONGHORNS

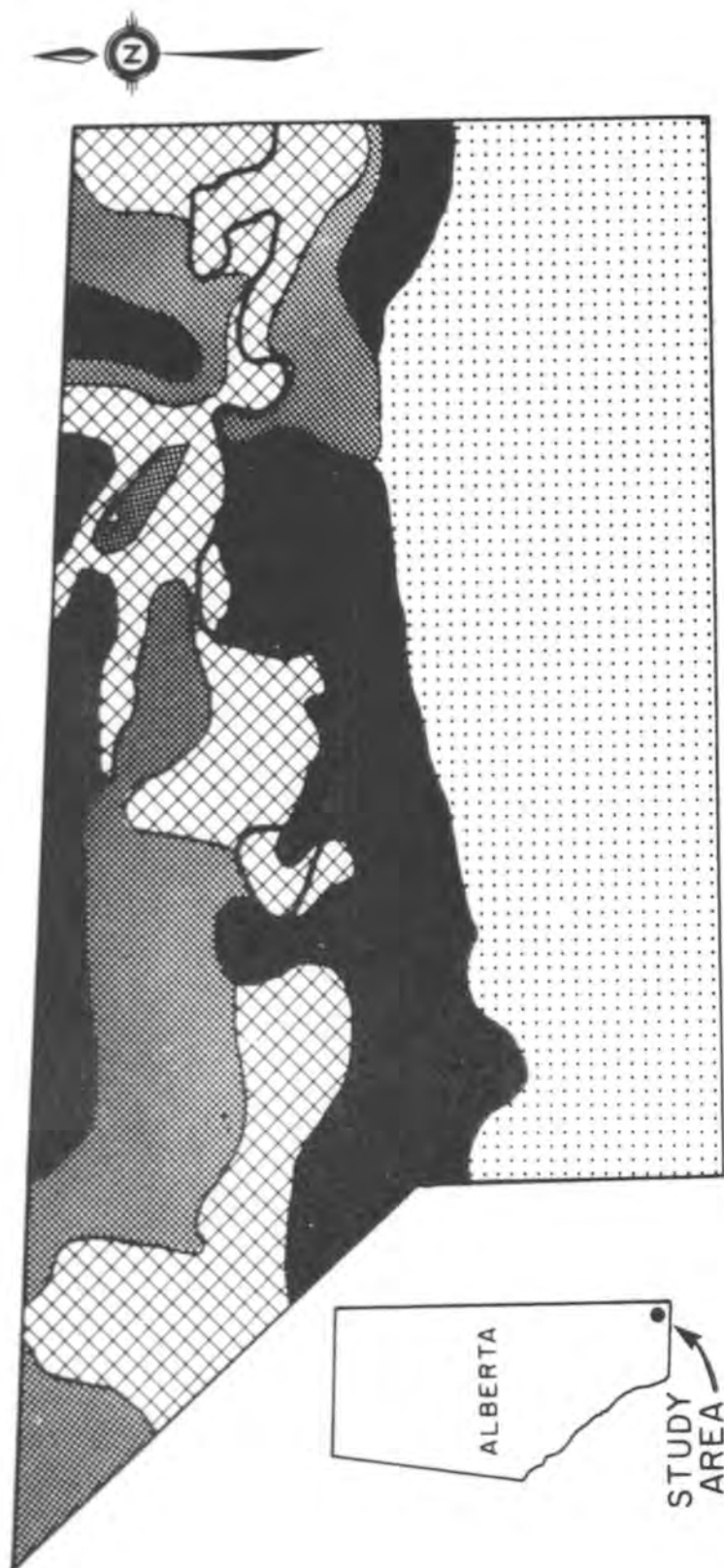


FIG. 6. VEGETATION COVER WITHIN 200ha PRONGHORN ENCLOSURE

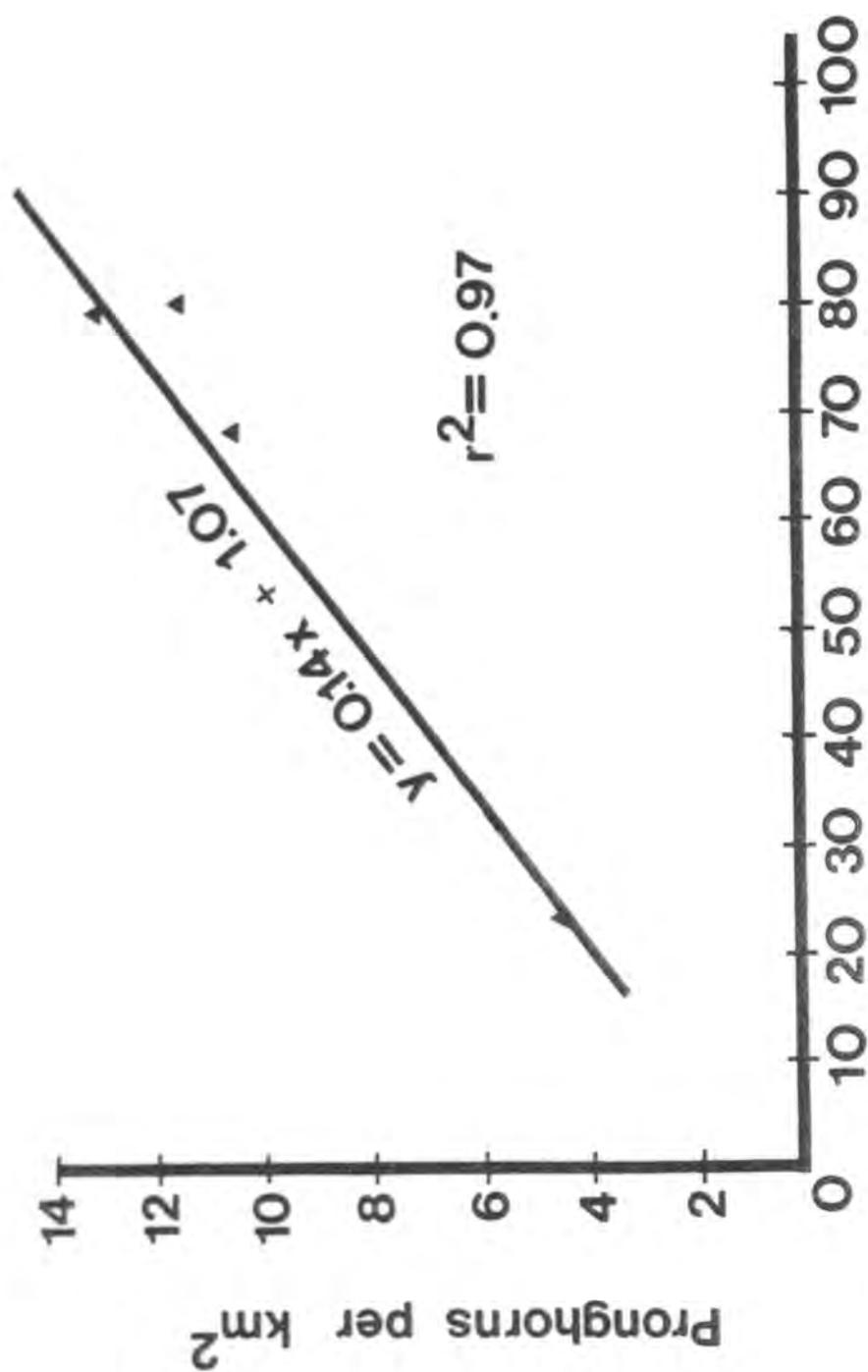
Nearly half of the weight of sagebrush stems occurred in the leaves and distal $\frac{1}{2}$ of the annual growth (Table 4). Only 31% of the weight of the annual growth was contained in the proximal $\frac{1}{2}$ of the stems. Browsing pressure which removes most of the leaves and half of the length of annual growth is indicative of heavy use.

Summer grazing by cattle stocked at 27 ha per animal unit on open range had no measurable impact on the growth of sagebrush. Heavy use of sagebrush by pronghorns during the winters of 1975-76 and 1976-77, (Table 3) appeared responsible for reduced growth of sagebrush during the following summer (Table 5). Reduced growth of leaders in all areas sampled during 1976 was attributable to arid conditions.

DISCUSSION

Selection of forage by pronghorns in Alberta was described by Mitchell and Smoliak and to a lesser degree by Bruns (1969, 1977) and Barrett (1974). The habitat associations of pronghorns presented in this paper indicates which of the range types available were selected by pronghorns. Wiltse (1978) reported habitat associations for pronghorns in Saskatchewan but presented no monthly or seasonal breakdown. Over 72% of 9,044 animals observed in Saskatchewan were on native rangeland and of these most were observed on a sagebrush - grassland association (Wiltse 1978). The seemingly high preference and perhaps dependence of pronghorns on sagebrush - grassland vegetation associations in winter underscore the need to maintain these important ranges for pronghorn in Alberta.

The formation of large herds of pronghorns in winter has been reported previously. Mitchell (1980) observed a smaller number of herds in Alberta between 1952 and 1965 and reported gross similarities to my findings with respect to general seasonal trends, however, there were extensive differences



Stems clipped (%), Nov. 1 to April 1

FIG. 7. LINEAR REGRESSION OF MEAN OVER WINTER DENSITY OF PRONGHORNS ON UTILIZATION OF SAGEBRUSH

Table 3. Relationship between pronghorn density and the proportion of sagebrush leaders browsed during winter within a 200 ha enclosure

Winter Period ^a	No. of Transects	Mean per Transect			Mean Density of Pronghorns Per km ²
		Stems Available	Stems Browsed	Percent Browsed	
1973-74	2	145	35	24.1	4.4
1974-75	14	176	120	68.2	10.5
1975-76	14	172	138	80.2	13.0
1976-77	14	173	139	80.4	11.5

^aTransects read in early April

Table 4. Length weight relationships of 40 sagebrush stems measured in late October ^a

	Leaves	Distal $\frac{1}{4}$	Disto- medial $\frac{1}{4}$	Proxo- medial $\frac{1}{4}$	Proximal $\frac{1}{4}$	Total
Mean weight (g)	13.1	16.8	12.0	9.1	9.7	60.7
Percent of total weight	21.5	27.7	19.8	15.0	16.0	100.0

^aStems had an average of 7.1 leaders and 27.3 cm of current years growth

Table 5. Length of sagebrush leaders under different grazing regimes

Growth Year	No. Leaders Sampled in Each Type	Leader Length After Growing Season (cm)		
		Open Cattle Range ^a	Pronghorn Enclosure ^b	Ungrazed Areas
1976	400	6.7	5.2	6.9
1977	400	10.3	7.0	9.2

^aStocking rate approximately 27 ha per animal unit (cattle)

^bStocking rate approximately 8 ha per animal unit (pronghorns)

in the monthly herd sizes. Differences in the average density of pronghorns and a very limited sample size for some months could explain some of the variation observed by Mitchell in relationship to my findings. There was considerable consistency in the annual chronology of movements to and from winter ranges but early snowfall hastened the formation of large herds in fall. Hoskinson and Tester (1980) suggested that decreasing moisture content of forage provides the stimulus for movement of pronghorns in the fall. Similarly, dispersal of pronghorns in late winter appeared to be inversely related to the persistence of snow cover. In one spring, a late April snowfall, resulted in approximately half of the previously dispersed pronghorns returning to their winter range. Hoskinson and Tester (1980) reported that spring dispersal of pronghorns appeared related to the disappearance of snow in Idaho.

Key wintering areas appear critical to the survival of pronghorns in northern latitudes. Habitat evaluation within these areas should provide managers with a priority guidelines for determining and preserving vital habitats. The relationship between the winter distribution of pronghorns and available habitat types further indicates the importance of sagebrush

communities in Alberta. In an exceptionally open winter, with little snowfall, pronghorns tended to be more widely scattered and showed less dependence on defined winter ranges than in normal winters. In the severe winter of 1977-78, many pronghorns left these winter ranges, seemingly in response to heavy accumulations of snow; overwinter mortality was high, but animals which retained access to sagebrush areas fared best (Barrett 1978).

The importance of sagebrush habitat to pronghorns in northern ranges seems indisputable. Browse, predominantly sagebrush, frequently forms more than 75% of the winter diet of pronghorns in northern ranges (Dirschl 1963, Wentland 1968; Bayless 1969; Beale and Smith 1970). During severe winters, browse is particularly critical for pronghorns. Martinka (1967) reported pronghorns restricted to grasslands in Montana died during a severe winter while those with access to sagebrush survived. This dependency on woody browse by pronghorns in severe winters has also been reported by Compton (1970) McKenzie (1970) and West (1970).

Browse transects have been used commonly to measure the impact of ungulates on their forage base Cole (1963); Wiltse (1978). This study provides a regression (Fig. 7) which may assist with the interpretation of data obtained from browse transects conducted on winter ranges. I do not recommend that browse use surveys of the type described herein be used to estimate the dry matter intake of pronghorns. Future research may reveal that such an application is valid and consequently the length - weight relationships presented in this paper are an initial step in that direction.

Reduced lengths of sagebrush leaders following heavy winter use by pronghorns (Table 5) suggests that these animals can reduce the productivity of their preferred forage. Leaders that had been browsed during the growing season in which they were measured, were, of course, excluded from these samples.

This preliminary information suggests that additional research is required on mechanisms by which pronghorns alter their habitat. Compton (1970) previously noted that heavy use of sagebrush on winter ranges increased the vulnerability of animals to winter kill. If heavy utilization in one winter results in reduced sagebrush production in the following year, then the problem compounds itself.

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MANAGEMENT IMPLICATIONS OF THE SEASONAL DISTRIBUTION OF PRONGHORNS AND LAND USE PRACTICES IN ALBERTA

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Abstract: This paper reviews the historical methods used to estimate the summer population of pronghorns (Antilocapra americana) in Alberta. Surveys which more closely reflect land use practices and local densities are recommended. The winter distribution of pronghorns within the province was determined through aerial and ground surveys conducted over a 5-year period. In addition to the Suffield Military Range, 11 sites, totalling 3,037 km² were identified as receiving consistent use by pronghorns during winter. Populations in southeastern Alberta were more stable than northern herds and had access to winter ranges with higher densities of sagebrush (Artemisia cana). Pronghorn densities and population stability within hunting areas were analyzed and revealed substantial local variation. Revised hunting areas are recommended which recognize these differences and which promote the management of pronghorns on a local population or herd basis. The proposed hunting areas are based on the available current knowledge and reflect the known winter ranges, local movement patterns, and density and stability of regional populations of pronghorns.

INTRODUCTION

Sporadic pronghorn censusing in Alberta first began in 1955; however, it was not until 1963 that the first reliable estimates of the summer populations were obtained. There has been a continuing demand to provide

reliable estimates of the total population, and since 1963, summer surveys have been gradually modified to provide more accurate data.

Despite the importance of secure winter range to pronghorns, their winter distribution had not been studied prior to 1970. In that year, documentation of winter ranges selected by pronghorns in Alberta began. Data gathered on summer and winter pronghorn densities, population characteristics, pronghorn movements and use of winter forage have suggested pronounced differences in local pronghorn populations throughout Alberta. Existing hunting areas were defined in 1964 and did not take into consideration differences in population characteristics. A precise regulated harvest of the different population units is difficult under the present system.

The objectives of this study were: (1) to review and modify the survey methods used to determine the annual summer population estimate for pronghorns, (2) to confirm the existence and identify the location of key wintering areas for pronghorns, and (3) to review and modify the hunting zones used to regulate the harvest of pronghorns in Alberta.

SUMMER AERIAL SURVEYS

Historical Review

Aerial surveys of pronghorns in Alberta first began in 1955 when transects spaced 19 to 29 kilometers apart were flown as part of a waterfowl censusing program. From 1957 to 1963 surveys for pronghorns became progressively more intensive. In 1963 most of the pronghorns range was surveyed by transects spaced 10 kilometers apart. Intensive study areas in the Lake Newell and Pakowki Lake area were surveyed by transects spaced 1.6 kilometers apart. From 1963 to 1969 antelope surveys consisted, in theory, of flying one-third of the pronghorn range annually at 50% coverage to obtain a total count. The remaining area was sampled by random surveys for production indices. Data

obtained were used as the basis for estimating the provincial population of pronghorns. Total count surveys were shifted to different portions of the range annually so that after 3 years the entire pronghorn range would be surveyed (Mitchell 1965). Because of manpower and fiscal restraints this program was not always faithfully adhered to. Secondly, because of variation in the quality of pronghorn range and the density of animals from area to area, this system was less than ideal.

Proposed Changes

In 1970 the current system was adopted whereby representative blocks are flown annually. Initially, only a portion of Alberta's pronghorn range was surveyed by this method; however, in 1972 the system was expanded to include their entire range. The transect blocks (Fig. 1) located in a variety of representative habitat types are flown at 50% coverage. In 1979 further changes were made in the survey system. It had become apparent that certain land use types within the pronghorn range were not being surveyed as intensively as others. As a result, a new block, SF, was established within the cultivation zone. Block E was changed for 25% coverage and a larger area was sampled as a result. Block S was also converted to 25% coverage and the complement of flying time used for a new block, X, north of the Red Deer River. Transects on this block were spaced 10 kilometers apart and enabled the survey crew to sample a much larger portion of the northern pronghorn range than did the survey blocks P and V.

The summer surveys are best suited to provide data on annual changes in numbers on the blocks and an indication of fawn recruitment and population composition. Nine years of summer surveys have indicated that pronghorn populations south of the South Saskatchewan River (Region 1) are more stable than those populations on the northern and western portions of Alberta's

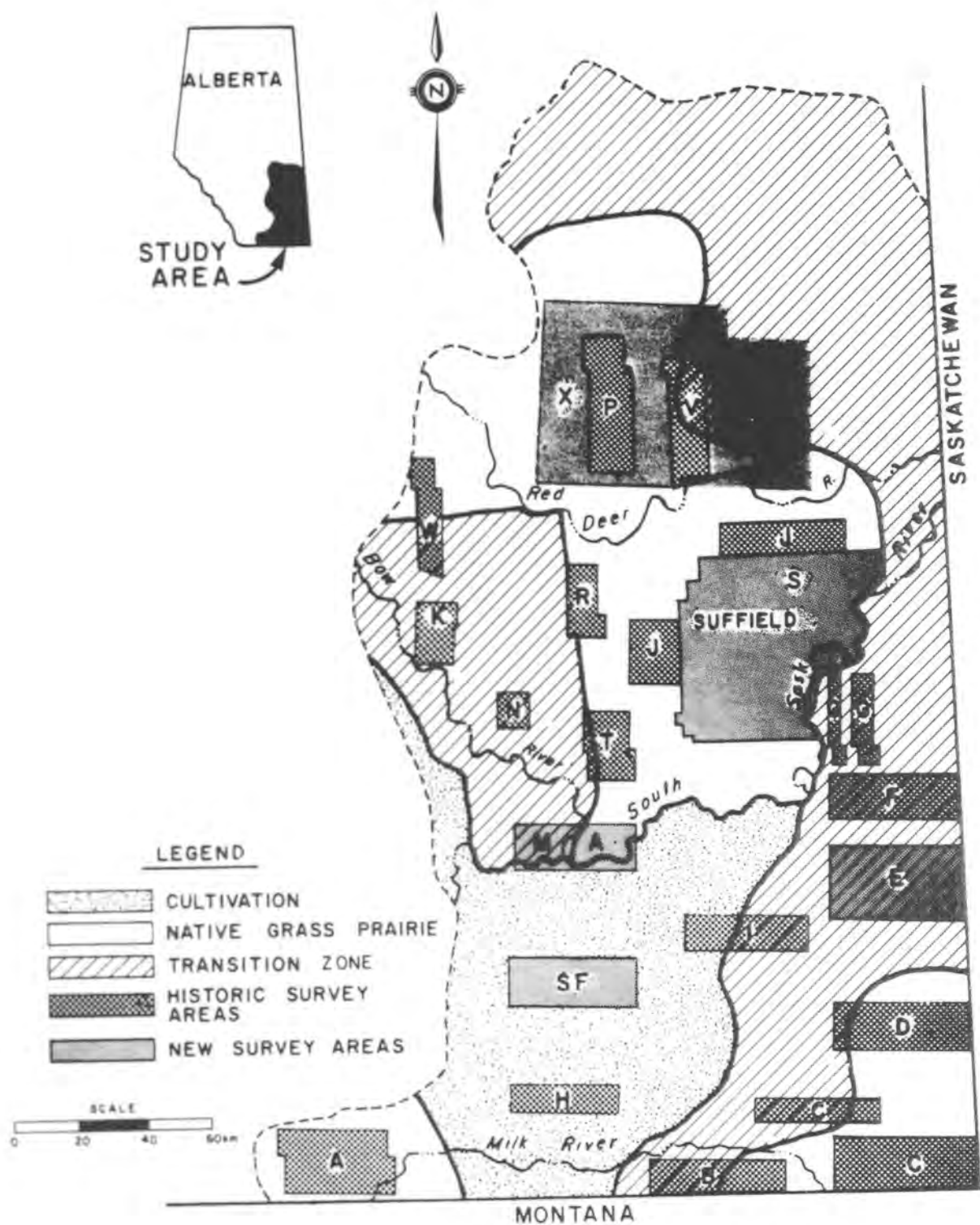


FIG.1. MAJOR LAND USE ZONES WITHIN THE PRONGHORN RANGE IN ALBERTA

pronghorn range (Region 11). Table 1 illustrates the degree of change in pronghorn populations in these areas.

Table 1. A comparison of pronghorn population changes in the different hunting areas in Alberta from summer surveys for the period 1971-79

Region	Hunting Area	Survey Blocks	Lowest Recorded Population	Highest Recorded Population	High/Low
1	A	A & B	1,341	3,649	2.72
	B	C	880	2,010	2.28
	C	D, E & I	1,649	3,236	1.96
	F	F, G & J	1,449	2,533	1.75
11	D	M & M-A	46	733	15.93
	E	K, N, T, R-W	485	2,357	4.85
	G	P & V	425	2,350	5.53
	SUFFIELD	S	840	2,550	3.04

There is a continuing need to provide reliable population estimates and to relate pronghorn densities to land use practices. In 1966 Alberta's pronghorn range was mapped using 1960 aerial photos. Cultivated areas were indicated on 1:250,000 scale topographical maps. In 1979, using 1970 aerial photos, the range was again mapped. The percentage cultivation and native grass prairie (NGP) was determined for each township and 3 general land use zones were identified (Fig. 1). Cultivation zones consisted of more than 75% cultivation, transition zones consisted of 25-75% cultivation and NGP consisted of less than 25% cultivation. The percentage cultivation within each antelope hunting area and summer survey block was also determined.

Fawn recruitment and pronghorn density on the survey blocks are presented with the proportion of land under cultivation (Table 2). No correlation existed between fawn recruitment and pronghorn density ($r = .02$). A positive correlation ($r = 0.32$) exists between recruitment and percent cultivation; however, the relationship is a weak one with fawn recruitment on areas with less than 30% cultivation ($n = 13$) averaging 66.49 fawn/100 does. Areas with more than 40% cultivation ($n = 3$) had an average recruitment of 68.27 fawns/100 does. The difference of 1.78 fawns is too small to be of any significance.

Pronghorn density was negatively correlated ($r = -0.36$) with percent cultivation. This relationship is somewhat stronger with densities of $0.64/\text{km}^2$ on areas with $\leq 30\%$ cultivation ($n = 13$) compared to 0.43 pronghorns/ km^2 on areas with $>40\%$ cultivation ($n = 3$). Only one area had $>50\%$ cultivation, however, we feel a greater sample in this high cultivation range would only strengthen the relationship.

WINTER RANGES

Location of Ranges

Winter ranges for pronghorns are considered critical for the maintenance of the population at northern latitudes. Pronghorns in Alberta, with the onset of winter, move to traditional wintering areas. Prior to 1970 no documentation of these winter ranges had taken place. Pronghorn management was based almost exclusively on the result of summer surveys.

In 1970 delineation of pronghorn winter ranges began with extensive file searches, landowner interviews and ground surveys. A number of areas where animals concentrated was recognized. From 1971 to 1975 an extensive aerial survey program was undertaken to outline these and other winter ranges. Each winter approximately 35 hours of flying time were utilized exclusively

Table 2. Nine-year average of summer recruitment and pronghorn density on the survey blocks (1971-79)

Survey Block	FAWN RECRUITMENT		Pronghorn Density km ²	% Cultivation
	No. fawns No. does	Fawns: 100 does		
A	1365/1755	77.2	1.01	8.51
B	302/683	44.2	1.01	7.68
C	807/1473	54.8	0.50	3.76
D	616/1414	43.6	0.69	0.52
E	497/778	63.9	0.64	43.09
F	550/732	75.1	0.68	27.34
G	369/673	54.8	0.43	20.05
H*	237/276	85.9	0.24	95.96
I*	337/613	55.0	0.40	40.10
MA**	466/560	83.2	0.96	21.83
S	2158/2807	76.9	0.66	0
N	225/335	67.2	0.66	2.68
T	510/660	77.3	0.84	5.46
J(Buffalo)	305/462	66.0	0.33	13.35
J(Tide L.)	217/285	76.1	0.39	3.35
P	106/156	67.9	0.17	9.30

* Eight years' data

**Five years' data

to document pronghorn distribution. All potential winter ranges were surveyed and all drainage systems throughout the pronghorn range were surveyed as well. In addition, extensive flying associated with the relocation of marked pronghorns and the annual winter deer surveys also yielded data on the distribution of pronghorns.

During the 5-year monitoring period, winter ranges received coverage on at least 5 occasions and most areas were surveyed 10 times. Maximum occupation counts and annual winter range boundary limitations were determined on the basis of pronghorn distribution. A series of paralleling flights resulted in complete coverage of past known use areas. Random flights beyond these areas were employed to look for new wintering areas. All herd locations were recorded on 1:250,000 topographical maps. In all winter ranges, results from aerial surveys were supplemented by ground observations on an annual basis.

Five years of winter surveys delineated 12 winter ranges (Fig. 2). Some survey areas which were presumed to have potential for wintering pronghorns received negligible use (i.e. Empress Sandhills, Manyberries Creek). Most of the winter ranges were associated with drainage systems of the prairies and all winter ranges had an abundance of sagebrush. Excluding Suffield, which is a Department of National Defence training area with no hunting, 3,037 km² of winter range were delineated. Table 3 presents the maximum and minimum pronghorn numbers and density observed for these winter ranges.

General movements of pronghorns in the southeast corner of Alberta were determined using both visually and radio-collared pronghorns (Barrett, unpubl. data). Probable movement patterns of pronghorns in other portions of their range (Fig. 2) are not confirmed by marked animals but are based on familiarity with the distribution of pronghorns derived through nearly 8 years of investigations on the species. Movements of pronghorns in the extreme southeast corner of Alberta are more extensive than those of northern populations. Pronghorns in Saskatchewan exhibit this same tendency with average movements of 24.8 kilometers recorded on northern ranges and

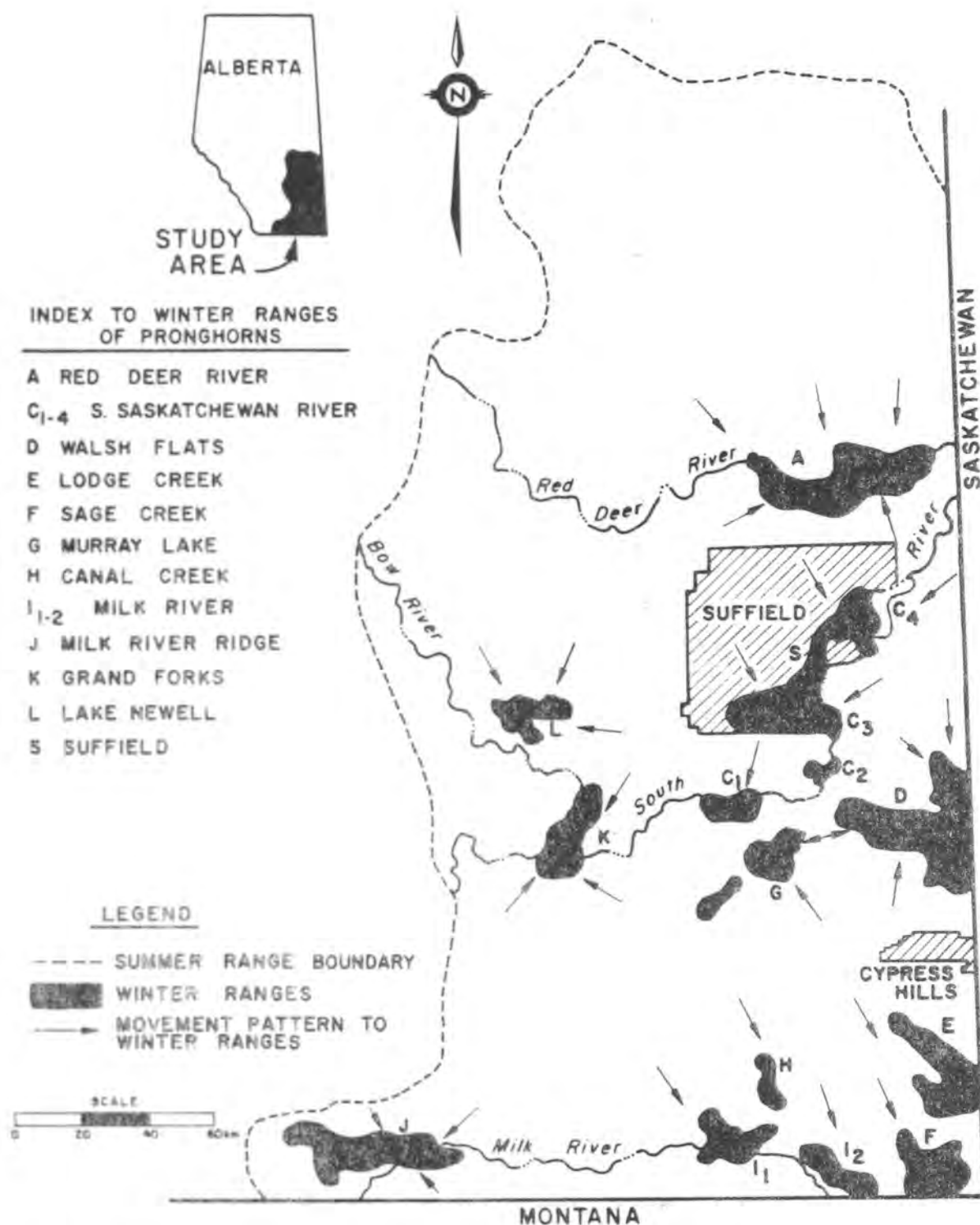


FIG. 2. DELINEATION OF THE SUMMER DISTRIBUTION, KEY WINTERING AREAS AND GENERAL MOVEMENT PATTERNS OF PRONGHORNS IN ALBERTA

Table 3. Maximum and minimum pronghorn populations and densities on winter ranges in Alberta and 5-year average density as determined from aerial survey 1971-75

Winter Range	Area (km ²)	Maximum Population	Maximum Density (km ²)	Minimum Population	Minimum Density (km ²)	Average Density Over 5-year Period/(km ²)
A	439	1,346	3.07	293	0.68	3.56
C ₁ -C ₄	250	424	1.70	62	0.25	0.84
D	634	953	3.90	558	0.88	2.37
E	251	692	2.76	159	0.63	1.75
F	327	643	1.97	220	0.67	1.27
G	156	336	2.15	36	0.23	0.93
H	125	273	2.18	80	0.64	0.58
I ₁ , I ₂	386	618	1.60	88	0.23	1.09
J	387	532	1.37	88	0.23	0.91
K	244	623	2.55	150	0.61	1.52
L	224	517	2.31	296	1.32	1.88

129 kilometers on southern ranges (Wiltse 1978). Amstrup (1978) recorded movements of 15-36 kilometers for 8 radio-collared pronghorns along the Montana-Wyoming border.

Relationship to Sagebrush

Pronghorn dependence on Artemisia spp. is well documented (Alberta: Barrett (1974), Mitchell and Smoliak (1971); Saskatchewan: Dirschl (1973); Montana: Bayless (1969). Maintenance of pronghorn populations at a level which results in less than 50% use of Artemisia spp. is considered optimal for Alberta (Barrett 1974) and should maintain the health and vigor of the sagebrush. Thirty-five permanent browse transects, using silversage as the key species, were established on the various ranges. Procedures were

described by Barrett (1974). Habitat mapping determined the extent of silversage communities on winter ranges (Barrett 1980). Densities of sagebrush were determined using 60-m straight line intercepts. Rates of utilization of sagebrush were compared to observed winter densities of pronghorns (Table 4).

Correlation coefficient for percent leaders browsed to percent annual growth utilized was $r = 0.96$. The percent of growth utilized was positively correlated ($r = 0.91$) with pronghorn density.

Winter ranges in southeastern Alberta have higher densities of sagebrush (26.1 plants/60-m line intercept) compared with the remainder of the winter ranges (13.9 plants/60-m line intercept). Two winter ranges received substantially higher use of sagebrush (39.2% and 55.2%) relative to use on other winter ranges. A more detailed description of the vegetation types found within winter ranges of pronghorns in Alberta is presented by Barrett (1980).

SPORT HUNTING UNITS

Historical Review

In 1963 the first reliable pronghorn survey was conducted in Alberta and in 1964 the pronghorn range was divided into Wildlife Management Units (WMU's). WMU boundaries were selected using major geographical landmarks and transportation networks. Seven pronghorn hunting areas were established based on these WMU boundaries (Fig. 3). Since then 15 years of research and improved survey methods suggest that changes are needed to improve our management strategies for pronghorns.

Table 4. Fall to spring utilization of sagebrush on permanent browse transects, each consisting of 25 tagged plants. Data are summarized for the winters of 1971-72 to 1974-75, inclusive

Winter Range	No. of Transects	No. Sagebrush Plants Per 60 m Line Intercept	Sagebrush Use Overwinter		Mean No. Pronghorns Per km ² of Sagebrush Vegetation on Range
			Leaders Browsed (%)	Annual Growth Used (%)	
A. Red Deer River	3	21.4	25.3	19.8	5.44
C. South Saskatchewan River	3	5.8	23.8	18.1	2.65
D. Walsh Flats	5	21.6	55.5	39.2	8.25
E. Lodge Creek	4	27.2	25.0	14.7	4.78
F. Sage Creek	3	24.8	12.8	14.4	3.71
H. Canal Creek	2	28.0	17.3	8.4	--
I. Milk River Valley	3	29.0	28.5	26.5	10.51
J. Milk River Ridge	2	14.4	65.7	55.2	22.57
K. Grand Forks	2	12.6	22.3	19.8	5.22
L. Lake Newell	3	15.2	24.0	22.4	3.69
Mean		20.0	30.0	23.8	7.42

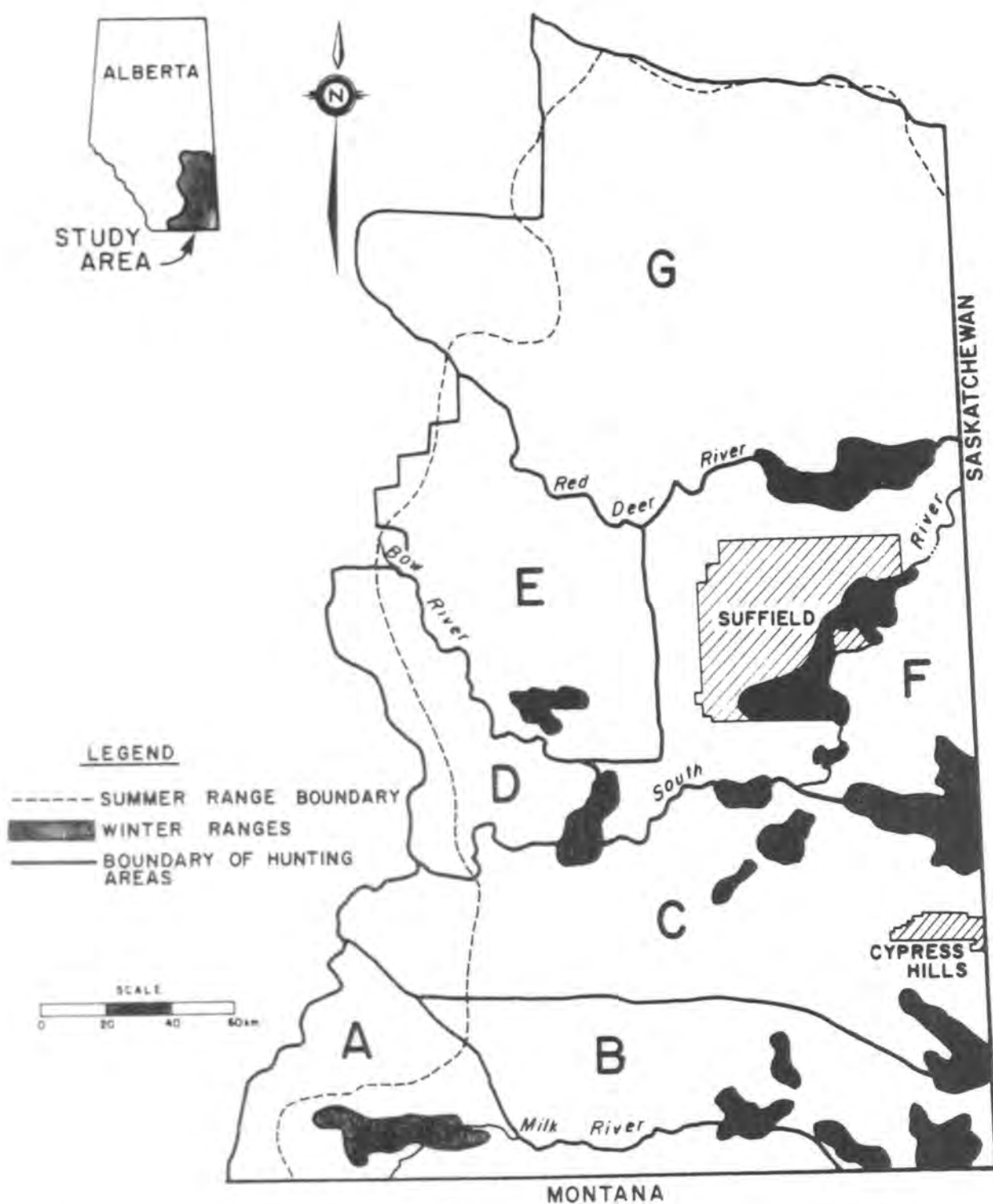


FIG. 3. RELATIONSHIP OF CURRENT HUNTING ZONES TO KEY WINTERING AREAS OF PRONGHORNS IN ALBERTA

Alberta's pronghorn population is comprised of a number of different population units which are basically defined by the different winter ranges. Range and population characteristics of these units vary considerably throughout the province. For instance, pronghorn movements in the south-east corner of Alberta are greater than those of northern Alberta but fawn recruitment was lower than in the north. Low fawn recruitment and greater movements are characteristic of pronghorns in portions of their range in hunting areas A, B, and C; this same area has a greater relative abundance of winter range with high densities of sagebrush. Hunting areas A, B, and C also contain populations which are isolated from the remainder of Alberta's pronghorn range (e.g. winter ranges J and D). Pronghorn winter densities on these ranges are above average; sagebrush utilization on these winter ranges is also high (55.2% and 39.2%, respectively). These same hunting units contain areas with extensive cultivation, low pronghorn densities, high recruitment and no winter range. Present hunting area boundaries do not reflect these different population characteristics and subject these different population units to the same hunting regime.

Existing hunting area boundaries separated some distinct population units into 2 or more different hunting areas. Pronghorns, wintering on Walsh Flats (winter range D), summer in hunting areas F and C. The Grand Forks population (winter range K) summers in 3 different hunting areas (C, D, and F). The Red Deer River population (winter range A), is also split into 2 hunting areas, G and F.

Generally, pronghorn populations south of the South Saskatchewan River (Region I) are much more stable than those north of the river (Region II). During the 9-year monitoring period (1971-79) summer pronghorn populations in Region I fluctuated 52.7% between 6,241 animals in 1975 and 9,527 in 1977.

Region II populations fluctuated 271.6% between an estimated 1,569 in 1971 and 5,830 in 1979. The more stable southern populations are likely a reflection of reduced snow depths, greater abundance of winter range, and high silversage densities. Pronghorn summer densities in Region I have varied from 1.4 to 2.1 animals per km² compared to 0.39 to 1.5 animals per km² for Region II.

Proposed Changes

Hunting area boundary changes are proposed (Fig. 4) to allow for the separation of the different pronghorn populations. The changes will allow for more effective management based on different population characteristics and availability of winter range. The proposed boundaries no longer dissect winter ranges and isolate pronghorn populations which are naturally separated by range characteristics.

Increasing cultivation has reduced pronghorn densities in our study and has effectively eliminated pronghorns from much of their former range throughout North America (Autenrieth 1978, Leftwich, and Simpson 1978). Cultivation should be recognized as the most severe factor limiting pronghorns in Alberta; survey and hunting areas much reflect this relationship. The proposed hunting boundary changes separate the most expansive tract of cultivation on pronghorn range into one management area (B) and allows for special management of this land use zone. Continued documentation of land use changes and their effect on pronghorns are necessary to promote effective land management for pronghorns.

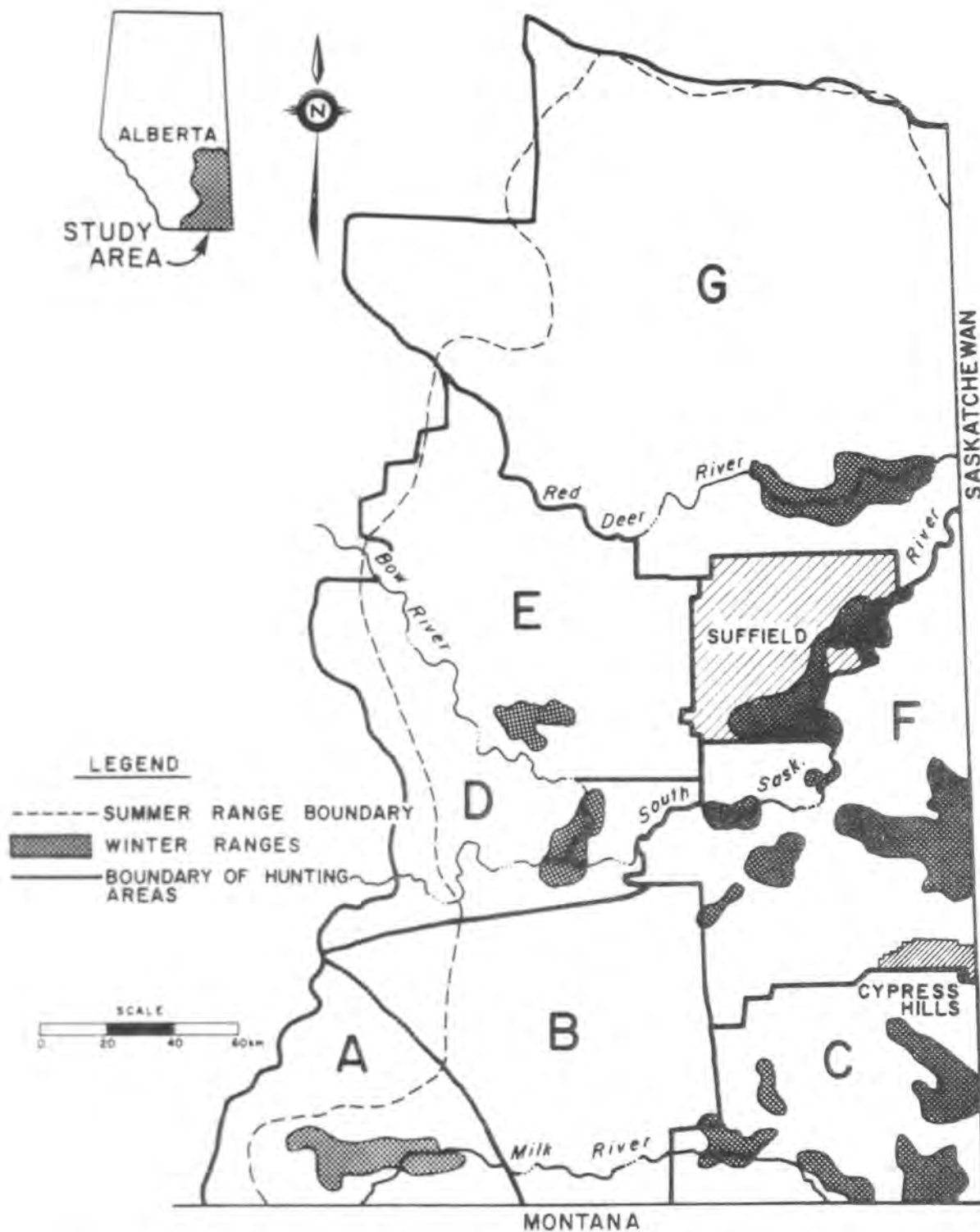


FIG.4. RELATIONSHIP OF KEY WINTERING AREAS OF PRONGHORNS TO PROPOSED HUNTING ZONES

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HABITAT IMPROVEMENT FOR PRONGHORN ANTELOPE ON THE ARIZONA STRIP

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INTRODUCTION

We are pleased to have the opportunity to present to this workshop what we on the Arizona Strip are looking at in the way of improving antelope habitat. Among the variety of planned antelope habitat improvements, water permanence and availability is what we will concentrate on. We believe that there has not been enough field work completed in antelope habitat management concerning the relationships between water, livestock fences, and antelope. In particular, how do you provide water for antelope on yearlong livestock ranges and still eliminate fence conflicts? If an antelope water is fenced, at what point does the size of the enclosure affect antelope use of that water? Will a larger enclosure encourage antelope use of the water in comparison to a smaller enclosure? Are gates in net wire fences that surround stock ponds sufficient in providing escape routes from predators? Though antelope can physically negotiate many types of fences and gates, what influence will their behavior play in their willingness to enter such enclosures to water? We have been unable, at this point, to obtain clear cut data that may answer the above questions.

The Arizona Game and Fish Department and Bureau of Land Management are currently pursuing a course of action on the "Strip" that will hopefully help to alleviate water permanence and availability problems and to evaluate the effectiveness of these actions.

WATER CATCHMENTS

Two catchments were constructed in 1970 to provide water solely for antelope. These catchments have an antelope proof fence around the apron and an adjoining 4 strand wire cattle proof fence that encloses 2 acres around the catchment. A 6 foot wide antelope pass was installed in one corner of one of the catchments. To date, these catchments are receiving little antelope use. Antelope appear to prefer nearby unfenced stock ponds when they contain water.

Fences are needed around catchments for 2 reasons: (1) to protect aprons from livestock trampling, and (2) to keep livestock from drinking the catchments dry. The Arizona Game and Fish Department and Bureau of Land Management are constructing 8 catchments this year for servicing antelope. We are taking 3 different approaches in the hope of gaining some insight as to the best design that antelope will readily use even where fences are required due to yearlong grazing by cattle.

Combination Catchments

Four of the catchments to be built this year involve the construction of what is essentially livestock type catchments. One acre aprons will be used to fill an 80,000 gallon storage tank at least twice a year. Water from the storage tank will be piped into 3 different pastures. Each trough will be built for both antelope and livestock use and will be at least 300 yards from the nearest pasture fence. By using large capacity catchments, the problem of fencing out livestock is solved and consequently troughs can be located in the open, away from fence obstructions. Of course if livestock congregate around the trough, antelope may avoid coming in to water. However, at least 1 of the 3 pastures should be rested at any given time and therefore 1 of the 3 troughs will be available solely for antelope.

Conventional Catchments

Up to now, our wildlife catchments were built in the center of 2 to 5 acre enclosures. Except for the 2 previously mentioned catchments, all other catchments were built for deer use. Enclosure size was determined by terrain and available cover with a 5-acre enclosure being the maximum size allowed under district policy. All catchments were fenced with a 4-strand wire fence, with the bottom wire smooth and 16 inches above ground, and the top 3 wires barbed and no higher than 42 inches. Three strand antelope type fences were considered to be insufficient to keep livestock out.

Since antelope can negotiate both type of fences, we really don't know if there would be an antelope preference towards negotiating 3-strand fences over 4-strand fences. However, we believe that the less fence the better, and as antelope view a fence, a 3-strand fence would appear less of an obstacle. Also an important factor is the size of the enclosure surrounding the catchment and how that may affect antelope use of the catchment. It appears that the larger the enclosure the more apt antelope are to use the enclosed water.

We are therefore planning to construct 2 wildlife catchments that will be fenced with 3-strand wire fence encompassing 8 to 9 acres. It is hoped that the larger enclosure size will help to alleviate livestock pressure on the fence. More importantly, we feel that the 3-strand fence in conjunction with the 8 to 9 acre enclosure will better benefit antelope use of the enclosed water.

Livestock Proof Trough

The third approach in catchment design for antelope use is the installation of livestock proof troughs. The catchments will be designed the same as our typical wildlife type catchments which includes a ground level trough

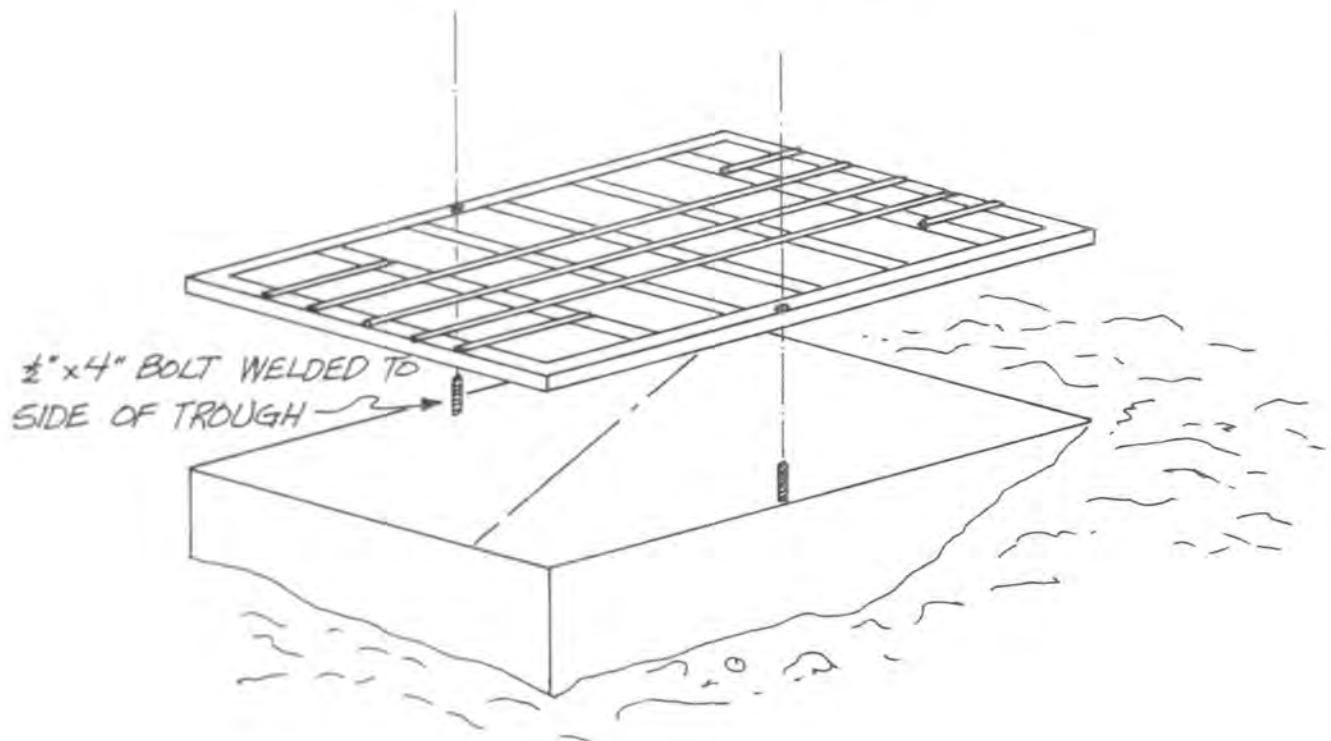
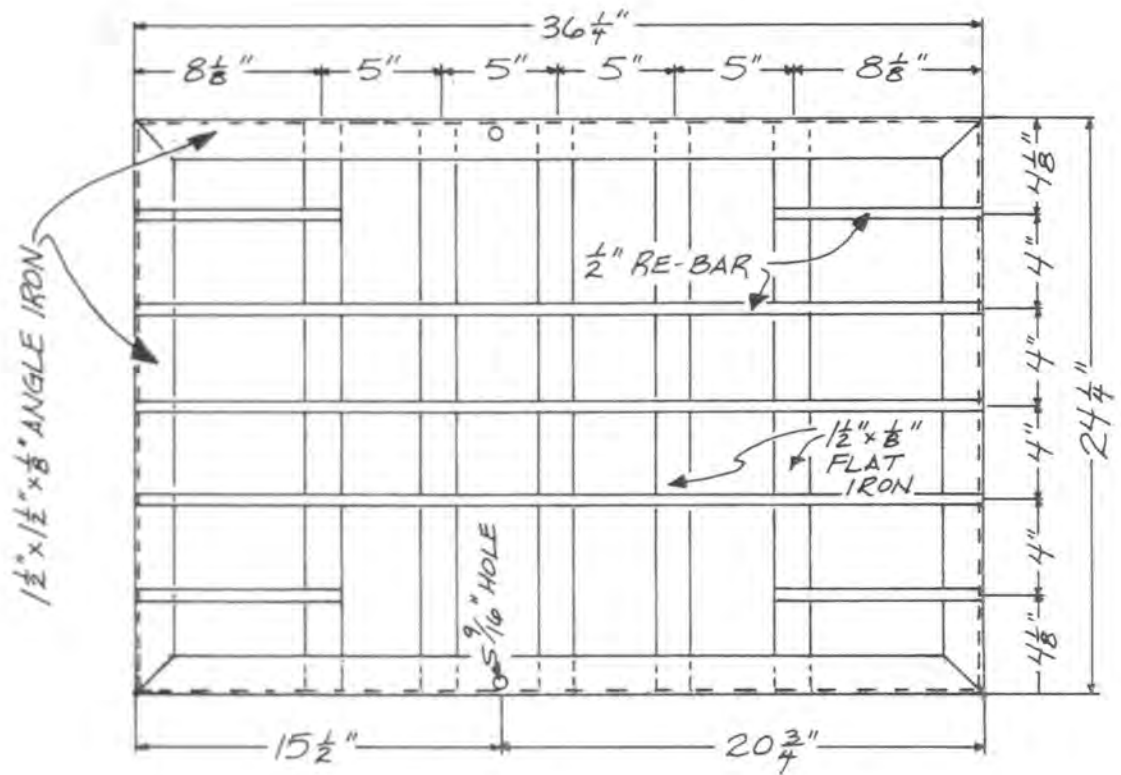
adjacent to the apron. These catchments will be built in the center of 2 to 3 acre exclosures. However, in addition there will be a separate trough piped out approximately 300 feet from the exclosure. This trough will be of a special design. Trough dimensions will be 3 feet long, 2 feet wide, and 5 inches high at the lip. A steel grate will be installed over the trough. The interspaces between crossarms of the grate will be $3\frac{1}{2}$ inches in diameter. This will allow antelope to get their muzzles through the grate to the water but will be too small for cattle to do the same; however, calves will be able to water. (See Chart I for muzzle measurements). There are 2 problems that may arise with this trough design. First, we are not sure that antelope will stick their muzzles through the grate to reach the water. Secondly, there is a feeling among some of our range people, that if livestock can see the water, they will attempt to water, even if they are unsuccessful and consequently will choke. Both of these potential problems will be closely monitored. One critical factor concerning the trough design is that the water level will be very critical and will not be able to fluctuate more than a few inches. If the water level is higher than a few inches from the top of the grate, livestock will be able to get a drink and this will consequently encourage them to hang around the trough.

However, if this trough design works as hoped, it will allow us to locate troughs away from fences, for antelope use, without the worry of livestock draining the catchments dry.

WATERLOT FENCE MODIFICATIONS

The approach to alleviating water availability problems has been based upon 2 factors: (1) BLM policy which states that water will be made safely available to wildlife, and (2) the resistance of livestock operators to the

GRATED TROUGH



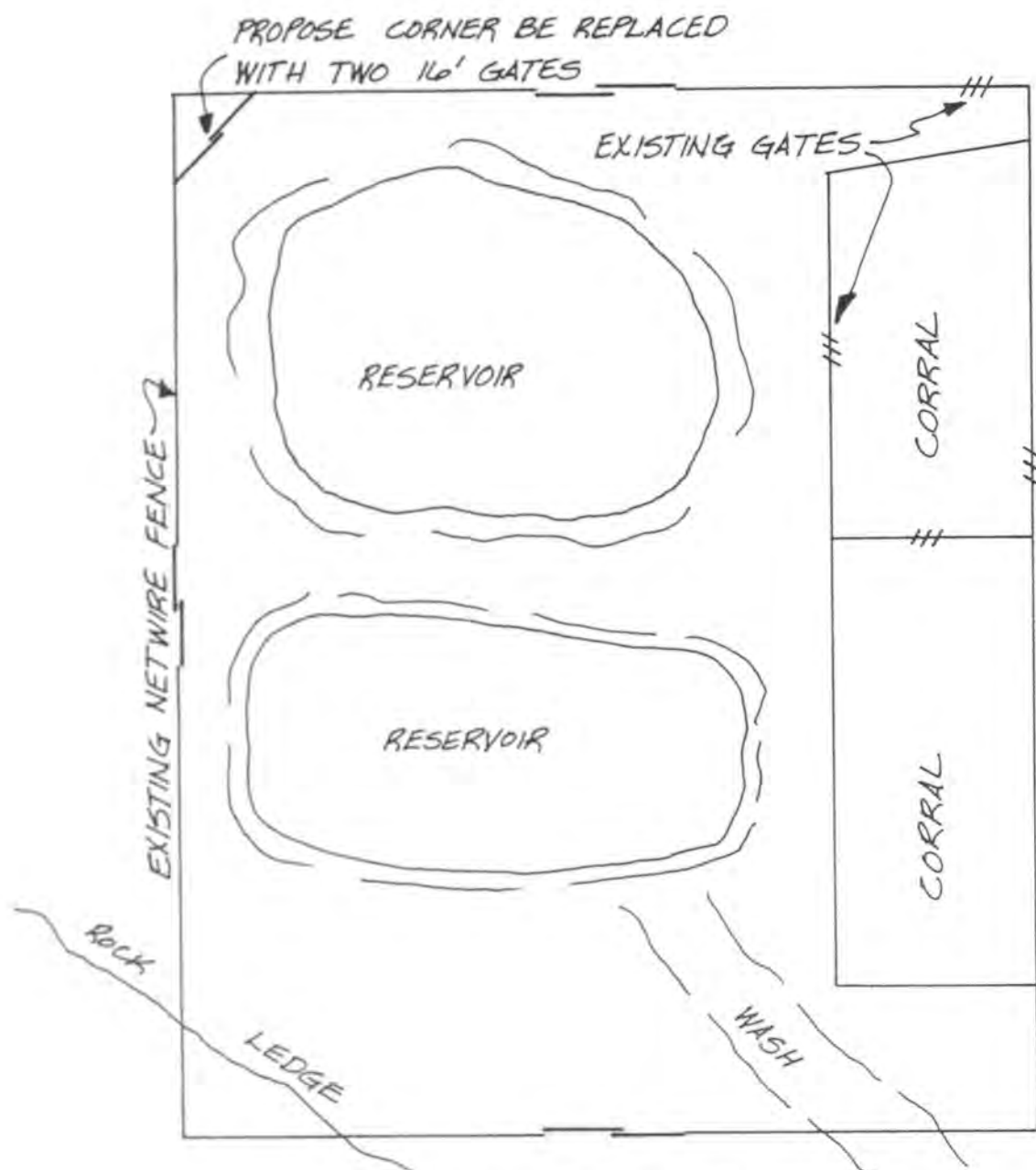
modification of Sec. 4 projects. (Sec. 4 projects are those projects that the livestock operator has built and that BLM has issued the operator a permit recognizing his or her ownership of the material used in the project. Though BLM can cancel a Sec. 4 permit, it is an action that receives such hostility from the permittee that it is only done rarely and as a last resort). Reality dictates that political considerations play an important part in waterlot fence modifications.

Some livestock operators have used waterlots as collection pens, and consequently have built strong impenetrable fences usually consisting of net wire or 6 and 7 strands of barb wire. These fences work effectively in holding or keeping out livestock, but presents a serious problem to wildlife use of the waterlot. A definite conflict occurs between the 2 uses that must be resolved to the benefit of all parties concerned.

Consequently, we have taken a look at each individual waterlot fence conflict along with the operators' fence requirements to determine what action could be taken to alleviate the fence conflict without adversely impacting the operator's livestock operation. This procedure has advantages and disadvantages.

The advantage is that we are making fence modifications without completely alienating livestock operators and are able to achieve fence modifications without resulting in decisions which may be tied up in the appeals process.

The disadvantage is that we do not know if some of the proposed fence modifications will do the job that we hope. However, a lack of data from experience or the literature has made it difficult to convince decision makers that some of the fence modifications may be inadequate.



WATERLOT FENCE MODIFICATION USING GATES

Proposed Gate Construction at June Tank Reservoir

Legend

-  Existing net wire fence
-  Two 16 foot gates as proposed
-  Existing gates

Scale

1" = 30 feet

The extent of modification where a fence conflict occurs is primarily dependent upon the degree to which the affected livestock operator will cooperate. At some waterlots, we have been able to replace the entire net wire fence with a 4-strand fence that has a smooth bottom wire 16" above ground. In other cases we have or will modify only a portion of the existing fence. And in particularly difficult cases, we are installing 32 foot gates on each side and corner of the waterlot fence. The gates will be net wire and will be left open yearlong except during the 1 to 2 week period each year when the operator traps livestock.

We have proposed to some livestock operators that the waterlot be divided in half with a net wire fence on one side and down the middle and a 4-strand wildlife type fence on the other side. In every case this modification proposal has been rejected by the operator. Two reasons have been consistently cited: (1) the stockponds must be trampled by livestock to keep their water holding properties, and (2) a fence across the middle of a stockpond will cause too many problems when time comes to clean out the pond. Therefore, this alternative for fence modification has gone nowhere.

We will continue to work towards modifying fence conflicts around stockponds. These modifications will be evaluated to determine which designs are most effective and therefore will give us better data to work with.

RANGE FENCES

To facilitate antelope movement, we are planning to modify 150 miles of range fences over the next 3 years. This year we are presently in the process of modifying 51 miles of fence line. Most of the fences are 4-strand barb wire with the bottom wire anywhere from 7 to 14 inches above ground and the top wire 42 to 48 inches high. A few of the fences are of 5-strand barb

wire. Bottom barbed wires are being replaced with a smooth wire 16 inches above ground. On 5-strand fences, the second to bottom wire is moved up to 19 or 20 inches and the bottom wire is replaced with the 16 inch high smooth wire. We are not doing anything with the top wires for 2 reasons: (1) the additional cost involved, and (2) all of our data relating to the "Strip" antelope show that the animals are going under the fence rather than over. Consequently we do not feel that the height of the fence poses any problems with antelope movement. Those existing fences that have barbed bottom wires that are 16 inches or more above the ground are not being modified.

ANTELOPE WATERING EVALUATION

As stated in the introduction, we have a lot of questions that need to be answered. The various catchment and waterlot fence modification designs are based upon incomplete data and educated guesses. We plan to set-up a study over the next few years to evaluate which designs give us the best results.

We have not as yet established the exact procedures that will be used but do have some ideas. A time-lapse camera will be set-up at various watering sites to monitor antelope use and their behavior as they come in to the water. For instance, will antelope hesitate and act nervous upon entering a small enclosure or when going through a gate to water? Or, will their behavior be the same as that when they water at an unfenced site? Will all of the antelope in a particular group come in to the water under adverse conditions or will some stay away?

We will also monitor the intensity of antelope use of watering sites under different conditions e.g., fenced vs. unfenced, gates in net wire vs. 4-strand and 3-strand wire fences and so on. In addition, to using the remote camera, on the ground observations and track counts will also be used.

This study will commence in May or June and will continue on and off throughout the summer. It is hoped that the results of the study will give us some good management guidelines to use in the developing of additional water for antelope.

If anyone has any data relating to our course of action or have recommendations that will help to increase the value of our studies, please contact our office.

Chart I. Cow and antelope snout measurements*

	Nose		Orbital		Nose	
	Circumference (in.)	Diameter (in.)	Circumference (in.)	Diameter (in.)	Length (in.)	
Holstein Calf	9.50	3.02	15.00	4.77	3.00	
Heifer	17.25	5.49	27.75	8.84	8.25	
Heifer	17.50	5.57	26.00	8.28	9.00	
Heifer	17.75	5.65	25.25	8.04	8.25	
Heifer	16.75	5.33	25.50	8.12	8.50	
Sub-Total		<u>22.04</u>		<u>33.28</u>	<u>34.00</u>	
Bull	21.50	6.85	32.00	10.19	8.75	
Total		<u>28.89</u>		<u>43.47</u>	<u>42.75</u>	
Average without bull & calf	17.31	5.51	26.13	8.32	8.50	
Average with bull, without calf	18.15	5.78	27.30	8.69	8.55	
Antelope	9.00	2.86	16.00	5.09	8.75	
	7.75	2.47	15.25	4.54	7.50	
	8.50	2.71	15.75	5.01	8.25	
	9.25	2.94	17.25	5.49	8.50	
	9.75	3.10	15.50	4.93	8.75	
	7.50	2.39	16.00	5.09	9.00	
	7.00	2.23	17.75	5.65	8.50	
	8.50	2.71	16.00	5.09	8.00	
	8.50	2.71	17.00	5.41	9.50	
	8.25	2.63	18.50	5.89	9.00	
	9.50	3.02	14.00	4.46	--	
	7.00	2.23	15.00	4.77	--	
	7.00	2.23	17.00	5.41	8.50	
	8.50	2.71	19.00	6.05	8.50	
	9.00	2.86	16.00	5.09	8.50	
	8.25	2.63	14.00	4.46	8.25	
	10.00	3.18	16.00	5.09	8.25	
	9.75	3.10	14.50	4.62	7.50	
	9.00	2.86	15.13	4.82	8.00	
Total		<u>51.57</u>		<u>96.96</u>	<u>143.25</u>	
Average	8.53	2.71	16.03	5.10	8.43	

*Cow snout measurements were collected by BLM personnel, and antelope measurements were collected by AG&FD personnel.

REESTABLISHMENT OF PRONGHORN ANTELOPE ON THE ARIZONA STRIP

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INTRODUCTION

Little is known or recorded concerning the historical occurrence of pronghorn antelope (Antilocapra americana) in the area known as the Arizona Strip (that portion of Arizona north of the Colorado River). The majority of the knowledge exists primarily through stories as related by early settlers rather than written documentation from explorers or trappers. By the early 1800's the Strip and adjacent lands had a reputation as an area of limited wildlife resources. Davis (1973:34) reports, George C. Yount and party nearly starved in 1827 before reaching Zuni, after separating from the James O. Pattie party near the mouth of the Virgin River. From such reports, we can only assume pronghorn antelope, if abundant in the area, were restricted in terms of range as most early explorers in Arizona recorded the presence of antelope.

Webb and Robeck (1962) reported the Strip was important pronghorn antelope range prior to the turn of the century. This statement was derived primarily from local accounts. These same accounts indicated indiscriminate hunting and range abuse by excessive numbers of livestock resulted in extirpation by the early 1900's. Despite apparent declines in numbers by the late 1800's the area known as Antelope Valley did produce a very large buck in 1878. This pronghorn antelope was recorded as Number 1 by the Boone and Crockett Club (1977:305) until recently.

Reports indicate pronghorn antelope were extirpated by 1900 and were to remain absent from the area until 1961.

No written recommendation for reintroduction was recorded until 1960, although the idea was evidently an important topic of discussion prior to this time. Reed (1960), after a floral and faunal investigation of the Strip stated that Antelope Valley was the only area that showed any potential as pronghorn antelope habitat. Reed further indicated that other areas visited were heavily damaged by livestock and were not suitable habitat. A preliminary reconnaissance of the Antelope Valley area was made in 1961 to evaluate the quantity and quality of potential pronghorn antelope habitat. Webb and Robeck (1962) believed that at least 1,000 sections of pronghorn antelope habitat existed in this vicinity. Based on this evaluation a reintroduction effort was proposed. This effort was financed by P-R funds, Project W-53-R-28, WP6, J1.

LOCATION AND DESCRIPTION OF THE AREA

Location

The Arizona Strip includes all lands in Arizona north of the Colorado River. The local meaning is usually restricted to those lands north of the Colorado River and west of Kanab Creek. This paper will be concerned only with the latter lands despite the fact a small transplant pronghorn antelope herd exists south of US 89 and east of the Kaibab Plateau in Houserock Valley.

The herd which is the topic of this paper has a center of distribution which approximately corresponds to the Clayhole Resource Conservation Area (Fig. 1). A small but apparently separate herd also exists near Tuweep Ranger Station (National Park Service) in Tuweep Valley (Fig. 2).

Climate

The annual mean temperature of this area is 52°F, with a summer mean temperature of 70°F and winter mean temperature of 34°F. Often summer

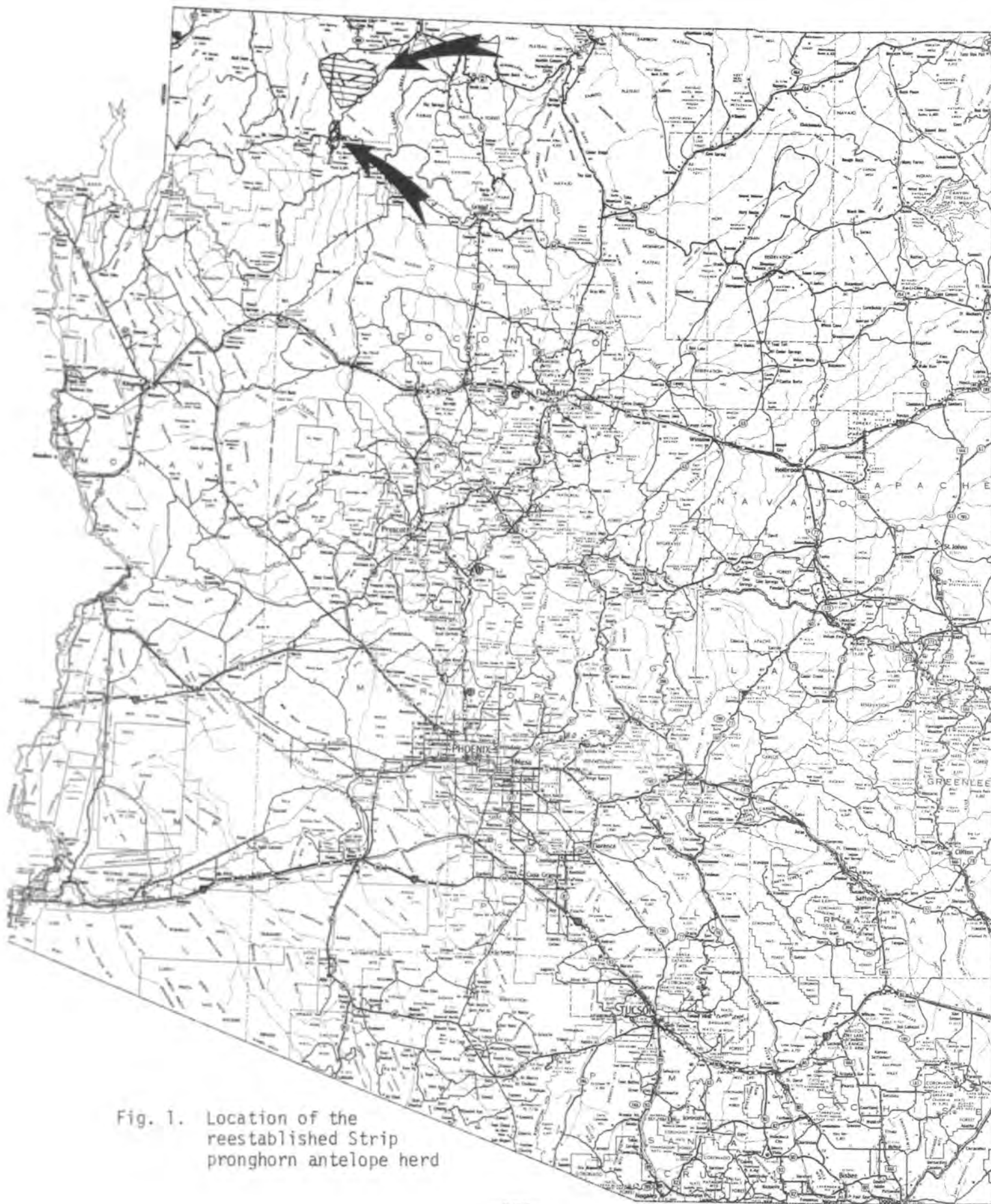
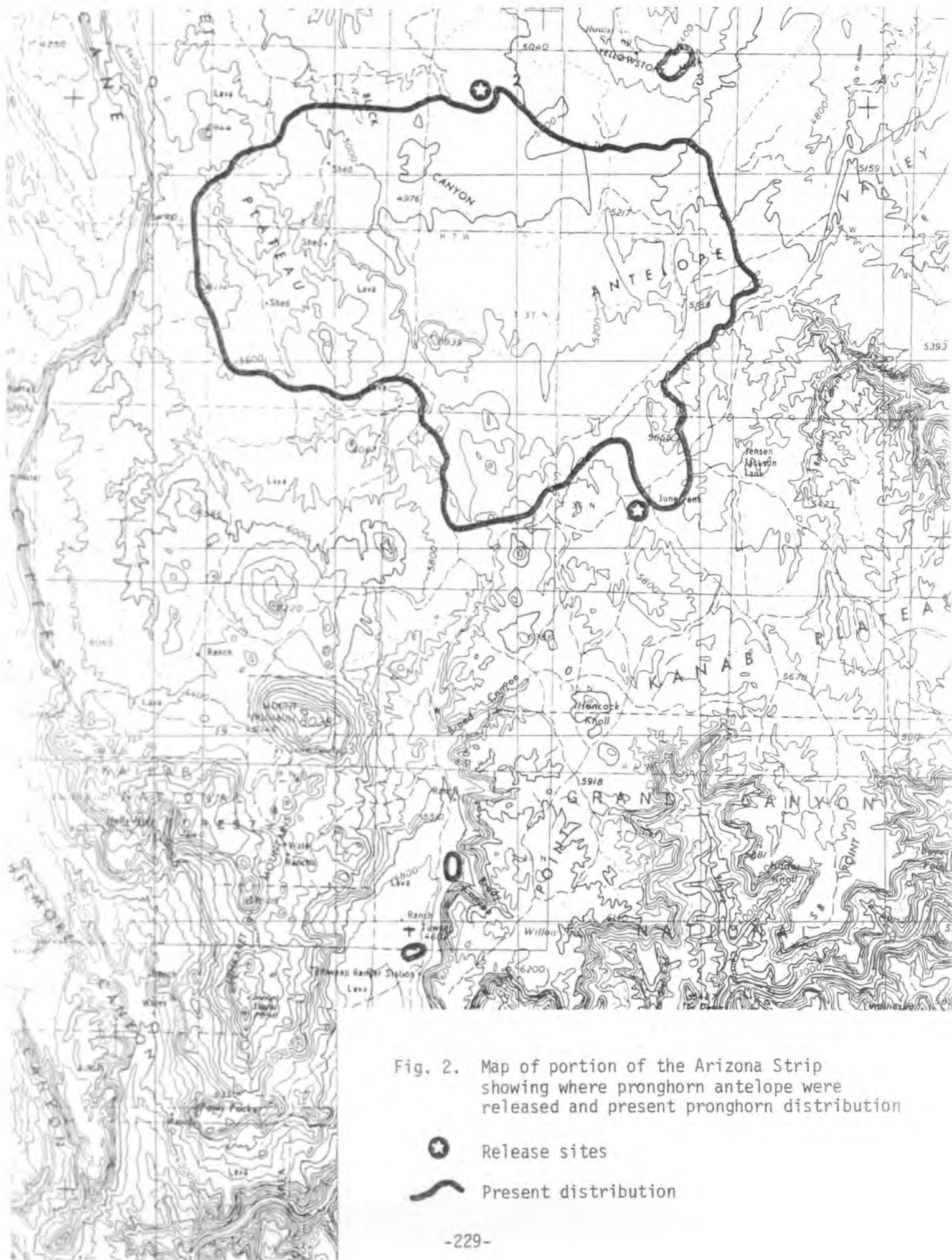


Fig. 1. Location of the reestablished Strip pronghorn antelope herd



daytime temperatures exceed 95° F while winter temperatures may dip below 0° F. Day and night temperatures often differ by 40° F. Precipitation levels vary from 6-12" annually. Two definable wet periods exist. One occurs during July through September. This period is characterized by spotty but often violent thunderstorms. Winter precipitation occurs during the period of October through March. The form of winter precipitation varies each year, however, snow cover rarely exceeds 12" and usually melts within a few days. In terms of annual precipitation, the majority occurs during the winter months.

Topography

Generally the topography varies from rolling hills to flat valleys such as Clayhole and Antelope Valleys. Several prominent features are present. Two of these features are Yellowstone Rim and Lost Spring Mountain which are located on the northern end of the present antelope range. These features present mesa-like land forms with steep escarpments 100 to 200 feet high (Wilhelm, et al. 1979). To the east are the heads of several rough canyons (Burnt, Grama and Hack's) which drain into Kanab Creek. To the south of Clayhole Valley are several cinder cones which contrast the adjacent flat valley floor. This cinder cone and rolling land form continues to the west and ends abruptly along the Hurricane Rim, a large geologic fault line extending from the Utah State line to Lake Mead.

Tuweep Valley, located south of the above mentioned area, is a large flat valley surrounded on each side by steep ridges. Tuweep Valley ends along the rim of the Grand Canyon.

Soils

Four major soil associations occur in this area. They are: Rudd-Cabazon, Winona-Boipag, Moenkopie-Shalet, and Palma-Clovis-Redland. Of the

above the first and second are the most productive and possess the greatest capacity for holding water. The Moenkopie-Shalet Association is the least productive being extremely alkaline (Wilhelm, et al. 1979).

Vegetation

Ten recognizable vegetative types exist in the area (Wilhelm, et al. 1979). They are: shade-scale, salt-bush, black-brush, grassland-desert shrub, grassland sagebrush, sagebrush, sagebrush-pinon-juniper, pinon-juniper and riparian.

Vegetation typically found in the shade-scale type includes: Shade-scale (Atriplex confertifolia), four-wing salt-bush (Atriplex canescens), rabbit-brush (Chrysothamnus spp.) and mormon tea (Ephedra spp.). This type, with the exception of salt-bush, is not productive in terms of platable forage and is not favored by pronghorn antelope in this area.

Vegetation in the salt-bush-type includes: Four-wing salt-bush, winter fat (Eurotia lanata), big sagebrush (Artemisia tridentata) and various species of grass. This vegetative type not only provides a source of excellent forage but also provides concealment cover for fawns. This vegetative type is favored by pronghorn antelope on the Strip.

The grassland vegetative type produces an excellent crop of annual forbs in wet years. During such periods pronghorn antelope spend a great deal of time in this vegetative type. Species common to this type include: gallata (Hilaria jamesii), sand dropseed (Sporobolus cryptandus), needle-grass (Stipa comata), grama grass (Bouteloua spp.), winterfat, and rabbit-brush.

The grassland-desert shrub type is the largest of the aforementioned vegetative types. The shrub component comprises from 20 to 50% of this type. Species common to this vegetative type include: big sagebrush,

rabbit-brush, mormon tea, four-wing salt-bush, bigelow sagebrush (Artemesia bigelovii), galletta and grama grass. This area is also very important to pronghorn antelope. In fact, one of the plant species, bigelow sagebrush, found here has proved to be the single most important constituent of the fall diet.

The grassland-sagebrush type is probably the single most important vegetative component of pronghorn antelope habitat in this area. It is essentially a continuous ecotone. It provides excellent forage production including a large volume of forbs along with big sagebrush which provides concealment cover for fawns.

The sagebrush vegetative type offers less diversity than the previous type, as big sagebrush tends to be dominant and juniper (Juniperus spp.), becomes more common. The presence of dense stands of sagebrush preclude forbs as well as other shrubs and half-shrubs. This type offers much opportunity for pronghorn antelope range enhancement through the use of fire. In some instances sagebrush stand density and height is such that it precludes use by pronghorn antelope.

The sagebrush-pinon-juniper is an ecotone type. In this type pinon-juniper (Pinus edulis) become more common. Shrub development other than big sagebrush is minimal. This type does, however, offer good cover during periods of inclement weather.

Two variations of pinon-juniper vegetative type exist in this area. One occurs with a grass understory, primarily blue grama (Bouteloua gracilis), while second occurs with a big sagebrush understory. The latter is of little value to pronghorn antelope while the former, when it occurs as isolated islands affords both forage and cover.

The black-brush type is located along the western end of the present antelope range (primarily along the Hurricane Rim). Understory development here varies in diversity but generally is sparse. The dominant black-brush (Coleogyne ramosissima), overstory usually precludes extensive understory development. To date pronghorn antelope have not shown much favor for this vegetative type.

The riparian type is extremely limited in total acres and distribution. It occurs adjacent to springs in steep canyons, and because of this, affords little habitat to pronghorn antelope.

TRANSPLANT EFFORTS

The following is a chronological summary of events which describe to date pertinent events relative to the successful reestablishment of pronghorn antelope on the Arizona Strip.

1961 - First Release

On November 1, 1961, 34 pronghorn antelope captured near Anderson Mesa, were released at June Tank (Fig. 2).

Intensive post release investigations were not possible, however, Department and Bureau of Land Management (BLM) personnel did make several surveys in the vicinity of the release site during the year and observed 33 animals. The largest group, a herd of 14, was observed 15 miles west of June Tank. No observations were made on 2 aerial searches conducted during the spring of 1962, 1 by the Department and 1 by BLM. Webb and Robeck (1962) noted range conditions were excellent in April.

1962

Winter trapping efforts near Anderson Mesa were unsuccessful and no animals were released. Observations were not numerous in 1962 but reports indicated pronghorn antelope were located in the vicinity of June Tank and

Yellowstone Rim. At least 2 groups of animals accompanied by young were observed in the Yellowstone Rim area. Aerial surveys again produced negative results (Webb and Robeck, 1962).

1963

Pratt (1964) reported observing 14 animals during 1963. Most were in the juniper breaks of Yellowstone Rim, Hack's Canyon and Robinson Tank. He recommended the release of additional animals and believed predators had taken many of the original 1961 release.

1964

No pronghorn antelope observation reports were recorded in 1964. Pratt (1965) believed the lack of success was attributed to 2 factors, the lack of permanent water and the high predator population. He recommended the release of additional animals and the construction of a rain water catchment at Gannon Gap.

1965-Second Release

The status of the pronghorn antelope on the Strip did not improve in 1965. The Montana Fish and Game Department had been contacted and requested to supply animals since Department trapping efforts had been fruitless. Webb (1965) believed the 1961 release had been too small as animals appeared to have scattered and reproduction did not seem significant. On October 29, 1965, 55 animals were shipped from Montana to the June Tank release site in a semi-trailer transport truck. These animals had been captured at Moiese National Bison Range by the Montana Fish and Game Department on October 28, 1965. All animals with the exception of 1 doe appeared to be in good physical condition upon release.

Range conditions at the time of release were poor. Little free water was available and most of the forage was dry. Browse, however, was available (Webb and Carrier, 1966).

Post release surveys again indicated random movement by small groups of animals. One herd of 21 was observed. By November 19, 6 animals were known to have crossed the Utah-Arizona State Line, 3 near Colorado City and 3 near Fredonia. One buck was reported at Bull Rush Wash and 3 animals were seen in Tuweep Valley (Webb and Carrier, 1966). Pratt (1966) found a dead adult doe at Cantaloupe Tank east of Mount Trumbull.

1966

Pronghorn antelope began to assume a distribution which was similar to that found in later years (i.e. 1975 onward). Pratt (1967) reported good survival, some reproduction and observations of animals in the Black Ridge area. Observations were also reported from Tuweep Valley and the Yellowstone Rim.

Additional animals were not trapped by Montana in 1966. Five surveys (2 aerial and 3 vehicular) were conducted in 1966-67. Aerial survey results indicated pronghorn antelope were concentrated in Black Canyon and the Clayhole Resource Conservation Area. Fawns were again observed and survival seemed to be good (Carrier, 1967).

Carrier (1967) believed the lack of permanent water was a significant factor and recommended the construction of several rain water catchments. He also inspected the Clayhole Resource Conservation Area (RCA) and selected it as the next release site, (Fig. 2). It was chosen based on attributes of forage, water and the fact that it was completely enclosed by a fence. It was hoped the fencing would act as a barrier to reduce the tendency of the animals to randomly scatter after release.

1967

No pronghorn antelope became available from Montana in 1967. Forty-four observations were reported during the year as a result of both ground

and aerial surveys. Most of the observations occurred within 10 miles of the release site. Reproduction was noted to be poor (Carrier, 1968). Pratt (1968) again recommended the construction of rain water catchments. Carrier (1968) reported finding a dead doe.

1968

This year proved to be a repeat of 1967-no pronghorn antelope were released and surveys produced only 36 observations (Weaver, 1969). Reproduction, however, did improve. Weaver (1969) reported on a meeting held with BLM at Clayhole RCA where the decision to use this area as the next release site was finalized.

1969

Montana did not trap any animals in 1969. Two rain water catchments were constructed in the vicinity of Hat Knoll (Weaver, 1970).

1970

The coming of 1979 brought about a change in the transplant strategy. Weaver (1971) recommended the use of Arizona pronghorn antelope, preferably animals inhabiting areas north of Interstate 40 in Wildlife Management Unit 10. He believed these animals would be better adapted for existence in the release area. As in 1969, Montana was unable to furnish animals. Survey efforts in 1970 produced only 17 observations with no indication of reproduction.

1971-Third Release

On November 17, 1971, 37 pronghorn antelope arrived at the Clayhole RCA. As in 1965, these animals were trapped by the Montana Fish and Game Department at Moiese National Bison Range and transported by a semi-trailer transport truck to the release site. All, with the exception of 1 doe, appeared in good physical condition when released. The herd remained in

the fenced area (5,367 acres) for several months. Post release surveys were only slightly encouraging. Most of the animals seen were in small scattered herds, however, 1 herd of 26 was observed on several occasions (Weaver, 1972). John Riffey, an employee of the National Park Service at Tuweep Ranger Station, reported animals in the vicinity of Larrimore Tank. This area was later to become an important wintering area. Pronghorn antelope continued to be observed in Tuweep Valley.

1972

Observation records in 1972 were not impressive and indicated no reproduction. The lack of reproduction was of utmost concern (Webb, 1973).

1973

The year 1973 was similar to the previous year except that 5 fawns were reported. Geographic distribution of 21 observations was similar to previous years (Peterson, 1974).

1974

Sixty-four observations were reported by Department personnel in 1974; 11 were seen during an aerial survey. Bureau of Land Management personnel reported 53 observations.

Despite the increased number of observations, recommendations were proposed to trap additional animals. The trapping was to take place near Seligman, Arizona in 1976. During this same year, a floral reconnaissance was made of the proposed trap and release site. Results of this reconnaissance indicated both areas were grasslands. The grassland native to the Strip was found to be more closely allied with Great Basin Desert Scrub while the grasslands near Seligman were more closely associated with Plains Grassland. Precipitation records also indicated the Seligman area was in a summer rainfall regime while the Strip received most of its precipitation

in the winter. Despite these differences, transplanted pronghorns were given a good chance of survival (Webb and Phelps, 1975).

1975-Herd Establishment

In 1975, survey results indicated herd establishment. During this year, 127 pronghorn antelope observations were reported. Aerial surveys in August produced 48 of the observations. Nine fawns were observed, the highest number ever recorded on aerial surveys.

During this same period, BLM personnel photographed 48 animals at Larrimore Tank, a location that has since proven to be an extremely important wintering area.

The majority of the observations were located within a 5 mile radius of Langston Reservoir (central Clayhole Valley area). The small herd which had been observed in Tuweep Valley previously for several consecutive years was not observed in 1975. Based on the increased number of observations, plans to trap and transplant additional animals were cancelled for at least 1 year.

1976

The 1976 aerial survey was even more fruitful as total observations increased nearly 100%, to 94 animals including 22 fawns. There was also a noticeable increase in the number of young bucks. One group of 9 young bucks was observed. Two animals were observed in Tuweep Valley.

The geographic distribution of the observations was similar to that reported in 1975 except there was a noticeable increase in observations in the Heaton Knolls and Jody's Lake areas (eastern and south-western portion of Clayhole Valley). When combined with ground observations provided by BLM personnel, these observations seemed to indicate pioneering and expansion of range.

As a result of survey data, a conservative hunt limited to 5 permits was proposed for 1977. A checking station was planned to collect data on animals harvested during the hunt.

Plans to trap and transplant additional pronghorn antelope were indefinitely postponed.

1977

Aerial surveys in 1977 were again encouraging. Although only 81 animals were observed, some of the decrease was attributed to poor visibility due to the presence of high levels of atmospheric moisture. Also, the usual summer vegetation growth had not occurred and pronghorn were difficult to contrast against the background of dried vegetation. Fawn survival decreased 50% compared to the previous year. The decrease was attributed to poor spring range conditions. Again, as in 1976, the geographic distribution of both ground and aerial surveys indicated pronghorn antelope were expanding their range.

The pronghorn antelope hunt proposed in 1976 was held on September 17, 1977. All 5 permit holders participated in the hunt and had all harvested bucks by September 18. Four of the 5 animals were harvested within a 5-mile radius of Hat Knoll; the other was taken 1 mile east of June Tank. All bucks were determined to be 3 years of age by the dental cementum layer technique described by Smith (1970).

1978

Winter and spring observation reports were similar to those of the previous year. Bureau of Land Management personnel photographed 65 pronghorn antelope at Larrimore Tank during January 1978. Two interesting reports (reliability is subject to question) were provided by local residents to BLM personnel in the spring of 1978. One individual reported observing

a lone buck at Wolf Hole, nearly 30 miles from the observed center of distribution. Another individual reported a lone animal in Hurricane Valley, some 8 miles west of the previously reported most western observation.

In late May 1978, a preliminary reconnaissance was conducted in the Clayhole Valley area. The purpose of this reconnaissance was to collect data pertinent to formulation of habitat management plan. The plan was to be a joint effort by Arizona Game and Fish Department and the Bureau of Land Management, Arizona Strip District. During this reconnaissance 12 animals were observed in Tuweep Valley, Clayhole RCA and Antelope Valley areas. Most observations were of does either solitary or in company with another doe. All of the does appeared to be pregnant. This conclusion was based on external physical characteristics.

During a conversation with Mrs. John Riffey of Tuweep Valley (National Park Service Ranger Station), it was learned that 9 animals had been observed earlier in the spring, west of Vulcan's Throne along the rim of the Grand Canyon. This is the only observation ever recorded from this area.

Aerial surveys will be conducted in late January 1978. Survey conditions were poor as a result of weather and use of an untrained pilot. Despite the limited number of survey observations, fawn production appeared excellent. A second survey was conducted in September. Again fawn survival was excellent (81 fawns:100 does).

Five antelope permits were again issued for this area. Four hunters participated and all were successful. One of the harvested animals was eartagged indicating it was released in 1971.

1979

The Clayhole Habitat Management Plan, developed cooperatively between BLM and Arizona Game and Fish Department was signed by both agency state offices. This plan was directed primarily towards the enhancement of pronghorn antelope habitat on the Strip.

Winter survey flights produced an observation of 1 herd which numbered 102 animals. This herd was located near Larrimore Tank, a previously identified key wintering area.

Annual aerial surveys in August indicated a decline in fawn survival from the previous year. Likewise observations recorded during the year indicated little pioneering. Overall the population appeared to remain stable.

Hunt permits were increased to 8. This increase was based on the observed abundance of bucks in the population above the level considered necessary for maximum productivity and herd expansion. In 1979 all 8 hunters were successful. Age distribution of the harvest was good with all age classes from yearlings to 5-7 year olds represented.

CURRENT HERD PRODUCTIVITY, HARVEST, AND STATUS

Productivity

Fawn survival is a paramount problem on Arizona's pronghorn antelope ranges. This fact is well documented by Neff and Woolsey (1979) in the Anderson Mesa area. The problem of poor recruitment is widespread and is probably the single most critical factor limiting pronghorn populations second only to habitat loss, in Arizona.

Fawn survival for unknown reasons has been good, by Arizona standards, on the Strip. It has averaged 51 fawns:100 does during the past 6 summers. In contrast an area immediately to the south across the Colorado River

(Wildlife Management Unit 10) has averaged only 22 fawns:100 does during this same period. Strip mean fawn survival has also been higher than the statewide mean of 31 fawns:100 does during the past 5 years. Some credit is given to the presence of big sagebrush, which is abundant on the Strip, for the high recorded fawn survival. It is believed that this portion of the vegetative component serves as excellent concealment cover for neonatal fawns and substantially reduces fawn loss.

Harvest

Sport hunting has been permitted on the Strip since 1977. Since 1977 a total of 18 permits have been issued for a 3 day hunt held in each of the 3 years. In all 3 years all hunters which participated have been successful.

Hunters have taken animals ranging from yearlings to 7 years of age. During check station operations food habits data has also been collected which was in turn used to assist in forage allocations.

No large animals have been taken despite the area's "image" as a trophy area. Horn size has ranged from 8-14" and averaged about 12". In fact, no one has even observed an antelope recently that was believed to measure in excess of 14". Continuation of sport hunting is planned as long as it is not believed to be a deterrent to population increase or range expansion.

Herd Status

The frequency of pronghorn antelope observations increased annually beginning in 1975. Observations also became more widely distributed during this period. Based on reported observations, we estimate antelope have been reported from about 50% of the total habitat available in the area. Marked increases in range extensions were noted each year until 1979. Apparently the availability of water has now become a limiting factor to future

extensions. Water availability has been critical the past 2 summers and autumns because of below average summer precipitation.

A viable herd estimated to number between 150 and 220 animals is now established in the Antelope Valley - Clayhole Valley area. It is our belief that this herd, encouraged by habitat enhancement projects primarily in the form of water developments, will continue to increase in size and become more widely distributed. The small herd located in Tuweep Valley appears to be on the verge of extinction and will probably vanish within the next 5 years.

FUTURE MANAGEMENT PLANS

Clayhole Habitat Management Plan

As previously mentioned, a habitat management plan was signed by BLM and Arizona Game and Fish Department in 1979. The plan addressed all aspects of habitat management with a goal of improving pronghorn antelope habitat within the constraints set by the physical capabilities of the land and multiple use management. It assured pronghorn antelope a reasonable share of forage and adequate consideration in any future plans for the use of the area. The specifics of the plan will be covered in the next presentation by Sid Slone and Ralph Wolfe, of BLM.

Additional Reintroductions.

Eighty-four pronghorn antelope captured near Lyman, Wyoming were released in Hurricane Valley in mid-December, 1979. The purpose of this release was to expedite establishment of a viable population in the Hurricane-Main Street Valley areas. It was believed the geographic barrier effect of the Hurricane Rim would substantially delay range extensions of animals currently located east of the rim. To date this effort appears to have been successful as observations are common.

An additional release is proposed for the same area to insure repopulation. The exact status of this proposal is uncertain at this time.

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HISTORICAL BIOGEOGRAPHY AND DIET OF PRONGHORN IN KANSAS

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Abstract: Pronghorn were common throughout most of Kansas before settlement of the region by European man. They had begun to decline in numbers, even in sparsely-populated western Kansas, by 1877, and were nearly extirpated in the state by 1915. However, small herds of pronghorn persisted along the Kansas-Colorado state line, and these were augmented by herds introduced into several regions of Kansas during the years 1964-79. The diet of the most successful population of pronghorn in Kansas was found to consist largely of forbs in late spring, summer, and early autumn, of forbs supplemented with wheat and other dicots in late autumn and early spring, and of wheat in winter. Pronghorn are able to live and reproduce where 30% of the land is used for cultivated crops at least in part because they are able to use those crops as food during months when native foods are in short supply.

INTRODUCTION

In an attempt to reestablish pronghorn antelope (Antilocapra americana) in Kansas, the Kansas Fish and Game Commission recently introduced herds from Colorado, Nebraska, Wyoming, and Montana. Much of the prairie in Kansas has been either fenced for livestock grazing or plowed for crop production, and it was questionable whether the dietary and habitat requirements of pronghorn could be met in a patchwork of rangeland and cultivated crops. Although the introductions have proven successful, at

least in westernmost Kansas, it is not known how the available habitat has satisfied the dietary requirements of pronghorn.

The objectives of this study, therefore, were to summarize the historical biogeography of pronghorn in Kansas, to determine the diet of the most successful population of pronghorn in Kansas, and to speculate regarding the prospect for pronghorn in the state.

HISTORICAL BIOGEOGRAPHY

The pronghorn is a characteristic inhabitant of the High Plains, and frequently was mentioned in the records of European explorers. For example, in 1540 Coronado wrote of "siervos, remendados de blanco" (stags patched with white) as he crossed the plains of what eventually would become Kansas (Brennan 1932). Likewise, when (in 1806) Pike passed through what are now Anderson, Lyon, and Chase counties of Kansas, he noted that antelope were common (Pike 1810). An early trapper in Kansas, J. R. Mead, reported (1899) that, in 1859, "Antelope were abundant everywhere, in summer, migrating south in winter to the Staked Plains." J. A. Allen, reported (1874) that, in 1871, antelope were common in Kansas as far east as the middle of the state but that, during winter, they migrated southward and westward out of the state. Although they were frequent in northwestern Kansas at that time, they were not as common as in eastern Colorado or southern Wyoming. Knox (1875) said that antelope were present "in great numbers on the western plains, in herds of 10 or 20."

Records kept at the Fort Hays Military Reservation suggested that pronghorn were declining in numbers by 1877 (Choate and Fleharty 1975:12); the annual report for that year noted that in western Kansas "The antelope still lingers on the hills hereabout, but in diminished numbers; whether his stay is due to the peculiarity of his habits or to the fact that he eludes

his pursuers more easily than the buffalo, I do not know." Baker (1889) noted that pronghorn were "Still comparatively common; and until quite recently, very numerous."

The population of pronghorn in Kansas declined rapidly thereafter. Lantz (1905) wrote that antelope were "Fast disappearing. A recent law protects these animals, but the law is ignored by many of the settlers in western Kansas. A few small herds have been reported to me within the last year as occurring in the extreme western counties of the state." By 1912 the only report of antelope in the state was by C. D. Bunker, who saw 3 in Stanton County (Kellogg 1915).

For the next 50 years, pronghorn were considered extirpated or extremely rare in Kansas (e.g. Cockrum 1952) although small herds were seen periodically in western counties. In a letter dated 2 July 1924, Hal G. Evarts of Hutchinson wrote that he had received reliable information that, in 1916, a herd of 62 pronghorn was ranging about 42 km (25 mi) northwest of Cimarron, in the Pawnee Creek breaks in southwestern Kansas. In 1918, he saw 7 animals which wintered within 1.6 km (1 mi) of the town of Cimarron and, in 1921, a band of 16 spent the summer and winter about 24 km (15 mi) south and west of Garden City in southwestern Kansas (Nelson 1925).

A census conducted by Nelson (1925) revealed that, by 1923, pronghorn had been nearly exterminated from Kansas. He reported only 1 band (estimated to contain 8 animals) in Morton County, in the southwestern corner of the state. In April of 1931, T. E. Gruver saw a pair of antelope in Hamilton County, south of Syracuse, and others said they had seen as many as 4 or 5 in that vicinity (Brennan 1932).

Pronghorn generally were neglected in Kansas until July of 1962, when the Kansas Fish and Game Commission began a study of the few remaining pronghorn in the state. A search in western counties revealed the presence of 37 antelope in Wallace and Sherman counties. These animals were scattered in small groups and, because most of the males were concentrated in one area, the potential for reproduction was judged to be inadequate (Moore et al. 1962). Thus, in 1963, plans were made to introduce a small herd of pronghorn into Kansas. On 26 November 1964, 84 antelope were transported from Montana and released in Wallace and Sherman counties. At least 13 of these died during or soon after their release (Moore et al. 1964). In January of 1966, 61 antelope from Colorado were released in Barber County and 8 were sent to Maxwell Game Refuge in McPherson County. Also in 1967, 50 antelope from Nebraska were released in Ellsworth County; these animals previously had been confined, and rapidly separated after their release, thus resulting in a non-reproductive population. Thirty-three antelope from Nebraska also were released in Edwards County, and 2 adult does dispersed as far as 145 km (90 mi) from the site of release (Coleman et al. 1968).

By 1969 no pronghorn remained in Edwards County, only 15 head remained in Ellsworth County, and the population in Barber County showed no evidence of growth. The only introduction that had proven successful was that in Wallace and Sherman counties. The population in those counties increased at an annual rate of 17% through 1969. During 1967, the population increased by 67 head to a total of 211 (Gasswint et al. 1971). By January of 1973 the population had reached 531, and had increased at an annual rate of 20% since 1969 (Montei and Hlavachick 1974).

On 29 January 1975, antelope populations in Wallace, Sherman, and Logan counties (the last became inhabited by pronghorn that dispersed eastward from the other 2 counties) were censused. A total of 673 animals were counted, a 27% increase over the count made in 1973. A count in Barber and surrounding counties that same year revealed 54 antelope, 12 of which had dispersed into Comanche County (Queal et al. 1975).

The increased numbers in Wallace, Sherman, and Logan counties were in spite of the first controlled hunting season for pronghorn in Kansas, which was held in September of 1974. Now, regulated hunting is used as an annual tool for management of this population. The numbers of pronghorn in western Kansas were monitored continuously by the Kansas Fish and Game Commission from the time of the release in 1964 until the winter of 1978, when 845 animals were counted (Funk 1979a).

Plans were made in 1977 for another transplant of pronghorn from Wyoming. In January of 1978, 63 antelope were released in Clark County and 37 in Chase County. Those releases increased the population in Kansas to between 1,200 and 1,300 head (Funk 1978). Other introductions were made in January of 1979, when 98 pronghorn were released in Chase County, 75 in Ellsworth County, 74 in Clark County, 36 in Morton County, and 68 in Gove County. These introductions increased the population of pronghorn in Kansas to its highest numbers since the beginning of the Twentieth Century (Funk 1979b).

The latest introductions were made in an attempt to unite the existing herds in the state. It was anticipated that, if these new herds were as successful as those in Wallace, Sherman, and Logan counties, the distributions of these isolated populations soon would overlap. The current (December 1979) distribution and abundance of pronghorn in Kansas is illustrated in Fig. 1.

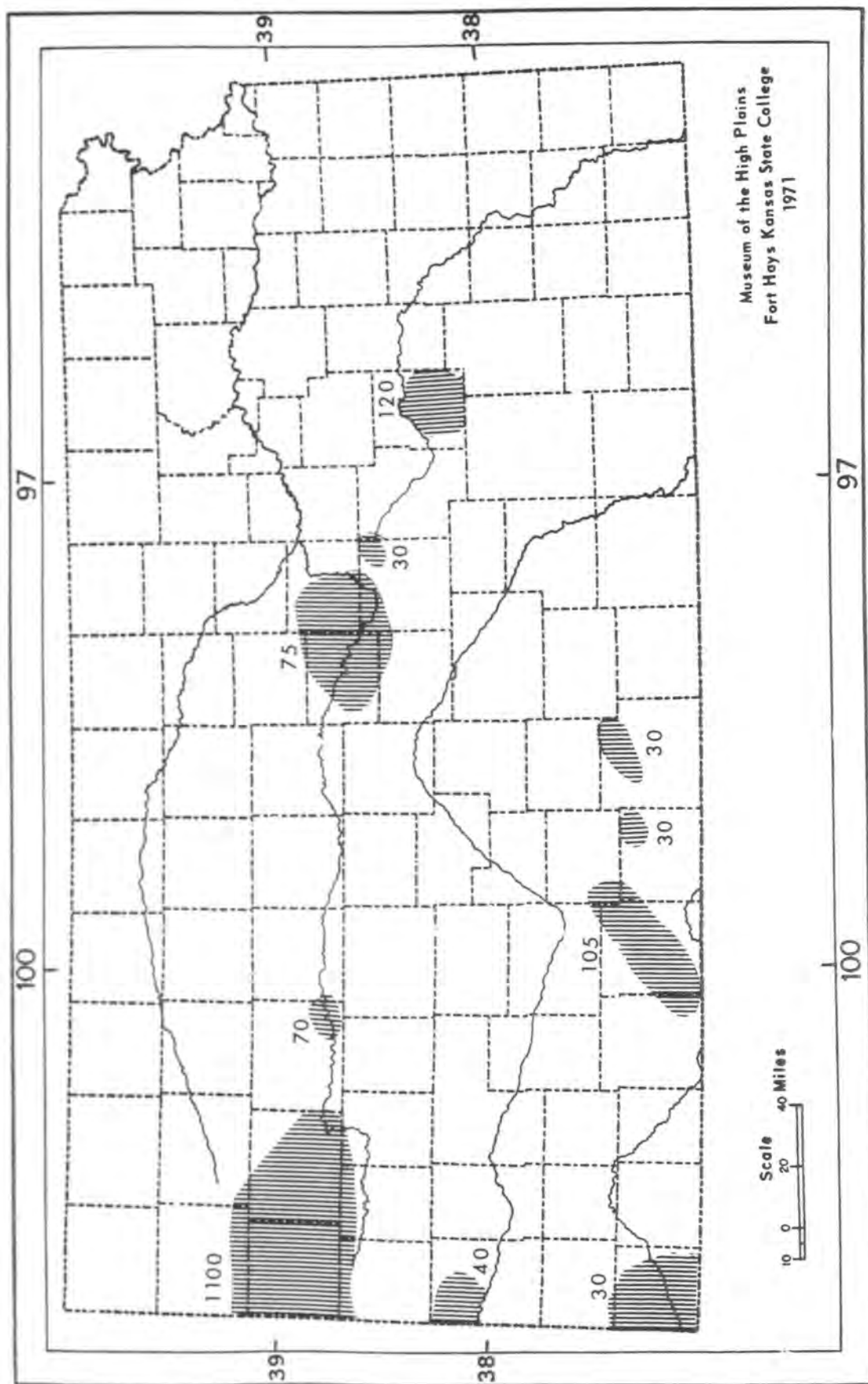


Fig. 1. Geographic distribution and abundance of pronghorn in Kansas as of December 1979

RESEARCH AREA

The research area was on the High Plains of western Kansas (Fig. 2). It comprised the western part of Wallace County, with its western boundary on the Colorado-Kansas state line. The southern boundary extended eastward from a point where the state line bisects the southern border of section 12, Township 13S, Range 41W, to the southeastern corner of section 8, T. 13S, R. 41 W. From this point, the eastern boundary extended northward to the northeastern corner of section 5, T. 12S, R. 41W. The northern boundary was formed by a line extending westward from this point to the state line.

The area encompassed 17,887 ha (44,200 A) of native shortgrass prairie and cultivated cropland. Shortgrass rangeland occurred on 12,664 ha (31,244 A), a hard red winter wheat (Triticum aestivum) on 4,808 ha (11,880 A), feed grain and forages on 310 ha (766 A), and alfalfa (Medicago sativa) on 126 ha (310 A). Cultivated acreage occurred on level land throughout the research area. The study area was inhabited by approximately 100 pronghorn. During winter they were generally observed in large herds of about 50 to 75 animals.

Vegetation on the rangeland was predominantly warm-season perennial grasses and forbs. Most of the rangeland is grazed by cattle (cow-calf) in all except the winter months. Topography varies from flat to gently rolling, with numerous gullies draining toward the main drainage of the region, the Smoky Hill River. The highest elevation in the study area (and in Kansas) is 1,227 m (4,025 ft), reached in an area of native rangeland on a rise known as Mt. Sunflower. Two drainages (Goose Creek in the northeastern corner and Willow Creek across the southern edge) cross the study area and drain into the Smoky Hill River. Small ponds and stock tanks provide other watering facilities for cattle and pronghorn.

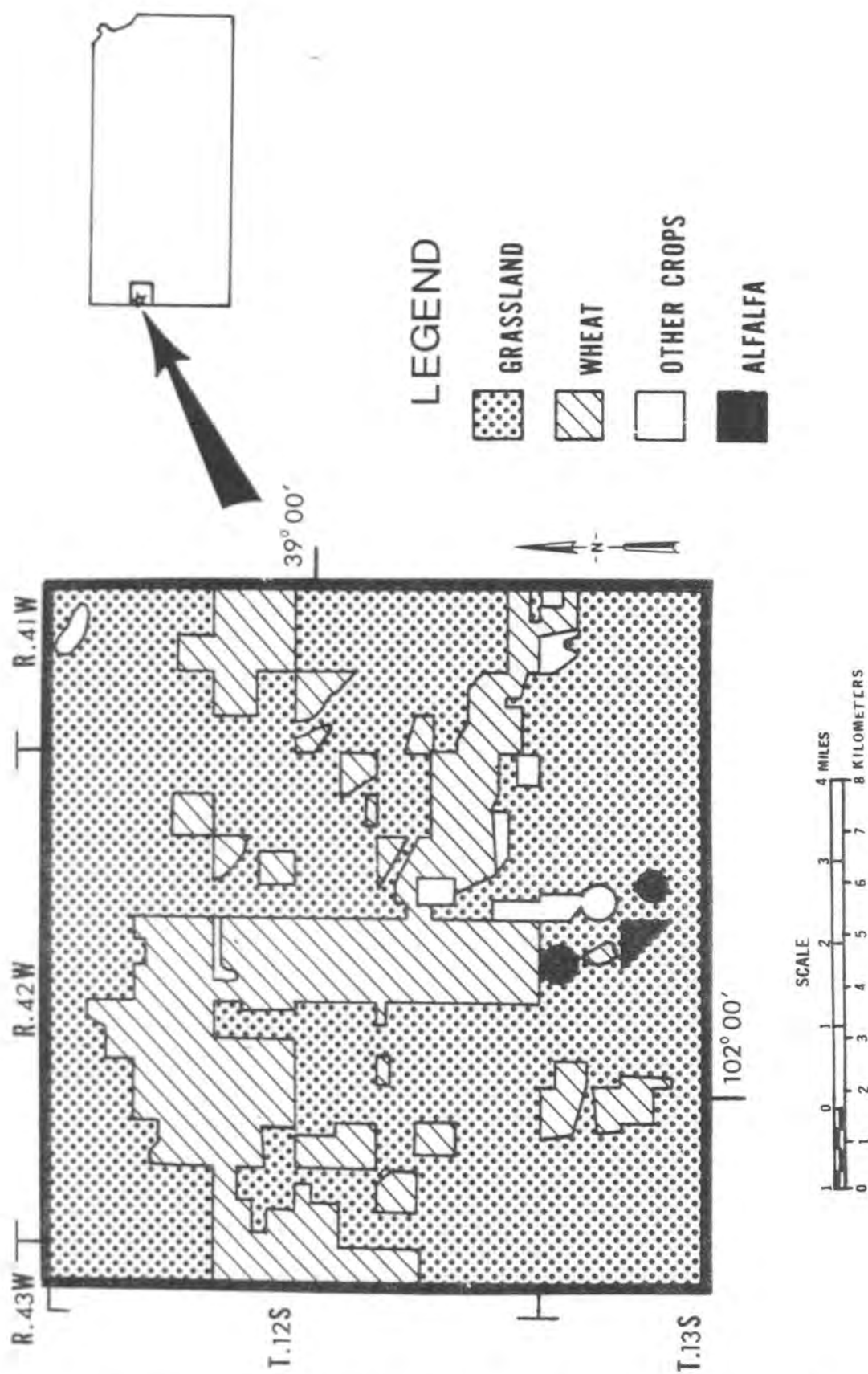


Fig. 2. Geographic location and vegetation of the research area

More than 90% of the cultivated land is planted to winter wheat every 2 years; therefore, in any year, half the fields are fallow and contain residue and half are planted. Wheat sometimes is used during winter for grazing cattle. The remainder of the cultivated land is planted to sudangrass (Sorghum bicolor), corn (Zea mays), or alfalfa. Sudangrass and alfalfa are baled for feeding of cattle in winter, whereas corn is harvested in autumn as a grain crop. Roadside ditches and wheat fields that have been harvested commonly contain weedy plants, such as kochia (Kochia scoparia), rough pigweed (Amaranthus retroflexus), Russian thistle (Salsola kali), and western ragweed (Ambrosia psilostachya), and often contain winter wheat.

The study area received approximately 36 cm (14 in) of precipitation, or slightly less than average, during the research period (November 1977 through October 1978). Most snow fell in January, February, and March, with the heaviest snowfall (about 38 cm, or 15 in) in February. Rainfall was sparse until late April, when a 5 cm (2 in) rain was received. The remainder of the rainfall was spread evenly through the spring and summer months except in May, when only 1.25 cm (0.5 in) of precipitation was received.

METHODS AND MATERIALS

The duration of the study was November 1977 through October 1978. Vegetation of the prairie was analyzed by the modified step-point technique (Dwensby 1973). Because additional data were needed on species composition of the forbs, this technique was modified further by recording the nearest forb for each point taken. Samples were obtained at 3 times (21 May, 31 July, and 10 September) during the growing season to monitor changes in species composition. Four sites were selected for analysis: high level

prairie (T. 21S, R. 42W, NW $\frac{1}{4}$ sec. 23); gently sloping prairie (T. 12S, R. 42W, NE $\frac{1}{4}$ sec. 23); steeply sloping prairie (T. 12S, R. 42W, NW $\frac{1}{4}$ sec. 25); lowland prairie (T. 12S, R. 42W, SW $\frac{1}{4}$ sec. 13). During each sampling period, 100 points were taken on each of the 4 sites. Indices calculated included percent cover, percent composition of all species, and percent composition of forbs.

A standardized procedure for fecal collection and analysis was followed throughout the sampling period. Observation routes were traveled twice monthly, and pronghorn were observed for at least 15 min. after they were found. During this period, the animals would become nervous and defecate before running. Samples of their feces then were collected, placed in plastic containers with alcohol, and sealed for shipment.

Sampling consisted of 2 fecal collections semi-monthly from November 1977 through October 1978. On each sampling day, 6 specimens were collected and preserved until sent to the Department of Range and Wildlife Management, Texas Tech University, for standardized microscopic analysis. An attempt was made on each sample day to obtain fecal specimens representative of the entire population of pronghorn on the research area. For this reason, if pronghorn were dispersed into several groups, samples were taken from as many groups as could be found.

Trophic diversity (h) for each sample was calculated as follows (Margalef 1958):

$$h = -\sum_{i=1}^S (n_i/N) * \ln (n_i/N) \quad (1)$$

where S is the number of species in the sample, N is the total of individuals of all species, and n_i is the number of individuals of the i th species.

Evenness (e) or equitability for each sample also was calculated using the

following index (Pielou 1966):

$$e = h/\ln s \quad (2)$$

Species richness (d) of the diet was defined as the ratio of the total number of species (s) to the total importance (N) of all species. The index of Margalef (1958) was used to calculate species richness:

$$d = (s-1) (\ln N)^{-1} \quad (3)$$

VEGETATIONAL ANALYSIS

Because no apparent differences in plant composition were found among samples taken in May, July, and September, data from 1,200 points were combined to calculate total species composition. The most abundant plants found in the research area were short grasses. Buffalograss (Buchloe dactyloides) and blue grama (Bouteloua gracilis) were the most abundant, comprising 38.1 and 34.0% of the vegetation, respectively. Other common grasses were : western wheatgrass, Agropyron smithii (11.3%); sideoats grama, Bouteloua curtipendula (5.3%); sand dropseed, Sporobolus cryptandrus (1.4%); red threeawn, Aristida longiseta (1.3%); little barley, Hordeum pusillum (1.2%). Each of the other plant species accounted for less than 1% of the total composition.

Considering only forb composition data, prickly pear, Opuntia sp. (20.6%) was the most common, followed by scarlet globemallow, Sphaeralcea coccinea (17.3%), and broom snakeweed, Xanthocephalum sarothrae (11.8%). Other forb species with values of 1% or more of the forb composition were: Russian thistle, (8.5%); Kansas sage, Artemisia kansana (4.5%); heath aster, Aster ericoides (4.3%); upright prairie coneflower, Ratibida columnifera (3.7%); rush skeleton plant, Lygodesmia juncea (2.9%); slimflower scurfpea, Psoralea tenuiflora (2.7%); ball cactus, Neomammallaria radiosa (2.3%); western ragweed, Ambrosia psilostachya (1.7%); scarlet gaura, Gaura coccinea (1.7%);

purple poppymallow, Callirhoe involucrata (1.2%); wavy leaf thistle, Cirsium undulatum (1.0%); annual sunflower, Helianthus annuus (1.0%); woolly plantain, Plantago purshii (1.0%). The remaining 13.6% was dispersed among 38 other forbs.

FECAL ANALYSIS

Analysis of feces of the pronghorn herd from November of 1977 to October 1978 revealed the presence of 11 grasses and 44 forbs (Table 1). The semi-monthly data were averaged by month and pooled into 5 categories: (1) wheat (2) other grasses (3) alfalfa (4) other forbs (5) prickly pear (Fig. 3). In each month from October through March, winter wheat made up at least 60% of the diet, ranging from a low of 41.2% on 5 November to a high of 100% on 25 February. The only other species important during winter were prickly pear, which was utilized throughout most of the year, and alfalfa, which made up more than 10% of the diet of pronghorn at certain other times of the year. On 27 April, alfalfa made up 41.6% of the diet of pronghorn; that percentage was the greatest both for that date and for alfalfa.

By April, the percentage of forbs in the diet was nearly equal to that of wheat. Between the latter sample dates in March and April, the abundance of wheat in the diet decreased from 79.9 to 1.7%, whereas the proportion of forbs increased from 20.2 to 96.7%. This was reflected in the increase in dietary diversity and richness from 0.7 to 2.1 and 0.8 to 3.7, respectively (Table 2). By May, more than 83% of the diet consisted of forbs. This trend continued through June (90.4%), July (90.5%), August (78.3%), and September (77.1%), and richness of the species in the diet remained high (≥ 3.00). On 24 June, the sample period with highest diversity, 28 species were identified. The most common of those species were western ragweed (24.9%), purple poppymallow (8.9%), scarlet gaura (9.6%), kochia (6.1%), and slimflower scurfpea (11.2%--Table 1).

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978

Months Collection Dates	Jan. 10 21	Feb. 4 25	Mar. 13 25	Apr. 8 27	May 7 23	June 2 24
GRASSES:						
<u>Agropyron smithii</u> (Western wheatgrass)				0.6 2.1 7.0 3.9 5.2 1.3		
<u>Bouteloua gracilis</u> (Blue grama)				0.6 0.4 1.3 3.9 1.1		
<u>Buchloe dactyloides</u> (Buffalograss)		0.8		3.1 0.4 0.3 0.4 2.2		
<u>Triticum aestivum</u> (Winter wheat)	73.8 97.6 81.0 100.0 94.4 79.9 72.3			1.7 2.0 1.9 3.2		
Other grasses				0.4 1.3		
BROWSE:						
<u>Artemisia filifolia</u> (Sand sagebrush)				14.6 29.3 14.3 5.2		
FORBS AND LEGUMES:						
<u>Ambrosia psilostachya</u> (Western ragweed)				5.2 3.3 15.5 21.4 24.4		
<u>Artemisia kansana</u> (Kansas sage)				0.3 2.8 2.6		
<u>Aster tanacetifolius</u> (Tansyleaf aster)				0.6		
<u>Astragalus pectinatus</u> (Narrowleaf milkvetch)				2.6 0.7 2.7 2.4 6.3		

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978 (Cont'd.)

Months Collection Dates	July 18	July 28	Aug. 12	Aug. 26	Sept. 9	Sept. 30	Oct. 8	Oct. 23	Nov. 5	Nov. 24	Dec. 10	Dec. 28
GRASSES:												
<u>Agropyron smithii</u> (Western wheatgrass)	0.4	0.8	0.4			1.5						
<u>Bouteloua gracilis</u> (Blue grama)			0.4			1.0			0.5			
<u>Buchloe dactyloides</u> (Buffalograss)	0.4	0.4		1.0	1.0				0.5	0.8		0.7
<u>Triticum aestivum</u> (Winter wheat)						2.7	59.2	74.1	41.2	82.1	98.4	85.0
Other grasses		0.4	1.7	1.1	0.5	0.7	0.6	2.2				
BROWSE:												
<u>Artemisia filifolia</u> (Sand sagebrush)						2.0		1.5				
FORBS AND LEGUMES:												
<u>Ambrosia psilostachya</u> (Western ragweed)	23.8	8.7	16.6	10.5	10.4	0.3	0.6				0.7	
<u>Artemisia kansana</u> (Kansas sage)	7.9	26.9	20.0	11.1	8.3	2.0			22.2			
<u>Aster tanacetifolius</u> (Tansyleaf aster)						18.0	0.6					
<u>Astragalus pectinatus</u> (Narrowleaf milkvetch)	0.4				0.5							

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978 (Cont'd.)

Months Collection Dates	Jan. 10 21	Feb. 4 25	Mar. 13 25	Apr. 8 27	May 7 23	June 2 24
<u>Callirhoe involucrata</u> (Purple poppymallow)					0.3	0.4 8.9
<u>Chrysopsis villosa</u> (Leafy goldaster)				0.4	4.0 4.7	2.4 4.5
<u>Dyssodia papposa</u> (Prairie dogweed)						0.4
<u>Erysimum asperum</u> (Plains erysimum)	3.5	0.8	3.6	1.3	2.0 4.7	7.1 2.9
<u>Gaura coccinea</u> (Scarlet gaura)			1.2	9.4	13.0 15.1	10.3 9.6
<u>Kochia scoparia</u> (Kochia)			0.7		0.8	14.3 6.1
<u>Lesquerella ovalifolia</u> (Ovalleaf bladderpod)	12.8				2.7	0.3
<u>Medicago sativa</u> (Alfalfa)			11.5	0.6	41.6 5.0	3.9 3.2 0.3
<u>Oenothera serrulata</u> (Serrateleaf eveningprimrose)					6.9	0.4 0.3
<u>Psoralea tenuiflora</u> (Slimflower scurfpea)					2.6	5.7 5.0 3.6 11.2
<u>Ratibida columnifera</u> (Upright prairiecone flower)			0.6	0.4	1.0 2.3	4.0
<u>Sphaeralcea coccinea</u> (Scarlet globemallow)			3.8	3.4	20.3 4.7	2.8 4.2

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978 (Cont'd.)

Months Collection Dates	Jan. 10 21 25	Feb. 4 25	Mar. 13 25	Apr. 27 7	May 23 7	June 2 24
<u>Verbena stricta</u> (Woolly verbena)				6.3 1.3	3.1 0.4	1.0
Other forbs	5.7 2.4 2.3			3.3 3.6 2.6	9.2 10.1	10.6
CACTUS:						
<u>Opuntia sp.</u> (Prickly pear)	3.5 15.1		5.6 4.3	5.7 1.7 0.6	1.2 0.4	1.0

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978 (Cont'd.)

Months Collection Dates	July 18 28	Aug. 12 26	Sept. 9 30	Oct. 8 23	Nov. 5 24	Dec. 10 28
<u>Callirhoe involucrata</u> (Purple poppymallow)	3.8		11.0			
<u>Chrysopsis villosa</u> (Leafy goldaster)	17.2	7.2 0.4	0.3	1.8		
<u>Dyssodia papposa</u> (Prairie dogweed)		13.6	2.8			
<u>Erysimum asperum</u> (Plains erysimum)		10.2	1.6 8.8	0.3		
<u>Gaura coccinea</u> (Scarlet gaura)	5.0	14.0 5.5	3.3 1.0			
<u>Kochia scoparia</u> (Kochia)	5.0	12.0 6.0	0.5	0.7		0.8
<u>Lesquerella ovalifolia</u> (Ovalleaf bladderpod)		0.4	0.6	8.0		
<u>Medicago sativa</u> (Alfalfa)	1.3	2.1 0.4	5.0 13.0		10.3	15.4
<u>Oenothera serrulata</u> (Serrateleaf eveningprimrose)		1.2		3.0 1.2	0.7	
<u>Psoralea tenuiflora</u> (Slimflower scurfpea)	10.5	3.7 1.3	3.3 2.6	2.0 0.6	0.7	
<u>Ratibida columnifera</u> (Upright prairiecone flower)				3.3 7.1	0.7	
<u>Sphaeralcea coccinea</u> (Scarlet globemallow)	3.3	7.0 4.3	2.8 7.8	14.0 20.7		2.1

Table 1. Mean relative percent frequency of plant species comprising 3% or more of the diet of pronghorn for at least 1 sample date between November 1977 and October 1978 (Cont'd.)

Months Collection Dates	July 18 28	Aug. 12 26	Sept. 9 30	Oct. 8 23	Nov. 5 24	Dec. 10 28
<i>Verbena stricta</i> (Woolly verbena)	2.9 0.8		0.5	0.6		0.8
Other forbs	11.8 7.8	15.4 26.8	23.3 25.6	4.0 16.4	2.6 0.1	3.6
CACTUS:						
<i>Opuntia</i> sp. (Prickly pear)	5.9 7.0	3.4 31.1	21.8 3.6	3.0 3.7	20.6 1.6	0.8 9.9

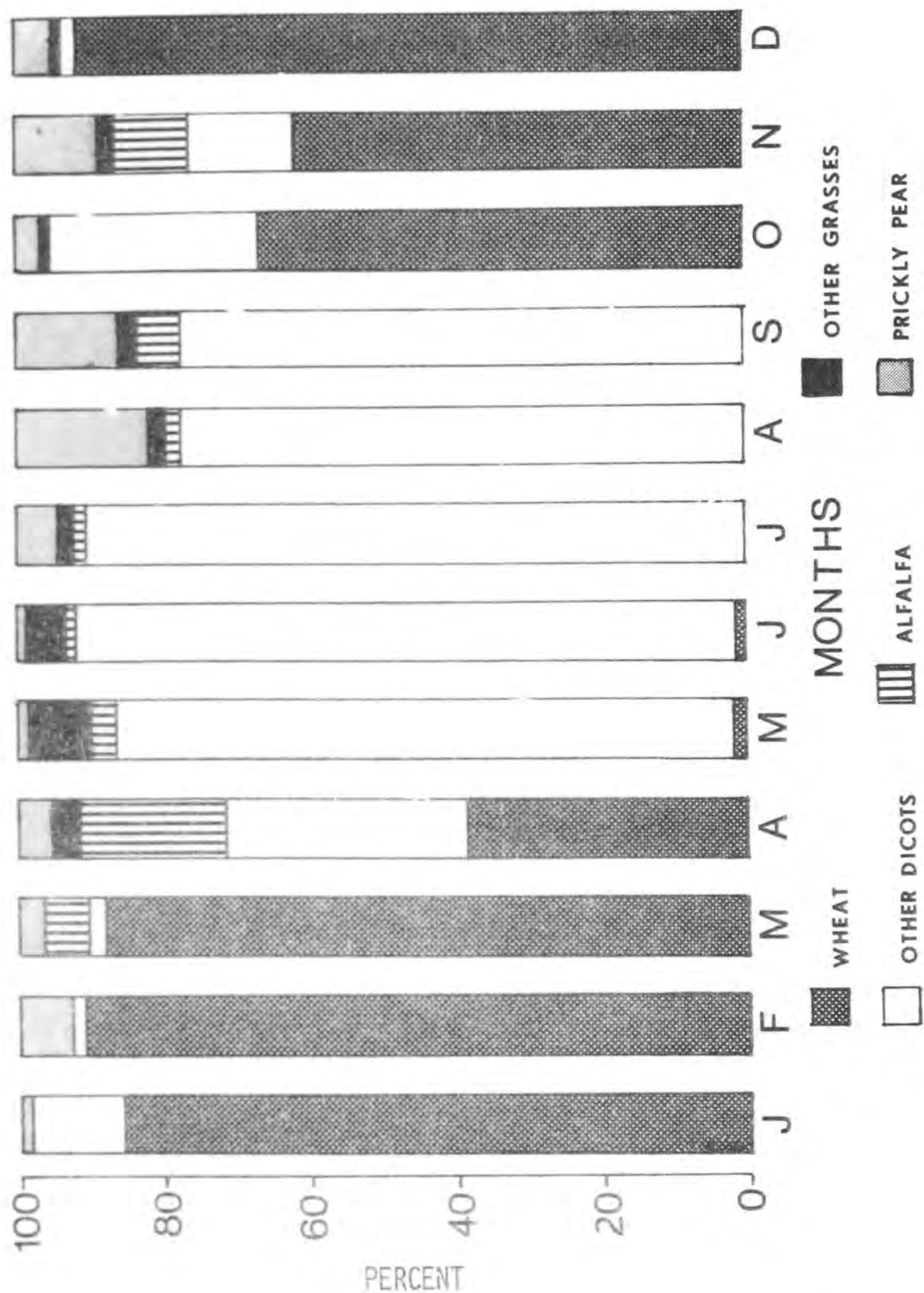


Fig. 3. Monthly dietary percentages of wheat, other dicots, alfalfa, other grasses, and prickly pear in the diet of pronghorn in western Kansas for the period November 1977 through October 1978

Sand sagebrush (Artemisia filifolia) was an important component of the diet from 27 April through 2 June, and comprised 29.3% of the diet on 7 May. Western ragweed constituted an average of 14% of the diet from 27 April through 9 September. During the period 18 July through 9 September, Kansas sage comprised an average of 14.8% of the diet; on 5 November, it increased to 22.2%.

Scarlet globemallow was important through most of the spring, summer, and fall: on 7 May it comprised 20.3%; on 28 July 7.0%; on 9 September 7.8%; on 30 September 14.0%; on 8 October 20.7%. Forbs still were an important dietary component in October (30.9%), but had been replaced by wheat (66.7%) as the most abundant constituent. Prickly pear was found in feces in all months of the year, and was most abundant (17.3%) in August. Grasses other than wheat were relatively unimportant in the diet, and were represented by a percentage only as high as 8.9% in May.

DISCUSSION

Forbs constituted an important component of the diet of pronghorn in late spring, summer, and fall. On the study area, forbs made up only 5.2% of the species composition of the shortgrass prairie ecosystem but accounted for more than 90% of the diet of pronghorn during certain months of the year. During May through September, an average of 95% of the diet of pronghorn consisted of plants other than grasses. Forbs also were important, but to a lesser degree, in April, October, and November. Similar results have been obtained in other studies of pronghorn on the High Plains of Kansas; Hlavachick (1968), for example, reported that the diet of pronghorn in Kansas consisted of 78% non-grass species, of which prickly pear made up 40% and Kansas sage made up 16%. Two of the forbs (scarlet globemallow and prickly pear) utilized extensively by pronghorn in this study were common on the research area. Sand

Table 2. Richness, diversity, and evenness of species in diets at each sampling date from November 1977 through October 1978

Date	Richness	Diversity	Evenness
10 January	2.22	1.03	0.41
21 January	0.62	0.14	0.10
4 February	1.03	0.64	0.36
25 February	0.00	0.00	----
13 March	0.21	0.22	0.31
25 March	0.81	0.72	0.45
8 April	2.96	1.24	0.45
27 April	3.67	2.05	0.67
7 May	4.03	2.30	0.72
23 May	4.32	2.76	0.86
2 June	4.37	2.63	0.82
24 June	4.52	2.52	0.77
18 July	4.02	2.37	0.76
28 July	3.64	2.29	0.75
12 August	4.40	2.54	0.79
26 August	3.66	2.26	0.76
9 September	3.04	2.29	0.81
30 September	4.56	2.63	0.80
8 October	2.92	1.51	0.55
23 October	1.43	0.66	0.32
5 November	1.90	1.52	0.64
24 November	0.62	0.56	0.40
10 December	0.42	0.10	0.09
28 December	1.03	0.50	0.28

sagebrush, on the other hand, was an important forage plant during April, May, and June even though it was found growing only in the lower drainages. Pronghorn seldom were seen in those areas except during those months. Barrington (1975) explained that, in southeastern Colorado, "Areas where sand sage was moderately dense and the understory vegetation was vigorous and diverse, seemed to be more heavily utilized by pronghorn does for fawning." Autenrieth (1976) also suggested that fawning often is associated with woody habitats. Most forbs, other than prickly pear, scarlet globemallow, and sand sagebrush, were not plentiful in the vegetation samples but were conspicuous because of their size and showy appearance.

Winter wheat made up a substantial part of the diet of pronghorn during late autumn, winter, and early spring (October through March), and alfalfa was consumed more in April and November than in other months. These observations suggest that pronghorn in western Kansas utilize wheat as a substitute for green forbs during months when green forbs are not available. In spring, when alfalfa emerges but rangeland forbs are not yet abundant, pronghorn use alfalfa to supplement their diet of native dicots. Cultivated crops are an insignificant component of the diet during summer, but increase in importance when green forbs become scarce in autumn. Damage to winter wheat by pronghorn is unlikely. Grazing of wheat by livestock in this region is not common; however, the period (mid-October to mid-April) during which pronghorn consume wheat coincides with the time when wheat might possibly be used for grazing.

Pronghorn, which once occurred throughout most of Kansas but were nearly extirpated after the state was settled, have proven their ability to live and reproduce where at least 30% of the land is cultivated for crops. This ability depends, at least in part, on their consumption of winter wheat and alfalfa, in much the same way as by jackrabbits, during months when native foods are in

short supply. Accordingly, the reestablished populations of pronghorn have the potential to disperse into many of the regions of Kansas that were inhabited by pronghorn before the arrival of European settlers and, although extensively cultivated regions may prove unsuited for habitation by pronghorn, there is reason to believe that the isolated populations of pronghorn in Kansas eventually might reestablish a continuous gene pool.

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AGE DETERMINATION IN PRONGHORN ANTELOPE FAWNS

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Several studies concerning pronghorn antelope (Antilocapra americana) fawns have been conducted in recent years (Autenrieth and Fichter, 1975; Beale and Smith, 1973), however, an accurate technique for estimating ages of young pronghorn fawns has not been developed. The accurate aging of fawns is useful in determining fawning dates and accurately determining age groups most affected by mortality factors such as disease, abandonment, or predation. Haugen and Speake, (1958), developed a technique for estimating the age of white-tailed deer (Odocoileus virginianus) fawns by using new hoof growth measurements. This paper describes an adaptation of the new hoof growth technique for aging young pronghorn antelope fawns.

During the 1978 fawning season in the Trans-Pecos region of Texas, 25 pronghorn antelope fawns were captured using the nighttime capture technique described by Brownlee and Hailey, (1970). Physical characteristics as well as new hoof growth measurements were recorded at capture. Fawns 1 to 2 days of age were identified by moist navel condition, soft hooves, and a pronounced cryptic behavior (Autenrieth and Fichter, 1975). Fawns 3 days of age and older had scabbed or healed navels, and hard hooves.

Some cryptic behavior was exhibited by fawns up to 30 days of age; however, it was not as pronounced in fawns 7 to 30 days of age. Fawns 7 to 30 days of age would flee if approached too slowly or without sufficient light blinding the fawn during nighttime capture efforts. Fawns 0 to 6 days of age usually remained bedded and would allow the capture team to closely approach

without attempting to escape. Fawns 7 days of age and older struggled vigorously at capture; whereas, younger fawns tended to struggle only when first handled and rapidly became docile.

Hooves were soft and grayish in color at birth, but appeared to be hardening after the first day. Haugen and Speake (1958) reported a gelatinous like material on the hooves of white-tailed deer fawns at birth. No antelope fawns, however, were examined immediately after birth. New hoof material that grew after birth was distinguished by an advancing protruding ridge, referred to as a wave-like line in white-tailed deer fawns (Haugen and Speake, 1958). On each fawn the hairline was located by smoothing the hair back and upward, exposing the upper portion of the hoof. The distance from the hairline to the distal edge of the new hoof growth line was measured in millimeters (mm) with the aid of vernier calipers. All measurement of new hoof length was taken using the lateral hoof of a front foot. (Fig. 1)

Of the 25 fawns captured, 7 were available for remeasurement at a later date. Six were available due to predator involved mortalities and 1 fawn was recaptured. Following death or recapture, the new hoof growth was remeasured, the accumulated growth between captures was calculated, and the number of intervening days was determined. These data were used to calculate the rate of growth for new hoof material. These calculations yielded a regression equation which described new hoof growth for young antelope fawns.

The relationship between the new hoof growth and days of age ($Y = 0.893549 + 2.3419353 X_i$; $P < 0.01$) accounted for 92.4% (R^2) of the variation observed in these data. The age of fawn in days (Y) is calculated by multiplying the mm of new hoof growth (X_i) by 2.34193 and adding 0.893549.

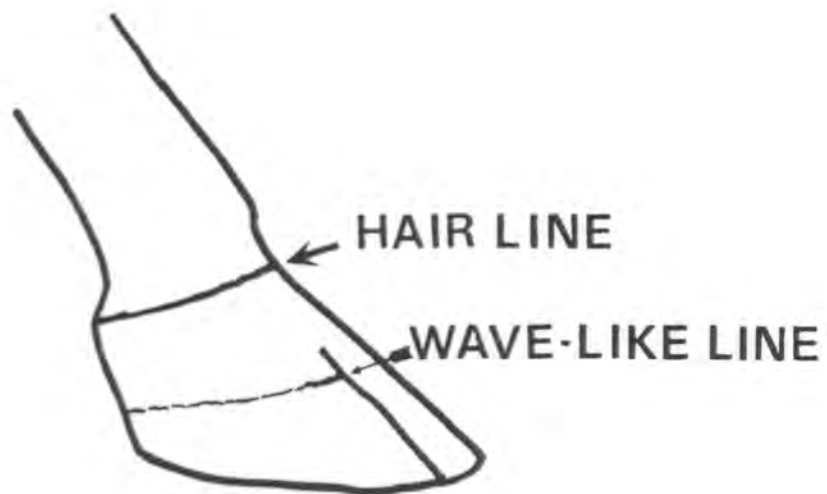


Fig. 1 Drawing of antelope hoof showing position of hair line and wave-like line

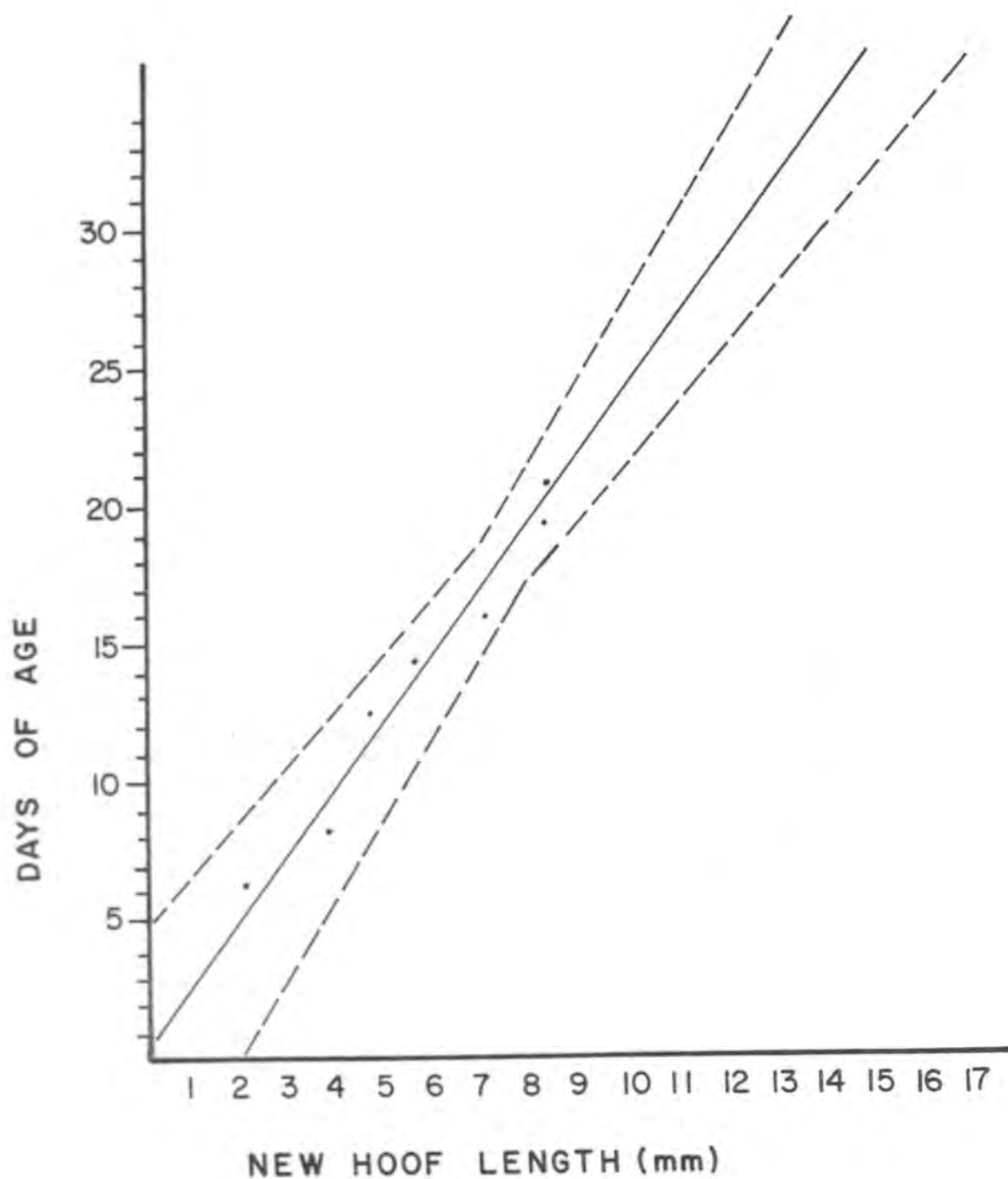


Fig. 2. Relationship of age to new hoof-growth length of 7 antelope fawns. The broken line indicates 95% confidence interval

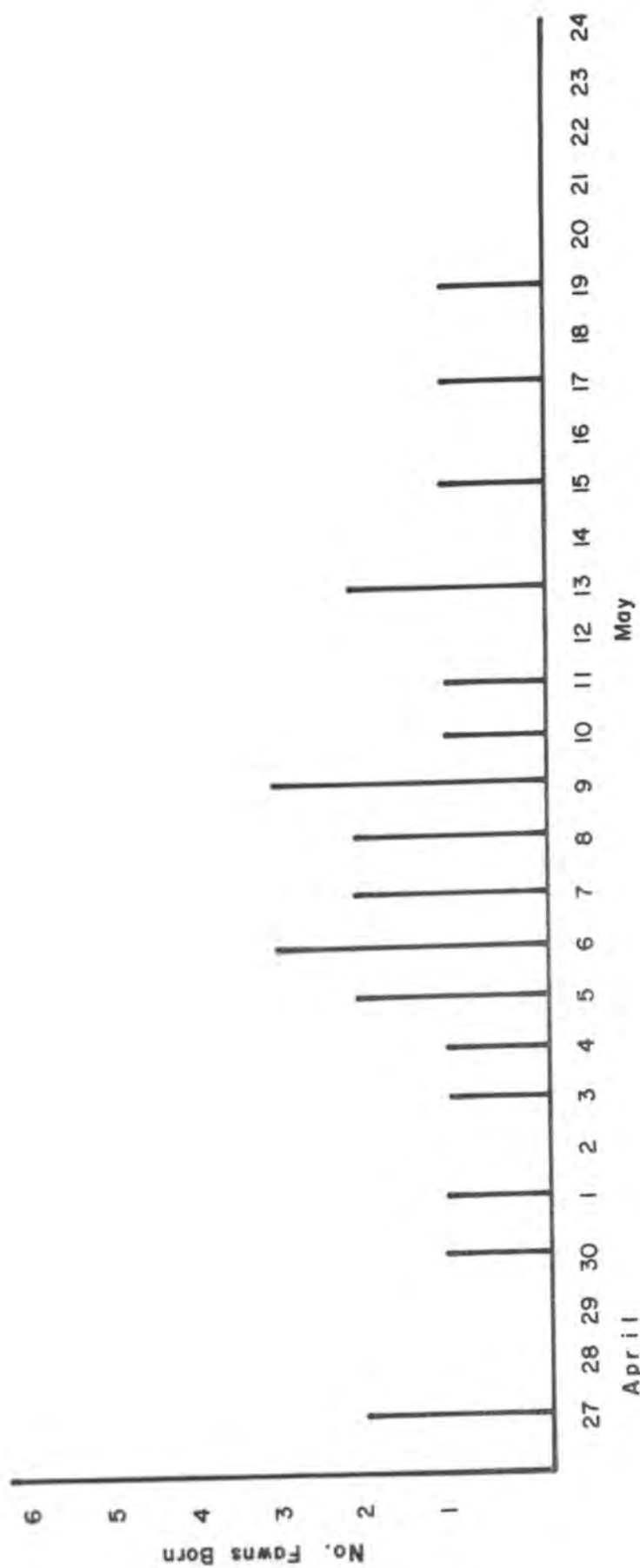


Fig. 3. Birth dates of 25 antelope fawns calculated using new hoof length measurements

Although this equation was developed using data from only 7 fawns, there is a high degree of correlation ($r = 0.96$; $P < 0.01$) between the new hoof length and age of the fawn in days (Fig. 2).

The birth dates of the 25 fawns which were captured during this study were calculated using this method. Calculations indicate that the fawning period on the west Texas study area (Fig. 3) extended from 27 April 1978 to 18 May 1978, with the peak fawning period occurring between 3 May 1978 and 13 May 1978. The first reported fawn observation was 29 April 1978 in the Alpine, Texas area (F. Sigmund, personal communication). It is believed that this technique will prove useful with a high degree of accuracy for aging antelope fawns up to 31 days of age. The accuracy of this technique for fawn ages exceeding 31 days cannot be determined from these data.

Acknowledgement.--The Houston Livestock Show and Rodeo and Sul Ross State University provided financial assistance and support. Sincere appreciation is also extended to the Kokernot Ranch of Alpine, Texas for allowing access to the study area. We also wish to thank S. Brownlee (Texas Parks and Wildlife Department, Alpine, Texas) for his suggestions and assistance during capture efforts. Appreciation is also extended to B. Burton, T. Dickinson, M. Freeman, M. Howard, J. Kimball, T. Payton, D. Ratliff, M. Redus, F. Sigmund, R. Tucker, L. Tupper, and G. Wampler for their help in fawn capture and tagging.

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COMMENTS AND QUESTIONS

AMSTRUP: How were the known ages determined or how did you know the ages of the 7 fawns that were used to set up the correlation?

BALL: They were captured and a measurement taken, then by recapture or through mortality studies they took a measurement.

AUTENRIETH: Were they observed at birth? How do you know what the starting point was?

BALL: Through field observation.

AMSTRUP: For the 7 fawns, were the fawns actually observed being born and caught immediately.

BALL: I would have to assume that they were. I can't answer that for sure. All I can give you is clarification of what is presented in the paper, beyond that Ron Tucker would have to tell you that himself.

POJAR: Was the data for a single year?

BALL: For this particular part of the study, yes.

OLDING: Do you know if they had any multiple recaptures and measurements to see if the rate of hoof growth was constant? Were there 2 captures and 1 measurement for each fawn?

BALL: A total of 25 fawns were caught, but there were only 7 fawns that were really measured and they were radio collared.

OLDING: One remeasurement on each fawn?

BALL: Yes. The point that was made in the study was that there was only 7 fawns where regrowth or growth measurements were taken at a second

time. It was because the measurements were taken during mortality studies. But as you can see there was a high correlation from those 7 fawns even though the number was low, it was a very high correlation. It has been shown in the other paper that I mentioned on whitetail buck deer fawns that this technique had a high correlation also in that species.

WEIGHTS AND HORN MEASUREMENTS OF NEBRASKA PRONGHORNS - FIRST SEASONS AND
TWENTY YEARS LATER

KARL MENZEL, Nebraska Game and Parks Commission, Bassett

Nebraska's first antelope season was held in 1953, with only a small portion of the Panhandle open to hunting. Most of the primary antelope range was added to the open area during 1954 and 1955. Data obtained during this period should approximate that from previously unhunted populations.

At the 1978 Antelope Workshop, Fichter and Autenrieth presented a paper entitled "Is Trophy Hunting Fostering 'Unnatural' Selection for Smaller, Less Vigorous and Nonterritorial Pronghorn Bucks?" As a possible partial answer to this question, I examined data on weights and horn measurements of over 3,000 pronghorns which were collected during early and later seasons.

Prior to 1962, age determination was based primarily on the number of permanent incisors. Use of the mandibular wear technique (Dow and Wright 1962) starting in 1962 made comparisons with earlier years impractical except for fawns and yearlings, which showed almost no variation between methods.

In 1978, using the incisor replacement technique of aging, data were obtained on one or more measurements for 44 fawns and 222 adults (long yearling and older). Methods conformed to those used in earlier years: field-dressed weights were obtained to the nearest pound on platform scales, and the left horn of males was measured, with basal circumference recorded to the nearest 1/8" and length to the nearest 1/2".

Intended follow-up on this work in 1979 did not materialize, due to reductions in antelope permits and consequent impracticality of obtaining sufficient sample sizes.

FINDINGS

Analysis of variance showed no significant difference in horn or weight measurements among management units or among observers. Therefore, all similar data were pooled by sex and age class. We also measured tarsal length, but since these data showed differences among observers they were excluded.

Weights of male fawns and of females of all age classes obviously did not decline during the period of hunting (Table 1), and these data were not subjected to statistical analysis. A similar lack of difference is not apparent for adult males.

Data for adult males were examined by comparing 95% confidence intervals. Weights of yearling bucks were significantly less in 1959 and 1971 than those of 1954, 1955, and 1956. However, the 1978 weights for yearling bucks were not different from those of any year.

Weights of each age class of 2-year and older bucks were all less in 1978 than in 1954 and 1955. The 1978 weights were also less than those in 1956 for 2-year olds, 1957 for 3-year olds, and 1956, 1957, and 1959 for bucks 4½ and older. Additionally, the 1957 weights for 2-year olds were less than those in 1954 and 1955. No other significant differences in weights were present.

Data on horn measurements were limited to 3 and 4 years for length and circumference respectively, and did not include the earliest years of hunting. Horn length and circumference were significantly less in 1978 than in 1956 for 2½ and for 4 year and older bucks. Horn circumference was also less in 1978 than in 1957 for 2½ year olds (Table 2).

Table 1. Field-dressed antelope weights (pounds) by sex and age class by year

Year	Males			Females		
	Sample	Mean	Std. Dev.	Sample	Mean	Std. Dev.
<u>Fawns</u>						
1954	22	38.3	5.1	21	36.0	4.0
1955	43	39.1	6.8	44	36.0	4.9
1956	50	38.4	4.3	41	36.1	4.9
1957	52	40.1	6.8	69	37.4	6.2
1959	10	39.8	3.8	6	38.0	3.4
1968	34	41.7	4.9	62	40.6	4.8
1971	30	42.0	4.4	23	39.8	6.6
1978	27	45.2	5.0	17	44.1	3.3
<u>1½ Years Old</u>						
1954	69	75.6	7.8	43	68.1	7.9
1955	147	74.7	6.6	47	66.8	5.2
1956	158	75.2	6.5	55	66.3	6.3
1957	109	73.4	6.9	51	66.5	5.9
1959	31	70.1	7.0	11	64.7	6.0
1968	91	74.5	8.6	35	69.9	5.7
1971	39	71.7	4.4	19	66.1	7.5
1978	69	73.4	5.1	23	68.6	5.5
<u>2½ Years Old</u>						
1954	85	87.9	7.8	34	69.1	7.4
1955	132	87.7	6.6	58	69.5	6.8
1956	103	85.1	7.3	61	70.2	6.0
1957	101	83.8	7.0	47	67.8	8.1
1959	39	84.9	7.6	9	66.2	5.5
1978	32	81.2	6.6	14	72.2	8.0
<u>3½ Years Old</u>						
1954	41	91.5	6.5	16	69.0	5.4
1955	60	91.7	9.6	35	68.9	6.2
1956	62	87.7	7.1	38	68.6	5.7
1957	47	90.8	6.2	49	70.6	6.8
1959	19	85.4	9.3	4	64.2	2.9
1978	7	81.7	9.2	10	75.1	7.1
<u>4½ Years and Older</u>						
1954	36	93.0	7.4	17	72.5	5.6
1955	94	91.8	8.6	62	70.6	6.9
1956	63	91.0	6.9	58	70.5	5.6
1957	61	89.1	7.0	59	70.5	7.2
1959	11	93.1	10.1	5	70.8	3.7
1978	8	81.1	5.8	28	70.6	5.9

Table 2. Antelope horn measurements (inches) by age class by year

Year	Length			Circumference		
	Sample	Mean	Std. Dev.	Sample	Mean	Std. Dev.
<u>1½ Years Old</u>						
1956	135	7.50	1.05	127	4.74	0.46
1957	86	7.21	0.64	91	4.80	0.63
1959	--	--	--	17	4.41	0.60
1978	88	7.36	0.93	88	4.70	0.39
<u>2½ Years Old</u>						
1956	99	12.31	1.39	97	5.65	0.37
1957	101	11.84	1.49	102	5.57	0.49
1959	--	--	--	24	5.38	0.68
1978	41	11.34	1.49	41	5.26	0.33
<u>3½ Years Old</u>						
1956	62	13.48	0.93	59	5.88	--
1957	48	13.38	1.38	47	5.83	--
1959	--	--	--	7	5.77	--
1978	9	13.22	1.34	9	6.00	0.81
<u>4½ Years and Older</u>						
1956	52	13.82	1.28	51	6.15	0.54
1957	57	13.41	1.63	57	6.00	0.28
1959	--	--	--	9	5.75	0.54
1978	9	12.27	1.35	9	5.68	0.47

DISCUSSION

Data used here may be weak in several respects as indicators of potential detriments from hunting.

Differences in older (2 plus) bucks were based almost entirely on a one year (at the end) comparison. This is probably not sufficient, since invalid conclusions could have been drawn regarding lower yearling weights in 1971 if the 1978 data had not been added.

The aging technique used, although the same each year, is not accurate beyond yearlings. Lesser numbers of older bucks in later years, within supposed one year classes, would give lower physical measurements for those groups.

Nebraska's antelope hunters are strongly selective for bucks, with about 50% of the harvest consisting of adult males compared to 15 to 20% bucks in the population. However, they may not be selective much beyond "a buck", since 50 to 60% of the buck harvest in recent years consisted of yearlings. If this is true, a reasonable portion of the fittest, in relation to total bucks, could survive.

How long would it take for the results of "unnatural" selection to be manifested? Is 20 years sufficient? If the apparent deterioration in physical characteristics of bucks is actual, it would be.

However, though statistically different, it is unrealistic to state that weights, at least, have deteriorated. No age class of does showed a similar decline. Why would weights of only one sex be affected? This may be primarily or entirely caused by hunting season dates, which started the second Saturday in September from 1953 through 1959 and on the last Saturday during later years for which data is herein presented. Bucks undoubtedly lose weight during this 2 to 3 weeks because of behavior associated with the

rutting period. Yearlings did not show similar lower weights, but they are probably less affected by the rut than older males.

It is doubtful that these data, at least at this point, can be used to show a change or lack of change in physical measurements of bucks following 20 years or so of hunting. They do show that females have not been adversely affected, assuming that a cause and effect relationship could be implied.

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COMMENTS AND QUESTIONS

POJAR: What is your hypothesis for explaining the increased weight in the last year of your study?

MENZEL: I didn't have a slide to show the difference in doe condition, but the does during hunting season were in a lot better condition. The work that was done on whitetails indicate that there is that relationship.

THE IMPLICATIONS OF HUNTING PRONGHORNS DURING THE RUT

GARY COPELAND, Idaho State University, Pocatello, Idaho

OBJECTIVES

Study the relationships of buck territories, habitat selection, breeding behavior, and hunting by:

1. Determining the pattern of the spring break-up of wintering groups in terms of the sexes and status of groups, i.e., doe groups, buck-doe groups, buck groups, and lone animals.
2. Following and mapping the geographic movements of the radio-collared bucks from winter range to summer range and territories.
3. Inventorying and mapping the distribution of:
 - a. the bachelor groups
 - b. non-territorial lone mature bucks
 - c. territorial bucks.
4. Observing the behavior of all classes of bucks.
5. Observing the effects and impacts of hunting on breeding behavior.
6. Conducting vegetative analysis of territories to determine canopy coverage and frequency of forage on all zones of use.

SUMMARY

A comprehensive study of the social organization and behavior of pronghorn bucks in a hunted population was initiated March 1, 1977. Data collection occurred over 3 seasons totalling 22.5 months.

The study was conducted in the upper Birch Creek valley, Lemhi County, Idaho.

The major findings and conclusions are as follows:

1. A traditional territorial breeding system was established by dominant pronghorn bucks, prior to hunting.

2. Observations were made in 2 contrasting breeding situations:
 - a. a traditional territorial breeding system, which accounted for all observed breeding
 - b. a hunt disrupted territorial system where breeding was indiscriminate.
3. Ninety territories were established over the 3-year study. The number of territories per season ranged from 28 to 31. Territories established in 1978 overlapped 1977's territories 39%. Territories over all 3 years exhibit a 59.5% overlap.
4. Eleven bucks reestablished territories and 7 bucks lost territorial status and became "bachelor" bucks. Twenty-eight territorial bucks (TBS) were hunter harvested with 3 additional TBs being lost to poaching.
5. Territories which received doe-fawn use during the mid-summer and rut periods offered available free water and higher densities of preferred forage.
6. Vegetation analysis on 15 territories demonstrated a 7.09% increase in canopy coverage as well as a 9.53% increase in species diversity on areas occupied during the rut when compared to areas used prior to the rut. Those portions of the territory that were used 90% of the time prior to the rut yielded a 19.99% increase in canopy coverage and 14.56% increase in species diversity when compared to the area sampled off territory.
7. The primary effect of hunting during the rut was that the dominant, most vigorous bucks in the population did not contribute to the bulk of the breeding either because they were harvested, or the lack of social order (which an undistributed territorial regime provides) in "mega-groups" rendered breeding indiscriminate with females unable to escape harassing non-territorial bucks.
8. During the hunts, significant increases were documented in both the number and length of TB-buck and buck-doe interaction. These reflected harassing of the does unprotected by territories and TBs unable to maintain

social order in "mega-groups". It is reasonable to assume that the energy budget of the study population was drawn on excessively as a result of the collapse of the traditional breeding system.

9. Although hunting pressure subsided before all breeding was accomplished, the large number of TBs which had been harvested and the disrupted social organization precluded dispersal back on to traditional breeding areas.

10. Two-year-old bucks were known to have been successfully territorial.

11. Yearling bucks breed as a result of the disruption of territories by hunters.

12. The number of buck-bands remained the same over the 3 years. Areas unused by territorial bucks were repeatedly used by buck-bands.

13. "Bachelor" bucks and bucks that occupied a home range without defending it comprised a small percentage of bucks. These bucks were selected for by trophy hunters as were the territorial bucks.

14. Pronghorn arrived back on summering areas during April and started their return to winter range around mid-October, after the rut.

15. Interspecific competition was observed between pronghorn and sheep and cattle. Water use practices implemented by BLM, USFS and ranchers precluded pronghorn use. Domestic stock left on areas of high quality range "graze off" forage preferred by pronghorns.

COMMENTS AND QUESTIONS

POJAR: Did you notice any difference or did you measure any difference in population density during the years of the study?

COPELAND: We had a slight increase. We started out with about 630 animals in the study area and last year we had about 750 animals. So we had a population increase and that in fact increased the population density. Not all of the Birch Creek study area is the same high quality vegetative

community. So there is a competition for territories in preferred forage areas. We've seen a density increase and an increased competition for those areas.

POJAR: It has been theorized that higher population densities, I don't remember what the number of animals per square mile is, lead to the multi-buck group, where a lower density population leads to pair forming. Would you comment on that in relation to your experience?

COPELAND: Could you rephrase the question?

POJAR: It's been theorized that a higher density population leads to a multi-buck grouping during the breeding season where at a lower population density you would see more pairs formed.

COPELAND: I think because there are other variables within the study it would be very hard for me to comment legitimately on that. During the first year of study we were in an undisturbed situation during the rutting period. That was also the low point during our 3-year study of total number of animals within the study area. The animals moved towards a multiple buck system after the disturbance which was in the second and third year of the study instead of the first, so you have 2 opposing variables and I don't know how a person would really assess those. Any other questions?

AMSTRUP: Could you restate the hunting regime that you were subject to? Was there a centerfire rifle hunt?

COPELAND: There was in 1977. It occurred from the middle of October to the latter part of October. This was because we had felt that there was a migration of animals in the Lemhi drainage through the Birch Creek valley system. The hunt was postponed to take advantage of both populations. In 1978 and 1979 we had only primitive weapon hunts. That

is from August 4th until the second weekend of September we had an unlimited archery hunt and from the second or third weekend in September we had a 2½ week 75 to 150 permit muzzle-loader hunt. Last year we had 150 muzzle-loader permits, no centerfire rifles.

POJAR: Did you see any difference in the length of the breeding season under hunted vs. unhunted conditions?

COPELAND: I understand that in Colorado it is suspected that you might have twin fawning peaks, is that correct?

POJAR: There's that theory, yes.

COPELAND: I'm in the process of computer analyzing a lot of this information now. If you plot the peak fawning period as a function of time, in 1979 we had a fast slope up to a peak period with a gradual decrease. In 1978-79 the slope went up about the same but went over about a 3 to 4 day longer period, indicating that breeding had occurred over a longer length of time.

AMSTRUP: When do your antelope shed their horn sheaths?

COPELAND: During the Birch Creek study we found that it happens during the last week of October and principally the first 2 weeks in November.

ANDERSON: What was your ultimate fawn production in relation to this study?

COPELAND: It increased. In 1977 we had 84 fawns per 100 does. Last year we had 101 fawns per 100 does. Again I think that's an artifact related to the continually increasing quality of the range and not necessarily to the hunting regime. Obviously the does were getting bred. We didn't see a great number of unbred does. What we did see is animals that in a traditional system would not breed doing a predominant share of the breeding.

QUESTION: Do you believe the breeding by younger possibly nonterritorial bucks affected the population?

COPELAND: We know that some animals are genetically superior to other animals and we recognize this. If that wasn't true there wouldn't be such a thing as a \$4,000.00 bull for instance. We also know that only animals that are more vigorous than others become successful territory holders. So it would be logical to assume that the quality of their genetic makeup is time tested. We also indicate from the findings of our study that it's not just a genetic argument that we should be concerned with. We should be concerned with conserving the energy budgets of that population since the territory has a significant value to the does, conserving their energy budget by protecting them from harassment and guaranteeing them quality grazing area during the breeding periods.

BALL: I agree with you to a certain extent, but I think it would take further study to say a particular buck defending a territory is genetically superior than some of the others.

COPELAND: Time is a major selective factor in a wild animal population. And it would seem logical to me that an animal which breeds as a yearling is not time tested as opposed to an animal that is 3 or 4 years old and had been subjected to a number of environmental selective pressures and survive those pressures and then contributes genetic information to the gene pool. It is assuredly an academic question. If you assume that the evolution of behavior has a lot to do with the survival value of that particular species, you have to assume that territoriality has a survival value to the animal species.

QUESTION: How could it be that those antelope assumed different distribution patterns during the 2 years?

COPELAND: The predistribution was a day or two prior to the season opening. The hunt or the impacted distribution was 3-5 days after the opening. In the archery area the animals dispersed because the pressure decreased towards the latter part of the season. During the muzzle-loading season, since the pressure occurred during the peak of the breeding season, the animals did not disperse back on the territories.

MORE ON PRONGHORN GROUPS*

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Abstract only: From 1956 to 1975, inclusive, we secured compositional counts on 2,244 groups of pronghorns on 9 counting areas in Idaho and in Yellowstone National Park; 1,533 groups were seen from the ground, 711 from helicopters. There groups yielded a cumulative count of 21,671 pronghorn-sightings; sightings of does, bucks, and fawns respectively composed 46.8, 27.6, and 25.5% of the cumulative count. Of the total number of groups inventoried, 1,893 (84.3%) were found in the drainages of the Pahsimeroi and Little Lost rivers, Butte and Custer counties, Idaho. Four counting areas in these drainages constitute the Primary Counting Area; Counting Area 1 in the Upper Pahsimeroi is coterminous with the Primary Study Area.

The data are organized with respect to 10 annual periods which vary in length and are based on the pronghorn's annual cycle of biological events, largely expressed by social behavior and organization as observed on the Primary Study Area; the numbers gathered on this area during annual periods 5-9, beginning 8 June and ending 5 October (46% of total groups inventoried and 49% of total pronghorn-sightings), are given particular attention at this time.

Seven kinds of groups are dealt with: doe-fawn (excluding 1 doe with 1 or 2 fawns), doe-fawn-buck, doe-buck, doe, buck, buck-fawn and fawn.

The fact that 61.3% of the groups inventoried on the Primary Counting Area were doe-fawn groups, either with or without one or more bucks, and 76.8% of the pronghorn-sightings were within those groups, quantifies what

*See Proceedings of the Fifth Biennial Antelope States Workshop, pp222-232.

observations on behavior over several years have indicated: during the summer and early autumn, the basic social unit in this species is the doe-fawn group--and that most of the population was organized into these units. Particular attention is given these groups in this progress report.

Some of the preliminary findings for the Primary Study Area follow:

1. The percent frequency of doe-fawn-buck groups increased by 2.6 times from Annual Period (AP) 5 (8-26 June) to AP 9 (16 September to 5 October--the rutting season).
2. The mean size of doe-fawn and doe-fawn-buck groups (lumped) dropped from 17.0 (the summer's high) for AP 8 (16 August to 15 September) to 8.1 for AP 9.
3. The percent frequency of doe-fawn groups with no buck(s) decreased from 53.4 for AP 6 (27 June to 15 July) to 4.3 during the rut; that of doe-fawn groups with one buck increased from 37.8 for AP 5 to 78.5 during the rut.
4. The mean frequency of does plus fawns within doe-fawn and doe-fawn-buck groups reached a summer peak of 15.0 for AP 8 (16 August to 15 September) and dropped to 6.5 for the next AP (rut).
5. A marked increase in the number of fawns (67.7) per 100 does (within doe-fawn and doe-fawn-buck groups) for Ap 8 to 92.1 for the rut period remains to be explained.
6. The mean size of buck groups rose from 5.0 for the 3-year period 1962-64 to 9.7 for the year 1965 following 4 consecutive closed seasons (1961-64) in the Upper Pahsimeroi.

COMMENTS AND QUESTIONS

WINKLER: In your closing statement you mentioned you had all the harvest you could stand and maintain quality and I was wondering if you could elaborate on that point?

AUTENRIETH: In terms of mature bucks 3 years old or better, which are being managed for a trophy situation in Idaho. I happened to have a permit when we first opened the area in 1965 and was quite impressed with the availability of quality sized bucks then as compared to now. We can get some feel for the difficulty in finding quality bucks or bucks at all by the increase of the does in harvest. In the Chalice study area, the last year prior to closing, the number of does in the harvest increased significantly.

BARRETT: Bob you presented data which indicated that the size of the buck groups decreased extensively every year. Would you comment on whether the number of bucks on territory decreased proportionately and did you notice anything wrong if it did? What were the size of territories?

AUTENRIETH: What happened and I've specifically been watching that situation for the past 2 years because I felt Pahsimeroi might show us an indication of the total harvest problem. I could find no territorial bucks this past year. To be sure my objective while flying that country was to determine doe-fawn ratios and lone bucks are not as seeable as groups so undoubtedly I did miss some but I don't feel shakey at all saying that the number of territorial bucks is on the upward swing at this time. Which is somewhat of a reverse of what Tom Pojar theorized yesterday regarding lower density population areas being the areas where you would see the territorial buck more so than the higher density population areas.

YOAKUM: I can say this that of all the presentations that I have ever seen at this particular meeting and at other professional meetings I have never seen a series of graphs that were more enjoyable to see. Obviously a lot of work but they were beautiful.