# Proceedings of the Twelfth Pronghorn Antelope Workshop

MARCH 11-13, 1986 RENO, NEVADA

*Hosted by the*

**Nevada Department of Wildlife**
**1100 Valley Road**
**Reno, Nevada 89520**

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# PROCEEDINGS

# OF THE

# TWELFTH PRONGHORN ANTELOPE WORKSHOP

RENO, NEVADA

MARCH 11 - 13, 1986

CHAIRMAN

MIKE HESS

Cover photograph of an antelope buck scent-marking.

By:
Mike Toone of Reno, Nevada

# PREFACE

The 12th Western States Pronghorn Antelope Workshop was held in Reno, Nevada on March 11, 12 and 13, 1986; and was hosted by the Nevada Department of Wildlife. Forty-three people representing 14 states, one Canadian province, 2 universities, 6 federal agencies and one private company attended the workshop.

Reports on pronghorn antelope population status were presented by 15 states or provinces. A total of 12 technical reports were presented at the conference with six of these being available as abstracts only for the proceedings. Questions and responses following the presentations were lost because of audio equipment failure, as was a recording of the closing business meeting. The Chairman assumes responsibility for this ommission. The business meeting summary was compiled from sketchy notes taken by the Chairman at the time.

The Western Association of Fish and Wildlife Agencies requested application for re-sanctioning of the Pronghorn Antelope Workshop. The workshop application was approved by the Western Association on August 28, 1986.

Mike Hess
Workshop Chairman

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ATTENDEES AT THE 12TH PRONGHORN
ANTELOPE WORKSHOP, 1986

Donald M. Beale
Utah Division of Wildlife Resources
106 N. 1150 W.
Cedar City, Utah 84720

Kraig M. Beckstrand
Nevada Department of Wildlife
P.O.Box 237
Panaca, Nevada 89042

David E. Brown
Arizona Game & Fish Department
2222 W. Greenway Road
Phoenix, Arizona 85023

Mike Dobel
Nevada Department of Wildlife
480 Galletti Way
Sparks, Nevada 89431

David F. Dvorak
Texas Parks & Wildlife Department
P.O. Box 416
Clarendon, Texas 79226

Kathy Firchow
Virginia Polytechnic Inst. &
State University
Deparment of Fisheries & Wildlife Science
Cheatham Hall - VPI & SU
Blacksburg, Virginia 24061

Terry L. Funk
Kansas Fish & Game
Route 2, Highway 183
Hays, Kansas 67601

Ron Garner
Oregon Department of Fish & Wildlife
P.O. Box 8
Hines, Oregon 97738

Walt Gasson
Wyoming Game & Fish Department
5400 Bishop Boulevard
Cheyenne, Wyoming 82002

Thomas P. Gerlach
Virginia Polytechnic Inst. &
State University
Box 29
Model, Colorado 81059

Larry Gilbertson
Nevada Department of Wildlife
P.O. Box 1109
Ely, Nevada 89301

Bill Haley
Wyoming Game & Fish Department
1934 Sheridan
Laramie, Wyoming 82070

Frank Hall
California Department of Fish &
Game
697-940 Gold Run Road
Sunsanville, California

Gary Hammond
Montana Fish, Wildlife & Parks
621 N. Meade
Glendive, Montana 59330

Jim Jeffress
Nevada Department of Wildlife
6080 Solar Drive
Winnemucca, Nevada 89445

Marvin R. Kaschke
U.S. Fish & Wildlife Service
617 South I Street
Lakeview, Oregon 97630

George Keister
Oregon Department of Fish & Game
Box 8
Hines, Oregon 97738

Jim Liewer
Colorado State University
917 12th Street #302
Greeley, Colorado 80631

Dr. John W. Loundre
Idaho State University
Department of Biological Science
Pocatello, ID 83209

James C. Lusk
Nevada Department of Wildlife
P.O. Box 927
Tonopah, Nevada 89049

Bob McCarty
Bureau of Land Management
940 Lincoln Road
Idaho Falls, Idaho 83401

James V. McKenzie
North Dakota Game & Fish Department
100 N. Bismarck Expressway
Bismarck, North Dakota 58505

Kirk W. Navo
Colorado Division of Wildlife
P.O. Box 99
Maybell, Colorado 81640

Bart O'Gara
U.S. Fish & Wildlife Service
Montana Cooperative Wildlife Research Unit
University of Montana
Missoula, Montana 59812

Lloyd Oldenburg
Idaho Fish & Game
600 S. Walnut
P.O. Box 25
Boise, Idaho 83707

Tom Pojar
Colorado Division of Wildlife
317 W. Prospect Street
Ft. Collins, Colorado 80526

L. "Bud" Pyshora
California Department of Fish & Game
601 Locust Street
Redding, California 96001

Tim Reynolds
U.S. Department of Energy
785 Department of Energy Place
Idaho Falls, Idaho 83402

Leslie Rice
South Dakota Department of Game, Fish & Parks
3305 West South Street
Rapid City, South Dakota 57702

Richard Saiz
New Mexico Department Game & Fish
P.O. Box 1145
Raton, New Mexico

Mike Scott
Idaho Department of Fish & Game
P.O. Box 25
Boise, Idaho 83804

Jennifer Slater
Colorado Division of Wildlife
307 South 5th
Lamar, Colorado 81052

Elroy Taylor
Rocky Mountain Energy
P.O. Box 2000
Broomfield, Colorado 80020

Larry Teske
Nevada Department of Wildlife
645 Oak Circle #33-9
Battle Mountain, Nevada 89820

Douglas J. Thayer
California Department of Fish & Game
P.O. Box 1623
Alturas, California 96101

Steve Van Riper
U.S. Fish & Wildlife Service
Cabeza Pireta N.W.R.
1611 N. 2nd Avenue
Ajo, Arizona 85321

Joseph A. Vincenty
California Department of Fish & Game
1416 Ninth Street, 12th Floor
Sacramento, California 95814

Mike Watson
Alberta Fish & Wildlife Division
Main Floor, North Tower
Petroleum Plaza
9945-108 Street
Edmonton, Alberta
CANADA

Joseph M. Welch
U.S. Fish & Wildlife Service
Sheldon Refuge
P.O. Box 11
Lakeview, Oregon 97630

Joe Williams
Nevada Department of Wildlife
P.O. Box 129
Wells, Nevada 89835

Mitch Willis
Oregon Department of Fish & Game
P.O. Box 8
Hines, Oregon 97738

Lee M. Wollrab
Wyoming Game & Fish Department
5400 Bishop Boulevard
Cheyenne, Wyoming 82002

Jim Yoakum
Bureau of Land Management
P.O. Box 9098
University Station
Reno, Nevada 89507

Summary of Pronghorn Workshops held to date.

| MEETING DATES AND LOCATIONS | NUMBER OF ATTENDEES | CHAIRMAN | HOST AGENCY |
|---|---|---|---|
| April 14-16, 1965<br>Santa Fe, New Mexico | 18 | W. Huey | New Mexico Department of Fish & Game |
| February 16-17, 1966<br>Denver, Colorado | 32 | G.D. Bear | Colorado Game, Fish and Parks Department |
| February 5-6, 1968<br>Casper, Wyoming | 97 | J.L. Newman | Wyoming Game & Fish Commission |
| January 27-28, 1970<br>Scottsbluff, Nebraska | 85 | K.E. Menzel | Nebraska Game & Parks Commission |
| June 19-22, 1972<br>Billings, Montana | 85 | O.V. Compton | Montana Fish & Game Department |
| February 19-21, 1974<br>Salt Lake City, Utah | 52 | D.M. Beale | Utah Division of Wildlife Resources |
| February 24-26, 1976<br>Twin Falls, Idaho | 68 | R. Autenreith | Idaho Department of Fish & Game |
| May 2-4, 1978<br>Jasper, Alberta | 84 | M.W. Barrett | Alberta Fish & Wildlife Division |
| April 8-10, 1980<br>Rio Rico, Arizona | 64 | J.S. Phelps | Arizona Game & Fish Department |
| April 5-7, 1982<br>Dickinson, North Dakota | 69 | J.V. McKenzie | North Dakota Game & Fish Department |
| April 10-12, 1984<br>Corpus Cristi, Texas | 45 | C.K. Winkler | Texas Parks & Wildlife Department |
| March 11-13, 1986<br>Reno, Nevada | 43 | M. Hess | Nevada Department of Wildlife |

# PROVINCIAL AND STATE REPORTS

ALBERTA ANTELOPE STATUS REPORT

Mike Watson
Big Game Unit
Alberta Fish and Wildlife Division

Population Status:

Classified aerial surveys in July of 1985 indicated a provincial pronghorn population of approximately 24,000 animals. This is a 25 percent decline from the record 32,000 antelope that were estimated in Alberta in July of 1984. The long winter of 1984 in southern Alberta, the drought conditions of the summers of 1984 and 1985 and extended hunting seasons for females and fawns in 1984 are expected to have contributed to this decline.

Sex Ratios and Productivity:

In 1984 the buck:doe ratio was 42/100 and the fawn:doe ratio was 54/100. In 1985, the provincial buck:doe:fawn ratio was 44/100/54. While there was little change in sex ratios and productivity on a provincial basis, there were significant differences on a Wildlife Management Unit basis indicating shifts in antelope groups. There seemed to be a slight increase in the use of cultivated land from 1984 to 1985 which would be expected under drought conditions.

Harvest:

In 1984 pronghorn management areas were restructured to reflect the historic wintering sites of individual antelope herds. This allowed more precise harvest quotas to be established and provided better control of winter range quality from an animal density perspective.

The greatest proportion of pronghorn hunting in Alberta is done on private land. Thus, the Fish and Wildlife Division has to be sensitive to landowner concerns about hunter densities. Recent studies of acceptable hunter densities have concluded that landowners will tolerate approximately 4,300 hunters during any single antelope hunting season. This amounts to about 1 hunter per 4 square miles. Seasons have been limited from the third week in October when farming operations are finished to the first week of November when horn shedding commences. Harvest contingencies are in preparation to maintain antelope populations at levels that will maintain both access to the animals and a high quality hunting experience for hunters.

Antelope are hunted in Alberta by means of a limited entry draw only. Residents are eligible to apply for both trophy and non-trophy antelope licences and non-resident Canadians may apply for trophy antelope licenses. (A trophy animal is defined as a male pronghorn with horns 5 inches or more in length while a non-trophy pronghorn is one with horns 3 inches or less in

length). A person successful in the trophy antelope draw may not apply again within the next two calendar years.

Demand for trophy antelope licenses has been perennially far greater than availability. On the other hand, harvest quotas for non-trophy antelope have not been met in the last 5 years due to undersubscription for the available licenses. Combined with recent mild winters, pronghorn populations have increased dramatically.

Table 1. Pronghorn License Availability and Demand in 1984 and 1985.

| | Trophy | | Non-Trophy | |
|---|---|---|---|---|
| | 1984 | 1985 | 1984 | 1985 |
| Licenses Available | 3,800 | 3,305 | 7,495 | 3,022 |
| Applicants | 6,716 | 5,126 | 4,610 | 2,277 |

An increased frequency of complaints about crop depredation by pronghorns and concern about long term winter range damage, precipitated an attempt to reduce the provincial antelope herd by 30 percent in 1984 by increasing the female/fawn harvest. The non-trophy antelope license objective was, however, undersubscribed in spite of two extra permit draws and the implementation of "quota" licenses issued on a first come-first serve basis in local Fish and Wildlife offices.

Compounding the harvest problems due to disinterest on the part of hunters, an early snowfall in southern Alberta in the second week of October, 1984, initiated a large scale southerly migration of pronghorns. The result was a lower success rate for hunters who had selected the northern-most antelope hunting areas. Harvest data are presented in Table 2. A total of 12,719 recreational hunting days were provided in 1984.

In 1985 a different method was chosen to effect a better harvest of non-trophy animals. In four management areas where hunter application was less than half of the desired number of hunters, two tags were issued for non-trophy animals only. Hunter success did not differ significantly from one tag to two tag areas but the total harvest was significantly higher in two tag areas. A total of 8,275 recreational hunting days were accumulated.

Table 2. Pronghorn Harvest and Hunter Success in Alberta, 1984 and 1985.

| | Licenses Issued | | Active Hunters | | Harvest | | % Hunter Success | |
|---|---|---|---|---|---|---|---|---|
| | Trophy | Non-Trophy | Trophy | Non-Trophy | Trophy | Non-Trophy | Trophy | Non-Trophy |
| 1984 | 3,793 | 5,729 | 3,525 | 4,459 | 1,863 | 2,357 | 53 | 53 |
| 1985 | 3,209 | 3,355 | 2,955 | 1,742* | 2,111 | 1,814* | 71 | 59 |

* Two tags issued in four zones.

A one week pre-rifle bow season from October 14-19, 1985 was established for both trophy and non-trophy pronghorns. Bowhunters had to take part in the same license draw as rifle hunters and as a result the number of bowhunters in the field was small and the harvest was negligible.

Research:

There are no research programs for pronghorns in Alberta at present.

ARIZONA ANTELOPE STATUS REPORT

# PRONGHORN ANTELOPE POPULATION STRUCTURE AND MANAGEMENT IN ARIZONA

David E. Brown
Game Branch Supervisor
Arizona Game and Fish Department

ABSTRACT

Of the five endemic races or ecotypes of North American pronghorns, three are endemic to Arizona. Like other western states, Arizona pronghorns reached their lowest levels about 1925 during the height of the settlement period. Unlike some other western states, Arizona populations are again threatened. Forty acre subdivisions, intensified grazing systems, scrub encroachment, and suburban development are taking an unprecedented toll of the most productive habitats. Arizona populations are characterized by low fawn recruitment rates and long-lived animals. As a result annual productivity is low and trophy opportunities are high for the state's approximately 9,500 animals.

Arizona's explorers and early settlers found pronghorn in virtually all of the valleys and open country including the deserts (Davis 1982). Good populations continued to be reported until the 1880's when the railroads opened the state to large scale ranching and settlement. An antelope season from October through January was established in the first Territorial Game Code in 1887 and hunting was limited to bucks in an 1893 amendment. All market hunting was prohibited in 1897 and in 1905 the Territorial legislation closed the antelope season for six years -- the season was not again opened until 1942.

Collections established three races or ecotypes of pronghorns as being in the state. The Rocky Mountain or Intermountain subspecies, americana was present north on the Mogollon Rim; the mexicana or Chihuahuan form occupied semidesert grasslands in southeastern, central and western Arizona; and the Sonoran pronghorn, sonoriensis, was present along the Mexican boundary in the southwest.

Pronghorns declined precipitously in Arizona during the first quarter of the 20th century, not as a result of market hunting but from the effects of settlement. Fences, overgrazing, subsistence hunting, and possibly disease took a heavy toll. By 1925 the pronghorn had disappeared from north of the Colorado river, southeastern Arizona and much of central Arizona. Only about 700 animals, mostly in northern Arizona, were estimated to still be present in the state (Nelson 1925).

The 1930's saw the abandonment of hundreds of homesteads, a dramatic increase in pronghorn numbers, and even some improvements in distribution. In 1942, the Arizona Game and Fish Commission commissioned a study of the species' status and determined that sport hunting was feasible (Knipe 1942). Although the war intervened, enough animals were deemed present on Anderson Mesa to support continued hunting and a restocking program. Both recommendations were approved under the post-war Federal-Aid program. Annual surveys and hunts have been held each year since 1947, and pronghorns have been transplanted to San Rafael Valley, the Empire Ranch, San Bernadino Valley, San Simon Valley, Sulphur Springs Valley, the Arivaca area, Oracle Junction, Houserock Valley, and two locations on the Arizona strip.

Hunt permits increased to more than 1500 when a drought period in the mid-1950's reduced fawn survival and population recruitment. Permit numbers since then have fluctuated annually between 800 and 1400 in response to variations in recruitment and numbers of buck available. Arizona is not a major pronghorn state and since 1970 the annual take has hovered around 500 bucks. The effect of recent declines in population levels has been somewhat offset by reduced firearm permits and increased archery opportunity. Firearm hunt success averages about 65% and archery hunt success is around 10%. Archery permits now constitute about 25% of the permits. Almost all pronghorn hunting in Arizona is "buck only".

Arizona's relatively low harvest levels are due to chronic low fawn recruitment rates exacerbated by livestock grazing, brush encroachment, coyote predation and possible disease. During the last three years fawn survival rates in northern Arizona have averaged only 37 fawns:100 does -- the lowest in the United States. Fawn survival in the southern part of the state has fared somewhat better, about 60 fawns:100 does during this relatively wet period.

Arizona's low recruitment rates are compensated by low mortality of adults. Winter kill - a common occurrence in more northern states, is rare in Arizona. The last significant winter kill in northern Arizona occurred during the winter of 1967-68, but because of low recruitment, population recovery was low. This necessitated the implementation of coyote control measures as a means to encourage population recovery. An experimental control program using helicopter attacks on denning coyotes in fawning areas on Anderson Mesa just prior to the fawn drop demonstrated notable success. Similar operations in other units have yet to demonstrate cause and effect.

Management guidelines call for population structures of between 25 and 33 bucks per 100 does. Conservative management and the low mortality of mature bucks provides trophy opportunities found in no other state. More than half of the bucks taken with horns 18" long or better in the Boone and Crockett Club's 1981 Records of North American Big Game are from the Grand Canyon State. The odds of getting drawn for a permit are about 10:1 for firearms hunters but archers have almost a 1:1 opportunity for being drawn.

Problems faced by Arizona pronghorns include continued brush encroachment, competition with domestic stock, and most importantly displacement from 40 acre subdivisions and other rural developments. Some of the most productive units have been among those most heavily impacted, and the resulting increase in poaching, harassment by dogs, and other disturbances are now taking a toll that effects the availability of open areas and permit numbers. Less than 25% of the state's pronghorn habitat is on federal land and this trend toward increased habitat loss is expected to continue. Increasing, or even maintaining, the present population of about 9,500 pronghorns will require the careful husbandry of populations on public lands and increased efforts to restock historical ranges now unoccupied.

## LITERATURE CITED

Davis, G.P., Jr. 1982. Man and wildlife in Arizona: the American exploration period 1825-1865. Arizona Game and Fish Dept.

Knipe, T. 1942. The status of the antelope herds of northern Arizona. P-R Proj. 9-R. Arizona Game and Fish Commission.

Nelson, E.W. 1925. Status of the prong-horned antelope, 1922-24. U.S. Dept. Agric. Bull. 1346.

# CALIFORNIA ANTELOPE STATUS REPORT

L. "Bud" Pyshora
California Department of Fish and Game

## Herd Surveys:

The annual aerial census of the northeastern California range area was conducted January 6-10, 1986. Censusing conditions ranged from good to excellent. Most winter ranges were snow free and light conditions were excellent for viewing during most of the survey period. Antelope were well scattered on winter ranges. The interstate range in Surprise Valley was not checked.

Seven-thousand-two-hundred-fifty-six (7,256) antelope were counted in the northeastern California populations. The 1986 total is 747 animals higher than the 1985 census and is the highest total ever counted in the survey area. It is five percent above the current five year average.

A ratio of 28 bucks per 100 does was obtained during our 1985 herd ratio survey, based on a sample of 3,852 animals classified. These data are obtained via an aerial survey, usually taken in late July annually.

This is one less buck per 100 does than in 1984 but equals the current five year average.

The 1985 kid survival ratio of 45 per 100 does was the highest since 1976, and six higher than the average since 1981.

## Harvest:

The special hunt program on antelope was initiated in 1942. Special hunts were held during several years during the period from 1942 to 1964. Since 1964 hunts have been held in northeastern California each year. In 1984 limited hunting was initiated on the population of antelope in the Mono Lake area. The first year that the Mono Lake area population has ever been legally hunted in California was 1984.

Five-hundred-fifty-four permits were issued for the 1985 season as follows: 88 for "pre-season" archery and 466 for regular season bucks. No doe permits were issued in 1985 since none of the herds were above established population goals.

Archery season hunters reported 24% hunter success, the highest ever for California. Regular season buck hunters reported a success rate of 85%.

Permit quotas in northeastern California are based on herd ratio and census data obtained during annual aerial surveys. Quotas are designed so that a minimum of 20 bucks per 100 does remains in the populations after the hunt.

The mandatory tag return system remained in effect again this year. Response to this system is generally very good. Forty-three permittees failed to return their tag(s) this year. A follow-up letter was sent to non-responders reminding them that tag returns were required whether or not the permittee harvested an antelope. As of December 15, 1985, all but 17 permittees had responded. Since most non-responders are unsuccessful, we discontinued the procedure of a second follow-up letter and an ensuing visit by a warden if necessary. This extra effort was felt to be too costly to justify the extra manpower required.

A hunter orientation session was held in Alturas on the Friday preceding the hunt, as usual. About 25% of the permittees attend this session each year.

Nineteen percent of the bucks aged were yearlings and 46% were over four years old. Both the yearling and the four plus age classes were slightly above the long-term means.

California has issued 8,568 antelope tags in the past twenty-two years and 6,581 animals have been reported taken. During the same period our antelope population has increased by 177%.

Over 17,000 applications were received for the 554 permits issued. This demand indicates the high public interest in this wildlife species.

No public hearing was held prior to the California Fish and Game Commission's authorizing this hunt in 1985. Based on 21 years, when public hearings have been held, during this current series of hunts, support for the antelope hunting program has been very positive.

Transplants:

On February 21, 1985 approximately 150 antelope were trapped of which 110 were transplanted. Fifty of these animals were taken to Mono County and released to supplement two previous releases there. Fifty-one were taken to the Tejon Ranch in southern California and released on historic ranges there and nine were given to Mexico, to supplement a population in a reserve there. The remaining 30-40 animals were released at the trapping site. These antelope were taken from an area where their population was in excess of that area's herd populations goal, and where depredation to alfalfa was occurring.

Private Land Wildlife Management:

In 1984 legislation was enacted that permitted landowners, who agreed to place more emphasis on wildlife, to qualify for special hunting privileges. This law would permit qualifying landowners or leasees to receive private lands permits (tags) and request extended seasons and/or bag limits for wildlife. The manager of such an area can sell these permits to any licensed hunter for whatever price they can get. This has prompted some landowners to begin devoting more attention to antelope and antelope habitat. In the

long-term basis this should result in significant improvements for antelope on private lands. We are requiring landowners entered in the program who wish to obtain private land antelope tags to increase the antelope population on their lands above the base line numbers (the population on the area when they entered the program) before they can begin harvesting them. They will then be entitled to harvest a segment of this increase.

Research:

There is no research being conducted in California by our Department. A University of California graduate student, Audrey Coldsmith, has been studying the antelope relocated to Mono County.

Disease:

No disease outbreaks have been reported.

# COLORADO ANTELOPE STATUS REPORT

Thomas M. Pojar
Colorado Division of Wildlife

Pronghorn (Antilocapra americana) population estimates in Colorado are based on a combination of aerial trend count data and computerized population models. The statewide estimate for the winter of 1986 is 47,250 which is down 18 percent from the estimate of 57,500 for two years ago. The winter of 1983-84 was particularly severe in the northwest portion of the state and resulted in the loss of approximately 50 percent of that population. The severe winter conditions were not experienced in the eastern parts of the state and pronghorn populations in the southeast registered increases over the past two years of 20 to 30 percent. Fawn to doe ratios vary widely across the state, from 8:100 to nearly nearly 100:100, but generally average about 70:100. The buck to doe ratio is also variable and averages about 50:100 preseason.

All permits for hunting pronghorns with a rifle are issued on a limited basis. Application must be made by an early June deadline for a computerized selection process. The probability of drawing a permit varies from a 10 to 1 chance in some areas of the northwest to a 1 to 1 chance for some doe-only permits. Undersubscription for available permits is not common even for doe-only permits. This may be partly due to the Division's policy of publicizing the previous year's number of applicants and the number of available permits for each game management unit. This information gives the applicant a rough idea of the probability of successfully drawing a permit, and it helps ensure that doe-only permits will be fully subscribed.

Total harvest of pronghorns in Colorado for 1985 is 7,475. Of these, 7,097 were taken by rifle hunters with a 67 percent rate of success. Archery hunters took 378 pronghorns and had a success rate of 22 percent.

## Management Changes:

The hunting season length has been changed from the traditional three-day hunt to seven days for the entire state. The rationale for the longer season was to provide a higher "quality" hunt. The three-day season was adhered to in the past, apparently for the convenience of landowners. Efforts are being made by the Wildlife Commission to alleviate conflict between pronghorn hunters and landowners. In the southeast region of the state, landowners remove livestock from the range by 1 October and have agreed to allow more hunter access if the season was held after livestock removal. The upcoming hunting season is scheduled for the first week in October to accommodate the wishes of landowners and possibly provide more access to private land by hunters.

In a few experimental areas of the northeast region of the state, hunters are required to verify permission to hunt on private land before an application for a permit is submitted. In areas that are dominated by privately owned land, hunters have complained that although they draw a permit, they have no place to hunt. The requirement of prior permission to hunt is designed to alleviate this complaint. It is also possible that landowner relations could be favorably influenced since the hunter must contact the landowner far in advance of the hunting season for permission to hunt.

In the northwest region of the state, archery hunters are uncommonly successful. This may be due to the fact that most archery hunting is done over water catchment structures. Success rate of archery hunters has been upwards of 35 percent in recent years, and the archery harvest can equal one-third of the rifle harvest under the unlimited archery permit system. Because of this situation, it was determined that it was necessary to limit the number of archery permits in this area. In 1985, through control of permit numbers, archery hunters harvested 14 percent of the pronghorns taken in the northwest region. The success rate for archery hunters was 47 percent in 1985.

Experimental Census:

Random quadrat and random strip transect sampling systems are being tested in two common pronghorn habitat types in Colorado (sagebrush steppe and shortgrass prairie). Population size and herd structure are estimated in each area using both sampling designs. The objective is to determine if either of these designs will adequately estimate both population size and herd structure during the same fly-over in late summer. These censuses are conducted using a helicopter (Bell-Soloy) flying 50 to 100 feet above the ground at 60 knots (circa 70 mph).

Accuracy, precision, and efficiency are key features in the evaluation of these census techniques. Thus far, data indicate the precision is roughly equal for both techniques; efficiency favors the transect sampling design because of less ferry time between sample units, and accuracy is vastly different between the two techniques. It is believed that better accuracy is obtained with the quadrat method because a more thorough search for pronghorns is possible on these sample units.

Preliminary tests were conducted on a third census design (the line transect method) this past year in the sagebrush steppe habitat type. This method shows promise of producing better precision than the other two methods, efficiency equal to the strip transect method, and density estimates (presumed accuracy) similar to the quadrat method. Further experimentation is scheduled for this method.

The ultimate product of this research is to develop census methodology that will produce reliable estimates of density and herd structure more efficiently than conventional methods. Current methods in Colorado require separate censuses for density and herd structure resulting in aerial coverage of one and one-third times per year for any particular herd unit. All three experimental census methods are based on designs that sample from 10 to 35 percent of a herd unit area and produce estimates of both density and herd structure from the same fly-over.

# IDAHO ANTELOPE STATUS REPORT

Lloyd E. Oldenburg
State Wildlife Manager
Idaho Department of Fish and Game

## Pronghorn Antelope Management Plan:

Pronghorns are Idaho's most observable big game animal because they occupy open country, often occur in large herds, are not protectively colored, and are not secretive. They are a favorite subject for wildlife observation and photography.

Pronghorns are highly mobile animals, and their seasonal movements are often affected by snow conditions, water availability, vegetative conditions, and disturbance by man or livestock. However, these movements can and have been severely restricted by agricultural development, transportation corridors, fences, and other obstructions.

Pronghorn habitat in Idaho generally falls into two major physiographic types: broad mountain valleys and sagebrush-dominated lowlands. Most of Idaho's pronghorn habitat is administered by the Bureau of Land Management (BLM) and United States Forest Service (USFS), but significant amounts are also managed by Idaho Department of Lands (IDL) and private landowners.

Pronghorns feed primarily on shrubs and forbs, including alfalfa. They are highly dependent upon sagebrush for year-round food and cover. Therefore, loss of sagebrush habitats can severely impact pronghorns.

The 1986-1990 Pronghorn Plan reflects numerous changes from the 1981-1985 plan. Thirty percent of the problems addressed in the old plan have been resolved and thus deleted from the plan. Significant progress has been made in collecting data, and the BLM has emphasized increasing available water sources and modifying fences. BLM also published an antelope habitat management plan in the Idaho Falls district. Although much remains to be done, the efforts made during the past planning period by the Department and BLM personnel have resulted in important gains in the management of pronghorn in Idaho.

Many of Idaho's pronghorn herds have increased during the past several years, and now have reached optimum levels in many of their habitats. A decline occurred in some herds in the mid-1950s and again in some areas in 1983. In both instances, the decline was caused by severe winters and winter range loss to wildfires. Severe winters and range fires could again cause significant winter losses.

The Department has traditionally authorized either-sex permits for pronghorns, and the harvest rate has generally been light. Hunters are highly selective for bucks; therefore, these conservative harvests have had limited impact on the size and growth rate of pronghorn populations. In some units, it is necessary to control the size of pronghorn populations. In these units, doe-fawn only hunts have been or will be implemented to increase the harvest of female pronghorn.

The density and productivity of pronghorn herds vary considerably in Idaho. In general, both density and productivity increase as precipitation increases because wetter habitats supply more nutritious forage and provide better hiding cover for newborn fawns. Annual fluctuations in precipitation can markedly affect pronghorn habitats, populations, and production.

Pronghorn population densities vary from low to moderate. In general, Idaho's pronghorn habitats do not support the densities which are characteristic of high quality habitat in Wyoming and Montana. Low annual precipitation and poor range conditions are probably important reasons for the difference. However, the Birch Creek, Medicine Lodge, Little Wood, and Little Lost valleys support herds at a relatively high density.

Many of Idaho's pronghorn populations could withstand higher harvests, especially of does. However, harvest intensity must be closely matched with herd productivity (i.e., fawn:doe ratios), population trends, and age of harvested animals. Additional information on these population characteristics are needed. At a minimum, possession of the lower jaw should be required to aid check station data collection but a mandatory check would provide the most complete data.

Pronghorns have been harvested in Idaho under a permit system since 1940 because of their vulnerability to modern, long-range weapons, four-wheel drive vehicles, and a high demand/low supply situation. Since all authorized pronghorn hunters are known to the Department and can be readily contacted, harvest statistics for pronghorns are among the best we have. Hunter success exceeds 70% in most hunts (statewide average is about 80%), and the proportion of bucks in the harvest usually exceeds 75%.

Partly because of the ease of obtaining harvest questionnaire data from permittees, the Department has operated few checking stations for pronghorn hunters. Thus, our data on age structure and buck size are limited to certain units where check stations have been operated. Herd composition flights are usually made in August to determine pre-hunt sex and age composition of the population. Winter flights are conducted periodically to assess population size and distribution. More intensive management will require additional check stations or some form of mandatory check to obtain sex and age data of harvested pronghorns and winter counts (to measure population trend) conducted a minimum of once every three years. Mandatory jaw requirements or tooth envelopes may be considered for evaluating age ratios of the bucks in selected management units.

An economic survey was conducted in 1984. The study determined that the net present value to antelope hunters from maintaining a typical antelope unit offering 90 permits is $165,950. If resident fees are included, the net value is $234,000. When this figure is multiplied by the 33 antelope units, the statewide value for antelope hunting is significant. The resulting values for antelope habitat may exceed that for other commodities for which the habitat is managed. This information provides important support for maintaining and enhancing antelope habitat.

Much of the data used in preparing this plan, and in making annual recommendations on pronghorn management, has been gathered under a statewide pronghorn research project initiated in 1973 and completed in 1982.

# KANSAS ANTELOPE STATUS REPORT

Terry L. Funk
Wildlife Biologist
Kansas Fish and Game Commission

Antelope hunters (Firearms and Archery) harvested a total of 214 animals (113 bucks and 101 does) during the 1985 season. Three hundred thirty-four hunters actually went afield.

## ARCHERY SEASON

The tenth archery season was held in Kansas, September 28 - October 5, 1985. Archery pronghorn hunting was open in parts of 10 counties (Finney, Greeley, Hamilton, Kearney, Logan, Scott, Sherman, Thomas, Wallace, and Wichita) in extreme western Kansas. A total of 99 applications were received for the 150 available permits. Questionnaires mailed with permits were utilized to obtain archery pronghorn season data. A 91.9% response was obtained.

Of the 99 permittees, 84 archers actually went afield. Archers harvested 6 pronghorns (6 bucks) for a hunter success of 7.1%. The 1985 archery season provided 274 mandays of recreation (3.3 days/archery). Archery hunters in 1984 harvested 12 pronghorns (9 bucks and 3 does) for a hunter success of 9.6%. The 1984 season provided 4.9 days/archer or 574 mandays of recreation.

## FIREARM SEASON

Kansas' twelfth firearms pronghorn season was held during the fall of 1985. The season dates were October 12-14, 1985. Of the 270 permits allowed, 135 went to landowners and 135 to general resident; all had to be legal residents of Kansas. Questionnaires mailed with permits were utilized to obtain antelope season data. A 97.0% response was obtained.

Of the 270 permittees, 250 hunters actually went afield. These sportsmen spent 337 mandays (1.4 days/hunter) hunting and harvested 208 antelope (83.2% hunter success).

Essentially, the antelope season was a one-day affair. Opening day accounted for 81.7% of the harvest and 72.1% of the hunting pressure; this compares with 75.1% and 81.4%, respectively, in 1984. Twenty-eight antelope were taken the second day, and 10 were harvested, the last day of the season. Of the 208 harvested antelope, 107 were bucks, and 101 were does.

## POPULATION STATUS

An aerial survey to classify pronghorns was conducted on July 25, 1985, in Wallace and Sherman Counties west of Highway US-77. A Cessna 206 aircraft was used, flying north-south transects at one-half mile intervals.

Aerial surveillance accounted for 219 pronghorn antelope, classified according to sex and age, compared to 251 in 1984. The herd sex and age classification was based on the total animals classified. The buck:doe:fawn ratio for 1985 was 50:100:58 compared to 49:100:66 for 1984 (Table 1):

Table 1. Pronghorn Antelope Herd Sex and Age Composition, 1984-85.

| Bucks | | Does | | Fawns | | Total | | Bucks:Does:Fawns | |
|---|---|---|---|---|---|---|---|---|---|
| 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 | 1984 | 1985 |
| 57 | 53 | 117 | 105 | 77 | 61 | 254 | 219 | 49:100:66 | 50:100:58 |

The percent of fawns was 27.9 compared to 30.6 in 1984 and the past three-year average of 28.8%. Bucks accounted for 24.2% of the classified antelope and does accounted for 46.4%. This compares with 22.7% and 46.6%, respectively, in 1984. There were 58 fawns and 50 bucks for every 100 does. This compares with 66 fawns and 49 bucks per 100 does in 1984.

WINTER SURVEY

Aerial surveys were conducted December 30 and 31, 1985 to obtain winter population data. Surveys flown over the major range in Sherman, Wallace, and Logan Counties accounted for 525 antelope. This amounts to an 18.1% decrease from last year. This years average herd size was 33, while in 1984 it was 17. A herd of 100 was observed this year, with 65 being the largest herd in 1984.

# MONTANA ANTELOPE STATUS REPORT

Gary Hammond
Wildlife Biologist
Montana Department of Fish, Wildlife and Parks

Winter conditions in Montana since the severe winter of 1978-1979 have continued to be normal to very mild, with the winter of 1984 being characterized by much below average precipitation and above average temperatures.

Antelope population levels are continuing to increase in many areas of Montana. In fact, many of these populations are at their highest levels since the initiation of systematic surveys. Selected population parameters have begun to display the combined effects of the extended drought and these increasing population levels, with both productivity and recruitment generally stabilizing or decreasing in 1984. The exception to this observation occurred in northern Montana where productivity varied from 88 to 140/100 does and averaged 114. Antelope distribution appeared to be affected by the effects of the drought, with most antelope being concentrated in areas where succulent vegetation occurred and/or where open water was located.

Trends in population size and composition are determined by total coverage surveys of either selected counting units, trend areas, or entire hunting districts, with budgetary constraints being considered as well. Each area is sampled at least once every three years on a rotation basis, and more often if the area in question is of high priority, and if budgets allow. Data collected includes the number of yearling and adult males, females, and fawns as well as the location of each antelope group

Harvests have increased statewide concurrent with the increases in population. In 1984, 43,279 licenses were issued. A total of 37,007 people hunted and subsequently harvested 33,090 antelope, for a success rate of 89.4%. Antelope hunters averaged 3 days of hunting per animal harvested in 1984. Harvest figures and hunter numbers for the 1985 hunting season are not available, however, both parameters are thought to be up significantly.

In Montana, non-residents may be issued up to 10% of available licenses, with 15% of the licenses in any hunting district being reserved for landowners.

In 1984, the cost of resident and non-resident antelope tags was $6.00 and $100.00, respectively. As in the recent past, antelope gun seasons opened the 2nd weekend in October and ran for approximately 4 weeks. Archers can apply for a general antelope license and hunt during an early archery season running from the first weekend in September until the first weekend in October.

A research effort was initiated to ascertain the efficiency of the July-August antelope survey. Impetus for the study comes from summer and fall flight comparisons, which revealed that we were significantly underestimating antelope populations in our midsummer survey. Field work for the two-year study was initiated in July of 1985, and is being carried out in central Montana, in an area where long-term continuous data is available.

# NEVADA ANTELOPE STATUS REPORT

Jim Jeffress
Biologist
Nevada Department of Wildlife

## Antelope Population & Distribution:

Nevada currently supports an estimated 14,000 antelope over approximately 18,000 square miles of occupied range throughout the central and northern portions of the state. The antelope range represents 16% of the total land mass within the state, the vast majority of which is found on public lands.

## Harvest:

A total of 691 antelope tags were issued for the general rifle season in 1985 which ran from August 24th through September 2nd. Those tags were allocated among twenty-seven separate hunt units. Split seasons were conducted in two hunt units to minimize hunter concentrations. Those early hunts were conducted from August 17th through August 25th. A total of 3,956 applications were received for the available tags. Report card data (98.1% returns) indicated an 85% success rate among participating hunters with the average hunter spending 2.6 days in the field. Archery season dates varied around the state from July 27th to August 18th with the average season being fourteen days. A total of 200 tags were issued and allocated among the same hunt units as the general rifle season. Hunter return cards showed a harvest of 31 bucks for a 17% success rate among the participating hunters.

## Composition Surveys:

Annual summer composition flights are conducted in August on a statewide basis with the department's Cessna 206. The 1985 composition flights resulted in 5,612 antelope being classified with a ratio of 28 bucks/100 does/37 fawns. A department helicopter continues to be utilized in the major antelope herd units of northwestern Nevada during this same period. The helicopter is used primarily to obtain more accurate composition in these higher density antelope units, minimize stress on the animals, and classify yearling bucks in an attempt to more accurately gauge recruitment levels from the previous production year.

## Trend Counts:

Mid-winter trend counts are attempted over a statewide basis by plane, but are often very difficult to accomplish in the lower density units when combined with January weather conditions. Therefore, the primary emphasis is again placed in the northwest part of the state. Aerial photo's with a hand held zoom lens are taken from the plane in order to more accurately count the larger group sizes encountered in this particular region. The 1986 mid-winter counts yielded a count of 6,277 antelope or a 5% increase over

1985 levels. Generally, the statewide population appears to be expanding in most units.

Transplants:

The state has been actively involved in antelope transplant programs over the past two years. A total of 440 antelope have been received from Wyoming, Utah, and Oregon for release into ten separate release sites. All the transplants appear to be viable and expanding to varying degrees.

Research:

Nevada is not conducting any formalized research programs for pronghorn at this time.

Disease:

Nothing to report.

# NEW MEXICO ANTELOPE STATUS REPORT

Richard B. Saiz
Northeast Area Game Manager
New Mexico Department of Game and Fish

## POPULATION DATA

New Mexico's pronghorn population is estimated to be close to 30,000 animals. Eighty percent occur in the eastern plains while the remaining 20 percent occupy scattered habitat throughout the rest of the state.

Aerial population surveys are conducted between March and July each year. Antelope herd units are flown on a rotational basis every third year, unless a need is demonstrated for consecutive surveys in some units. Surveys are 33 percent surveys except where it is determined a 100 percent survey is needed. Survey strips of 33 percent surveys are flown 200 feet above the ground level and at one and one-half mile intervals. One hundred percent surveys are flown 100 feet above the ground and at one-half mile intervals.

Aerial fawn crop surveys are flown after July 1 in selected herd units. The doe:fawn ratio is based on a sample of 100 does per herd unit. Flights are not flown in a strict north-south strip pattern, but are directed to known herd ranges. The statewide doe:fawn ratio was 49.0, and ranged from 11 to 107. These estimates are believed to be reasonably accurate. They are used to justify adjustments to harvest rates the following year.

## HARVEST DATA

During the 1985-86 license year there were three rifle hunts, four bow hunts, one muzzleloader hunt, and one hunt for the handicapped. Table I is a summary of the harvest data observed during each of these hunts.

Table I. New Mexico's Antelope Harvest Data, 1985.

| Hunt Code | Weapon Type | Projected Hunters | Projected Harvest | Harvest Rate | Remarks |
|---|---|---|---|---|---|
| A-1 | Bow | 134 | 5 | 3.6% | |
| A-2 | Rifle | 2,293 | 1,815 | 79.0% | All weapons legal |
| A-3 | Rifle | 233 | 207 | 88.5% | All weapons legal |
| A-4 | Rifle | 2,067 | 1,727 | 83.5% | All weapons legal |
| A-5 | Muzzleloader | 121 | 69 | 56.3% | |
| A-6 | Rifle | 8 | 8 | 100.0% | Handicapped persons |
| A-7 | Bow | 29 | 4 | 11.8% | |
| A-8-A | Bow | 60 | 8 | 10.8% | |
| A-8-B | Bow | 53 | 16 | 17.2% | |

## RANGE AND DISTRIBUTION

No major changes in ranges or distribution are noted. A transplant of 89 pronghorns was made from one ranch near Roswell to another ranch near Corona. The release was made on Bureau of Land Management land and under agreement between the Department, the B.L.M., and the two ranches involved. Antelope were indigenous to the release area but were decimated due to conflicts with sheep and fencing.

## RESEARCH

No research projects have recently been completed and none are presently anticipated.

## NEW METHODOLOGIES FOR MANAGEMENT

No new methodologies for management of pronghorn antelope in New Mexico are planned. We are satisfied with our existing methods.

## ITEMS OF INTEREST

Much of the major antelope ranges in New Mexico occur on areas that are of mixed land status. We sign hunt agreements with each individual ranch involved in hunting. Once a total number of hunters for the ranch is agreed upon, those hunters are grouped as public hunters or landowner hunters depending upon the percentage of public land on the ranch. Public hunters are selected through a drawing and are assigned to the ranch on a fair and equal basis as the landowner hunters. The landowner may give or sell his landowner permits to anyone of his choice. This system involves a considerable amount of paperwork and time on the part of the Area Game Manager. The results are beneficial, however, because we have a very intensive system for managing harvest on a ranch-by-ranch basis.

# NORTH DAKOTA ANTELOPE STATUS REPORT

James V. Mckenzie
North Dakota Game and Fish Department

Weather conditions during the winter months play an integral role in the ecology of American pronghorn in North Dakota. Specifically, a winter with below normal snow precipitation and above normal temperatures is usually a harbinger to a good year for pronghorn. The reverse is also true.

Since the winter of 1964-1965, North Dakota has experienced five major winter-kills. The losses have reduced pronghorn numbers from the modern-day high of about 15,000 animals in 1964-1965 to a recent low (1980) of but 1,800 pronghorn antelope. Severe winters do treat pronghorns rough in North Dakota.

The five years since 1980 have been good years with comparatively mild winters, consequently, little if any winter mortality occurred and the pronghorn population responded in a positive way. It has increased to a range of 5,000-6,000 animal range even with an annual harvest of about 1,000 animals per year during each of the last four years (1982 through 1985).

Things are on course as our Pronghorn Antelope Interim Management Plan in North Dakota established a goal of providing "...recreational hunting/harvest on a sustained annual basis and to reach 7,000 (6,500-7,500) pronghorn by 1995."

Annual population estimates are derived during a July aerial survey on portions of the pronghorn range in North Dakota and are based on as near a complete count as possible of approximately one-third of the range each year. Cumulatively, this provides a look at most management units once every three years. Population densities and distribution, sex ratios, and fawn production are obtained through this method. Table 1 is an overview of this information since 1977, including two years with severe winter kills (1977-1978 and 1978-1979).

Since 1951, the first legally proclaimed season, a total of 30 pronghorn antelope gun seasons have been held in North Dakota (the season was closed in 1978, 1979, 1980 and 1981 following disastrous winter-kills in 1977-1978 and 1978-1979). Totally, over 48,000 pronghorn have been harvested by nearly 53,000 North Dakota gun hunters and another estimated 2,000 animals have been bagged by over 12,000 archers over the years. Gun hunters average 91.2 percent success and archers slightly more than 14 percent.

Legal weapons for hunting in North Dakota are centerfire rifles - 22 caliber or larger; muzzleloading rifles - 45 caliber or larger; handguns (cartridge specifications) - 1.285 inches or longer and .257 inches or more in diameter; and hunting bows capable of casting an arrow 130 yards. Only paraplegics may use a cross-bow.

The split-time hunting season experiment initiated in 1983 did not alleviate crop depredation in the two hunting units where it was tested. Some hunter induced dispersal to adjacent areas was evident and the pronghorn population on the problem area was reduced (by 27 percent), however, the depredation problem did not go away. The approach since 1983 has been to exert additional hunting pressure on that depredation area within the time frame of the regular season.

In 1984, the pronghorn gun season extended for 9½ days from 12:00 noon, Friday, October 5 through sunset October 14 (big game hunting seasons in North Dakota must open at 12:00 noon on a Friday). All participants were chosen by lottery with 4,523 residents applying for the 1,375 any antelope permits distributed through 16 units. There were 9,314 square miles open to gun hunting in 1984.

Of the 1,375 permittees, 1,297 (94.3 percent) actually went into the field hunting and 1,166 (97.4 percent) successfully bagged an antelope (793 bucks, 173 does and 200 fawns - 4.5:1:1.2).

The 1984 "any pronghorn" archery season opened at noon on August 31 and extended through September 30. The hunting by 662 archers resulted in an estimated harvest of 108 animals based on past surveys as a separate harvest survey was not conducted in 1984.

The gun season in 1985 opened on October 4 for 9½ days to sunset October 13. There were 4,374 resident applicants for the 1,025 permits. A harvest of 867 animals by the 966 people who actually hunted resulted in a success ratio of 89.9 percent. The total area open to hunting in 1985 was 9,350 square miles.

The 1985 pronghorn archery season was of a split-time framework on the same area that was open in 1984 (33,759 square miles). The season extended from noon August 30 and extended through November 3 with archery hunting being prohibited during the 9½ day gun season (October 4 through October 13). The "any antelope" regulations attracted 760 hunters who harvested an estimated 121 animals.

One of the major pronghorn management problems in North Dakota has been a void of knowledge regarding just how much native prairie remains in the state. Compounding this problem is the continued conversions of these prairie lands to other uses - the common scenario being habitat loss to cultivated fields or to pastures with one or two forage species or to ecological deserts from overgrazing; or even worse, being turned upside down on the alter of energy development (coal, oil or water resources).

A recent study (Jatnieks-Straumanis, 1983) mapped the location and extent of pronghorn habitat in seven counties of southwestern North Dakota by the use of remote sensing techniques. These techniques have been modified, updated, and expanded through a grant to the Department of Geography at the University of North Dakota, Grand Forks, North Dakota, to generate pronghorn habitat

(½-inch to a mile) maps of all counties in the western half of the state (33,759 square miles) and to replicate these maps and habitat data at 10-year intervals. This first set of maps will be generated in the very near future.

Hopefully, this data will help explain the agony of pronghorn winter-kill in North Dakota.

## LITERATURE CITED

Jatnieks-Straumanis, Sarma A. 1983. A study of pronghorn range in southwestern North Dakota. Pages 189-194 in Proc. 11th Biennial Pronghorn Antelope Workshop. Corpus Christi, TX, April 10-12.

Table 1. Overview of pronghorn population, density, distribution and reproduction (1977-1985).

| | Primary Range (5,570 sq. mi.) | | | Secondary Range (13,040 sq. mi.) | | | Tertiary Range (15,149 sq.mi.) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Density Per Sq. Mi. | Per 100 Does Bucks | Per 100 Does Fawns | Density Per Sq. Mi. | Per 100 Does Bucks | Per 100 Does Fawns | Density Per Sq. Mi. | Per 100 Does Bucks | Per 100 Does Fawns |
| 1977 | .82 | 43 | 74 | .23 | 34 | 59 | .18 | 29 | 76 |
| Winterkill | | | | | | | | | |
| 1978 | .47 | 39 | 61 | .04 | .28 | 75 | .02 | .8 | 85 |
| Winterkill | | | | | | | | | |
| 1979 | .32 | 11 | 61 | .04 | 24 | 57 | .02 | 12 | 59 |
| 1980 | .22 | 42 | 86 | .04 | 33 | 73 | .01 | 27 | 107 |
| 1981 | .39 | 43 | 96 | .03 | 22 | 82 | .06 | 54 | 78 |
| 1982 | .77 | 39 | 80 | .08 | 32 | 69 | .02 | 27 | 100 |
| 1983 | .78 | 48 | 96 | .15 | 44 | 85 | .03 | 38 | 64 |
| 1984 | .77 | 42 | 71 | .12 | 33 | 62 | .06 | 40 | 69 |
| 1985 | .71 | 39 | 70 | .11 | 32 | 71 | No Data | | |

# OREGON ANTELOPE STATUS REPORT

Ron Garner
Oregon Department of Fish and Wildlife

Oregon has an estimated 16,000 antelope located primarily in the southeast quarter of the state. They are censused annually from fixed-wing aircraft between late January and mid-March. We prefer censusing the animals while they are still grouped, and on a snow-free portion of their winter range. With optimum counting conditions, we census an estimated 75 to 80% of the total antelope population.

Herd composition information is gathered each year in late July and early August before the hunting season. We accomplish this work primarily from fixed-wing aircraft, but some classification is done from the ground in areas with good vehicle access.

The 1985 buck ratio of 19 per 100 does is below the 10-year average of 25 bucks per 100 does. Buck ratios have been declining the past few years as a result of poor recruitment. However, recruitment during 1985 improved to 34 fawns per 100 does compared to the previous 10-year average of 29 fawns per 100 does.

The Department of Fish and Wildlife issued 2,030 antelope permits for 1985, which included 1,390 rifle buck permits, 80 doe permits, 450 archery tags, 60 muzzleloader tags and 50 either sex rifle tags. The 1,011 antelope harvested was the highest on record. Rifle buck hunters had 71% success during the August 17 through 23 season with 95% of the permit holders participating in the hunts. Antelope tags cost $10.00 for residents and $125.000 for non-residents.

Legal Weapons during the antelope rifle season are as follows:

1). Centerfire rifles .23 caliber or larger or developing at least 900 foot pounds of energy at 100 yards.

2). Any .40 caliber or larger muzzleloading rifle.

3). Any long, recurve or compound bow with a minimum 40-pound pull rating.

In addition to the controlled rifle season, 450 archery permits were offered for a 1,000 square mile area in south central Oregon, which is closed to centerfire rifle antelope hunting. Sixty muzzleloader permits were offered in two areas totaling 2,700 square miles.

The Department receives few antelope depredation complaints because the major herds are located predominantly on public land away from agricultural areas. However, some antelope damage has occurred primarily on alfalfa fields.

card questionnaires to a telephone survey during 1985. The telephone survey contacted a random sample of 62% of the antelope permit holders. This method should provide better harvest data than the questionnaires because a large percentage of the questionnaires were not returned during previous years.

Oregon has one research project on antelope located about 40 miles south of Burns. A study in this area during 1981 and 1982 showed that 97% of the antelope fawns died, primarily in the first three weeks of life, and that 66% of the mortality was caused by coyotes.

As a result of this information coyote control was initiated on the study area in 1985 to determine if summer fawn survival could be improved. In April and May, 66 coyotes were removed in 22 hours of helicopter time. Following control, August, 1985, fawns ratios were 34 fawns per 100 does on the study area compared to an average of 6 fawns per 100 does the previous four years with no intensive coyote control. This is an increase of 467%. In the remainder of Harney County fawn ratios increased only 63% to 39 fawns per 100 does from the previous four-year average of 24 fawns per 100 does.

Coyote control appeared to increase summer fawn survival on the study area in 1985. Results, however, are not conclusive and the study will continue for two more years.

# SOUTH DAKOTA ANTELOPE STATUS REPORT

Leslie Rice
Big Game Biologist
South Dakota Department of Game, Fish and Parks

At least once every ten years weather conditions in South Dakota are so severe that antelope populations are greatly reduced. The winter of 1978-79 caused herd reductions to an all time low for the 1970's. Unfortunately, 1985 dealt our antelope a double blow. Drought conditions during the summer were the worst since the 1930's. Range conditions by fall were extremely poor. Then winter weather during November and December brought extreme cold and heavy snowfall. We are again at all time lows for recent history. Numbers are probably even lower than in 1979. Winter losses range from 50 percent to 90 percent over most ranges. The bulk of our losses have occurred in primary range in the northwest corner of the state.

We experienced herding of antelope in cities similar to occurrences in other states during the early 1980's. Antelope numbers reached over 200 head in Sturgis. Other cities had less numbers but such occurrences were common. We even had antelope in heavily forested areas of the Black hills. Of course for the first few days, people in cities liked the oddity of antelope grazing on their ornamental shrubs. But within a week depredation complaints plus demand to "feed the starving wildlife" reached intolerable levels. As a stopgap measure, hay and corn were put out to try and short-stop antelope before they reached housing developments. We knew such measures would be largely unsuccessful in both holding antelope out of the cities and in preventing starvation losses. We experienced the usual problems of dogs killing antelope, deaths due to change in diet (some people put out lettuce and potatoes) and outright starvation. We also knew any feeding program would not be able to save the majority of our herds, but political reality decreed that we attempt limited feeding to at least show some effort was being made.

Contact with Colorado gave us the composition of pelletized feeds used in that state. Due to availability and short lag time, we modified the original formula to try and meet our needs. Below is the experimental mixture we tried based on one ton of pelletized feed.

| | |
|---|---|
| Wheat middlings | 860 lbs. |
| Sunflower meal | 500 lbs. |
| Sunflower hulls | 300 lbs. |
| Sun cured alfalfa | 240 lbs. |
| #2 yellow corn | 60 lbs. |
| Beet molasses | 36 lbs. |
| Trace minerals | 4 lbs. |

Total cost per ton was $156.00. Native grass hay was initially laid out in feeding locations and then pellets were placed over the hay. Antelope initially appeared reluctant to utilize the pellets. But within one week the majority of antelope around towns and cities were on the feed and losses were greatly reduced. I want to emphasize the feeding program was only used in high visibility locations and/or where herds were readily accessible. We did save most herds found in those locations but this probably amounted to less than 5 percent of total antelope numbers. The majority of our herds had to tough it out or else succumb to the winter weather. Costs, man power, and feeding program realities prevented further effort.

As had been reported in previous years our antelope management is based on county boundaries. Conservation Officer data collection and hunting season design are generally based on county unit boundaries.

Pre-hunt 1985 population was estimated at 55,000. This was down from record high numbers of 67,000 in 1983. Our management since 1983 was designed to reduce overall herd levels due to landowner tolerance. Wheat fields and high antelope numbers just do not mix. Spring aerial census was used to determine adult sex ratios and subsequent herd estimates while early summer flights were used to determine reproduction. Due to costs and duplication of data collection, reproductive counts will be dropped in 1985. Spring surveys were based on one-third sample of most hunting units.

Archery antelope season began August 24th and ran through September 30th. Resident and nonresident hunters could hunt all of the areas west of the Missouri River and four counties in the eastern part of the state. A total of 582 licenses were issued in 1985 (476 resident and 104 nonresident). In 1983, 508 licenses were issued. Licenses allowed the hunter to take "any antelope". Total harvest was 86 antelope for a project success of 15 percent.

The firearm season began October 5th and ended on October 13th for most units. Split seasons designed to distribute hunter pressure and later opening dates were used in a few, select hunting units. All seasons were completed by October 20th. Firearm hunting units comprised 40,000 square miles. In 1985, 12,755 licenses were authorized (11,810 resident and 945 nonresident). Of this total 3,560 resident and 285 nonresident licenses allowed the taking of two antelope, one of which had to be antlerless. There license holders were further required to harvest the antlerless antelope before the "any antelope" tag was used. Two tag licenses were used in select units to alleviate depredation complaints. Therefore, total tags authorized was 16,600. In 1984, 24,000 tags were issued. Of the 11,810 resident licenses authorized, we actually sold 11,758. For nonresident total sales were 1176 even though only 945 were authorized. Licensing procedures account for the additional sale of 231 nonresident licenses.

Total harvest for the 16,779 tags actually issued was 12,844 (77 percent success). Antlerless harvest accounted for 59 percent of all antelope taken. In 1984, harvest was estimated at 17,000 with antlerless making up 40 percent of the kill.

Firearm antelope hunters in South Dakota may use either a rifle or pistol with at least 1000 ft. lbs. of energy at the muzzle. Muzzle loaders are also legal but must be at least .42 caliber.

Occupied antelope range was estimated at close to 41,000 square miles before winter die-off occurred. Resultant occupied range will be determined from spring counts. We do not anticipate stocking effort in South Dakota even with the drastically reduced antelope populations.

Presently there are no research projects in progress or planned in South Dakota.

South Dakota antelope management objectives had seen tremendous changes since 1979. From the late 1970's to 1982 harvest strategies were designed to build antelope herds. We succeeded only too well. In 1983 and 1984 hunter selectivity and season design prevented harvest objectives from being reached. In 1985, we finally reached population levels which were more in tune with objectives. Hunters began to accept split season hunting design, antlerless harvest was finally accomplished and landowners with depredation complaints were satisfied. Winter mortality will in effect cause us to be back to square one. Hunter harvest undoubtedly will be severely restricted next fall. As of this writing, we do not anticipate over 3,000 licenses to be authorized this fall. Restrictions on resident applications will again be demanded by hunters, and it is doubtful if nonresident hunting will be allowed in 1985.

South Dakota depends almost entirely on aerial census made during May. Buck/doe ratios are determined from these flights as are total population estimates. Approximately one-third of each hunting unit is surveyed. Hunting units where less than 50 permits are authorized are surveyed from ground observation.

The survey flights do have inherent biases which cause concern over estimates and buck/doe ratios obtained. Our greatest concern is over variability caused by differences between observers. Our flights are made only one time with many different Conservation Officers flying various hunting units. Some officers naturally have more interest in flying than others. This same interest applies to survey effort and subsequent data obtained. In addition, terrain, vegetation differences, and other observability factors enter the picture. We are forced to make the assumption that our survey results are indicative of actual population changes. This may or may not be true. It is anticipated the population modeling using the Pop II system will be initiated this year. Such use will, of course, place even greater demand on survey accuracy.

# TEXAS ANTELOPE STATUS REPORT

D.F. Dvorak
Texas Parks and Wildlife Department

The Texas antelope population was estimated at 23,750 animals during the fall of 1985 with a herd composition of 1.75 does per buck and .46 fawns per doe.

During the five year period of 1981 through 1985, the Texas antelope population has fluctuated from a low of 12,011 animals in 1983 to the current high of 23,750 animals. The 1985 figure represents a population increase of 31 percent from the 1984 census. Eighty-four percent of the state's antelope population is found in the Trans-pecos District; approximately 10% in the Possum Kingdom District and the remaining 6% in the Pandhandle District.

Population estimates are obtained annually from aerial surveys of slightly less than one-half of the occupied antelope range. Aerial counts are conducted during the spring and summer. A rotation system allows the inventory of each area at least every third year. Aerial census data concerning herd composition and fawn production are supplemented with ground surveys conducted during June, July and August.

The antelope hunting season in Texas opens on the Saturday nearest October 1 and continues for nine consecutive days. The bag limit is one antelope per hunter per year by permit only. Archery equipment and all firearms, except those using rimfire ammunition, are legal for taking antelope. Persons may hunt from a vehicle within the boundaries of private property.

The antelope harvest is controlled by permits, designated either for buck or doe. These permits are issued to qualified landowners in areas where surveys have shown surplus antelope exist. The hunter must negotiate with the landowner to obtain trespass privileges and a permit.

Buck permit issuance has ranged from 695 to 1,618 during the past five hunting seasons. An insignificant number of doe permits were issued in unusual instances of high population density in 1982, 1984 and 1985. Buck permits are issued on approximately six million acres of private antelope range. The buck harvest during the last five years has been as follows:

1981 - 695 Buck
1982 - 821 Buck
1983 - 538 Buck
1984 - 594 Buck
1985 - 643 Buck, 30 Doe

Utilization of permits had remained above 65% for many years until 1982 when it dropped to 58%. This decline has continued to 53% in 1985. As expected, doe harvest was low at 15% of the doe permits issued.

This continued low permit utilization rate has been attributed to the rise in trespass fees charged to the hunter. In addition, an increasing number of landowners have set management goals for producing trophy bucks.

Hunter demand greatly exceeds the number of surplus antelope available for harvest. Present management policy is directed toward the hunter harvest of all bucks considered surplus to breeding requirements. The calculation of buck permit issuance rates incorporates a 25% factor for crippling loss and is aimed at maintaining a post season sex ratio of at least one buck per four does. The continued partial utilization of permits by Texas landowners has prevented the maximum harvest of surplus antelope, but has allowed for the production of some trophy class bucks.

# UTAH ANTELOPE STATUS REPORT

Donald M. Beale
Utah Division of Wildlife Resources

Pronghorn antelope are widely distributed in Utah despite low numbers. They currently exist in small scattered bands on 17 different areas or herd management units within the State. About 40 percent of these occupy the western desert areas and the remainder are in the northeast corner and in the south-central parts of the State. Populations in some herd units have increased in recent years, largely as a result of improved fawn survival. One herd unit in Eastern Utah, continues to decline. Total numbers, based on aerial trend counts and assuming 80 percent coverage, are estimated at 6,900 statewide.

Pronghorn habitat has not changed significantly in 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 diet overlap and competition for forage between pronghorns and livestock in these areas. As a result, some pronghorn populations have responded favorably.

Pronghorn antelope are hunted in Utah in September and early October on a permit basis. Applicants are allowed no more than one permit every three years. Over the past ten 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 1976, the number of applications for permits to hunt pronghorns had increased to over 4,000 per year. In 1984, there were 5,818 applications for 739 permits and these permittees harvested 669 pronghorns, including 169 does and fawns. Twenty-two of these permittees also purchased archery permits to hunt during the 15-day archery season held prior to the regular hunt.

Management data obtained annually in Utah includes late summer fawn to doe ratio counts, winter trend counts, and harvest information. August fawn to doe ratios have declined on some herd units during the past two years. The average ratios in 1984 and 1985 for 14 units were 45 and 46 fawns per 100 does and ranged from 17 to 117 and 15 to 85 fawns per 100 does respectively.

Research programs with pronghorn antelope in Utah, which were active between 1961 and 1980, have been completed and no additional studies are planned at this time.

The Utah Division of Wildlife Resources, in cooperation with other agencies, is continuing efforts to expand pronghorn populations by trapping and moving animals into new areas where habitat is suitable. In the winter of 1984-85 a total of 469 pronghorns were trapped from Awapa Plateau and Snowville to reduce population numbers. One hundred forty-nine of these were shipped to Nevada and 320 to release sites in Utah. In the winter of 1985-86 a total of 301 pronghorns were trapped from the Awapa Plateau and released in two sites in Utah.

The population on Awapa Plateau has been our most successful and productive introduction to date. It was started in 1965 with 129 pronghorns from Montana and has now expanded to over 1,200 head, and is maintained at about that level by hunting and by trapping for release to other sites. This population has extended its range to include considerably more habitat than it used in prior years.

Previous research at the Desert Experimental Range indicated that available drinking water was an important factor to pronghorn habitat. It was concluded that pronghorns 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 are considered an important factor in pronghorn management on desert ranges where natural watering sources are absent or limited. Proper placement of these watering systems has improved summer distribution of animals and also improved foraging conditions by enabling pronghorns, particularly does with fawns, to use range they would not otherwise be able to in drought periods.

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

## WYOMING STATE REPORT

Walt Gasson
Wyoming Game and Fish Department

Wyoming has 53 discrete pronghorn populations, totalling approximately 372,000 animals. In 1985, we harvested about 68,198 pronghorn. Hunter success varies by individual population, but generally ranges between 85 and 95 percent. In 1985, pronghorn harvest generated about 158,178 days of hunter recreation. This, in turn, generated about $4 million in license revenues to the Wyoming Game and Fish Department and about $24 million to the economy of the state.

Events of major significance with respect to pronghorn management include the apparent resolution of conflicts surrounding crucial pronghorn winter range at Red Rim in south-central Wyoming. The ramifications of this situation may be significant to pronghorn managers all over the western U.S.

Major problems in pronghorn management in Wyoming include a continued problem with habitat loss due to energy development, urban development and agriculture. We are facing an increased demand for antelope hunting on public land and decreasing demand for antelope hunting on private land in Wyoming. We expect this to continue through the short-term future. We are faced with increased emphasis on "special interest" management - trophy management, archery management, muzzle-loader/primitive weapons management, etc. We expect these demands to escalate, and conflicts between these groups to increase. We face an increased emphasis on privatization of wildlife - including pronghorn, from the agricultural community in Wyoming. We expect that to continue as long as the agricultural segment of the state's economy is depressed. We have been and will continue to resist the privatization of wildlife in Wyoming.

The future of pronghorn management in Wyoming is both challenging and promising. We expect a number of trends evident in America to have some effects on our management. We expect increased participation in our management by the public. We expect more controversy to accompany our decisions. We expect more input from "special interest" groups. We expect more interest in maintaining and improving pronghorn habitat, and at the same time, less assistance from other agencies in doing so. We expect less interest in pronghorn and pronghorn management for purely aesthetic reasons and more emphasis on the role of pronghorn (and all wildlife) in the economic stability of the state. We expect more emphasis on the role of nonconsumptive use of pronghorn and the importance of these animals to tourism and recreation in Wyoming.

Our objectives for pronghorn in Wyoming are:

| | |
|---|---|
| Population | 301,750 |
| Harvest | 76,062 |
| Hunters | 84,274 |
| Success | 90.3% |
| Recreation Days | 165,784 |
| Days/Animal | 2.2 |

Depredation is a problem in some herds units in Wyoming - most notably in the eastern one-third of the state which is predominantly private surface. This depredation is primarily on alfalfa and wheat. In Wyoming, we are required by statute to reimburse the landowner for such damage. As such, we have directed management efforts to maintaining an "acceptable" level of depredation by herd unit. We have had some success in directing harvest at depredation pronghorn through early seasons, late seasons, and special weapons limitations.

TECHNICAL SESSION

# PRONGHORN ANTELOPE PRODUCTIVITY ON SEMI-DESERT RANGE IN WESTERN UTAH

Donald M. Beale
Research Biologist
Utah Division of Wildlife Resources

## ABSTRACT

A population of pronghorn antelope (Antilocapra americana) ranging in size from 80 to 231 animals, was held in approximately 50 square miles of fenced range in western Utah, to study some of the relationships between fawn mortality and other ecological factors. During the 6 years this study was conducted, 1974-1980, data was obtained on fawn birth rates, fawn mortality, pronghorn antelope movements, predator and alternate prey abundance, precipitation and forage growth.

The study area is on semi-desert range. Precipitation is highly variable but the long term annual average is 6 inches. Growth year precipitation from 1975 through 1980 ranged from 3.38 inches to 10.79 inches. Two of the years studies were above average and two were well below average. One year, 1975, was one of the driest on record and very little forage growth resulted.

Fawn birth rates were good all years and ranged from a minimum of 1.55 to 1.77 fawns per mature doe. Apparent health and vigor of all fawns captured and observed following parturition was good.

During the first 4 years of the study, 102 pronghorn fawns were captured within 2-5 days of age, and fitted with radio transmitters so they could be monitored daily through the summer to determine their locations, movements and causes of mortality. A total of 72 cases of fawn mortality were discovered, most of which were in 1975, 1976, and 1977. Eighty-three percent of this mortality resulted from predation, of which 53 percent was from coyotes (Canis latrans) and 25 percent from golden eagles (Aquila chrysaetos). Annual observations of golden eagles during the study suggest that their numbers were relatively high during 1974 through 1977 and then declined. Bobcat (Lynx rufus) numbers, compared to previous years were low, probably because of the high fur prices and extensive trapping that took place between 1970 and 1974. Coyote populations, based on data from scent-post transects, did not change substantially over the study period.

Rabbit populations as indicated by observation transects changed significantly. From 1974 through 1977, rabbit populations, particularly black-tailed jackrabbits (Lepus californicus), observed on 30 miles of walked transects, were extremely low. An abrupt change took place in 1978, and counts indicated a 400 percent increase in jackrabbits between 1977 and 1978. Rabbit numbers declined slightly after 1978 but remained relatively high through 1980. Other alternate prey, such as kangaroo rats (Dipodomys spp.) and deer mice (Peromyscus maniculatus), increased to some extent during this same period but not as significantly as the black-tailed jackrabbit.

A substantial reduction in predation on fawns paralleled the increase in alternate prey available to predators. During the summers of 1975, 1976 and 1977 mortality from predation took 56, 80 and 83 percent, respectively, of radio marked fawns, but in 1978 only 9 percent of the marked fawns were lost to predators. Fawns were not radio marked in 1979 and 1980 but total mortality of fawns born did not exceed 35 percent in each of these years. Non-predator involved mortality of radio marked fawns was low each year and ranged from 3 to 24 percent. The highest non-predator losses occurred in 1975 and much of this resulted from an extremely heavy snow storm during the parturition period in May.

The total pronghorn antelope population on the study area increased significantly following years of low fawn mortality in summer and increased from 85 animals in the fall of 1977 to 231 by the fall of 1980. Before definite conclusions can be reached regarding the relationship of predation on fawns during summer and total pronghorn productivity, additional research needs to be conducted. However, these data suggest that an important relationship may exist between the extent of predation on fawns during summer months and the abundance of alternate prey species available to predators.

# POPULATION ECOLOGY OF PRONGHORNS IN SOUTHEASTERN COLORADO

KATHERINE M. FIRCHOW, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

MICHAEL R. VAUGHAN, Virginia Cooperative Fish and Wildlife Research Unit, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061

WILLIAM R. MYTTON, U.S. Fish and Wildlife Service, Fish and Wildlife Assistance Office, Golden, CO 80401

## Abstract

During January 1983 - July 1985 we studied pronghorn (Antilocapra americana) population dynamics on the 1040 $km^2$ Pinon Canyon Maneuver Site, in southeastern Colorado. The objective of this study was to provide baseline population information prior to military training, to aid in assessing impacts to the pronghorn population once training begins.

Forty-seven adult and 32 fawn pronghorns were radio marked; 245 adults were color collared or ear tagged. Five different population estimates were obtained during each of our aerial survey dates: an actual strip count; an adjusted strip count (adjusted by an index to observability); a Lincoln/Petersen (L/P) index for strip surveys; a L/P index for quadrat surveys; and a random quadrat estimate. Actual counts and adjusted strip estimates were not different across seasons or years. With one exception, L/P estimates for strip surveys were not different across season and year. The L/P estimates for strip surveys compared closely to the adjusted estimates in each season except January 1985. Neither the random quadrat estimate nor the L/P quadrat estimate were different across seasons or years. Random quadrat estimates did not differ from either the adjusted strip or the L/P strip, except during January 1985.

The L/P estimate for quadrat surveys, and the actual count for strip surveys underestimated the population and were eliminated from further analysis.

The observation efficiency from 1.6 km width strips was 54.8% (Sd=12.8) during summer, and 63% (Sd=19.9) during winter. Our best estimate of the population size was the mean of the random quadrat, the adjusted strip count, and the Lincoln-Petersen for strips. Summer estimates for 1983, 1984, and 1985 were 694 (0.96/km$^2$), 690 (0.96/km$^2$), and 657 (0.91/km$^2$) respectively.

Fawn:doe ratios did not differ ($p > 0.05$) between survey types during any of the survey dates, but were different ($p < 0.05$) across survey dates within survey types. August fawn:doe ratios in 1983 and 1984 were 36:100 and 22:100, respectively. Buck:doe ratios were quite variable in both survey types, averaging 40:100.

The adult female pregnancy rate was approximately 98%; mean litter size for females > 1.5 years was 1.9, and sex ratios of both fetuses and captured newborn fawns were not different from 1:1. Fawn mortality was 89% in 1983, 80% in 1984; 71% of fawn mortality was due to coyote predation. Adult mortality was 18% in 1983, and 32% in 1984; coyote predation accounted for 43%, and hunting for 36%. The annual rate of increase ($\lambda$) for 1983 was 1.01, and .939 in 1984, or a 2 year average of .975, a 2-3% decline per year. Low fawn recruitment coupled with occasional severe winter conditions appear important in maintaining the population at its current level.

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# PRONGHORN MANAGEMENT PROBLEMS RELATED TO HUNTER ACCESS IN THE CENTENNIAL HERD UNIT OF SOUTHEAST WYOMING

William H. Haley
Game Warden
Wyoming Game and Fish Department

## ABSTRACT

Problems and management strategies are reviewed for the Centennial Antelope Data Analysis Unit (DAU) in Southeast Wyoming. Comparisons of the various problems of the three different hunt areas within the DAU are given considering differences in landowner attitudes towards the pronghorn and hunters. Other problems are time frame mandated by the commission to set hunting seasons and the supply and demand of antelope licenses.

Some management strategies used recently are discussed. These strategies include various license types, manipulation of season lengths and use of special interest groups such as archers and muzzleloaders.

## INTRODUCTION

"Sure you can hunt antelope, but you can't quit until you have a pickup load". This was a common reply from a rancher to an antelope hunter a few years ago, but like an endangered species, the rancher who welcomes hunters with unlimited access and no trespass fee is fast becoming a thing of yesterday. In the Centennial Antelope Data Analysis Unit (DAU) of Southeast Wyoming, hunter access fees are now providing an additional and often substantial source of income for area landowners. While some ranches are starting to charge a trespass fee, others have been purchased by non-resident interests and are totally refusing access to hunters.

Management strategies employed in the Centennial DAU have included variations in license type, manipulation of hunting season opening and closing dates, and special seasons for such interest groups as archers, muzzleloaders, and shotgunners.

I will take this opportunity to survey some of the problems encountered in our attempt to meet the demands made on this wildlife resource.

The challenge for the Wyoming Game and Fish is to design hunting seasons and harvest strategies which result in proper hunter/harvest distribution within the framework of restrictions landowners are placing on the land and access.

## STUDY AREA

This DAU is located in Southeastern Wyoming, south and west of Laramie (Figure 1). The three hunt areas in the DAU are hunt areas 37, 44, and 45 (Figure 2). All three have similar physical characteristics. The DAU consists of high intermountain plain with elevations from 7,200 feet to 10,000 + feet. The land rises to the west forming a narrow transition area between the Laramie Plains and the Medicine Bow Mountains. The foothills and plains have mixed native grasses, interspersed with sagebrush (Artemesia spp.), greasewood (Sarcobatus spp.), and rabbitbrush (Chrysothamnus spp.). Sagebrush is found in scattered stands and is generally limited to draws, bottoms, and other sites where additional ground moisture is available. Bitterbrush (Purshia spp.) and serviceberry (Amelanchier spp.) are prevailant along ridges and foothills. The annual precipitation averages from 12 to 20 inches. There are irrigated native hay meadows along the creek bottoms and some isolated alfalfa fields. This unit totals 910,000 acres (1,422 sq. mi.) with approximately 85% of the antelope habitat on deeded lands.

Livestock grazing is the predominant use of the land in this area. Because large ranches are the rule this area is sparsely populated; the exception being a few scattered subdivisions and ranchettes. In Wyoming, as elsewhere, the agriculturist is feeling an economic crunch caused by declining cattle prices and escalating operating costs. As a consequence more and more ranches are investigating alternative sources of income. Subdividing, trespass fees, and big game outfitting are some of the options being utilized in this area.

Weather conditions play an important role in antelope management. After the severe winter of 1983-84, the antelope herds were decreased as much as 35% on some of the winter range within the DAU. This is a significant loss considering the antelope population contained an estimated 12,000 animals, well above the objective of 5,000.

Currently the post-season population is between 5,000 and 7,500 animals. An aerial trend count will be done this summer and the simulation model (II POP) will be updated.

I will briefly examine each of the hunt areas in respect to size, hunter opportunity, and land status. Hunt area 37 has approximately 214,000 acres (334 sq. mi.), of which 85% is deeded land, with much of the public access controlled by private landowners. For the past few years approximately half of the landowners allowed very limited hunting or no hunting at all, while the other half charged a trespass fee of from $25.00 to $50.00 per hunter.

Area 44 has about 266,000 acres (416 sq. mi.). Private property represents 70% of the hunt area with an additional 1,800 acres inside the Hutton Lake Wildlife Refuge. Until the hunting season of 1984 hunter access was not considered a problem. That year two major landowners, controlling nearly 50,000

acres, closed their land to hunting. In 1985, several landowners limited access to their land for antelope hunting by charging a trespass fee of $25.00 to $100.00. That year a total of 130,000 acres were affected. This left less than half the hunt area open to free access (Figure 3). This may seem like a nominal trespass fee to wildlife managers from other areas, but in this area where just a few short years ago ranchers thought of antelope almost as vermin; these ranch closures and trespass fees shocked the resident hunters.

Antelope area 45 is the largest of the three hunt areas. It has approximately 430,000 acres (672 sq. mi.). Deeded land makes up about 85% of the available antelope habitat and the landowners control much of the access to remaining public lands. However, in this hunt area landowners rarely deny access or charge a trespass fee.

## DISCUSSION

The ultimate goal for wildlife managers in Wyoming is to reach their objectives for the DAU as set forth in the Game and Fish Department's Strategic Plan. For this particular DAU the objectives are a population of 5,000 antelope supporting a harvest of 1,080 animals; providing 1,200 hunters with 2,160 days of hunting at a success rate of 90%. Some problems arise trying to simultaneously achieve these objectives. One problem is the time frame available in which to set hunting seasons. The first draft of hunting season recommendations must be completed by March 15th this year, with the final draft considered by the commission in late April. This schedule is difficult for two reasons. Often winter mortaility may not be assessed accurately because snowcover limits access to many areas and covers winter killed animals. The other reason is that in some years mortality can occur through late May and early June due to late and often heavy snowfall.

Another problem encountered in recent years is that the supply of antelope licenses has often exceeded demand. In 1984, there were a total of 3,000 licenses available and only 2,408 were sold. This figure includes half-price licenses to be discussed later. The problem is related to the fact that this DAU does not enjoy a reputation as a "trophy" area such as some units further west which attract non-resident hunters.

Another aspect, not necessarily a problem, is landowner cooperation. Without their cooperation wildlife management in this DAU would be very difficult. An important part of landowner relations is keeping wildlife damage to a minimum. In Wyoming, unlike many states, damage claims are paid to landowners who suffer losses of cultivated crops or have extraordinary grass damage done by wildlife.

Basically these are the problems in the management of this herd unit today. The following are some management techniques we have used in this DAU to help us achieve our objectives while dealing with the access restrictions we encounter.

One management tool utilized is manipulating hunt area closing dates. Since 1983, hunt area 45 has remained open until mid-October in our effort to attract the non-resident deer and elk hunters that come out early, harvest their deer or elk quickly and would like to hunt an additional big game animal. This technique has increased our total license sales and provided more opportunity to the non-resident hunter. The biggest drawback lies in the lack of personnel to collect harvest data and provide law enforcement coverage. It is simply not possible to have men in each hunt area when deer, elk, and antelope are hunted simultaneously.

Another strategy is an early opening date. We have found that people will apply for an area simply because it is the first area to open within a reasonable driving distance from home. Again, personnel should be available to answer calls in a timely manner and that is not always convenient that time of year.

Still another strategy is that of additional licenses. We have implemented a system which allows hunters to purchase two licenses in addition to the limited quota "Any Antelope" license. Usually the "additional" licenses are valid for does or fawns only. Starting the first day of the season, the licenses that have not been purchased through our central office may be purchased for half price from license selling agents located around the hunt area. With our fairly new single license draw system using hunt area numbers and "types", the possible combinations are nearly unlimited. By use of "types" one can fashion nearly any kind of hunting season option, being as restrictive or permissive as necessary. This system is used to designate the sex or age class of animals which may be taken; type of weapon to be used; and provides for opening and closing dates in all or a portion of the hunt area. In the Centennial DAU the additional doe/fawn licenses have been utilized to maintain herd objectives by increased harvest of the reproductive segment of the herd. At the same time, buck/doe ratios acceptable to the hunter can be maintained.

The use of special interest groups provide yet another means to address problems. For example, archery hunters in 1983 and 1984 helped to solve a damage problem. Antelope were coming into some irrigated alfalfa fields late in the summer as the vegetation on the plains was drying up. A small area was opened in early August for archery hunting only. One hundred limited quota additional licenses for any antelope were available. The use of archers here worked well. The area surrounding the alfalfa fields has houses and livestock so high power rifle hunting is not feasible. However, ranchers would let archers hunt for two reasons: their livestock were safe, and the archers would keep the antelope off the fields. Several things were accomplished with this season. The landowners knew the Game and Fish Department was genuinely concerned with their damage problem, the archers got 31 extra days of hunting, and personnel

did not spend an inordinant amount of time working antelope damage. Another favorable point is that the success rate was less than 3%, so adjustment in license quotas or season length was not needed to compensate for an overharvest. One negetive aspect of this type of hunt is that the landowners in the special hunt area without damage problems were asked permission to hunt simply because their land was located within an area open for hunting. This was not a large problem, but landowners mention it, and should be considered when planning this type of season. This year because of the same damage problem, compounded by the reluctance to allow rifle hunting, we may implement a muzzleloader and shotgun season on a limited basis.

## CONCLUSION

The problems faced in this DAU are solvable but we must remain realistic in our goals. In this area where access is becoming more restricted, public relations with the ranching community as well as with hunters is vital. Understanding the ranchers' problems and formulating a hunting season that will be compatible with their operation is essential to achieving management goals and keeping as much of the land open to hunting as possible. In recent years it has become evident that ranchers as well as sportsmen want some input into the management of the state's wildlife resource. Unit population objectives as well as seasons and license types are discussed at length with both ranchers and sportsmen in the area.

We have been able to control the antelope herd by the various techniques discussed here. At present, there are enough hunters willing to pay the few landowners their trespass fee to keep the antelope moving between the open areas and the restricted lands. If the transition from free use to trespass fee is gradual the sportsmens' reluctance to pay for the privilege of hunting on private land will be reduced and most will accept it.

FIGURE 1

Centennial Antelope Data Analysis Unit
Arlington
Area 45
430,000 Acres
Laramie
I-80
Cheyenne
Area 44
266,000 Acres
Area 37
214,000 Acres
Wyoming - Colorado State Line

FIGURE 2

Centennial Antelope Data Analysis Unit
AREA CLOSED TO HUNTING IN 1985
Arlington
Area 45
Laramie
Area 44
I-80
Cheyenne
Area 37
Wyoming - Colorado State Line

FIGURE 3

# DENSITY-DEPENDENT SUMMER PRONGHORN FAWN SURVIVAL RATES IN THE INTERSTATE ANTELOPE POPULATION

Mike Hess
Big Game Staff Specialist
Nevada Department of Wildlife

## ABSTRACT

Population and production census indices from the Interstate Antelope Conference for the period 1954-1985 were compared for correlation coefficients (r). Corresponding indices for the three states are highly significantly correlated for all indices ($P < 0.0001$). Highly significant positive correlations ($P < 0.0001$) exist between the winter population indices and the subsequently observed summer total pronghorn numbers, numbers of does and numbers of fawns for each individual state, and for the combined states' sample. Comparisons of both the winter population indices and the summer doe numbers versus the summer fawn:doe ratios yield highly significant negative correlations ($P < 0.0001$). The ratio of fawns:does age yearling or older is density-dependent. A literature search suggests several mechanisms for this density relationship. Several researchers have reported density-dependent summer fawn survival; but generally, pronghorn managers and researchers have failed to note the significance of this inverse correlation. High rates of fawn predation, starvation, abandonment and weak fawn syndrome are more likely symptoms of relatively high population densities than causes of low fawn survival rates. Pronghorn populations that are frequently subjected to winter related episodic mortality often have higher summer fawn ratios consistent with density-dependency. At the extreme northern end of the range, density-dependent summer fawn ratios may not be evident because of winter reduced rates of natality. The use of either antelope fawn ratios or densities as indices of habitat quality without further demographic qualification is of questionable validity.

TABLE 1. Correlation coefficients (r) between Nevada, California, and Oregon winter and summer pronghorn census indices for the period 1954-1985 (N=32). All correlations are highly significant, $P < 0.0001$.

| Indices | | CA Total Winter Nos. | OR Total Winter Nos. | CA Summer Doe Nos. | OR Summer Doe Nos. | CA Summer Fawn Nos. | OR Summer Fawn Nos. | CA Total Summer Nos. | OR Total Summer Nos. |
|---|---|---|---|---|---|---|---|---|---|
| Pop | Pop | | | | | | | | |
| NV Winter | Pop | 0.9227 | 0.8039 | | | | | | |
| CA Winter | Pop | | 0.8402 | | | | | | |
| NV Summer | Does | | | 0.8662 | 0.9536 | | | | |
| CA Summer | Does | | | | 0.9257 | | | | |
| NV Summer | Fawns | | | | | 0.7027 | 0.7984 | | |
| CA Summer | Fawns | | | | | | 0.6703 | | |
| NV Summer | Pop | | | | | | | 0.8397 | 0.9377 |
| CA summer | Pop | | | | | | | | 0.8928 |

TABLE 2. Correlation coefficients (r) comparing census indices for Nevada, California, Oregon, and Total combined samples for the period 1954-1985 (N=32). All correlations are highly significant ($P < 0.0001$).

| Indices Compared | Nevada | California | Oregon | Total |
|---|---|---|---|---|
| Total Winter Nos. vs. Total Summer Nos. | 0.9533 | 0.8862 | 0.8401 | 0.9754 |
| Total Winter Nos. vs. Summer Doe Nos. | 0.9695 | 0.9266 | 0.8291 | 0.9764 |
| Summer Doe Nos. vs. Summer Fawn Nos. | 0.9001 | 0.8857 | 0.7864 | 0.5958 |
| Total Winter Nos. vs. Summer Fawn Nos. | 0.8518 | 0.7235 | 0.7513 | 0.8756 |
| Summer Doe Nos. vs. Fawns/100 Does | -0.6059 | -0.7351 | -0.7513 | -0.7667 |
| Total Winter Nos. vs. Fawns/100 Does | -0.5759 | -0.7154 | -0.7178 | -0.6919 |

# HISTORY AND MODELING OF PRONGHORN POPULATIONS IN HARNEY COUNTY, OREGON

George P. Keister, Jr.
Oregon Department of Fish and Wildlife

## ABSTRACT

Historical data (1945-1982) concerning pronghorn (*Antilocapra americana*) populations in Harney County, Oregon, were analyzed to discover probable causes for declining fawn:doe ratios and to develop a population model. The population in Harney County was fairly high in the 1950's, declined to a low in 1960, then increased to a high in 1979. Analyses indicated that the difference between the number of fawns that survived during summer and natural mortality during winter determined population changes. Coyote (*Canis latrans*) abundance was the variable most highly correlated ($r = -0.64$, $P < 0.01$) with summer fawn survival. Abundance of black-tailed jackrabbits (*Lepus californicus*) and spring precipitation also made significant ($R^2 = 0.68$, $P < 0.01$) contributions to the regression equation for summer fawn survival. Weather severity, both snowfall and temperature, and proportion of fawns in the population made significant ($R^2 = 0.61$, $P < 0.01$) contributions to the regression equation for over-winter mortality. Weather severity during winter appeared to be the major factor controlling pronghorn populations between 1947 and 1982. The model predicts that coyote abundance can be high enough to limit pronghorn populations, particularly during years with severe winter weather. However, during years of mild to normal winters, coyote abundance can be relatively high without a decline in pronghorn populations. When winter severity exceeds 115% normal, a population decline is predicted even with low coyote numbers. Uses of the model were discussed.

# PRONGHORN IMPACT ON WINTER WHEAT IN EASTERN COLORADO

J.A. Liewer
Department of Fishery and Wildlife Biology
Colorado State University

A.W. Alldredge
Department of Fishery and Wildlife Biology
Colorado State University

S.C. Torbit
Colorado Division of Wildlife

R.B. Gill
Colorado Division of Wildlife

## ABSTRACT

In 1983 a 3-year project was initiated to ascertain impacts of pronghorn on winter wheat in eastern Colorado. This study involved use of systematic aerial surveys to determine timing and extent of pronghorn use on wheatfields, reobservation of neckbanded and telemetered pronghorn, monitoring of wheatfield use and impacts from free-ranging pronghorn, and a controlled grazing experiment using hand-reared pronghorn. Aerial surveys indicated extensive use of wheatfields from November through mid-March, but no relationship was found between pronghorn use and wheat yield data supplied by farmers. Reobservation of marked pronghorn indicated that pronghorn moved on to wheatfields in November and shifted activity to grasslands in late March or early April. All telemetered pronghorn abandoned wheatfields by mid-April. Use of a selected wheatfield by free-ranging pronghorn ranged from 117 to 38 animals per day during winter and spring respectively. No significant difference ($p > 0.01$) between grazed and ungrazed plots was detected for either biomass or final grain yield. Controlled grazing experiments involved 4 treatments (control, early, late and season-long grazing) replicated 3 times. Animals were randomly assigned to treatments. Mean grain yield for control, early, late and season-long were 32.21, 30.16, 32.88, and 31.13 bu/acre respectively. No significant differences ($p > 0.01$) were detected among treatments. Biomass estimates confirmed grazing pressure, but provided no correlation with final grain yield. The study is currently being repeated.

# RED RIM — MINING, FENCING, AND SOME DECISIONS

David S. Moody
Wyoming Game and Fish Department

A. William Alldredge
Department of Fishery and Wildlife Biology
Colorado State University

## ABSTRACT

Since 1983, when television coverage brought national attention to the plight of wintering pronghorn at Red Rim, in south-central Wyoming, numerous events have transpired that will have significant impacts on pronghorn and big game management in the west. The controversy involves mining of public and private lands that have been designated by the Wyoming Game and Fish Department as critical winter ranges, management of lands in checkerboard ownership patterns, and a fence that encircles public and private lands. Against the recommendations of their biologists, the U.S. BLM declared that Federal Unsuitability Criteria 15 did not apply in this case because of their interpretation of the word "population". The Wyoming Department of Environmental Quality on a vote of 4 to 3 failed to rule the area unsuitable for mining under state jurisdiction and the U.S. Office of Surface Mining adopted a mining plan alternative that would allow the north half of Red Rim to be mined but recommended that the south half of the Rim not be mined until the feasibility of reclamation could be proven. In all these decisions there is scant hope that biologists will be able to protect critical ranges for state important species. However, in October, 1985, a Federal Court judge in Cheyenne, Wyoming, ruled that a fence constructed by the livestock operator to preclude pronghorn from reaching critical winter range was illegal under the Unlawful Inclosures of Public Lands Act and ordered that segments of this fence be laid down within 10 days from the hearing date to allow pronghorn immediate access to their traditional winter range. He further rules that within 60 days the entire fence be either modified to comply with BLM standards for fences on pronghorn ranges, or that the fence be entirely removed. Currently, approximately 8 miles of the fence are down to allow pronghorn passage and the case is being appealed.

# EFFECTS OF FAWN ACTIVITY AND BEDDING COVER ON SUSCEPTIBILITY TO PREDATION

Bart W. O'Gara
Montana Cooperative Wildlife Research Unit
University of Montana

Mark E. McNay
Alaska Department of Fish and Game

Walter A. Bodie
Idaho Department of Fish and Game

ABSTRACT

Predation was the major mortality factor among 2 free-ranging pronghorn populations. A given fawn's susceptibility to predation appeared to be dependent on it's activity during the hiding phase. The less vigorous, less active fawns seemed to survive best. The value of bedsite cover apparently depends on the local situation. Under pressure by some predators and under certain conditions, low cover on expansive flat areas may be protective, but in a different topographical setting, the same cover may predispose fawns to predation. Does vigorously defend their fawns, but they sometimes cannot save them, even from a lone predator. Fences apparently gave coyotes an advantage during encounters with does and this should be considered when constructing fences on the spring ranges of pronghorns.

High fawn mortality is characteristic of most pronghorn (Antilocapra americana) populations throughout their range (Vriend and Barrett 1978.) Predation was the major cause of that mortality during studies in Utah (Beale and Smith 1973), Alberta (Barrett 1978), Arizona (Neff and Woolsey 1979), Texas (Tucker 1979), and Montana (Corneli et al. 1984). However, with the exception of the Alberta study, each of those populations was somewhat confined by fences. We conducted 2 independent studies to examine the causes and degrees of fawn mortality in free-ranging pronghorn populations. One was conducted during 1976, 1977, and 1978 in the Pahsimeroi River drainage of central Idaho (Bodie 1979). The other took place during 1978 and 1979 on the Sheldon National Wildlife Refuge in northwestern Nevada (McNay 1980). This paper summarizes our findings on effects of fawn activity and bedding cover on the susceptibility of pronghorn fawns to predation and the reactions of pronghorn does to coyotes (Canis latrans) and golden eagles (Aquila chrysaetos).

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

Both areas were sagebrush grasslands, and fawning areas occurred at elevations near or above 2,000 m. The Pahsimeroi fawning areas were in a high montane valley surrounded by steep, high hills. Those on the Sheldon were on flat plateaus surrounded by broad valley. Big sagebrush (Artemesia tridentata) and low sage (A. arbuscula) were the 2 major plant communities that existed as shrub overstory on both areas. Sandberg bluegrass (Poa sandbergii) was the most common grass on both study areas. Antennaria, Arenaria, Astragalus, Castilleja, Descurzinia, Erigeron, Eriogonum, Lupinus, Penstemon, Phlox, Ranunculus, Senecio, and Zigadenus were the common genera of forbs. Subfreezing temperatures, snow, and strong winds were common on both areas during the May fawning seasons.

## METHODS AND MATERIALS

Observers used telescopes and binoculars to scan fawning areas for does with fawns. When a fawn was sighted and it had selected a bed, a capture crew moved toward the fawn and captured it by hand or with the aid of a long-handled dip net.

When a birth was observed, no capture attempt was made for at least 4 hours; this allowed the completion of doe-fawn imprinting. Each captured fawn was weighed, measured, and fitted with a lightweight, expandable radio collar that would fall off 2-3 months after installation. Plastic gloves were worn while handling fawns and radio collars were rubbed with sagebrush leaves to minimize unnatural odors.

For each fawn, weight, rectal temperature, age, sex, and length and birth measurements were determined. An evaluation of each fawn's condition was made, noting abnormalities in behavior, pelage, and physical structure. Indications of internal disorders such as congested breathing and rectal or oral bleeding were also recorded. Rectal and throat bacterial cultures were collected in culturettes, manufactured by the Marion Scientific Corporation, and analyzed within 48 hours of collection. Samples were taken to the Lake District Hospital, Lakeview, Oregon, or the Treasure Valley Laboratory, Boise, Idaho. Blood samples were taken from the jugular veins of 27 fawns with a syringe or vacutainer, after a small patch of hair had been clipped to expose the vein, and analyzed at the same laboratories. Field evaluations of each fawn's condition, along with analyses of cultures and blood, were used to rate fawns as healthy or unhealthy.

Radio transmitters had mortality-sensing devices and the signal from each fawn was monitored at least once every day. At least every third day, each fawn was visually located. Care was taken not to flush the fawns from their beds. When a mortality signal was received, the transmitter was located immediately. Predator kills were identified by the presence of subcutaneous hemorrhaging and by feeding and killing patterns described by O'Gara (1978). Bedsites were categorized into 1 of 2 broadly defined community types: big or low sage.

## RESULTS AND DISCUSSION

During all years, at least 90% of the predation occurred before the fawns were 3 weeks old, and predation was the major cause of mortality among monitored fawns. Predation accounted for 65% of the natural mortality in the Pahsimeroi sample and 80% in the Sheldon sample, and 37% of all radioed fawns in the Pahsimeroi and 43% on the Sheldon. Other mortality factors included starvation, disease, and accidental deaths.

In the Pahsimeroi Valley, the golden eagle was the major predator, accounting for 7 of the 15 predator-involved mortalities; coyotes took only 4 fawns, and bobcats (Lynx rufus) 2. A small raptor also killed 2 fawns, and the pattern and size of talon punctures and the proximity of the kills to a nest, suggested a prairie falcon (Falco mexicanus) as the predator. On the Sheldon, 94% (n = 16) of the predator-involved mortalities were attributed to coyotes, and a golden eagle killed 1 fawn.

The mean birth weights of predator-killed fawns was greater than those of surviving fawns during all years except 1976 (Table 1). The sample sizes were too small for statistical significance, but we could not combine data among years because fawn weights were influenced by weather and range conditions among years. Fortunately, differences in weights between sexes did not affect the data.

Table 1. Mean birth weights, in kilograms, of radio-collared fawns killed by predators compared to fawns that survived.

| | Sheldon | | Pahsimeroi | |
|---|---|---|---|---|
| Year | Predator-killed | Survived | Predator-killed | Survived |
| 1976 | | | 3.3 (4)[1] | 3.6 (3) |
| 1977 | | | 3.8 (1) | 3.7 (6) |
| 1978 | 4.0 (3) | 3.6 (2) | 4.1 (4) | 3.3 (5) |
| 1979 | 4.8 (3) | 3.8 (4) | | |

[1]( ) = sample size.

We do not contend, with these limited data, that fawns taken by predators are bigger than those that survive. However, these data tend to refute the often heard cliche that predators kill only the sick and the weak. We believe fawns that end up in the stomachs of bobcats, coyotes, and eagles are as healthy as the ones that survive. The tendency for predators to select the largest fawns during our studies could have been related to

the relative activity of large and small fawns. Beale and Smith (1973) noted that the largest, most-active pronghorn twin was the one selected by a golden eagle. During studies of domestic lambs (Gluesing 1977) and white-tailed deer fawns (Jackson et al. 1972), the more active young were more susceptible to predation.

Assuming an increase in a fawn's activity increases it's susceptibility to predation, sick or weak fawns may be less susceptible to predators than strong, healthy ones. On the Sheldon, the predator-caused mortality of fawns classified at capture as healthy was 57% (n = 21), nearly 3 times the 20% (n = 5) predation losses experienced by fawns classified at capture as unhealthy. In Alberta, Barrett (1978) noted that predation was greatest on pronghorn fawns between 11 and 20 days of age, and that mortality of younger, seemingly more vulnerable fawns, accounted for only 22% of the losses to predation. Similar results were obtained on the Sheldon, where 62% of the losses to predators were fawns 1-3 weeks old, and 23% were fawns less than 1 week old. The higher predation on 1-3 week fawns corresponds to the period when fawns are becoming more active. After 3 weeks of age, fawns no longer hide, but join doe-fawn groups where their vulnerability to predation appears to be low.

Bromley (1977) suggested that vegetative characteristics of hiding sites were behaviorally determined in response to pressures applied by hunting predators. Because fawns have little scent during the hiding period, predators often locate fawns visually. Obvious movements would attract predators, and fawns using cover that conceals them when bedding, feeding, or playing should be afforded optimal protection from predators. However, in the Pahsimeroi drainage, fawns that bedded in high cover appeared to have increased their susceptibility to predation. Of 419 classified bed sites on the Pahsimeroi study area, 69% were in the low sage communities, 30% in big sage, and 1% in riparian habitat. Yet, only 14% of the predation occurred in the low sage areas and 86% occurred in the big sage. A degree of protection was probably given to fawns on low sage flats because hunters and local ranchers shot coyotes on and immediately adjacent to the study area. Consequently, coyotes were rarely seen on the low sage flats during the day. Eagles usually hunted along the foothills where updrafts facilitated soaring and where big sage was common. All known coyote dens and eagle eyries were located in the foothills. Therefore, predator activity was probably greater in the big sage along the foothills, making the chances of a predator encounter more likely for fawns bedded in those areas. Also, does could probably see and intercept predators more readily in the low sage.

On the Sheldon, 94% (n = 50) of the classified bed sites were in low sage communities, but unlike the Pahsimeroi, 96% of the predation also occurred on the low sage flats. Two major differences that existed between the study areas may explain the difference in predation rates in the low sage communities. First, the Sheldon fawning grounds were on plateaus surrounded by precipitous cliffs that offered eagles good nesting and

soaring habitat. Eagles were commonly seen soaring along the rims and out over the valleys below, but were rarely seen over the flat tablelands on top. Topographical features, as well as numerous lagomorphs in the valleys, undoubtedly reduced the predation of fawns by eagles on the Sheldon. Secondly, coyotes were protected on the Sheldon where ravines and canyons bisecting the major fawning grounds provided good denning habitat. Consequently, coyote densities on and near the fawning grounds were high and coyotes were observed on the low sage flats during the daylight hours almost every day during fawning and rearing periods. In addition, a comparison of bedsite vegetation on the Sheldon with similar measurements made in Montana (Pyrah 1974) and Idaho (Autenreith 1976) indicated the bedsite cover on the Sheldon was suboptimal. Therefore, fawns bedding on the low sage flats may have been inadequately concealed from the large numbers of coyotes that hunted during times of optimum visibility.

Autenreith (1984) reported a fawn killed by a coyote despite the presence of does in the area. During May 1978 on the Sheldon Wildlife Range, Worden and McNay (McNay 1980) sighted a doe with hanging fetal membranes. A yearling doe and buck and two newborn fawns accompanied her. Doe-fawn imprinting had been observed for about an hour when a large, light-colored coyote trotted along a fence line 100 m south of the pronghorn group. The fawns were bedded and the doe was aware of the coyote. When directly opposite the pronghorns, the coyote began a slow stalk toward the area where the fawns were bedded, breaking into a run when 50 m from the group. Immediately, the doe charged the coyote and a series of circular chases began in which the doe's aggressiveness seemed to be matched by that of the coyote. Breaking away from the encounter, the coyote ran toward the fawns and bit one as he passed over it at a run. With the doe in pursuit, the coyote continued past the fawns, turned, and ran a zig-zag pattern to the fence line. Immediately after passing under the fence, the coyote stopped, turned, and sat. Stopping short of the fence, the doe stared at the coyote but did not attempt to pursue it further. Returning to her fawns, the doe began moving to the northwest across the flat. The coyote again crossed under the fence and stalked the pronghorns. The doe confronted the coyote, who avoided her and "hit" one of the fawns, dragging it a few feet before being driven off by the doe. The coyote ran for the fence line where the pursuit ended as before. The second attack crippled the fawn, which was then unable to keep up with the doe and the other fawn. Within the next 40 minutes, the coyote made 4 more tries for the crippled fawn. Each encounter ended at the fence line, a refuge for the coyote and apparent barricade to the doe. The coyote finished the kill on the sixth attempt but was driven off by the doe and yearling buck. About 10 minutes later, a final stalk was made but the dead fawn was not defended.

The coyote had rushed the fawns 6 times in 1 hour and concentrated it's efforts on 1 fawn. The coyote contacted the fawn on all but the third attempt. The yearling buck stood passively by during the first 3 encounters, joined the pursuit of the coyote to the fence line during the fourth encounter, and led the chase during the fifth and sixth encounters. He periodically attempted to mount the doe, possibly in response to odors

produced during parturition. Necropsy indicated that the fawn was in good nutritional condition. Bruises, but no punctures, were evident beneath the skin of the back. The fatal wounds were in the throat and head.

Presence of the fence was apparently the factor that kept the doe from chasing the coyote away from her fawns. Corneli (1980), working on the National Bison Range, believed fences that divided the Range and restricted bison (Bison bison) movements, but permitted pronghorns to pass under, increased the vulnerability of inexperienced fawns. On 2 July, she observed 4 fawns wandering along a fence, apparently searching for a way to join 3 does on the other side. One fawn crawled under the fence after about 3 minutes, but the others continued wandering along the fence for about 10 minutes, stopping only after a doe rejoined them. Buechner (1950) observed 2 similar occasions when fawns refused to follow does under fences. Both times the does had to crawl back to rejoin the fawns. These factors should be considered before constructing fences on the spring ranges of pronghorns.

Published accounts of eagles killing adult pronghorns during winter (Lehti 1947, Thompson 1949) indicate that pronghorns try to escape by openfield running. This allows the big birds to simply bind to the running prey and repeatedly penetrate the lungs and aortas with talon thrusts between and behind the ribs while riding the animals' backs. Talons are well adapted for encircling backbones and puncturing blood vessels in body cavities.

Predation by golden eagles on adult pronghorns is apparently observed more often than that by other predators, partly because the great birds hunt only by day and draw attention by stooping from the sky. They are the only predators capable of catching pronghorns without a stealthy approach, which is difficult in open terrain, or with relay running as described by Grinnell (1897). Ranchers have frequently told O'Gara that they see eagles killing pronghorns during winter. A few have reported chases, but not kills by coyotes.

Published accounts of eagle attacks on pronghorn fawns and reactions of adult pronghorns to eagles near young fawns are lacking. During spring, does attack eagles, as they do coyotes. Bodie watched a doe charge and strike at a golden eagle that was attempting to take her fawn. She kept the bird from her mortally wounded offspring even though she simultaneously had to chase a coyote from her second fawn. The coyote apparently had seen the eagle attack and rushed to the scene. During Bodie's study, adult pronghorns, sometimes followed by yearlings, often charged eagles that were sitting on the ground. One such charge involved 2 eagles and 9 pronghorns of both sexes. Seven radio-instrumented fawns were killed by eagles. One uneaten fawn was being carried by an eagle when located and was dropped from 30 m in the air, breaking the radio. Three other fawns also were not fed upon by the eagles that killed them. Tracks at the kill sites indicated that adult pronghorns had been running and turning. Evidently, the does came to the defense of their fawns after they had been killed.

Bodie saw 17 interactions between golden eagles and pronghorns during 2 springs of study. Adult pronghorns detected flying eagles at great distances and watched them intently. As the distance decreased, the pronghorns paced about nervously before running toward the approaching birds. Lactating does frequently looked toward the location of their bedded fawns when eagles appeared, and Bodie found several unmarked fawns by such actions of nursing does.

O'Gara necropsied a 9-kg fawn that had been struck in the hindquarters by an eagle on the National Bison Range in 1977. The fawn escaped, only to die of peritonitis because 1 talon had penetrated the abdominal cavity. Presumably the doe came to the fawn's rescue because, judging from the talon patterns through the skin and into muscles, the bird had a solid grip on the fawn with both feet. That so small a fawn could have escaped by itself seems unlikely. Tourists watched an eagle kill 2 pronghorn fawns on the Range in 1978. The doe ran back and forth trying to defend both, and the eagle did not get a chance to eat until it carried the second fawn it had killed over a ridge. If the doe had not intervened, the bird probably would have killed and eaten only 1 fawn. Does seem to prevent more eagles from eating their fawns than from killing them.

Also on the Bison Range, a fawn that had been dead a few hours was found about 70 m from its twin, which had been killed by an eagle. Necropsy revealed no external wounds but bruises were present on the fronts of the shoulders and front and back legs and feet. The skeletal muscles were very pale, particularly in the hind limbs. Thin slices of these muscles revealed petechial hemorrages, and the limbs showed a small amount of edema. The fawn had a normal appearing thymus and liver, good fat reserves, and had fed shortly before death. It apparently had run through brush avoiding the pursuing eagle. The doe probably added to the melee; eagle feathers, tracks of a running pronghorn, and skid marks were evident over a large area. The gross necropsy findings were consistent with those for capture myopathy, an often fatal disease characterized by damage to muscles and organs following overexertion and vigorous use of many muscles (Chalmers and Barrett 1977). Although the necropsy was not sufficiently thorough for a confident diagnosis, the probable scenario following the attack of the fawns supports such a diagnosis.

In conclusion, does are very aggressive toward predators when fawns are in danger; however, they are not always able to protect fawns, even from a single predator. Fences apparently give coyotes an advantage during encounters with does.

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## LITERATURE CITED


Autenreirth, R. 1976. A study of birth sites selected by pronghorn does and the bed sites of fawns. Proc. Antelope States Workshop 7:127-134.

_____. 1984. Little lost pronghorn fawn study--condition, habitat use and mortality. Proc. Pronghorn Antelope Workshop 11:49-70.

Barrett, M. W. 1978. Pronghorn fawn mortality in Alberta. Proc. Antelope States Workshop 8:429-444.

Beale, D. M., and A. D. Smith. 1973. Mortality of pronghorn antelope fawns in western Utah. J. Wildl. Manage. 37:343-352.

Bodie, W. L. 1979. Factors affecting pronghorn fawn mortality in central Idaho. M.S. Thsis, Univ. Montana, Missoula. 98pp.

Bromley, P. T. 1977. Aspects of the behavioral ecology and sociology of the pronghorn (Antilocapra americana). Ph.D. Thesis, Univ. Calgary, Alberta. 370pp.

Beuchner, H. K. 1950. Life history, ecology and range use of antelope in Trans-pecos, Texas. Am. Midland Nat. 43:257-354.

Chalmers, G. A., and M.W. Barrett. 1977. Capture myopathy in pronghorn in Alberta, Canada. J. Am. Vet. Med. Assoc. 171:918-928.

Corneli, P.S. 1980. Pronghorn fawn mortality following coyote control on the National Bison Range. M.S. Thesis, Univ. Montana, Missoula. 69pp.

_____, B.Von Gunten Morgan, and B. W. O'Gara. 1984. Pronghorn mortality on the National Bison Range. Proc. Pronghorn Antelope Workshop 11:41-48.

Gluesing, E. A. 1977. Sheep behavior and vulnerability to coyote predation. Ph.D. Thesis, Univ. Utah, Logan. 121pp.

Grinnell, G. B. 1897. A coyote partnership. Forest and Stream 6 February: 104.

Jackson, R. M., M. White, and F. F. Knowlton. 1972. Activity patterns of young white-tailed fawns in south Texas. Ecology 53:262-270.

Lehti, R. A. 1947. The golden eagle attacking antelope. J. Wildl. Manage. 11:348-349.

McNay, M. E. 1980. Causes of low pronghorn fawn:doe ratios on the Sheldon National Wildlife Refuge , Nevada. M.S. Thsis, Univ. Montana, Missoula. 128pp.

Neff, D. J., and N. Woolsey. 1979. Effect of predation by coyotes on antelope fawn survival on Anderson Mesa. Ariz. game and Fish Dept. P-R Proj. W-78-R, Spec. Rep. 8. 36pp.

Pyrah, D. B. 1974. The relationship of vegetation type to the distribution of antelope fawn bedding cover. Montana Dept. Fish and Game, Helena. P-R Proj. W-105-R-9, Job W-4.4. 17pp.

Thompson, W.K. 1949. Predation on antelope. J. Wildl. Manage. 13:313-314.

Tucker, R. D. 1979. Pronghorn antelope fawn mortality, home range, habitat, and behavior in Brewster County, Texas. M.S. Thesis, Sul Ross State Univ., Alpine, Texas. 112pp.

Vriend, L. J., and M. W. Barrett. 1978. Low pronghorn recruitment, is it an issue? Proc. Antelope States Workshop 8:360-379.

# TAXONOMIC HISTORY OF THE PRONGHORN

Thomas M. Pojar
Wildlife Researcher
Colorado Division of Wildlife

## ABSTRACT

Pronghorns (Antilocapra americana) occupy a unique evolutionary position among the pecoran ruminants. Morphologic similarities with cervids and bovids resulted in early confusion in the taxonomy of the pronghorn. Based on the uniqueness of the pronged horn and annual shedding of the horn sheath, they were placed in a separate family, Antilocapridae. The fossil record supports separate family, Antilocapridae. The fossil record supports separate family status but recent biochemical evidence raises interesting possibilities of relatedness to Giraffidae and Bovidae. Exfoliation of portions of the horn sheath of bovids has recently been proposed as a parallel to horn sheath shedding of pronghorn and was used as evidence to put them in a subfamily of Bovidae. However, based on available morphological, biochemical, and fossil evidence, it is strongly suggested that pronghorns remain as a separate monotypic family.

The taxonomic position of the pronghorn has been a source of scholarly debate since they were first discovered. Grouping them with pecoran ruminants is logical; beyond that, assigning family affiliation is unclear. Pronghorns possess characteristics common to several families of Pecora. The family Bovidae contains a diverse group of subfamilies whose chief commonality is hollow core true horns that are not shed. Pronghorns were originally placed in a separate family because they have true horns that are shed annually. Early in the debate, Bartlett (1865) argued ineffectively for including pronghorns in the family Cervidae. His reasoning was based on general morphological similarities with cervids and annual shedding of head ornaments. He also mentioned the pronghorns' similarities with Giraffidae in the structure of the horns, legs, feet, and skin glands. Bartlett's apparent indecision serves to focus attention on the difficulty and controversy of assigning pronghorns to a "logical" taxonomic position.

In this paper I review the rationale and history employed in assigning pronghorns' their current taxonomic position. Recent biochemical evidence indicates a degree of relatedness to Cervidae (Baccus et al. 1983), Giraffidae (Beintema et al. 1979) and Bovidae (Curtain and Fudenberg 1973). Examination of the literature and observation on 4 of the 123 species (Corbet and Hill 1980) of bovids led O'Gara and Matson (1975:829) to conclude that pronghorns were more closely related to bovids than originally presumed. They construed the fact that some bovids exfoliate a portion of the horn sheath "once or twice during their lives" as a parallel to the pronghorns' annual shedding of the complete horn sheath. Here I take exception with that conclusion.

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## HORN SHEDDING AND FAMILY STATUS

Pronghorns' annual horn shedding is related to the sexual cycle (O'Gara et al. 1971) and is very similar in timing to the annual antler-drop of cervids. When first discovered, the shedding of the horn sheath was met with total incredulity in the scientific community. Bailey (1920:128) commented that this discovery has come "as a distinct surprise to every student of mammals--it has seemed to him almost impossible of belief and difficult to explain." He adds that "The history of our knowledge in regard to it, presents an interesting chapter of doubt, disbelief, and discussion." Bailey's assessment could not have been more accurate.

Army hunters at Fort Union, North Dakota, somewhere around 1850, first reported the shedding and regrowth of the horn sheath by pronghorns. Audubon and Bachman (1851) thought this to be so unlikely they published a denial that such a feature existed in the animal kingdom. Lyon (1908) traces the events that followed. In 1858, Cassin's report of the United States Exploring Expedition mentioned the pronghorns' peculiarity of shedding horn sheaths. Also, in 1858, Dr. C. A. Canfield (1866) reported on his observations on the deciduous nature of horns on wild and semi-domesticated pronghorns. He carefully documented these events and reported them in the form of a letter to Professor S. F. Baird, Secretary of the Smithsonian Institution. Because his letter was not published in the Proceedings of the London Zoological Society until 1866, Lyon (1908) suggested that Canfield's observations were doubted. Canfield's letter was published only after the same phenomenon was observed on a pronghorn that was obtained (purchased) from North America and kept at the gardens of the London Zoological Society. The results of these observations were published by Bartlett (1865) in the Proceedings a year earlier than the publication of the letter written by Canfield in 1858 (Canfield 1866). Apparently, deciduous horn sheaths were considered a significant taxonomic feature because in 1866 pronghorns were put in a separate family, Antilocapridae (Simpson 1945). However, this taxonomic arrangement was not universally accepted, probably because of some lingering doubt that horn sheaths are actually annually deciduous. Cope (1888:1081) did not recognize the family Antilocapridae and footnoted comments on the family Bovidae with the following:

> "Antilocapra is sometimes separated from the Bovidae as the type of a family, because it is said to sometimes shed its horny horn-sheath. This character, were it really normal, has no significance sufficient for the establishment of a family division."

By the 1890s it was very well documented and accepted that sheaths are shed annually. (See annotated bibliography in Lyon, 1908). By the turn of the century, there was almost complete agreement among systematists that the pronghorn should be placed in a separate monotypic family (Lyon 1908). Classification was based on the consideration that the horns are branched and shed annually, like the deer family, but that the horns are structurally and physiologically very similar to bovid horns.

The fact that the horns are deciduous was accepted and this feature, as well as the pronged horn, were the main distinguishing characteristics of this species. Whether or not these 2 features merited separate family status was questioned by Lyon (1908) shortly after the turn of the century. Because of so many other features in common with bovids, he suggested that pronghorns may merely represent "an aberrant subfamily" of Bovidae. He softened his contention for including them in Bovidae by suggesting that in the future a better understanding of osteology will reveal that pronghorns will "...possess certain peculiarities of structure not found elsewhere in the (Bovidae) family..." (Lyon 1908:399).

## THE FOSSIL RECORD

Examination of the fossil record supports the separate family status of pronghorns. Matthew (1929) favored what he termed "natural classification" which implied classification based both on morphological similarities and degree of relatedness as revealed by evolutionary evidence. Bovids and antilocaprids apparently began separate paths of evolution from a common ancestor very early in the Miocene (Matthew 1934). Further scrutiny of the fossil record by Simpson (1945) and Pilgrim (1946) indicated an implied separate evolutionary path for antilocaprids. Simpson (1945:269) contended that pronghorns and, of course, their ancestral forms "were not bovids at all..." and agreed with Matthew that it had been "conclusively established-...(that) they are antilocaprids." He conceded, however, that the knowledge of artiodactyl history failed to clearly describe the divergence of early antilocaprids from early bovids.

There remains a significant puzzle in the fossil records of bovids and antilocaprids. Ancestral antilocaprids first appeared in the Miocene and "...have always been exclusively North American..." (Simpson 1945:269). Early bovids also began to appear in the Miocene (indicating the general time of the divergence of the 2 groups) but they were found only in the Old World. From the Miocene to the Pleistocene (circa 23 million years) antilocaprids were exclusively North American and bovids were exclusively Old World. The curious feature of these presumed events (geologic and temporal separation) is the morphological similarities among cervids, bovids, and antilocaprids. Early ancestral antilocaprids were quite uniform in skeletal and dental structure, but showed significant variation and complexity in horn configuration (Romer 1966). The horns were frequently branched with a burrlike structure at the base. Romer (1966) postulated that the burr may have been the point at which the horn sheath separated from the boney core. Simson (1945:269) even suggested the possibility that antilocaprids may "be an offshoot from early American cervids, distinct

from the Old World bovids." Bubenik (1983:182) agreed with this theory because "The cranial and skeletal features point to a close relation with cervids." The possibility that antilocaprids may be more closely related to cervids than bovids cannot be ignored. Highly developed cervid stock shared the North American continent with antilocaprids since late Pliocene, and Frick (1937) suggests the possibility of a common North American ancestor in the ancient family, Hypertragulidae.

Because of the apparent geographic separation since early Miocene, most paleontologists assume separate evolutionary paths for bovids and antilocaprids before that time (Matthew 1934, Pilgrim 1946, Romer 1966). Given this separation, why the close resemblance of these 2 families after significant (in terms of geologic time) temporal separation? Simpson (1945:269) suggested this may be a case of "deceptive parallelism." Supporting this view is the evidence that the variety of antilocaprids that inhabited North America was reduced to a single genus after the invasion of bovids. Romer (1959) postulated, because of their high-crowned teeth, that bovids and antilocaprids evolved in parallel fashion as grassland grazers even though they were separated geographically. When bovids migrated to North America, competition with those larger grazing ruminants may have resulted in the reduction in variety of antilocaprid members (Romer 1959). The opportunistic feeding strategy or adaptive ability of the surviving genus may have prevented its extinction.

## BIOCHEMICAL TAXONOMY

Taxonomists are attempting to use biochemical similarities of various taxa to reveal discrepancies and inaccuracies and thus improve classification (Mayr 1969). The investigation of artiodactyl karyotypes tend to support much of the present classification (Todd 1975). However, the pronghorn has a diploid number (2n = 58) that is similar to some bovids. This suggests that the distant relationship, as indicated by the fossil record, between pronghorns and bovids may not be correct. There is great diversity in the karyotypes of cervids and bovids which results in a very complex situation. Karyotype numbers for bovids range from 2n = 30 for *Gazella* spp. to 2n = 60 for *Capra*, *Bison*, *Bos*, *Hippotragus*, *Litocranius*, *Aepyceros*, *Saiga*, and all 6 species of the subfamily Cephalophinae (Todd 1975). The 2n number for cervids is less variable, ranging from 56 to 70. Elevated diploid numbers imply adaptive radiation from ancestral stock. Careful appraisal of information provided by zoogeography, paleontology and karyology should ultimately furnish a more precise definition of relationships between ancestral and living forms of organisms. This information remains unavailable.

An organism's antigen system is a product of its evolution. According to theory, two organisms that have more antigens in common are more closely related than organisms that have fewer antigens in common (Duwe 1969). The cross-reactivity of 6 selected antigens of 21 ruminant species correlated well with the accepted taxonomic order of the ruminants (Curtain and

Fudenberg 1973). This investigation provided further evidence, through antigen comparisons, that pronghorns are most likely not an offshoot of early American cervids. Their antigen complement aligns them more closely to bovids than cervids.

However, rabbit antisera, which is commonly employed, was used by Curtain and Fudenberg (1973) in their tests. Rabbit antisera has inherent variability between individual rabbits and among bleedings that obviously affects the outcome of antigen comparisons. These authors suggest it would be desirable to use antisera prepared in other mammalian species to broaden this technique. Duwe (1969) recognized the variation of rabbit antiserum reactivity and used one bleeding from one rabbit on skeletal muscle antigens to test the relationship of chevrotain (Tragulus javanicus) to other artiodactyla. Traqulids are considered to be primitive pecorans (Romer 1966), but according to Duwe (1969), they are more closely related antigenically to collared peccaries (Dicotyles tajacu) than to species of the families Cervidae, Giraffidae, or Bovidae. The rate of evolution and diversification of these families in relation to Tragulidae may have left the tragulids antigenically more similar to an ancestor common to peccaries and chevrotains. It is also possible, because of the instability of rabbit serum, that these results are misleading.

Further biochemical investigations to expand the knowledge of pecoran phylogeny involves comparisons of pancreatic ribonuclease amino acid sequences. Results of a study by Beintema et al. (1979:305) provided evidences of "...a close relationship of the Giraffidae with the Antilocapridae." Other studies cited by Beintema et al. (1979) point to a closer relationship of the giraffe (Giraffa camelopardalis) to bovids than to cervids. Therefore, they suggest that the giraffe and pronghorn be placed together and that both be placed with bovids leaving cervids as a separate taxon. However, they listed several reasons why phylogenetic conclusions from amino acid sequencing can be wrong and suggested other methods to confirm or refute their proposed phylogenetic relationships.

## SUMMARY AND CONCLUSIONS

Pronghorns have provided the taxonomist with a delightful puzzle. The fossil record clearly points to a common pecoran ancestor in the Lower Miocene. Apparently there was geographic separation of antilocaprids in North America and other pecoran ruminants in the Old World through the Miocene, Pliocene, and a portion of the Pleistocene (circa 23 million years). In view of this lengthy separation, it seems strange that the morphological and behavioral traits of pronghorns and other pecorans would be so similar as to lead to the debatable taxonomic position of pronghorns. The influence of similar habitat on the evolution of these organisms may have contributed to the "deceptive parallelism" that Simpson (1945:269) suggested. Discovery of earlier (earlier than Pleistocene) bovid fossils in North American or antilocaprid forms from the Old World would fit nicely into this puzzle. Frick (1937) entertained the possibility that antilocaprid fossils may yet be discovered in the little-known Tertiary deposits of Asia.

Tracing evolution through biochemical means shows promise in filling in some of the taxonomic gaps left by paleontology. Biochemical results, thus far, have been used to validate the current classification of ruminants. It is not yet a strong enough discipline to be used to challenge or reorganize taxa, at least within the suborder, Ruminantia.

The sole purpose of the zoological classification system "is the ordering of animals into groups on the basis of their similarity and relationship..." (Mayr 1969:55). Mayr conceds that the definition of the terms "similarity" and "relationship" have been the root of many lively discussions. This is exactly the situation regarding the family status of pronghorns. Pronghorns are definitely related and similar to both cervids and bovids. However, the question is whether or not the degree of similarity and relatedness is close enough for them to be included in either of these groups. Distribution is an important tool in taxonomic analysis (Simpson 1945). Inclusion of pronghorns in either Bovidae or Cervidae would not be consistent with what is now known of their historic distribution. This is probably the strongest argument against close relatedness of pronghorns to cervids and bovids. It is more difficult to argue morphological differences, especially with bovids, as the basis for separate family status.

According to Mayr (1969:95), "the family is usually distinguished by certain adaptive characters which fit it for a particular niche..." The only pronghorn features that are not shared with bovids and cervids are the pronged horn and annual shedding of the sheath. It is necessary to "weight" features such as these quite heavily to use them as the distinguishing family characters. This is what taxonomists did, mostly because of uniqueness, not necessarily because of any adaptive significance.

Stability in family names is important because they are widely used in zoology (Mayr 1969). Compelling new evidence should be required to make changes in family names, otherwise the element of stability in the system will be defeated. If evidence is sufficient, then taxonomists should rule on the proposed change and make the change in an official manner. This way, the change is made most expediently and the time of overlap in the literature of the new and old name is minimized.

Common use of a proposed family name change is a barometer of the strength of arguments supporting the change (R.V. Melville, Sec. Internal. Comm. on Zool. Nomenclature, pers. commun.). It has been 11 years since O'Gara and Matson (1975) have proposed the change in family name of pronghorns and although most authors acknowledge the proposed change, few have accepted it. In Honacki et al. (1982) Antilocapra is included in Bovidae but the reader is referred to Corbet and Hill (1980) and Hall (1981). Both of these publications place pronghorns in a separate family. In addition, the classification as followed by Corbet and Hill (1980) is used as the standard by the British Museum of Natural History (J. Clutton-Brock, Mammal Sec., Br.

Mus. Nat. Hist., pers. commun.). The taxonomy that is accepted in the wildlife profession, i.e., The Journal of Wildlife Management (Clait Braun, Past Ed., J. Wildl. Manage., pers. commun.) retains them as a separate family (Jones et al. 1982), as does a major Canadian publication by Banfield (1981) and The American Society of Mammalogists (Anderson and Jones 1984).

O'Gara and Matson (1975) have proposed that pronghorns are not a unique North American family. They contend that pronghorns are a member of a separate subfamily Antilocaprinae within the family Bovidae. This contention is based on the occasional exfoliation of a potion of the horn sheath exhibited by a few of the 123 species of bovids. Exfoliation of horn sheath parts once or twice during the lifetime of the animal appears to be a weak parallel to complete annual shedding. The pronghorn's annual casting and replacement of the horn sheath is definitely associated with the sexual cycle; partial and sporadic exfoliation by bovids is not. Bubenik (1983:177) states that the "exfoliation" as described by O'Gara and Matson (1975) is simply regeneration of "Worn tips and sometimes the distal part of the horn..." He is skeptical that the comparison between exfoliation and casting is legitimate. Although the causes and mechanisms of exfoliation are largely unknown (Bubenik 1983), the presumed exfoliation may, in fact, be more a function of physical weakness of the horn material which results in mechanical damage. This possibility and the fact that exfoliation in bovids is not related to the sexual cycle dictates that the exfoliation feature is not a strong argument for relatedness to pronghorns. Therefore, to avoid unmerited and unnecessary taxonomic name changes, I strongly recommend that pronghorns remain in the monotypic family, Antilocapridae.

## LITERATURE CITED


ANDERSON, S., and J.K. JONES, JR. (eds.). 1984. Orders and families of recent mammals of the world. John Wiley and sons, New York. 686pp.

AUDUBON, J.J. and J. BACHMAN. 1851. As quoted in: V.H. Cahalane (ed.). 1967. The imperial collection of Audubon animals. Hammond, Inc., New Jersey. 307pp.

BACCUS, R., N. RYMAN, M.H. SMITH, C. REUTERWALL, and D. CAMERON. 1983. Genetic variability and differentiation of large grazing mammals. J. Mammal. 64:109-120.

BAILEY, V. 1920. Old and new horns of the prong-horned antelope. J. Mammal. 1:128-129.

BANFIELD, A. W. F. 1981. the mammals of Canada. Univ. Toronto Press. 438pp.

BARTLETT, A.D. 1865. Remarks upon the affinities of the prongbuck (Antilocapra americana). Proc. Zool. Soc. London. Nov. 18. pp. 105-110.

BEINTEMA, J. J., W. GAASTRA, and J. MUNNIKSMA. 1979. Primary structure of pronghorn pancreatic ribonuclease: Close relationships between giraffe and pronghorn. J. Mol. Evol. 13:305-316.

BUBENIK, A. B. 1983. Taxonomy of Pecora in relation to morphophysiology of their cranial appendices. Pages 163-185 in R.D. Brown, ed. Antler Development in Cervidae. Caesar Kleberg Wildl. Res. Instit., Kingsville, Tex.

CANFIELD, C.A. 1866. On the habits of the prongbuck (Antilocapra americana), and the periodical shedding of its horns. (A letter addressed to Prof. Baird, Assistant Secretary to the Smithsonian Institution, Washington, F.M.Z.S., and communicated by him to the Society.) Proc. Zool. Soc. London, Feb. 27. Pp 105-110.

COPE, E.D. 1888. The Artiodactyla. Am. Nat. 22:1079-1095.

CORBET, B.B., and J.E. HILL. 1980. A world list of mammalian species. British Mus. (Nat. Hist.) and Cornell Univ. Press. London and Ithaca, NY. 226pp.

CURTAIN, C. C., and H. H. FUDENBERG. 1973. Evolution of the immunoglobulin antigens in the ruminatia. Biochem. Genetics 8:301-308.

DUWE, A. E. 1969. The relationship of the chevrotain, Tragulus javanicus, to other artiodactyla based on skeletal muscle antigens, J. Mammal. 50:137-140.

FRICK, C. 1937. Horned ruminants of North America. Bull. Am. Mus. Nat. Hist. 69:1-669.

HALL, E.R. 1981. The mammals of North America. John Wiley and Sons, New York. 1:601-1181.

HONACKI, J. H., K.E. KINMAN, and J.W. KEOPPL. 1982. Mammal species of the world. Allen Press Inc., and The Association of Systematics Collections, Lawrence, Kans. 694pp.

JONES, J.K., JR., D.C. CARTER, H.H. GENOWAYS, R.S. HOFFMANN, and D.W. RICE. 1982. Revised checklist of North American mammals north of Mexico, 1982. Occas. Papers Mus. Texas Tech. Univ. 80:1-22.

LYON,M.W., JR. 1908. Remarks on the horn and the systematic position of the American antelope. Proc. U.S. Natl. Mus. 34:393-401.

MATTHEW, W.D. 1929. Reclassification of the artiodactyl families. Bull. Geol. Soc. Am. 40:403--408.

_____. 1934. A phylogenetic chart of the artiodactyla. J. Mammal. 15:207-209.

MAYR, E. 1969. Principles of systematic zoology. McGraw-Hill, New York. 428pp.

O'GARA, B. W., R. MOY, and G.D. BEAR. 1971. The annual testicular cycle and horn casting in the pronghorn (Antilocapra americana). J. Mammal. 52:537-543.

_____, and G. MATSON. 1975. Growth and casting of horns by pronghorns and exfoliation of horns by bovids. J. Mammal. 56:829-846.

PILGRIM, G.E. 1946. The evolution of the buffaloes, oxen, sheep and goats. J. Linn. Soc. Zool. 41:272-286.

ROMER, A.S. 1959. The vertebrate story. Univ. Chicago Press. 468pp.

_____. 1966. Vertebrate paleontology. Univ. Chicago Press. 468pp.

SIMPSON, G.G. 1945. The principles of classification and a classification of mammals. Am. Mus. Nat. Hist. 85:350.

TODD, N.B. 1975. Chromosomal mechanisms in the evolution of artiodactyls. Paleobiol. 1:175-188.

# SEASONAL ABUNDANCE AND DISTRIBUTION OF PRONGHORN ON THE IDAHO NATIONAL ENVIRONMENTAL RESEARCH PARK

Timothy D. Reynolds
Radiological and Environmental Sciences Laboratory
U.S. Department of Energy

## ABSTRACT

Seasonal abundance and distribution of pronghorn, including timing and routes of migration, were determined on the Idaho National Environmental Research Park (NERP) in southeastern Idaho. Monthly patterns of use by pronghorn of areas within 2.5 km of various energy research facility complexes were determined. Various vegetal, physiognomic, and edaphic factors were compared between areas used and not used each winter by pronghorn on the NERP. Approximately 750 pronghorn used the Idaho NERP each summer. About 450 of these animals were site residents with activities confined within NERP boundaries. The additional 300 animals generally occupied areas adjacent to the NERP but frequently moved onto the site. Numbers of wintering pronghorn varied widely between years, ranging from about 600 to over 4500 animals. Use and distribution appeared to be affected by the timing and extent of snow cover. Although the same wintering areas were not used every year, the soil from areas where pronghorn over-wintered had a significantly greater calcium content that soils from areas nearby that were not used by pronghorn. Other vegetation and soil parameters did not differ between winter use and non-use areas. Pronghorn use of areas near research facilities varied seasonally, with the greatest use occurring for short periods during spring and fall migration.

# TRENDS IN PRONGHORN POPULATIONS: 1800-1983

Jim Yoakum

Wildlife Management Biologist
U.S. Bureau of Land Management
Reno, Nevada

ABSTRACT: Pronghorns (Antilocapra americana) have increased from 30,400 in 1924 to 1,051,100 in 1983. This represents over a 3,000 percent increase for both Canada and the United States. Mexico experienced a 75 percent decrease during this same period. Four states (Colorado, Montana, South Dakota, and Wyoming) presently have almost 90 percent of all pronghorns. While herds accelerated in numbers, they were conservatively hunted in most states. Two species, A. a. sonoriensis and A. a. peninsularis are on the endangered species list. Both mainly inhabit rangelands in Mexico and represent less than a fraction of one percent of the total population in North America. Pronghorns are now second only to deer in abundance and harvested numbers for the United States.

## INTRODUCTION

Pronghorns are highly visible wild ungulates compared to species such as deer (Odocoileus hemionus) and elk (Cervus canadensis). They inhabit open western rangelands rather than wilderness areas. They do not hide in tall dense vegetation: they travel in herds, and can be seen miles away. In recent years, they have been censused comparatively easily by fixed wing aircraft and helicopters. Because they are so visible, pronghorn numbers have been better documented than most big game.

At present, there is no system for coordinating and comparing counts of pronghorns in the various state, provincial, and federal wildlife agencies in North America. Therefore, the objective of this paper is to compare recent survey results with prior surveys. Data for estimated numbers for 1800, 1910, 1923, 1964, and 1976 are based on published records as noted. Information for the 1983 figures was supplied by agencies in their reports printed in the proceedings of the 1984 Pronghorn Antelope Workshop, letters from Oklahoma, Nebraska, and Nevada wildlife agencies, and a report from Mexico.

## PROCEDURES AND FINDINGS

It can not be emphasized too strongly that biological data such as these population estimates are just that-estimates. The figures are not exact. However, they most represent the best estimates of professional government biologists and often are the only available data. These estimates are of greatest value when compared over a period of years. Much of the data are collected through similar techniques and can be compared and evaluated to show trends in populations. One can then ascertain whether the population is increasing, remaining stable, or decreasing.

1800: Prior to the arrival of European settlers, it is estimated there were 30 to 40 million pronghorns. It is possible the pronghorns were as numerous, or possibly even more numerous, than the legendary herds of buffalo (*Bison bison*) (Nelson 1925).

1910: The decline of big game herds on America's western plains was one of the swiftest wildlife carnages in man's history. Through relentless year-long hunting of all sexes and ages by thrill seekers, sportsmen, and commercial hunters, populations in some areas were completely decimated within a 10-year period. In other areas, the slaughter continued for several decades. In less than 50 years, most pronghorn populations remaining were small isolated herds. So ended the 19th century for the American pronghorn.

Just how many pronghorns remained was a paramount concern of conservationists. The American Bison Society, in its 1910 annual report estimated there were approximately 13,000 - the lowest number recorded in history. Within a 50-year period the herds had been catastrophically reduced from herds of countless millions to less than a fraction of one percent (Yoakum 1978).

1923-24: By the 1920's the American public was seriously alarmed with the loss of pronghorns, and many other species threatened with extinction. Every state by now had laws forbidding hunting.

From 1923 to 1924 Edward W. Nelson, a wildlife biologist working for the U.S. Bureau of Biological Survey (now the US Fish and Wildlife Service) commenced an extensive survey to document all herds in Canada, Mexico and the United States. Much of his data were provided by fellow wildlifers who supplied known ranges and estimated numbers. The result was a systematic survey of the pronghorns' total occupied range. His findings were published in 1925 and became the first thorough survey that has been a cornerstone reference for all subsequent population surveys (Nelson 1925). A summary of Nelson's findings is reported in Tables 1, 2 and 3. The total estimate was 30,400, a substantial increase since the all time low of 13,000 ten years earlier.

1964: The Pronghorn Antelope Workshop conducted its second meeting in 1968 at Cheyenne, Wyoming. At this meeting I presented a paper entitled "A review of the distribution and abundance of American pronghorn antelope." This was a compilation of estimated numbers

throughout North America from various state and provincial wildlife agencies. The estimated total in 1964 was 364,800. This represented more than a thousand percent increase for both Canada and the United States since Nelson's survey in 1924. Mexico apparently had a 50% decrease during this same period, probably because of indiscriminate hunting, although a total ban by law had existed for more than two decades.

1976: During 1976, another survey of pronghorns throughout North America was conducted in a similar manner as the 1964 inventory. The results were published in the Wildlife Management Institute's new monograph series on big game (Schmidt and Gilbert 1978). The world's population at this time totaled 431,400 (see Table 3). Obviously, pronghorns were still on a steady increase since the first survey in 1922-24 (except for Mexico).

1983: As an attempt to keep the records current, I completed another survey in 1985. The data on estimated pronghorn numbers again were obtained from state and province agency reports printed in the proceedings of the 1984 Pronghorn Antelope Workshop (Winkler 1984). Three states (Nebraska, Nevada, and Okalahoma) did not submit reports for the transactions, consequently, they were contacted by letter and written reports were received. Data for Mexico were obtained through a survey conducted in 1978 (Hernandez n.d.)

Tables 1, 2, and 3 contain the results of this latest survey. It is interesting to note that the population (except Mexico) again rose over 100% within the last decade. The pronghorn population continues its accelerated increase even though there is increased pressure to use more and more of the antelope's habitat for agriculture, energy development, and human occupation.

## DISCUSSION

Sixty years passed from Nelson's first extensive survey to the most recent one of 1983. Sufficient information is available to describe the trend in pronghorn populations during this half century plus of modern times.

1. 60 year trend: In 60 years from 1923 to 1983, pronghorn numbers maintained a constant upward trend. This trend is phenomenal in that it substantiates pronghorns have increased approximately 3,000 percent. This has occurred in spite of the accelerated use of western rangelands for agriculture, energy development, and human occupation. Although this 60 year increase is truly a landmark in recovery of a wildlife species during this century, it should be remembered that there are now fewer than 3% as many pronghorns as when Europeans first settled on this continent. Then too, Mexico's herds have experienced a continued decline during this demicentury.

2. Herd Distribution: In general terms, pronghorns are distributed throughout their primeval occupied habitat. That is, they existed in 16 western states when Lewis and Clark crossed the continent and they exist today in the same 16 states. However, since herds have been drastically reduced, their occupied habitats have likewise been drastically reduced. Originally pronghorns were in Alberta, Saschatchewan, and Manitoba where they still range except none now occupy Manitoba rangelands.

Attempts have been made to transplant herds outside of their historic range (Florida, Hawaii, and Washington), but no high sustaining populations have been established.

3. Population Center: Four states currently contain almost 90% of all pronghorns in the U.S. These are: Wyoming (60%); Montana (16%); South Dakota (7%); and Colorado (6%). This area of concentration can be delineated as the "circle of richness" for maintenance of high numbers.

4. Effects of Hunting on Population: An analysis of the trend data provided in this report substantiates that the legal harvesting of pronghorns has not had a limiting effect on the herds. Yoakum (1979) stated that over 2 million antelope were harvested between 1934 and 1976, during which time the herds continued their accelerated rate of increase. It is, therefore, obvious that wildlife agencies have maintained conservative hunting regulations during this period. This includes limited harvesting of does and fawns, which presently is allowed in several states and provinces with high herd numbers.

5. Endangered or Threatened Status: Of the five subspecies, two are presently classified as endangered: A. a. sonoriensis and A. a. peninsularis. Both predominately inhabit Mexico where they are and have been fully protected by law for years. However, in this region there is one of the highest human annual increases. With these necessary demands for use of the land, limited law enforcement has not been able to restore dwindling populations. For the total pronghorn populations, 99.9% are not in jeopardy of listing as rare, endangered, or threatened status.

6. No. 2 Big Game in U.S. With numbers over a million, pronghorns are second only to deer in abundance as a big game species in the United States. They are located in all 17 western states and hunted in 15 states (they are not hunted regularly in Washington and Okalahoma due to low numbers). In addition, American pronghorns provide each year countless thousands of recreation days to tourists along Interstate 80 freeway.

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## LITERATURE CITED

Hernandez, M.A. (n.d.) The antelope situation in northwestern Mexico. Department of Forestry and Wildlife, Mexico City, Mexico. Special Report. 7 p.

Nelson, E.W. 1925. Status of the pronghorned antelope, 1922-1924. U.S. Depart. Agric. Bull. No. 1346, Wash. D.C. 64 p.

Winkler, C.K. (chr.) 1984. Proceedings of the eleventh pronghorn antelope workshop. Texas Parks and Wildl. Depart., Austin, TX. 251 p.

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

_____. 1978. Pronghorn: pp. 103-121. In: Schmidt, J.L. and D.L. Gilbert. Big game of North America. Stackpole Books, Harrisburg, PA. 494 p.

Table 1. Estimated numbers of pronghorns in the United States from 1923 to 1983.

| State | 1923 1/ | 1964 2/ | 1976 3/ | 1983 4/ | Difference 1923-1983 | | Percent of pronghorns in 1983 | |
|---|---|---|---|---|---|---|---|---|
| | | | | | No. of Animals | Percent Increase | US | NA |
| Arizona | 700 | 10,000 | 7,300 | 9,000 | + 8,300 | 1,200 | T | T |
| California | 1,100 | 2,700 | 5,000 | 6,800 | + 5,700 | 500 | T | T |
| Colorado | 1,200 | 15,200 | 31,000 | 57,500 | + 56,300 | 4,900 | 6 | 5 |
| Idaho | 1,500 | 4,700 | 13,300 | 21,500 | + 20,000 | 1,300 | 2 | 2 |
| Kansas | 10 | 100 | 1,100 | 1,200 | + 1,100 | 11,000 | T | T |
| Montana | 3,000 | 95,000 | 71,200 | 161,500 | +158,500 | 5,300 | 16 | 15 |
| Nebraska | 200 | 9,000 | 9,800 | 9,000 | + 8,800 | 4,400 | T | T |
| Nevada | 4,300 | 4,500 | 6,500 | 9,800 | + 5,500 | 130 | T | T |
| New Mexico | 1,700 | 22,500 | 26,900 | 30,000 | + 28,200 | 1,700 | 3 | 3 |
| North Dakota | 200 | 14,200 | 8,100 | 5,700 | + 5,500 | 2,700 | T | T |
| Oklahoma | 20 | 200 | 200 | 400 | + 200 | 100 | T | T |
| Oregon | 2,000 | 8,900 | 11,300 | 14,000 | + 12,000 | 6,000 | 1 | 1 |
| South Dakota | 700 | 27,400 | 35,500 | 67,000 | + 66,300 | 9,500 | 7 | 6 |
| Texas | 2,400 | 9,400 | 10,500 | 12,000 | + 9,600 | 400 | 1 | 1 |
| Utah | 700 | 1,000 | 2,600 | 6,000 | + 5,300 | 800 | T | T |
| Wyoming | 7,000 | 140,000 | 168,000 | 608,000 | +601,000 | 8,600 | 60 | 58 |
| TOTAL | 26,730 | 364,800 | 406,300 | 1,019,400 | +992,700 | 3,700 | 96 | 91 |

1/ Nelson (1925). All population numbers rounded to closest 100, except Kansas and Oklahoma

2/ Yoakum (1968). All population numbers rounded to closest 100.

3/ Yoakum (1978).

4/ Data provided in this report.

Note: Data for Hawaii and Washington deleted as numbers were less than 100.

T = less than one percent

US = United States

NA = North America

Table 2. Estimated pronghorn numbers for Canada and Mexico from 1923 to 1983.

| Region | 1924 1/ | 1983 2/ | Difference between 1923 and 1983 | | Percent of World population in 1983 |
|---|---|---|---|---|---|
| | | | No. of Animals | Percent Increase or Decrease | |
| CANADA: | | | | | |
| Alberta | 1,000 | 21,500 | +20,500 | +2,050 | 2 |
| Saskatchewan | 300 | 10,000 | + 9,700 | +3,250 | 1 |
| TOTAL | 1,300 | 31,500 | +30,200 | +2,300 | 3 |
| MEXICO: | 2,400 | 600 | - 1,800 | - 75 | T |

1/ Nelson (1925).
All figures rounded to closest 100.
2/ Data provided in this report.
T = less than 1 percent.

Table 3. A summary of the estimated pronghorn numbers in North America from 1923 to 1983.

| REGION | 1924 1/ | 1964 2/ | 1976 3/ | 1983 4/ | Difference Between 1923-1983 | | Percent of world population in 1983 |
|---|---|---|---|---|---|---|---|
| | | | | | No. of Animals | Percent Change | |
| Canada | 1,300 | 20,300 | 22,300 | 31,500 | +30,200 | +2,300 | 3 |
| Mexico | 2,400 | 1,200 | 1,000 | 600 | - 1,800 | - 75 | T |
| United States | 26,700 | 364,600 | 408,100 | 1,019,000 | +982,300 | +3,716 | 97 |
| TOTAL | 30,400 | 386,100 | 431,400 | 1,051,100 | +1,010,700 | +3,358 | 100 |

1/ Nelson (1925).

2/ Yoakum (1968).

3/ Yoakum (1978).

4/ Date provided in this report.

Note: All figures rounded to closest 100.

T = Less than 1 percent.

Figure 1. Graphic depiction of estimated pronghorn numbers in North America from 1923 to 1983.

Figure 2. Trend in estimated pronghorn numbers in the United States from 1923 to 1983.

# INTEGRATING POPULATION SIMULATION MODELLING INTO A PLANNED APPROACH TO PRONGHORN MANAGEMENT

WALT GASSON, Wyoming Game and Fish Department, 5400 Bishop Blvd., Cheyenne, Wyoming 82002

LEE WOLLRAB, Wyoming Game and Fish Department, 5400 Bishop Blvd., Cheyenne, Wyoming 82002

Abstract: A Planned Management System consists of four phases: inventory, objectives, operations, and evaluation. These phases form an ongoing process which focuses management actions on objectives determined by the public. Progress toward achieving objectives is continually monitored. Population simulation modelling provides a useful tool for the manager in assimilating inventory data, illustrating the positive and negative ramifications of establishing objectives at various levels, simulating the effects of alternative management strategies, and evaluating progress in achieving objectives. This planned management approach, using population simulation modelling, provides significant benefits for both the manager and the public.

Key Words: Planning, Management, Population Simulation Modelling, Objectives, Planned Management Systems.

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As Crowe (1983) observed, it is unlikely that the major enhancements in wildlife management will be products of biological research, or enlightened conservation legislation. Continued research will, at best, only answer a few of our questions about specific management problems. Enlightened conservation legislation will likely grow scarcer as America passes from an era of environmental consciousness-raising to one of economic pragmatism. In fact, our major advances now are likely to come from more purposeful, more effective management. We as wildlife managers must strive to increase our effectiveness and our influence if the needs of free-ranging wild animals are to be met in the future.

Increasing our effectiveness as managers is likely to be no small task. But if we are to compete with the interests of transportation, agriculture, energy development, urban expansion and a host of other forces to preserve a place for free-ranging wildlife, there can be no question that we must be more effective. We must be effective in dealing with these special interests. We must be far-sighted enough to look beyond daily problems to long-term solutions. We must articulate our plans for the resource, set measurable objectives, measure our progress, and document the results. In short, we must plan.

We have had some tremendous successes in Wyoming. We currently manage most of the world's pronghorn - 54 discrete populations totalling about

371,000 animals. In 1984 we harvested over 83,000 pronghorn. In doing so, we generated over 174,000 days of recreation, $4.6 million in license revenue, and about $25 million in economic benefits to the state's economy. Obviously, some of the success may have little to do with active management. Wyoming still has a very low human population and vast amounts of excellent pronghorn habitat. But in recent years, these factors have been overshadowed by the same forces which pronghorn managers elsewhere have been faced with - energy development, agricultural expansion, fencing and other problems. We could no longer afford to rely on having plenty of habitat and few competing interests. Our success in management in these years has been attributable to several factors - good managers, strong public support, and sufficient financial resources all have played a part. But a primary factor has been our success in implementing a planned approach to managing pronghorn.

## A PLANNED MANAGEMENT SYSTEM

A Planned Management System can be described as having four phases as shown in Figure 1.

Figure 1. A Planned Management System.

1. INVENTORY
(Where are we?)
|
|
|

2. OBJECTIVES
(Where do we want to be?)
|
|
|

3. ACTIONS
(How will we get there?)
|
|
|

4. EVALUATION
(Did we make it?)

In fact, these four phases are best described as a continuum, with one phase leading logically to the next, as shown in Figure 2. A more complete description of each phase follows.

Figure 2. Elements of a Planned Management System.

Inventory (Where are we?)

This phase, also known as the "current status" phase, involves an assessment of the limits of the resource. In the case of pronghorn management, only two questions need be answered to adequately address this phase:

1. Where are they? The manager's first responsibility under this question is to delineate herd units, or discrete pronghorn populations. Each should have very little ($\geq$ 10%) interchange with adjacent herd units. Often the boundaries of herd units are major geographic barriers to pronghorn immigration/emigration - rivers, mountain ranges, etc. Increasingly, herd unit boundaries are defined by man-made barriers to pronghorn movement - highway fences, railroad lines, reservoirs, and urban areas. A second responsibility is that of developing and maintaining seasonal distribution maps for all the herd units delineated. In Wyoming, this was simplified by development of the Wildlife Observation System, a database which stores information about wildlife observations recorded by Game and Fish, BLM, USFS, USFWS and private sector biologists. By using data stored on this system, we have developed maps showing seasonal distribution for every pronghorn herd unit.

2. How many are there? The manager's responsibility in this part of the inventory phase is to maintain a current estimate of how many pronghorn exist in the herd unit. In Wyoming, we have found population simulation modelling an extremely valuable tool for answering this question. The software we use, POPII by Fossil Creek Software was developed to generate the information we need, using data our managers collect.

Objectives (Where do we want to be?)

This phase, also known as the "strategic planning" phase, involves the establishment of specific objectives for the use of the resource. In pronghorn management, herd unit objectives should be established for at least the following parameters:

Population (1st order)
Harvest (2nd order)
Hunters
Recreation Days > (3rd order)

Obviously, these objectives exist in a hierarchy. The population objective is most important - all others depend on it. Harvest is a secondary objective. Hunters and recreation days are third order objectives - they depend on harvest.

There are two vital considerations in objective setting:

1. Objectives should be the product of public input. It is impossible to overemphasize the importance of public involvement in establishing herd unit objectives. It should not be the role of the manager to establish objectives. Wildlife is the property of the public - it should be their decision how many pronghorn to maintain in a given herd unit, and how to use them. This process should involve public meetings, open houses, meetings with concerned groups and individuals. Everyone who has an interest in the management of a herd should have the opportunity to participate. Many tools other than the standard public meeting exist, and can be more effective than typical public meetings. Bleiker (1981) provides an excellent discussion of these tools.

2. Objectives should be measurable and realistic. The parameters suggested above for establishing objectives lend themselves to quantified, numeric objectives. These objectives have a distinct advantage - they make it easy to measure progress toward achieving them. Obviously, it is useless to establish objectives if progress toward them cannot be measured. Further, objectives should be realistic. Establishing an objective of 10,000 pronghorn for a herd unit that has never supported more than 1,000

is of no value. The objectives will be disregarded in that herd's management if the public perceives that the objectives have little relation to reality.

It is important to note that most of the establishment of objectives is socioeconomic, not biological, in nature. Two biological criteria define the limits of potential population objectives, minimum viable population and carrying capacity. Both are difficult to measure, and of little consequence to most managers. Between these two extremes, the criteria used to establish a population objective are dependent on the aesthetic, social, and economic desires of the public, as shown in Figure 3.

Figure 3. Range of Potential Population Estimates.

Actions (How will we get there?)

This phase, also known as the "operational planning" phase, involves development and implementation of management strategies directed at achieving the established objectives. One such development/implementation exercise involves the setting of hunting seasons. Too often, season-setting decisions are made hastily, with too little regard for potential economic and political impacts. Any harvest strategy to be implemented should be firmly linked to objectives for the population. It should be designed to move the population closer to objective level. Often, it is important to review the short-term history of the population at the same time - a look at where the herd unit has

been in relation to objectives and an estimate of the effects of the proposed hunting season in relation to objectives.

Another such exercise involves the review of environmental impacts of projects under the NEPA process. Often, managers are called upon to evaluate the potential impacts of a proposed project on a pronghorn population. Too often, managers have been characterized as being inflexible and negative in this context. Projects were opposed on the grounds that it might result in losses to a pronghorn herd, even in cases where we have directed our own management to reducing pronghorn numbers. In these cases, our credibility, and thus our political support, drops rapidly and recovers slowly. A more realistic approach should be to accommodate these projects unless they preclude meeting management objectives. The primary advantage of this approach is that, at that point, it is no longer one manager or one agency against the project but every agency, group, and individual who established the objective against that project. In fact, we stop fighting battles that are of little consequence and become more effective fighting battles of major importance.

Evaluation (Did we make it?)

This phase, also known as the "monitoring" phase of the system, involves measuring progress in achieving management objectives. Often it involves the repetition of the same tools used in the inventory phase. Many good inventory tools are designed for use as evaluatory mechanisms. In this phase, we must determine if the actions carried out in the previous phase actually had the desired effect on the population. Obviously, this process is closely related to a re-inventory. In fact, it leads the process back to the first phase, and the question "Where are we now?"

Thus, the system repeats itself, becoming a continual process of inventory (or re-inventory) evaluation of objectives, implementation of actions designed to achieve those objectives, and evaluation of progress. In practice, it becomes a "way of doing business." The focus of management shifts from the annual fluctuations of any pronghorn population to the long-term needs of the population. The manager has a fixed target to direct his or her actions toward, and is held accountable by the public for achieving the objectives they set forth. A Planned Management System leads to credibility and increased political support for the agency and the resource.

## POPULATION SIMULATION MODELLING

Population simulation modelling can be a valuable tool for the manager in implementing a Planning Management System. Simulation models do not give all of the answers to questions. Managers must still collect adequate data, interpret that data, and make the final management decision. They are incapable of doing those things. Simulation models are not a cure-all for poor data collection or a generic means of justification for bad decision-making. A model is only a tool within a sound Planned Management System. But it is an exceedingly powerful tool.

Population modelling is a simple mathematical tool that focuses the manager's attention on populations, instead of artificial units like hunt areas, counties, or game warden districts. Definition of a population is crucial to modelling, and indeed, to a planned pronghorn management system. A typical pronghorn population, or herd unit, is shown in Figure 4. This herd unit may include a multitude of land jurisdictions - USFS, BLM, state lands, private lands, etc. and may be bisected by a variety of administrative boundaries - a county line, a forest boundary, a BLM district boundary, a game warden district boundary, etc. While all of these may have some bearing on management of the population, in effect creating a management jigsaw puzzle, the basic unit for management is the population or herd unit.

Figure 4. A Pronghorn Herd Unit.

With the herd unit defined, all management data must be collected at the herd unit level. Good models depend on data quality, usually before data quantity. This data must be drawn from the entire population so that an accurate representation of the population can be drawn from it. The first two requirements for a sound population simulation model are:

1. A well-defined herd unit, and;
2. At least 3 years of sound management data.

The POP-II model used by the Wyoming Game and Fish Department was developed by John Bartholow of Fossil Creek Software, Ft. Collins, Colorado.

The model simply starts with pre-determined numbers of animals in each age and sex class, then subtracts animals as they are removed from the population (through natural mortality or harvest) and adds animals as they are added to the population (through natality). The rates at which animals are added or subtracted may be varied according to the data available for each population. POP-II is a deterministic model and does not include random input variables. As such, it is easily understood and lends inself readily to data collected by a management agency.

To begin building a pronghorn model, several basic biological points need to be confirmed. The biological year should begin on June 1. Fawning is assumed to occur during the first two weeks of June. An initial population structure must be estimated based on the maximum age of the pronghorn and the proportions of males and females within each age class. The best way to develop the initial population is to use harvest age structure data. This data may be biased by hunter selectivity, but is adequate initially, since it will change as the model is aligned.

With an initial population structure established, a summer mortality regime must be devised. This is set up as a percentage and applied to each sex and age class. The summer mortality rates account for such natural events as abortion, resorption, drought, road kills, accidents, etc.

The next information used is harvest. This is real data, based on a statistically valid questionnaire survey. The model categorizes harvest into adult male, adult female and sub-adult. Effort values can be used to direct a proportion of the harvest at given age classes in herds that are managed for either trophies or recreational opportunity.

After harvest, the winter mortality schedule is applied. As with summer mortality, rates are applied by sex and age class. In this case, these rates account for the deaths that would occur from post-hunt until the end of the biological year, which is the day before fawning begins.

The model starts with an initial population, subtracts preseason mortalities, subtracts the harvest followed by the winter mortalities. Parturition is applied at the end of the biological year. Fawns are added into the population as a rate expressed as fawns per 100 does. This variable will also be changed many times as the model is aligned. These reproductive rates are increased or decreased annually to bring the simulated fawn:doe ratios into agreement with the ratios observed in the field.

At this point, the model will cycle through the rest of the simulation (data) years in the same manner, adding animals as they are born and subtracting animals as they die.

Aligning the model may be a very time-consuming task. It requires changing variables such as initial population structure, mortality rates, reproductive rates, etc. to make the results simulate data collected in the field. A good model simulates good data very closely. A poor model does not. Without good data, the entire modelling process is of limited value.

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## INTEGRATING MODELLING INTO A PLANNED MANAGEMENT SYSTEM

Integrating the results of population simulation modelling into the Planned Management System is not difficult. A well-developed simulation model readily lends itself to the system. Its most common use is in the inventory phase. Quite simply, the model provides part of the answer to the question "Where are we?" by answering the question "How many are there?" A good simulation model provides estimates of total population size at the beginning of the biological year, at pre-hunt, at post-hunt, and at the end of the biological year. This estimate is the product of all available data and has been checked against other estimates from trend counts or other estimates of population size. The manager with a sound model can provide a defensible estimate of total population size at any time. Further, the model can graphically illustrate population trends, and even projects that trend into the future, answering not only "How many are there?" but also "Are they increasing or decreasing?"

A good simulation model is also of tremendous value in establishing realistic management objectives. As we have discussed, the establishment of a population objective is a primary consideration since all subsequent objectives are ultimately constrained by the population objective. It is important to consider that this objective must be a product of public input, must be measurable and realistic, and should be based on both biological and socioeconomic criteria. The population model addresses these criteria. In establishing a good population objective, it may be necessary to provide the public with a range of potential population objectives bounded by a figure near carrying capacity at the upper end and by minimum viable population size at the lower end. More often, it is necessary to provide the public with estimates of historic population size. Many people have no real concept of what a given population size means in terms of observed density, but they can readily relate to "about the same number of pronghorn we had in this herd unit in 1981". Finally, the model produces an annual estimate of population size - valuable in measuring progress against the population objective.

In the operational planning phase, population modelling provides a means to test various harvest strategies and determine the most effective strategy for meeting the predetermined objectives. In Wyoming, when the manager proposes a season he/she submits a proposal illustrating the current status of the population and the anticipated impact of the proposed season. In short, the manager must confirm that the proposed season will serve to move the population toward the management objectives. This gaming ability also provides the manager a vehicle to address the impacts of managing for special interests. For example, there may be considerable interest from some groups for "trophy" pronghorn management. The manager can use the simulation model to determine and illustrate the impacts of maintaining a high proportion of older males in the population while maintaining the population at or near objective through the harvest of females. Likewise, the manager can use the simulation model to contrast "trophy" management with "maximum sustained yield" management. The model provides administrators, special interest groups, and the public with the opportunity to review the potential impacts of a management strategy

before it is implemented and to have more information available in operational planning.

Finally, population modelling provides an extremely valuable tool for the evaluation phase of this Planned Management System. As management strategies are implemented, the resulting information can be incorporated into the simulation model, and an evaluation of their effectiveness gained. Did the strategy employed actually move the population toward objective level? What impact did this strategy have on other parameters such as post-hunt buck:doe ratio and age composition of the population? Could a more effective strategy have been used? The simulation model provides answers to questions such as these. In doing so, it provides a feedback mechanism. With such evaluation information, the manager can re-assess the status of the population, plot that status in relation to the objectives (and even re-assess the validity of those objectives), and then begin to formulate alternatives for the next management strategy to be implemented. Thus, the cycle of planned management goes on with assistance in each phase from the population simulation modelling process.

## SUMMARY

A Planned Managment System serves to direct all actions toward clear, measurable objectives. These objectives are structured so that progress toward their achievement can be readily monitored. Perhaps more importantly, these objectives are the product of public involvement. Thus, the public has a tangible element of "ownership" over the management of a resource which is in fact theirs. This element of ownership and the necessity of a direct link between management actions and objectives provides a positive form of public involvement in wildlife management. The system enables a manager to focus on long-term management at the herd unit level. The system is flexible, it accommodates change readily. It promotes a proactive, rather than reactive stance in management decision-making.

The use of population modelling provides a tool of tremendous versatility in a Planned Management System. It is vital that the manager focus his/her attention at the herd unit level. The herd unit is the foundation on which a successful Planned Management System for pronghorn is structured. The simulation model focuses this attention. Administrative boundaries and artificial barriers are disregarded as management is implemented and monitored by herd unit in the modelling process. Modelling provides a means to integrate all available data into a meaningful form at the herd unit level. Perhaps as important, modelling provides a means to identify poor data. The use of population modelling in big game management in Wyoming has led managers to redefine poor herd unit boundaries, to re-evaluate traditional ideas about tistical harvest data collection, and to become increasingly concerned about the stavalidity of management data collected. The upshot of this has been that more and better information is available for use in making management decisions. The ability to use the simulation models predictive capability has been a significant benefit in making management decisions as well. The ability to ask "What if..." has been invaluable, particularly in the development

of realistic management objectives and in selecting appropriate strategies to achieve those objectives. Finally, modelling fulfills the need in a system like this for continual monitoring. Modelling provides a tool which lends itself to the operation of an efficient and effective Planned Management System.

## CONCLUSIONS

The use of population simulation modelling as a tool in a Planned Management System for pronghorn or any other free-ranging wildlife population provides some significant benefits for the manager:

1. This system promotes a pro-active rather than reactive approach to management. A sound Planned Management System removes the manager from crisis management. It enables the manager to use his/her talents to pursue set goals and objectives, rather than reacting to the most recent "brushfire".

2. It provides a means of dealing with change. We live in a time in which change has been accelerated by technology. The demands for wildlife have never been greater. At the same time, the threats to wildlife and wildlife habitat have never been greater. The feedback mechanism built into this process provides the means to alter objectives, strategies, etc. as changes occur. Change can be viewed as a normal part of management, rather than as an object of dread and turmoil.

3. It provides a means to keep other resource users informed of the needs of wildlife. Competition for space and habitat is a serious problem for free-ranging wildlife in America today. If wildlife is to compete effectively with other uses, managers must be able to clearly define wildlife's needs. Having definite quantitative objectives serves to articulate the public's desires for wildlife and aids in quantitatively demonstrating the impacts of other land uses.

4. It provides a means for dealing with the increasing complexity of wildlife management. Wildlife management is a much more complex profession now than it was 20 years ago. Environmental legislation, trends in social values, economics, demographics, and government are having sweeping impacts on it. The growth of special interest politics has more wildlife decision making increasingly confrontational. A PMS provides a structured, systematic approach for making defensible decisions in this environment.

5. It provides the manager with a means to rationally defend management decisions. The demand for accountability in wildlife decisions has never been stronger than it is today. It is no

longer acceptable for the manager to adopt laws, promulgate regulations, and implement expensive programs with no accounting made to the public. The public demands that agencies entrusted with public resources achieve meaningful results in their management. This system provides a means of demonstrating effectiveness in meeting targets set out by the public. This factor serves to build credibility and increase public support for future management.

The implementation of a Planned Management System is a sound means of effectively managing free-ranging wildlife populations. Population simulation modelling is an important tool in the implementation of a Planned Management System.

## LITERATURE CITED

Bartholow, J. 1985. POP-II system documentation. Fossil Creek Software Co., Ft. Collins, CO. 64pp.

Bleiker, H. 1981. Citizen participation handbook. Institute for Participatory Planning, Laramie, WY. 89pp.

Crowe, D. 1983. Comprehensive planning for wildlife resources. Wyoming Game and Fish Department, Cheyenne, WY. 143pp.

BUSINESS MEETING

MINUTES OF BUSINESS MEETING
12th PRONGHORN ANTELOPE WORKSHOP
RENO, NEVADA
MARCH 12, 1986

The Business meeting of the 12th Pronghorn Antelope Workshop was called to order by Workshop Chairman Mike Hess at 1:00 p.m. Delegates were present from the following states or provinces: Alberta, Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Texas, Utah and Wyoming.

No delegates attended from Saskatchewan, Washington and Mexico.

## OLD BUSINESS

I. Depredation Guidelines:

Guidelines for handling pronghorn depredation on agricultural crops were submitted by Bruce Morrison (New Mexico) in 1980. These guidelines were discussed at the 11th Workshop in Texas, but no action was taken. The 11th Workshop appointed a committee to seek comments from the participating states and provinces prior to the 12th Workshop concerning pronghorn depredation guidelines. This committee apparently failed to pursue this assignment and several attempts by Chairman Hess to contact the committee members were unsuccessful. Dr. Bart O'Gara (University of Montana) reported that a subcommittee of the Western Association of Fish and Game Agencies was presently investigating big game depredation problems among its membership and that perhaps guidelines would be an outgrowth of that investigation. Dr. O'Gara introduced a motion that the Workshop contact Mr. Gene Allen (Montana) with regard to the Western Association Committee's findings and possible guidelines. This motion was seconded by Lloyd Oldenburg (Idaho) and passed unanimously by the delegates. Lloyd Oldenburg (Idaho) indicated he would contact Mr. Allen and also bring Idaho's guidelines to the next workshop.

II. Taxonomic Classification of Pronghorns:

Tom Pojar (Colorado) presented his findings on pronghorn taxonomy based on his recent literature review. Bart O'Gara (University of Montana) presented an alternative viewpoint. A motion (O'Gara) that the Workshop was not qualified to make a recommendation on pronghorn taxonomy (seconded by the Oregon delegate) failed adoption. Following further discussion, Pojar (Colorado) presented a motion that further investigation be conducted and presented at the next workshop. Seconded by Leo Pyshora (California), this motion was adopted by the delegates.

III. Status of Papers Published in the Workshop Proceeding:

No discussion was held on this topic.

IV. Guzzlers for Pronghorn:

Don Beale (Utah) discussed guzzler construction for pronghorn in Utah. Further discussion on including a water development section in the pronghorn management guidelines ensued, but the matter was tabled without a motion.

## NEW BUSINESS

I. No new business was presented.

II. Host for the 1988 Workshop:

Following a discussion on repeat hosting and a need for designating an alternative State or Province, it was moved (Oregon Delegate) and passed unanimously that the State of Oregon would host the 13th Pronghorn Antelope Workshop with the State of Colorado serving as an alternative. The State of Oregon has since confirmed that they will host the Workshop.

The business was adjourned at 3:00 p.m.

Respectfully Submitted,

Mike Hess
Workshop Chairman