AN ABSTRACT OF THE THESIS OF

Paul L. Milks for the Master of Science Degree

in Biology presented on 14 May 1982

Title: Ear/Horn Relationships of the Pronghorn

Abstract approved: Dwight L. Spencer

One method of determining the trophy qualities of big game animals involves calculating a size relationship between two anatomical structures. For the pronghorn, Antilocapra americana Ord, the most common size relationship used is ear length compared to horn length.

Two ear and four horn measurements of 60 pronghorns, harvested during the 1979 and 1980 Kansas firearms hunting seasons, were statistically analyzed with appropriate tests to determine if horn length could be estimated by using ear length as a known measurement to which unknown horn length was compared.

The two ear measurements were the standard ear measurement used by mammalogists and distance from the junction of the ear and skull to tip of the ear. The four horn measurements were total horn length, distance from ear tip to top of horn curve, prong length, and horn base circumference.

Statistical results indicated that total horn lengths could be estimated when compared to a predetermined ear length, and that prong lengths and base circumferences could be estimated from estimated horn lengths.

EAR/HORN RELATIONSHIPS OF THE PRONGHORN

A Thesis
Submitted to
the Division of Biological Sciences
Emporia State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Paul L. Milks
May, 1982

Dwight L. Spencer
Approved for Major Department

Harold E. Dunst
Approved for Graduate Council

ACKNOWLEDGEMENTS

I would like to thank the following people who helped with my research: the Kansas sportsmen who waited in line and allowed their animals to be measured; Marc Bowen and Neal Whitaker who helped man check stations during the 1980 season; members of the Kansas Fish and Game Commission, noteably Keith Sexson who measured animals during both collection years and provided the original idea, and Terry Funk who allowed check stations to be used for data collection; and members of my graduate committee, Dr. Spencer, Dr. Clarke, and Dr. Sobieski for their input, suggestions, and patience.

A very special thanks goes to my wife, Carlita. Without her limitless support it would not have been possible for me to carry out this study.

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INTRODUCTION

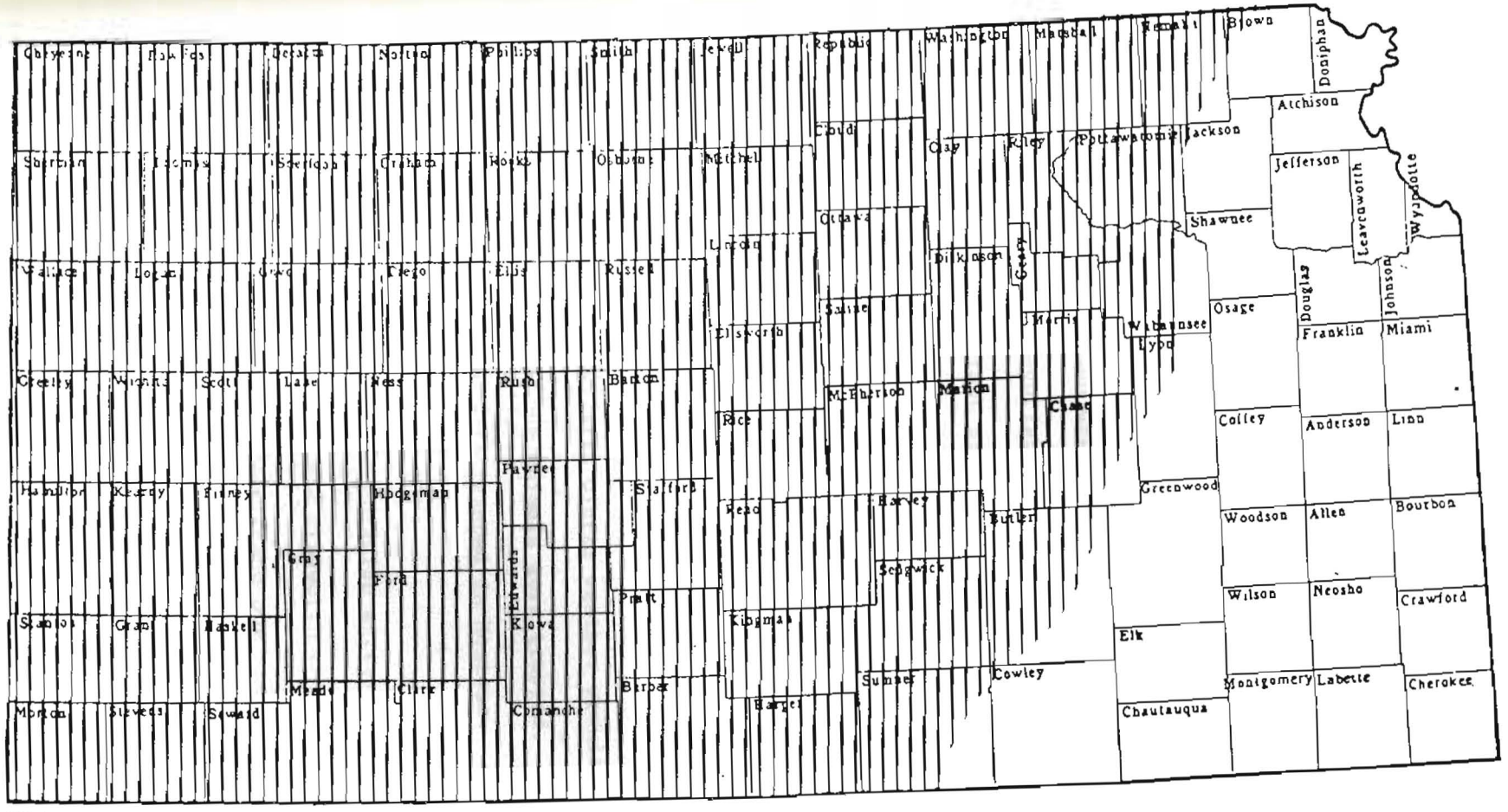
The pronghorn, Antilocapra americana Ord, has a population history similar to that of the bison, Bison bison (Linnaeus), in that both animals were once present in large numbers in North America.

Yoakum (1978) stated that the pre-Columbian pronghorn population was estimated at 30 to 40 million animals and Nelson (1925) speculated that pronghorn numbers once exceeded those of the bison. Hlavachick (1966a) noted that in the early 1800's the total pronghorn population in the United States was between 30 and 40 million animals, with several thousand found in what is now the western two-thirds of Kansas (Figure 1).

Like the bison, pronghorns were considerably reduced in number during the 1800's by the westward expansion of the human population and the resultant market hunting, and plowing, and burning of the prairies. Hlavachick (1966a) stated that pronghorns were reduced to an estimated 30,000 in the United States by the 1890's, and Nelson (1925) reported a total of 10 animals in Kansas in 1924.

Hall (1955) reported that a Mr. August Lalouette in Marion County had a young pronghorn imported from Montana in 1953, and in 1954 brought in 13 more from the same state. This was probably the first effort to reinstate the pronghorn in Kansas before 1962 when the Kansas Fish and Game Commission undertook efforts to determine distribution, numbers, and possible locales for future pronghorn introductions.

Figure 1. Historical range of the pronghorn in Kansas as reported by Hall (1955).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Rooks
Osborne
Mitchell
Cloud
Clay
Riley
Pottawatomie
Jackson
Jefferson
Leavenworth
Wyandotte
Wallace
Logan
Gove
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Shawnee
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Ford
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Pratt
Sedgwick
Wilson
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Stanton
Grant
Haskell
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Kingman
Elk
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Stevens
Seward
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Pronghorn Transplanting in Kansas

The following account of pronghorn transplanting and stocking in Kansas is from Hlavachick (1966b) and Funk (1979, 1980).

The present Kansas pronghorn population is a result of trapping-transplanting efforts by the Kansas Fish and Game Commission, after a 1962 summer survey indicated a total of 56 animals (12 males, 30 females, and 14 young) residing in Wallace and Sherman counties in northwest Kansas. The Commission determined that these animals were in danger of extirpation, and negotiations were begun with other state game agencies to obtain transplant stock.

Cooperative agreements with ranchers and farmers were entered into during the winter of 1962-63 and two release sites were chosen in the fall of 1963, one in Wallace County and one in Sherman County. Arrangements were made with game officials in Montana and South Dakota to transplant pronghorns in 1962.

Trapping attempts in Montana and South Dakota during the winter of 1962-63 were futile because mild winter weather resulted in a scattering of pronghorn herds, and no animals were trapped. During the winter of 1963-64 only 18 animals were trapped in Montana. These were given to various zoos.

During the fall of 1964, cooperative agreements were signed with landowners in Barber, Edwards, and Ellsworth counties. Two release sites were selected in Barber County and one site each in Edwards and Ellsworth counties.

On 26 November 1964, 84 pronghorns arrived in Kansas from the National Bison Range, near Missoula, Montana, and were released in groups of 35 and 40 at the sites in Wallace and Sherman counties.

respectively (Figure 2). Sex and age classifications were 16 adult males, 16 young males, 30 adult females, and 13 young females. Nine of the 84 animals were dead-on-arrival at the release sites and four more known mortalities occurred during the week following release.

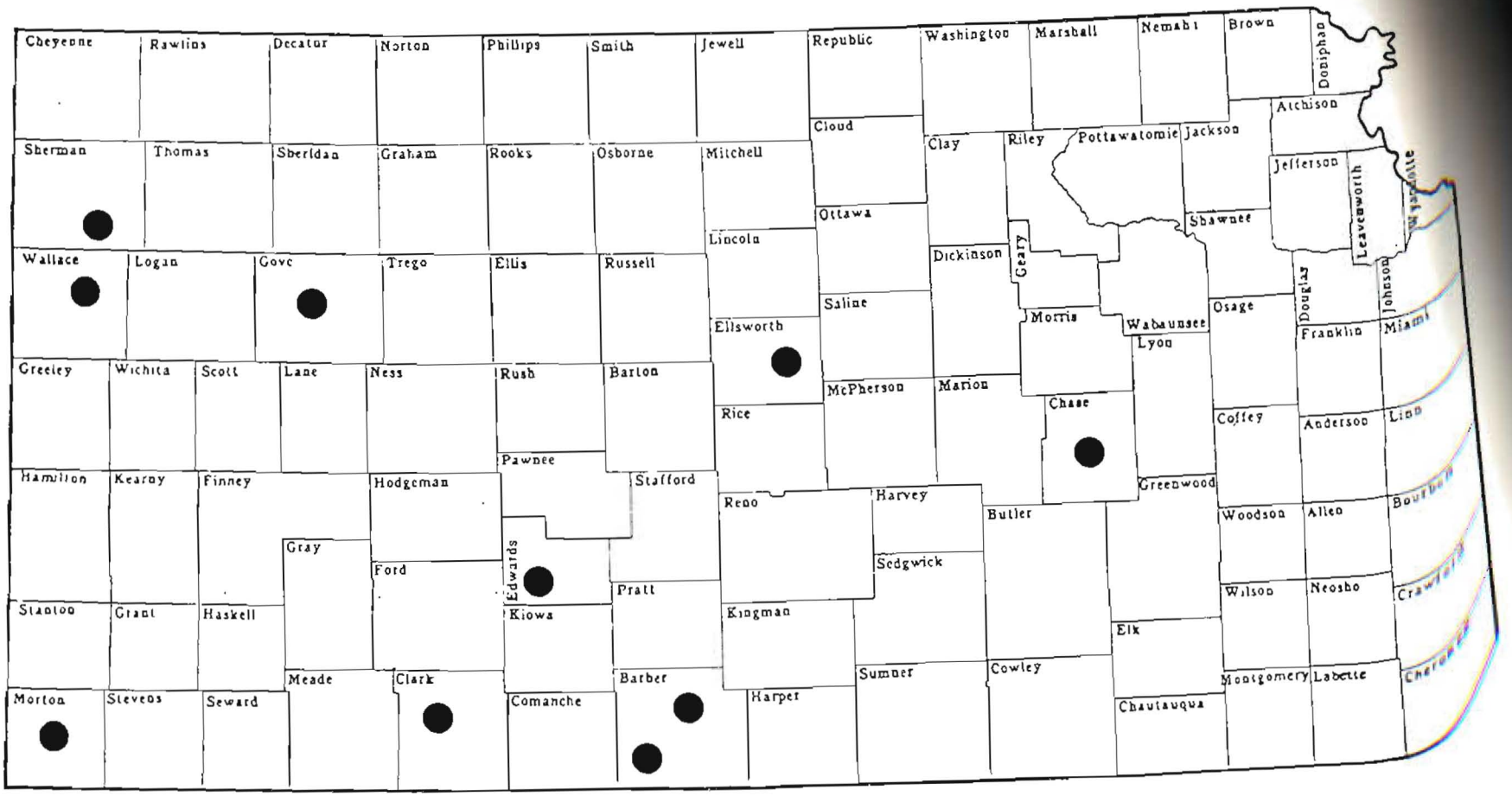
During the summer of 1965, Kansas and Colorado Game commissions entered into negotiations to trade pronghorns for white-tailed deer, Odocoileus virginianus, and lesser prairie chickens, Tympanuchus pallidicinctus. Under this agreement, Kansas was to provide about 125 prairie chickens and 50 white-tailed deer and Colorado was to trap and transplant about 100 pronghorns to Kansas.

Fifty pronghorns were shipped by Colorado game personnel on 18 January 1966 and were escorted to the Davis release site in Barber County (Figure 2). Of the 50 received, one was dead-on-arrival and eight (three bucks and five does) were sent to the Maxwell Game Refuge near Canton, Kansas. Sex and age classification of the Davis release were nine adult males, nine adult females, 12 male fawns, and 11 doe fawns. Three of the eight animals sent to the Maxwell Game Refuge subsequently died, leaving two bucks and three does in a small band.

On 20 January 1966, 23 more pronghorns were received from Colorado and were released at the Ash site in Barber County (Figure 2). Sex and age classification of this release were eight adult males, three adult females, three male fawns, and seven female fawns. One doe had a broken rear leg and was sacrificed at the site.

During the 1966 meeting of the Antelope States Workshop in Denver, Colorado, contact was made with the Nebraska Game Commission concerning the availability of the Sioux Army Depot pronghorn herd for possible transplant stock. In the fall of 1966, an agreement was made between

Figure 2. General areas of pronghorn release sites in Kansas.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Sherman
Thomas
Sheridan
Graham
Rooks
Osborne
Mitchell
Cloud
Clay
Riley
Pottawatomie
Jackson
Jefferson
Leavenworth
Wyandotte
Ottawa
Lincoln
Shawnee
Wallace
Logan
Gove
Trego
Ellis
Russell
Dickinson
Geary
Douglas
Johnson
Saline
Osage
Ellsworth
Morris
Wabaunsee
Franklin
Miami
Greeley
Wichita
Scott
Lane
Ness
Rush
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McPherson
Marion
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Hodgeman
Stafford
Greenwood
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Harvey
Butler
Woodson
Allen
Bourbon
Gray
Edwards
Ford
Sedgwick
Wilson
Neosho
Crawford
Pratt
Stanton
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Kingman
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Meade
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Seward
Comanche
Harper
Chautauqua

the Kansas and Nebraska commissions to obtain animals from the Depot herd. Under this agreement, Kansas was to pay all trapping and transplanting costs and provide personnel to aid in trapping operations.

Trapping of the Depot herd commenced on 11 January 1967 and 105 animals were captured in two days. Twenty animals were sent to the Maxwell Game Refuge to supplement the earlier release. Sex and age classification of these animals were two adult males, 12 adult females, four male fawns, and two female fawns.

Of the remaining 85 animals, 50, consisting of 10 adult males, eight adult females, two male fawns, seven female fawns, and 13 of unknown age and sex, were released at the Ellsworth County site (Figure 2). The remaining animals, consisting of three adult males, five adult females, two yearling males, three yearling females, three male fawns, eight female fawns, and nine of unknown age and sex, were released at the Edwards County site (Figure 2). Two animals, one adult male and one doe fawn, were dead-on-arrival at this site.

During January, 1978, Wyoming allowed Kansas game personnel to trap 100 pronghorns and two new herds were established in Kansas. Thirty-seven animals were released in Chase County and 63 in the Big Basin Area in Clark County (Figure 2). Kansas game personnel returned to Wyoming in January, 1979, and trapped 343 additional animals. These were released at five sites: 98 in Chase County, 75 in Ellsworth County, 60 in Gove County, 74 in Clark County, and 36 in Morton County (Figure 2). Sex and age classification of the 1978-79 releases were not available.

Progress of Transplanted Pronghorns

Of the transplants made during the mid-1960's, only those from

release, can be determined.

A total of 1,149 pronghorns was counted during the 1979 statewide winter survey, and the total statewide population was estimated at 1,300 animals by Terry Funk, Antelope Project Leader, Kansas Fish and Game Commission.

Harvest Trends

Since the first firearms season in 1974, a total of 3,861 applicants have applied for 700 available permits; harvest success has been 96 %. The first archery season was held in 1979 and 346 applicants have applied for 370 total permits available. The five-season archery success has been 10 %. Table 1 is a summary of harvest trends for firearms and archery seasons.

Because the number of firearms applicants exceeds permits available at a rate of five-to-one, successful applicants are limited in obtaining another permit for three years, with unsuccessful and new applicants given first priority in the next year's permit drawing. This limitation on successful applicants was imposed by the Kansas Fish and Game Commission in order to allow a greater number of Kansas residents an opportunity to hunt Kansas pronghorns. Only during years when available permits outnumber applications will successful applicants of prior years be considered for a current year's permit.

Since the Kansas resident is, at best, limited to a Kansas firearms pronghorn hunt once every four years, a method of determining the trophy qualities of a pronghorn should increase the quality of the sportsman's pronghorn experience by allowing the sportsman to harvest an animal that is above average in trophy aspects.

It must be remembered that one reason big game animals are hunted

Table 1. Firearms (1974-80) and archery (1976-80) harvest trends (From Funk, 1979).

Year	No. Days	Applications Received	Permits Available	Actual Number of Hunters	Pronghorns Harvested	Percent Success
Firearms						
1974	3	492	80	72	70	97.2
1975	3	262	80	78	76	97.4
1976	3	514	80	77	72	93.5
1977	3	560	100	96	91	95.0
1978	3	596	100	97	90	93.0
1979	3	688	100	94	91	97.0
1980	3	749	160	148	142	95.9
Archery						
1976	5	54	50	42	7	17.0
1977	5	59	60	52	4	8.0
1978	5	87	60	50	4	8.0
1979	5	86	80	73	2	3.0
1980	5	60	120	51	10	19.6

is that a sportsman might have the chance to harvest an animal that has bigger and better horns, or antlers, than any animal of the same species previously harvested. Recognition of the sportsman, by various sportsman's groups, for doing so is one of the rewards of hunting. Therefore, any method that will allow the sportsman to predetermine the trophy qualities of a big game animal will allow the hunter to be more selective in harvesting what the hunter determines to be a quality animal.

One method commonly used to determine the trophy qualities of big game animals is calculation of a size relationship between two anatomical structures. This method is based on a known structural measurement to which an unknown structural measurement is compared. In this manner, relative size of the unknown measurement can be determined.

Since factors that determine a trophy specimen vary among big game species, suitability of the use of a size relationship also varies. Generally, size relationship suitability decreases as factors increase in complexity, as is the case for species bearing antlers, and increases as factors decrease in complexity, as is the case for species bearing horns.

Although there is a dearth of scientific literature on methods of determining big game trophy qualities, authors in popular sporting magazines have used a size relationship when explaining methods of determining a trophy animal. For the pronghorn, most authors have used ear sizes as known measurements to which horn lengths have been compared.

O'Gara (1980) stated that an ear is five to six inches long and a buck's head is about 13 inches long from nose tip to the back of the head, and horns standing nearly as high as the length of the head should be of record class. Adams (1979) noted that if horn prongs start above

ear tips and, if horns have light-colored tips, the animal is an above-average specimen. Both Strung (1971) and Farmer (1975) observed that if the horns look at least twice the size of the animal's alert, upright ears, the animal is of trophy class. Barrus (1974) noted that a mature buck pronghorn will have ears that are six inches long and, from ear size, horn and prong lengths can be estimated. Milek (1979) noted that horn lengths can be judged accurately by comparing horn length to ear and face lengths which measure 5.5 to six and 12 inches, respectively.

Since the ear length to horn length relationship seems to be the most common method of determining trophy aspects of pronghorns, the purpose of this study was to statistically evaluate pronghorn ear and horn size relationships and determine their suitability for use in estimating horn and prong length and horn base circumference.

STUDY AREA

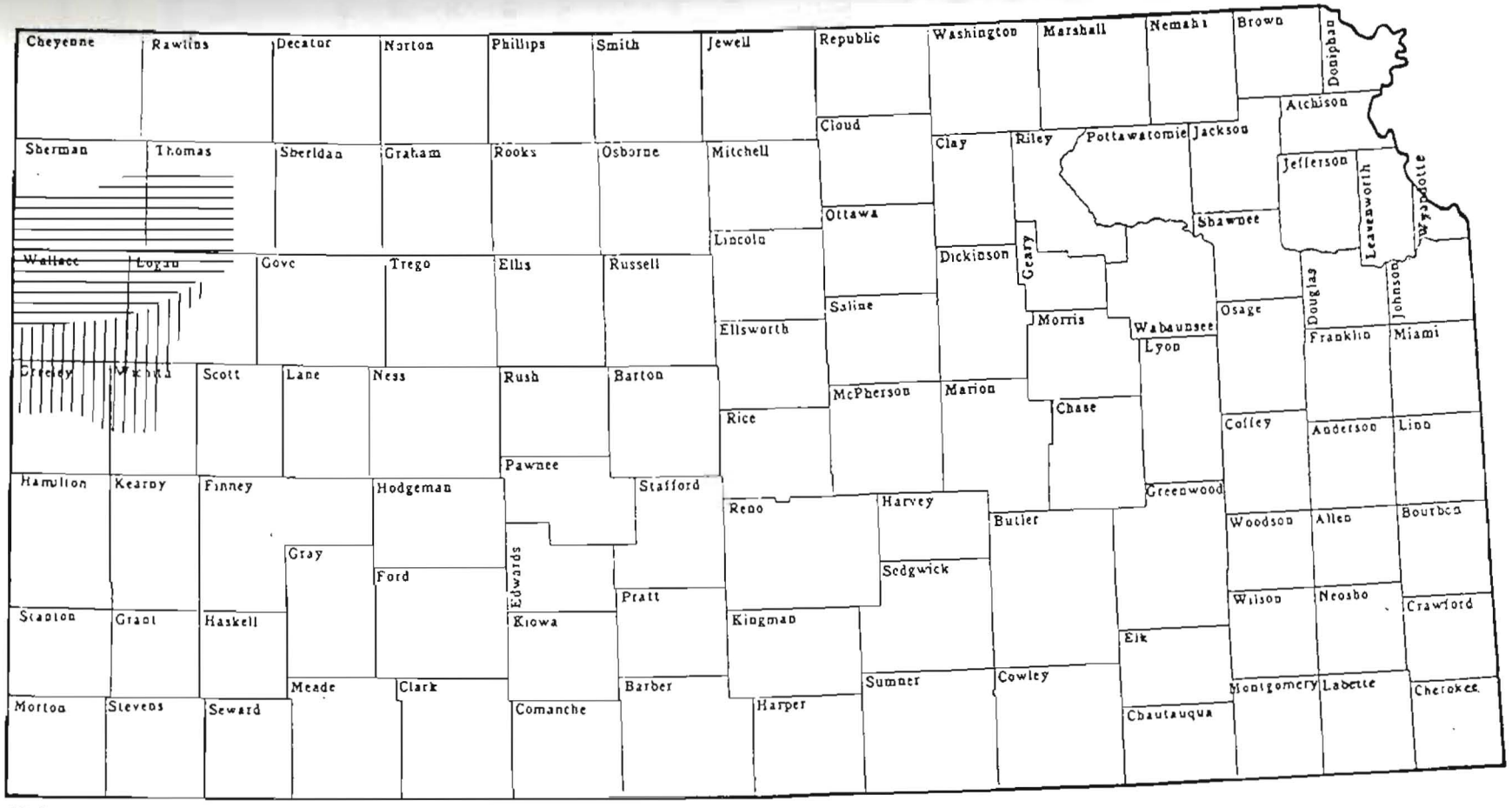
Since 1974 the area open to pronghorn hunting in Kansas has been in the High Plains of western Kansas and includes all of Wallace County and portions of Sherman, Thomas, Logan, Wichita, and Greeley counties (Figure 3).

Kuchler (1974) described the general area as a northern grama-buffalograss prairie of fairly dense stands of short graminoids with somewhat taller grasses in the eastern sections. Blue Grama, Bouteloua gracilis, and Buffalograss, Buchloe dactyloides, are the dominant native grasses.

For hunting purposes, the six county area is divided into two management units bounded on the north by U.S. Interstate Highway 70, on the east by Kansas Highway 25 (K25), and on the south by K96. U.S. 40 serves as the southern boundary of Unit One and the northern boundary of Unit Two. K27, which runs from Goodland south through Sharon Springs to Tribune, is the only other major roadway in the area. Major cities and towns are Goodland, Colby, Leoti, Tribune, and Sharon Springs.

Unit One has been open to hunting since the first Kansas hunting season in 1974. Unit Two was first open to hunting in 1980.

Since the Sherman and Logan Wildlife Areas are the only public hunting areas in the six counties, most hunting is done on private farms and ranches. Main agricultural practices are cow-calf ranching operations and wheat farming, although some corn and sorghum are grown with the aid of irrigation.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Nemaha
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Riley
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Pawnee
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Haskell
Ford
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Pratt
Kingman
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Wilson
Neosho
Crawford
Meade
Clark
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Morton
Stevens
Seward
Comanche
Harper
Sumner
Cowley
Chautauqua
Montgomery
Labette
Cherokee

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METHODS AND MATERIALS

Data Collection

Data were collected at the Sharon Springs pronghorn check station from animals legally harvested during the Kansas firearms seasons of 1979 and 1980. Seasons were the first Saturday, Sunday, and Monday in October of both years.

Two ear and four horn measurements, from both right and left sides of each animal, were recorded from each of 96 male pronghorns during the two years. The only requirement that had to be met before an animal was measured, was that horns and prongs be undamaged. Since horns of females usually do not exceed ear length, they were not used in this study.

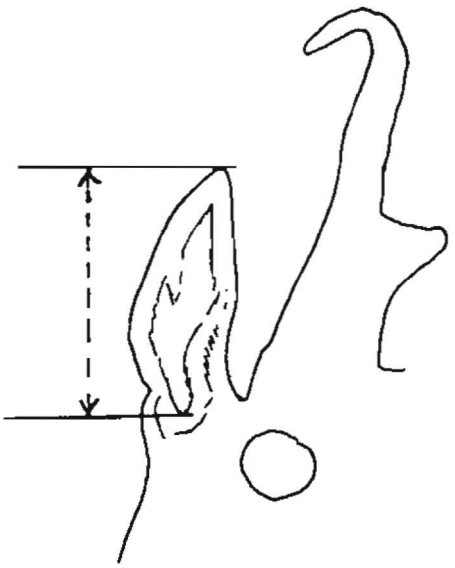
One ear measurement was the conventional ear length used by mammalogists, the distance from the bottom of the ear notch to the tip of the ear cartilage (Figure 4). This ear measurement, referred to as back of ear length (BEL), was recorded to allow comparison of ear lengths from other studies with those of this study. The second ear measurement was the distance from the junction of the ear and skull to the tip of the ear (Figure 5). This ear measurement, referred to as the front of ear length (FEL), was used as the known measurement to which unknown horn measurements were compared.

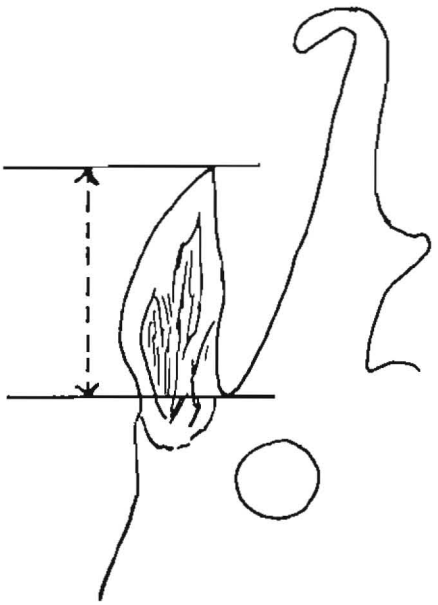
The four horn measurements were: total horn length, distance from ear tip to top of horn curve, prong length, and horn base circumference. Total horn length, prong length, and base circumference measurements were taken in accordance with Boone and Crockett Club, keeper of North American big game records, instructions for measuring pronghorn trophies.

Total horn length was determined by measuring along the center of

Figure 4. Conventional ear length used by mammalogists. Referred to as the Back of the Ear Length (BEL).

Figure 5. Distance from junction of ear and skull to tip of ear. Referred to as the Front of the Ear Length (FEL).





the outer horn surface from a point in line with the lowest edge of base to tip of horn (Figure 6).

Distance from ear tip to top of the horn curve was determined by pulling the ear in contact with the horn and measuring from that point where the ear touched the horn to the top of the horn curve, following the outer surface of the horn (Figure 7). In those animals where there was no definite horn curve, this measurement was from the point where the ear touched the horn to the tip of the horn, following the outer surface of the horn.

Prong lengths were determined by measuring from tip of the prong to the back edge of the horn, following the upper edge on the outer horn surface (Figure 8).

Horn base circumferences were determined by measuring around the base at right angles to the horn axis (Figure 9).

Ear lengths were measured, with a plastic ruler, to the nearest 1/8 inch (later converted to millimeters). Reasons for horns being measured in inches instead of millimeters is that Boone and Crockett Club instructions call for measurements to the nearest 1/8 inch and that hunters usually wanted to know the length of their animal's horns. By measuring horns in inches, the hunter was told horn length without converting millimeters to inches.

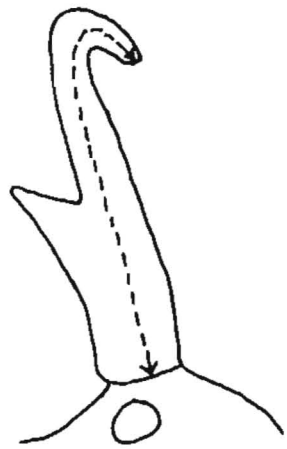
Data Analysis

All numerical data were analyzed with a Texas Instruments TI-55 calculator using appropriate statistical tests.

To facilitate data analysis, a subsample of 30 pronghorns was randomly selected, using a table of random numbers, from the total

Figure 6. Total horn length measurement.

Figure 7. Distance from ear tip to top of horn curve measurement.



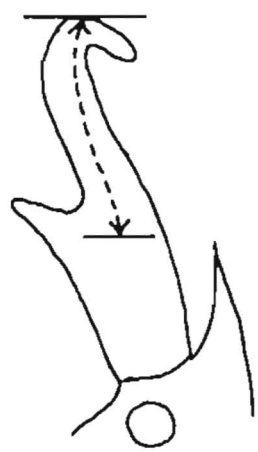


Figure 8. Prong length measurement.

Figure 9. Horn base circumference measurement.

animals measured for each year. To assure that each year's subsample was a true representative of the year's total sample, the total sample was divided into age classes from one year to four-plus years and the percentage of each age class determined. An equal percentage for the subsample was then randomly selected from the total number of animals measured in that age class for that year. This selection process provided a subsample with an age class percentage equal to that of the year's total sample.

Both ear measurements were analyzed to determine mean ear lengths for right, left, and both ears combined. Student's t-test, at the 0.05 level of significance, was performed to determine if significant differences existed between right and left FEL and BEL for each year, between 1979 and 1980 FEL and BEL right and left ear measurements, between FEL and BEL of the total sample and the subsample, and between mean BEL of this study and mean ear lengths as reported in the literature.

An index number for right and left sides of each pronghorn was calculated by dividing the distance from ear tip to top of horn curve by the mean length of the FEL. This index number represented the number of mean FEL of horn present from ear tips to top of horn curves.

Index numbers were used as Y coordinates in a linear regression with total horn lengths as X coordinates. After all X and Y coordinates were entered, horn lengths for index numbers representing 1/4 ear length, from zero through three (i.e., 0.000, 0.250, 0.500, 0.750 . . . . . 3.000), were computed. Reasons for computing horn lengths for 1/4 ear lengths were mainly to provide points for correlation diagrams and because it was believed that 1/4 ear lengths would be easier to determine in actual field practice than smaller increments if a favorable

correlation was found to exist.

Linear regressions were also performed between total horn lengths and prong lengths and between total horn lengths and base circumferences. Prong lengths and base circumferences were computed for horn lengths determined by the linear regression between index numbers and total horn lengths.

Linear regressions allowed computation of total horn lengths, prong lengths, and base circumferences for any increment (from zero through three) of mean FEL of horn present from ear tips to top of horn curves.

RESULTS AND DISCUSSION

Ear Lengths

Mean ear length, right and left ears combined, of the total sample (n = 192) was 143.4 mm for the FEL and 144.4 mm for the BEL. Ranges of ear measurements were 40 mm (125 to 165 mm) for the FEL and 45 mm (120 to 165 mm) for the BEL. Student's t-test showed no significant difference between FEL and BEL of the total sample.

Mean ear lengths, right and left ears combined, of the subsample (n = 120) were 143.6 mm for FEL and 143.9 for BEL. Subsample ear length ranges were 40 mm (125 to 165 mm) for FEL and 42 mm (123 to 165 mm) for BEL. Student's t-test showed no significant difference between FEL and BEL of the subsample.

Figure 10 shows mean ear lengths, ranges, and one standard deviation of FEL and BEL of the total sample and subsample. Student's t-test indicated no significant difference between FEL and BEL of the total sample and subsample.

Figures 11 and 12 compare mean FEL and BEL, ranges and one standard deviation of the subsample for 1979, 1980, and 1979-1980 combined, respectively. Student's t-test indicated no significant difference between FEL of 1979, 1980, and 1979-1980 combined; between BEL of 1979, 1980, and 1979-1980 combined; and between FEL and BEL of 1979, 1980, and 1979-1980 combined.

Subsample ear lengths were within the 5.5 to six inch range as reported by O'Gara (1980) and Milek (1979). However, ear lengths were shorter than the six inches reported by Barrus (1974). Figure 13 compares ear lengths and ranges of BEL of this study and mean ear lengths and ranges of those reported in the literature. Student's t-test

Figure 10. Mean ear lengths, ranges, and one standard deviation (box) of BEL and FEL of the total sample and subsample for 1979-1980 combined.

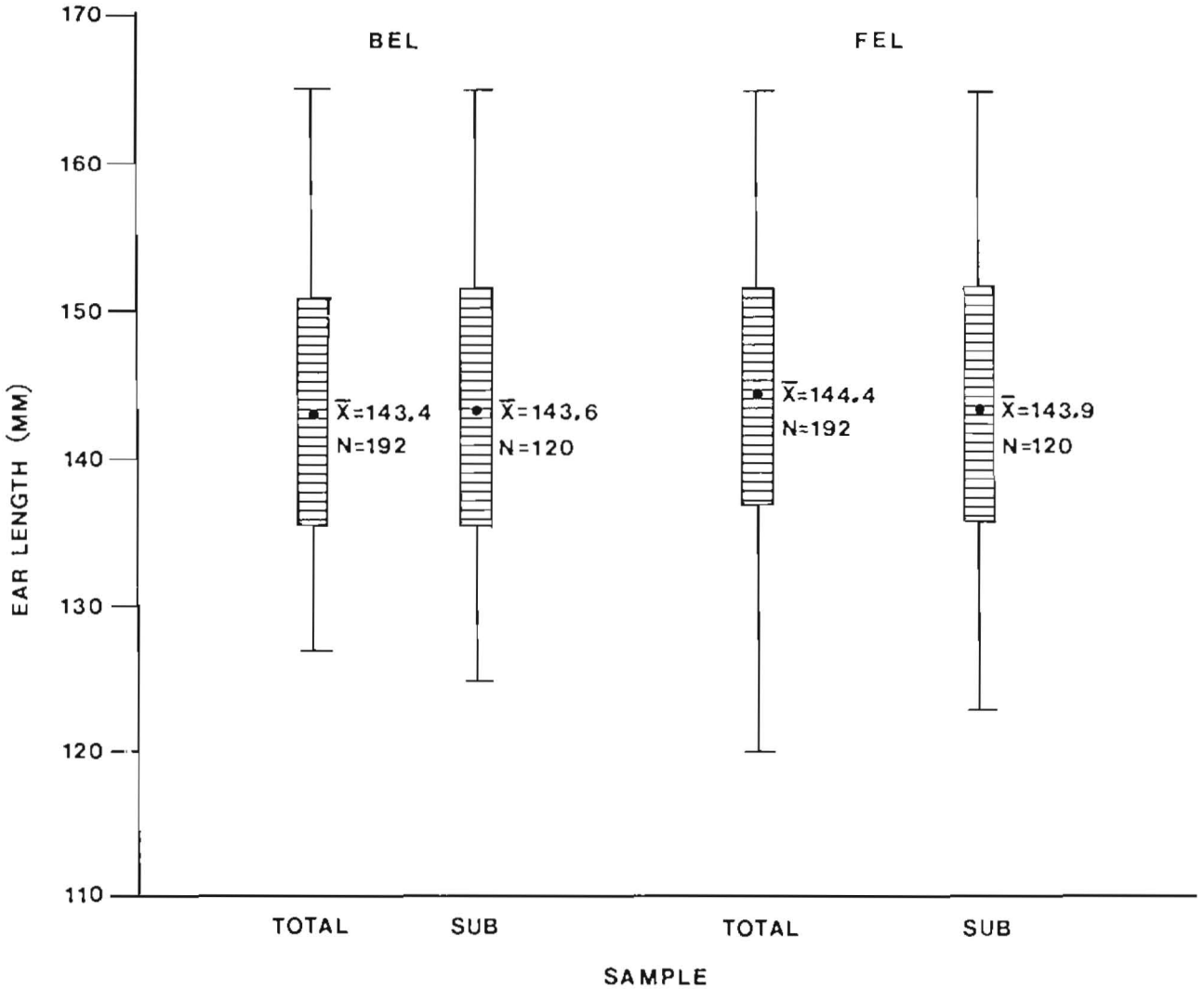

BEL
FEL
170
160
150
140
130
120
110
EAR LENGTH (MM)
X̄=143.4
N=192
X̄=143.6
N=120
X̄=144.4
N=192
X̄=143.9
N=120
TOTAL
SUB
TOTAL
SUB
SAMPLE

Figure 11. Mean ear lengths, ranges, and one standard deviation (box) of the subsample for 1979, 1980, and 1979-1980 combined of the FEL.

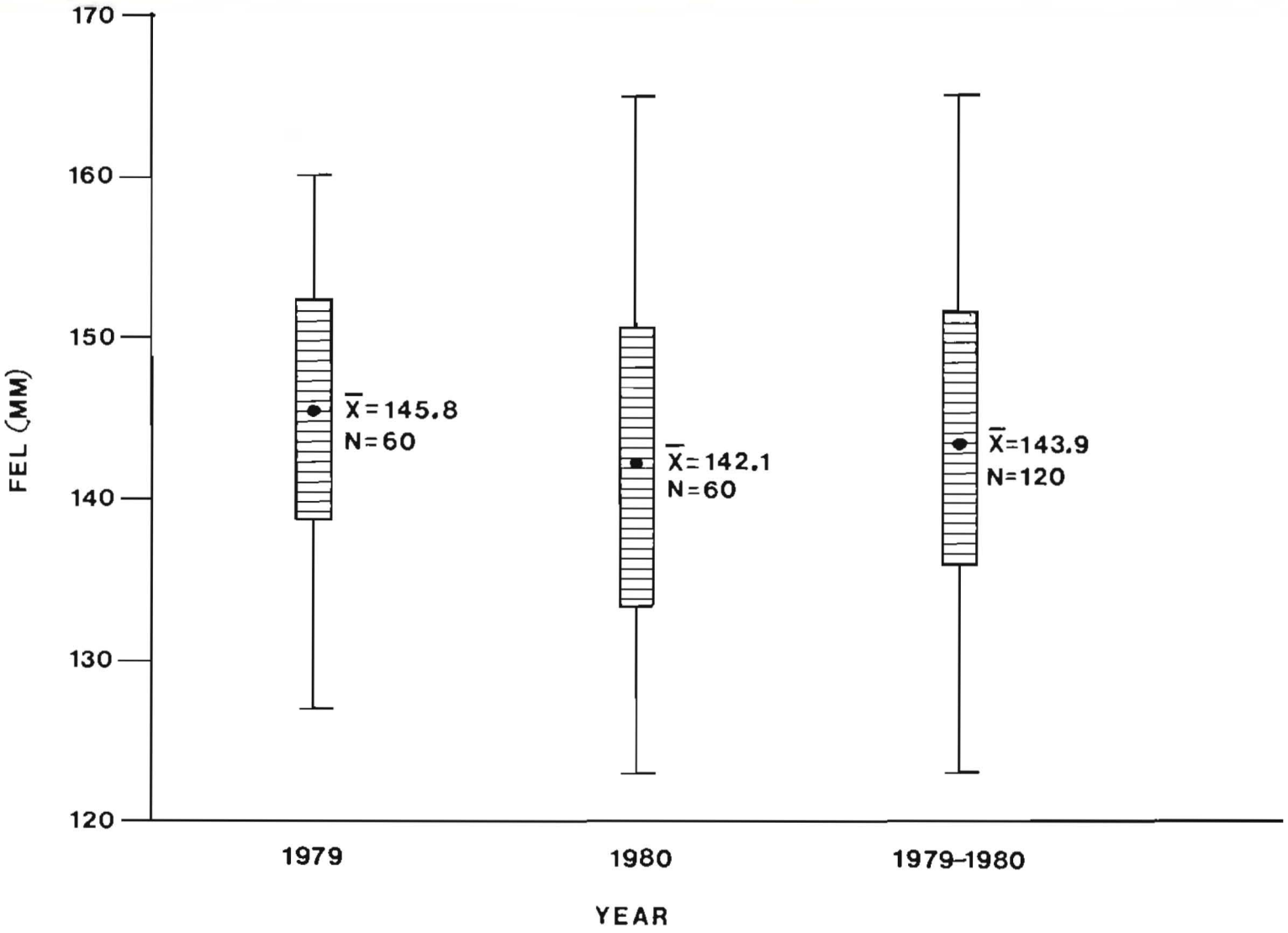

170
160
150
140
130
120
FEL (MM)
X̄ = 145.8
N = 60
X̄ = 142.1
N = 60
X̄ = 143.9
N = 120
1979
1980
1979–1980
YEAR

Figure 12. Mean ear length, range, and one standard deviation (box) of the subsample for 1979, 1980, and 1979-1980 combined of the BEL.

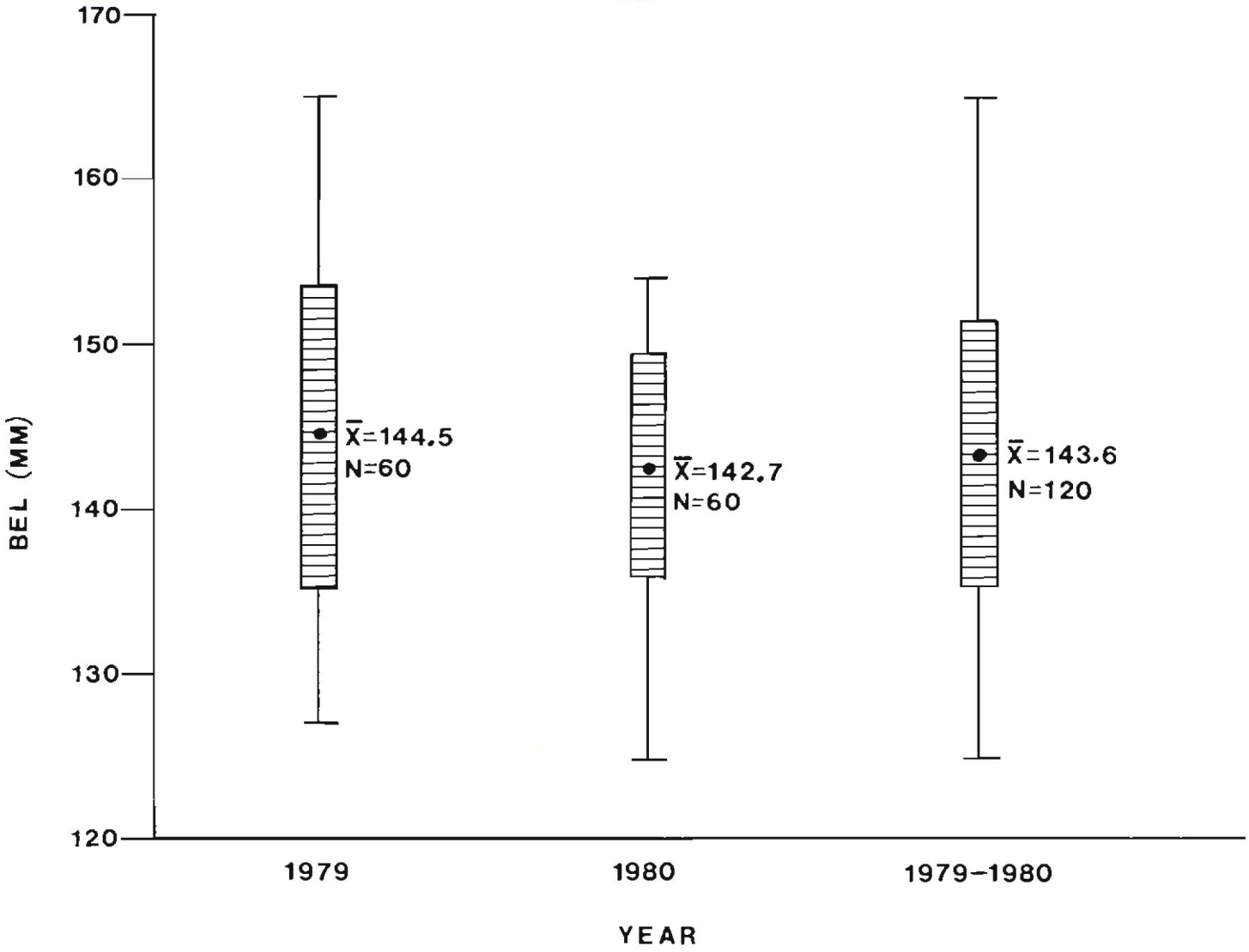
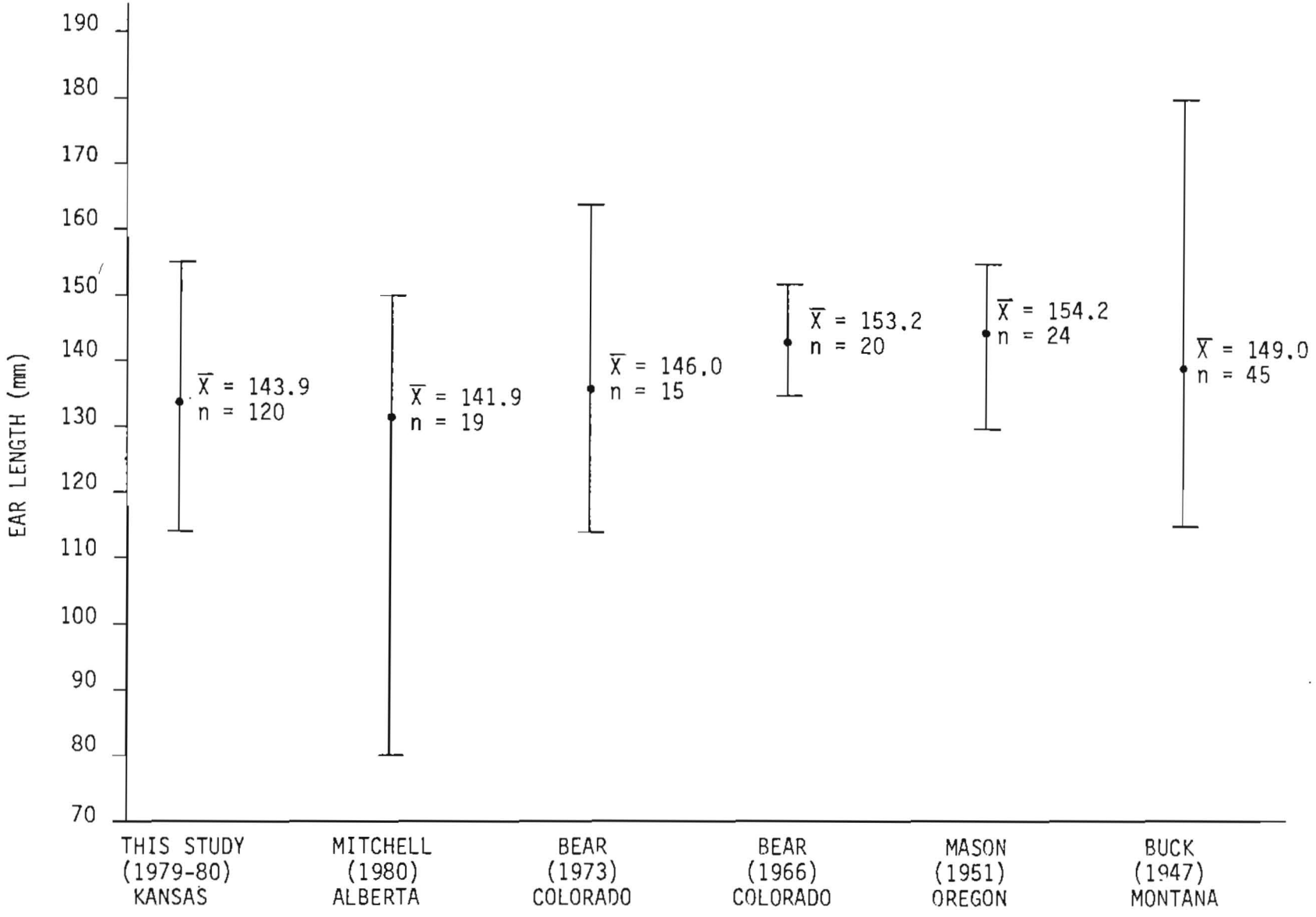

170
160
150
140
130
120
BEL (MM)
X̄=144.5
N=60
X̄=142.7
N=60
X̄=143.6
N=120
1979
1980
1979–1980
YEAR

Figure 13. Comparison of reported ear lengths and ranges and those of this study.


EAR LENGTH (mm)
190
180
170
160
150
140
130
120
110
100
90
80
70
X̄ = 143.9
n = 120
X̄ = 141.9
n = 19
X̄ = 146.0
n = 15
X̄ = 153.2
n = 20
X̄ = 154.2
n = 24
X̄ = 149.0
n = 45
THIS STUDY (1979-80) KANSAS
MITCHELL (1980) ALBERTA
BEAR (1973) COLORADO
BEAR (1966) COLORADO
MASON (1951) OREGON
BUCK (1947) MONTANA

indicated no significant difference existed between mean ear lengths of this study and those reported by Bear (1973), by Buck (1947), or by Mitchell (1980). However, a significant difference did exist between those of this study and those reported by Bear (1963) and Mason (1951).

Mean ear lengths of three Antilocapra subspecies, as reported by Mitchell (1980) and O'Gara (1980), are listed in Table 2. While statistical tests were not performed between these ear lengths and ear lengths from this study, the latter are comparable to those of A. a. americana and shorter than those of A. a. oregona and A. a. mexicana.

Index Numbers

Since index numbers were determined by dividing the distance from ear tips to top of horn curves (Figure 7) by FEL (143.6 mm), they represent the number of mean FEL of horn present from ear tips to top of horn curves, and not total horn lengths. Index numbers ranged from 0.132 to 1.636.

Table 3 lists a representative sample of index numbers, distances from ear tip to top of horn curves, and total horn length of five pronghorns. Table 3 shows that total horn lengths increase and distances from ear tip to top of horn curves increase as index numbers increase in numerical value. Also evident is a certain amount of variation between right and left sides of the same animal. Of the five animals represented in Table 3, only animal number five was symmetrical for the three parameters of the table.

Linear Regressions

Linear regressions between index numbers and total horn lengths, between prong lengths and total horn lengths, and between base circumferences and total horn lengths are shown in Figures 14, 15, and 16,

Table 2. Mean ear lengths of three subspecies of Antilocapra, as reported by Mitchell, 1980, and O'Gara, 1980.

Subspecies	Sample Size	Ear Length	Location	Authority
americana	36	150	Montana	Buck (1947)
	27	145	Montana & Yellowstone National Park	O'Gara (1968)
	16	143	Alberta	Mitchell (1971)
	15	145	Colorado	Bear (1973)
oregona	251-359	163	California	McLean (1944)
	21	155	Oregon & Nevada	Mason (1952)
mexicana	1	152	Texas	Buechar (1944)
	4	157	Southern Arizona and New Mexico	U.S. Nat. Museum

Table 3. Representative sample (n = 5) of (A) index numbers, (B) distance from ear tip to top of horn curve, and (C) total horn length. R indicates right side and L indicates left side of the same animal.

Specimen	Side	A	B (mm)	C (mm)
1	R	0.446	64	197
	L	0.355	51	197
2	R	1.462	210	356
	L	1.462	210	352
3	R	1.281	184	327
	L	1.372	197	333
4	R	1.107	159	308
	L	1.149	165	318
5	R	0.975	140	279
	L	0.975	140	279

Figure 14. Linear regression between index numbers and total horn lengths.

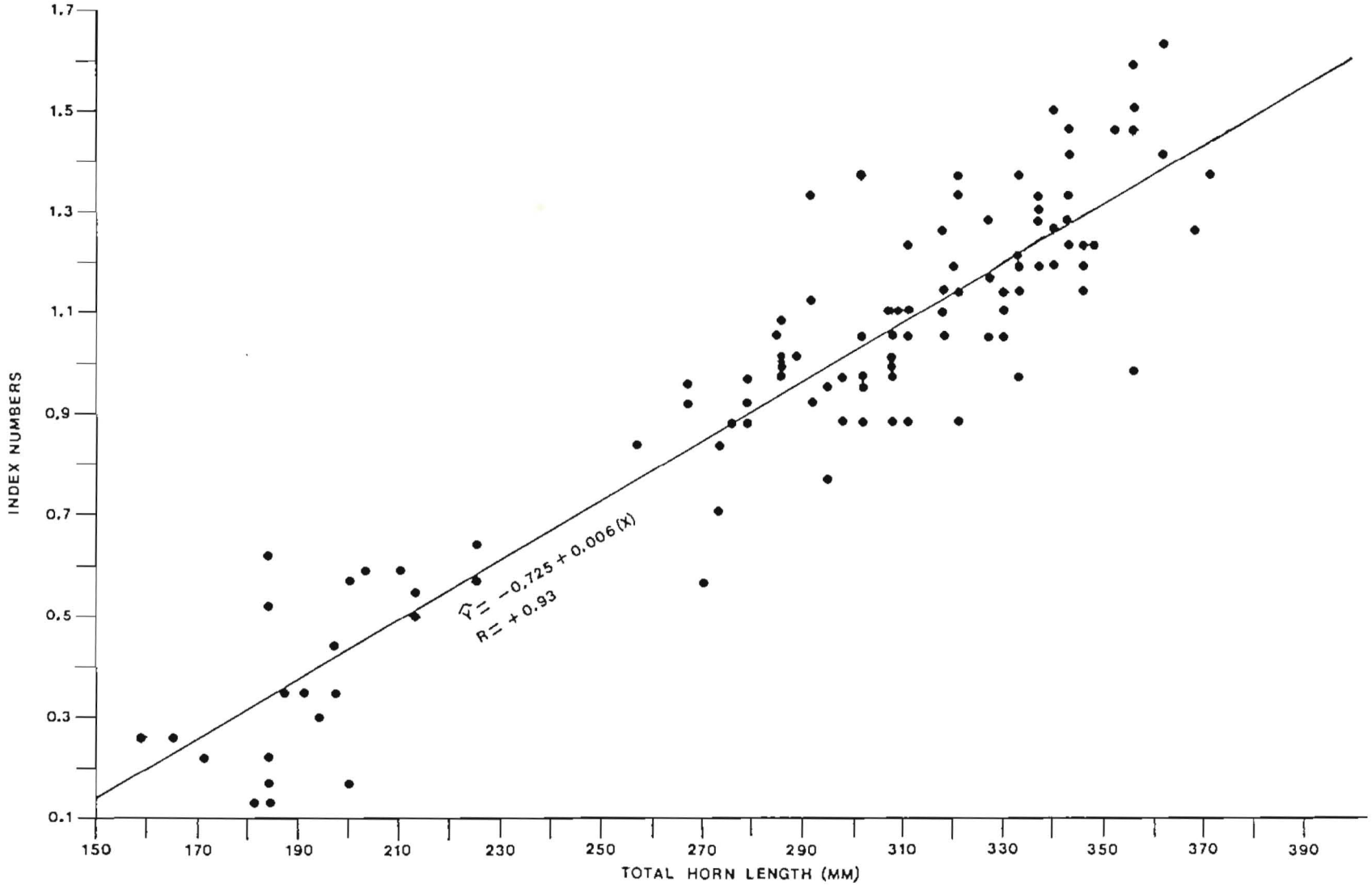

INDEX NUMBERS
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)
$\hat{Y} = -0.725 + 0.006(X)$
$R = +0.93$

Figure 15. Linear regression between prong lengths and total horn lengths.

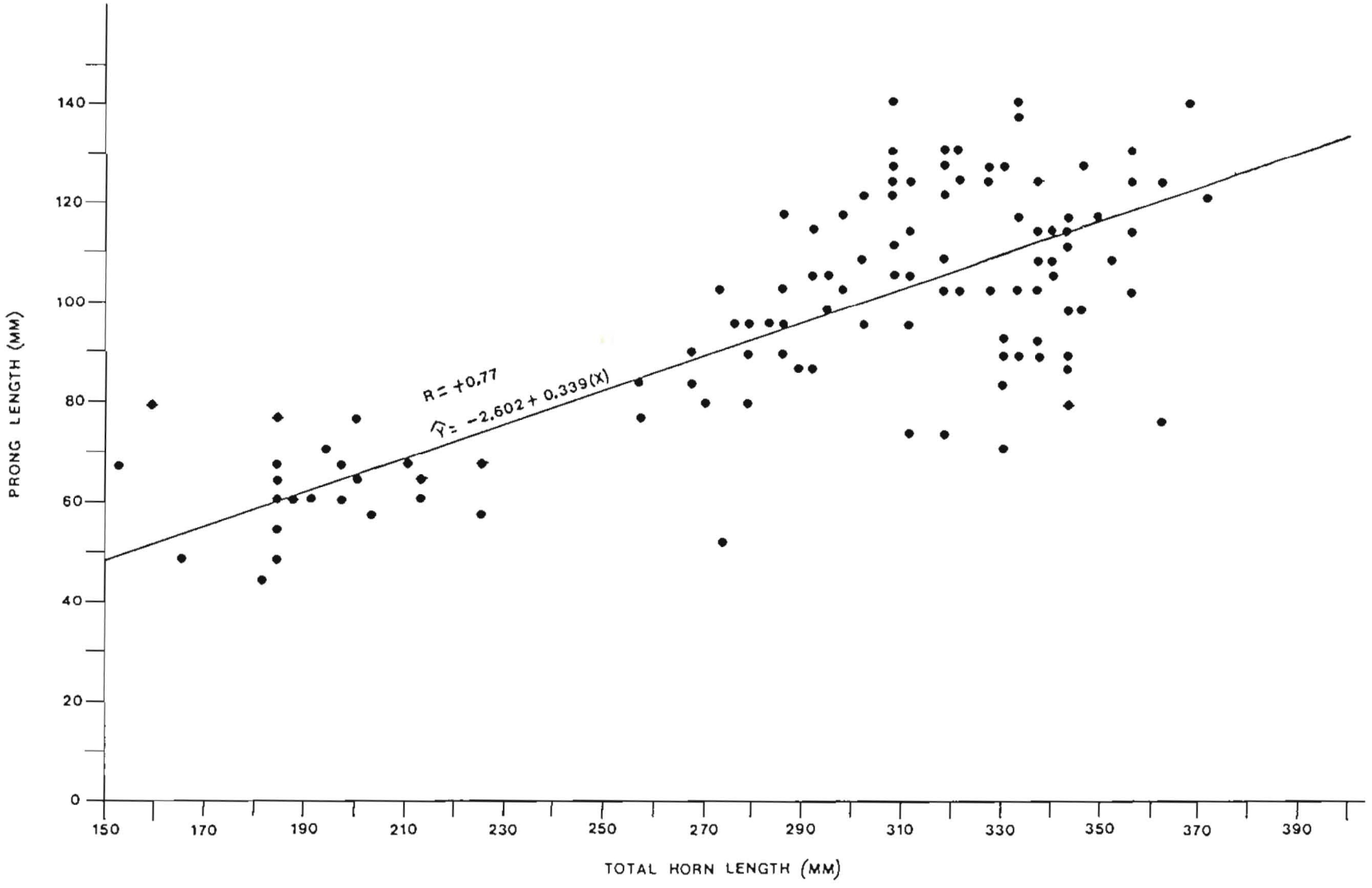
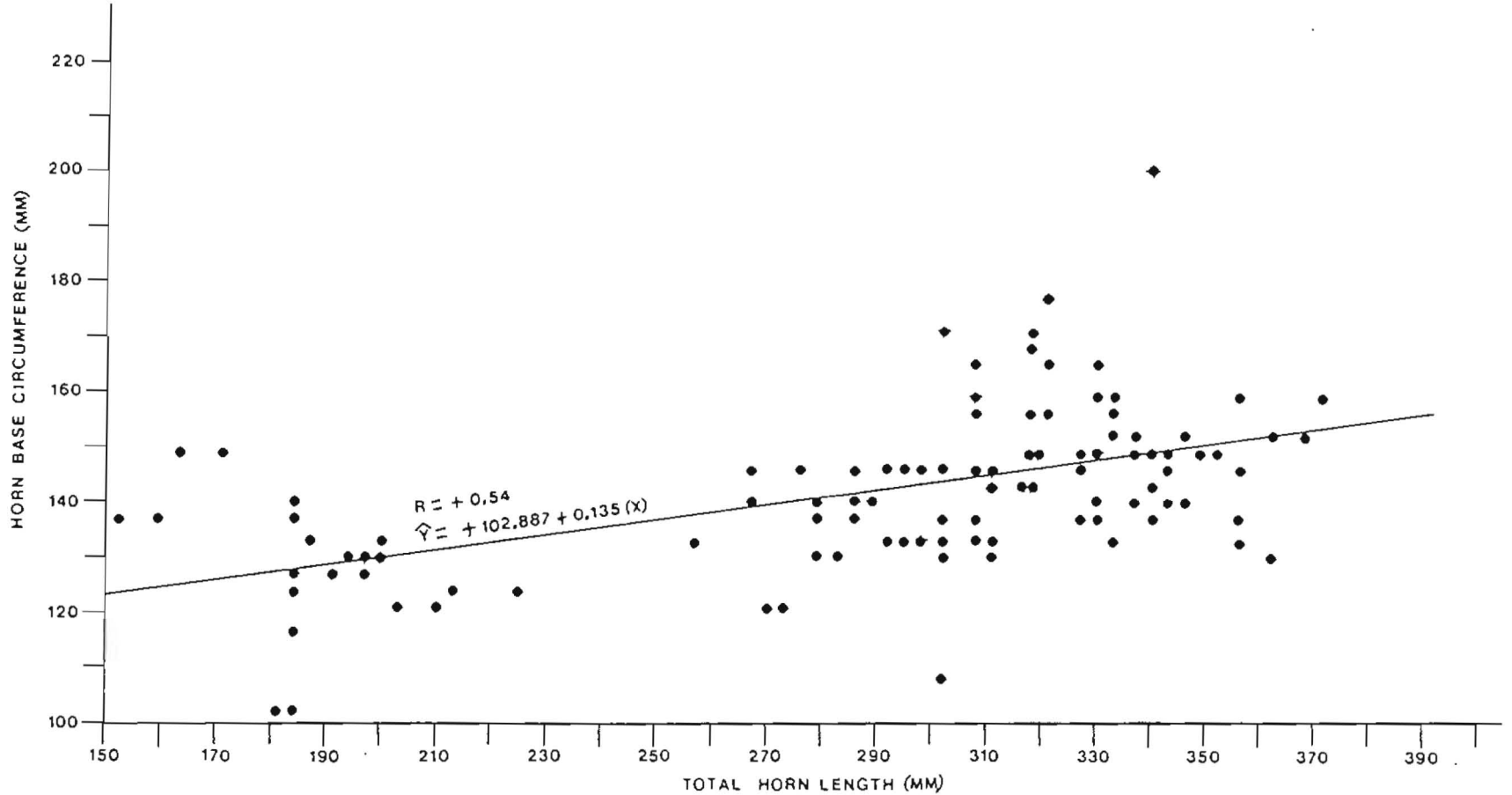

PRONG LENGTH (MM)
0
20
40
60
80
100
120
140
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)
R = +0.77
$\hat{Y}$ = -2.602 + 0.339(X)

Figure 16. Linear regression between horn base circumferences and total horn lengths.


HORN BASE CIRCUMFERENCE (MM)
220
200
180
160
140
120
100
R = + 0,54
Ŷ = + 102,887 + 0,135 (X)
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)

respectively. Correlation coefficients were + 0.93 between index numbers and total horn lengths, + 0.77 between prong lengths and total horn lengths, and + 0.54 between base circumferences and total horn lengths. Correlation coefficients are valid at P = 0.001.

In each linear regression there is an increase in Y coordinates as X coordinates increase. This increase is more evident in regressions between index numbers and total horn lengths and between prong lengths and total horn lengths than between base circumferences and total horn lengths, as the correlation coefficients indicate.

Once all X and Y coordinates were entered in the calculator, it was possible to compute an X value for any Y value and a Y value for any X value. Figure 17 shows the linear regression between index numbers and total horn lengths. Computed horn lengths for index numbers representing 1/4 mean FEL, from 0.250 through 1.150, of horn present from ear tips to top of horn curves are indicated by solid circles on the regression line.

Solid circles on regression lines of Figures 18 and 19 indicate computed prong length and base circumferences, respectively, for computed horn lengths. Table 4 lists computed horn lengths, prong lengths, and base circumferences for index numbers representing 1/4 mean FEL, from zero through three, of horn present from ear tips to top of horn curves.

Practical Applications

Any method of estimating trophy qualities of big game animals before actual harvest will have inherent problems. The method of using the number of ear lengths of horn present from ear tips to top of horn curves has several weaknesses, the most important being the ability of

Figure 17. Linear regression between index numbers and total horn lengths. Computed horn lengths for 0.25 ear lengths from 0.25 through 1.50, are indicated by solid circles on the regression line.

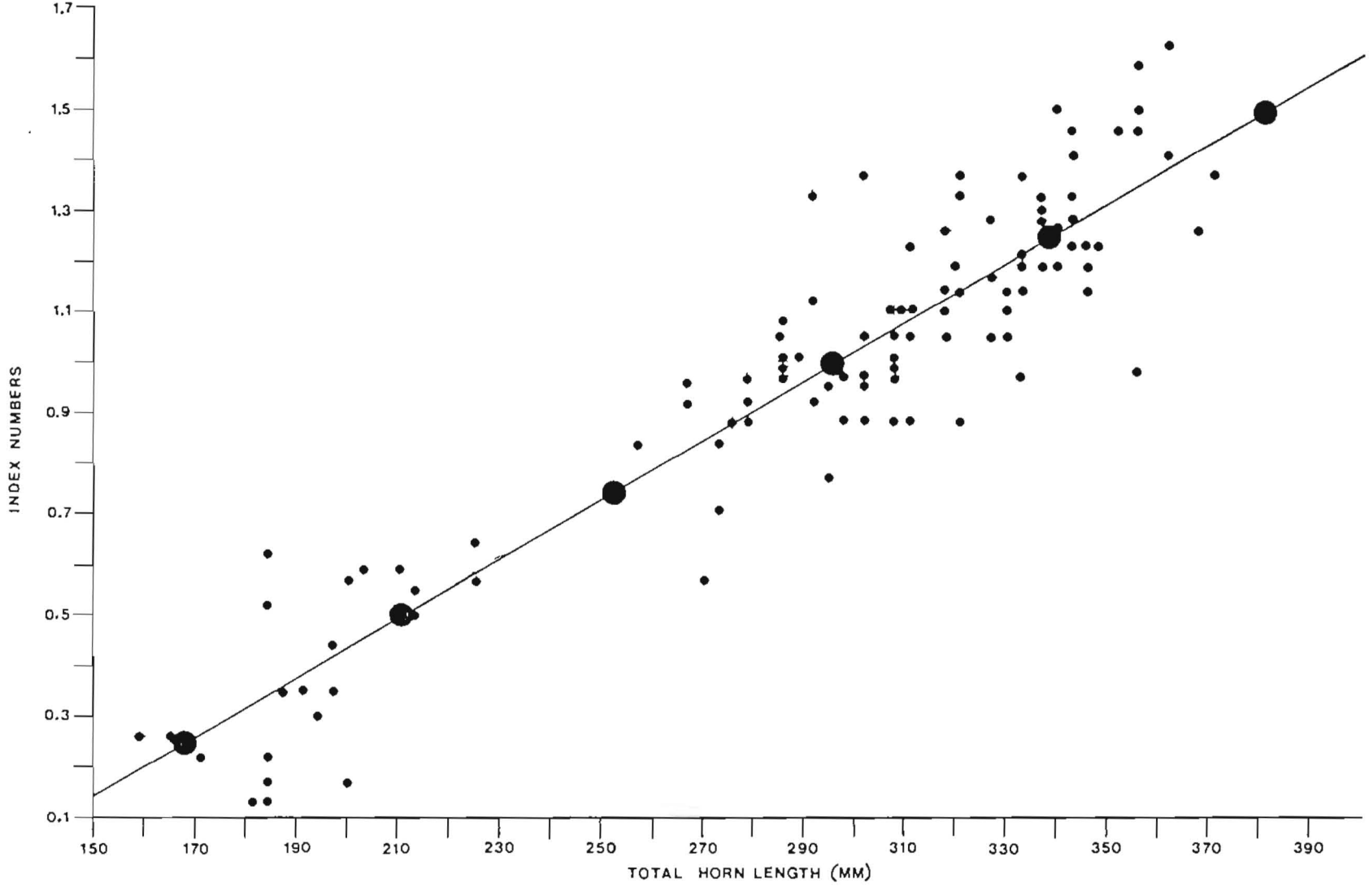

INDEX NUMBERS
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)

Figure 18. Linear regression between prong lengths and total horn lengths. Computed prong lengths for the computed horn lengths of Figure 17 are indicated by the solid circles on the regression line.

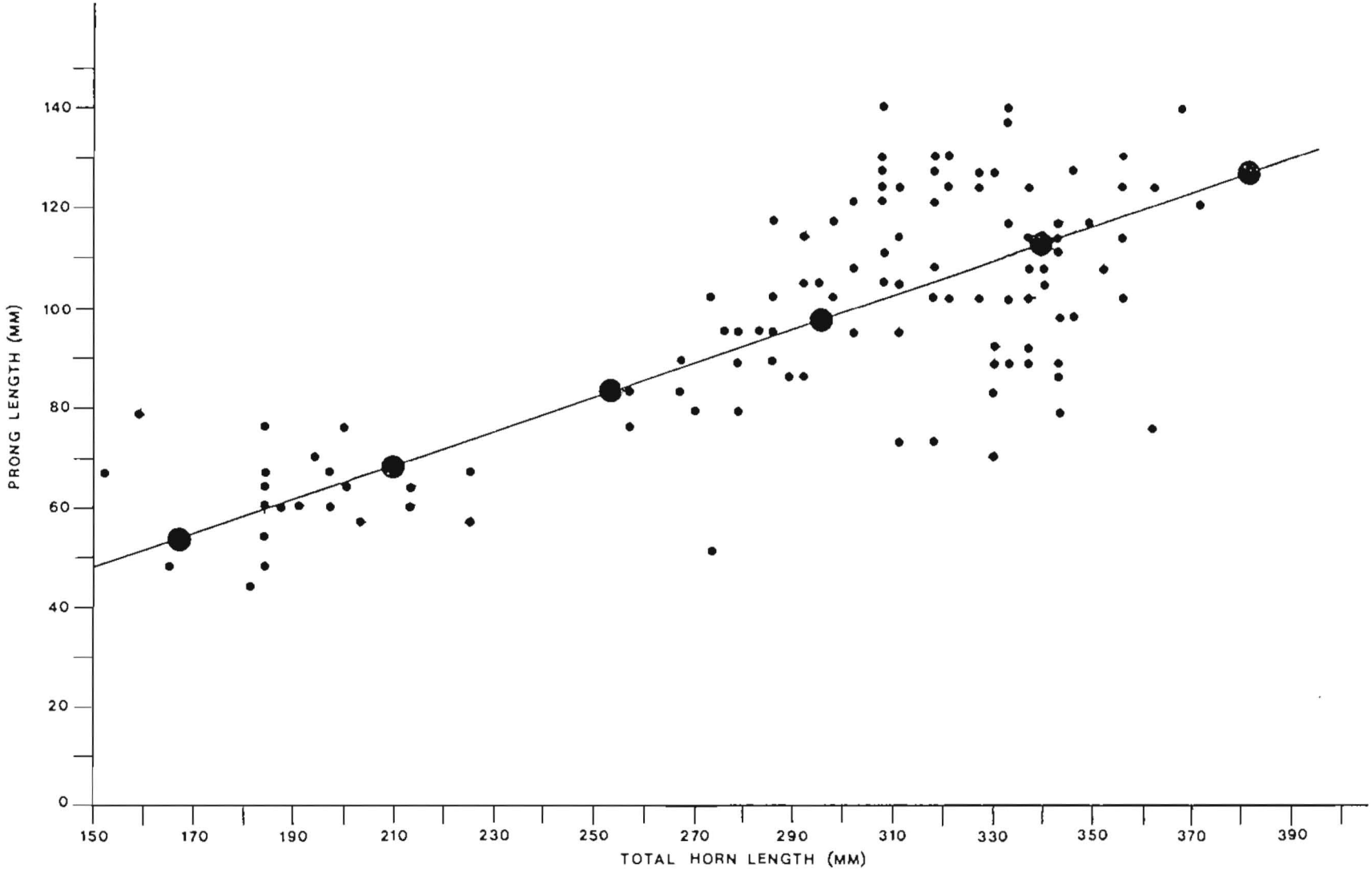

PRONG LENGTH (MM)
0
20
40
60
80
100
120
140
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)

Figure 19. Linear regression between horn base circumferences and total horn lengths. Computed base circumferences for the computed horn lengths of Figure 17 are indicated by solid circles on the regression line.

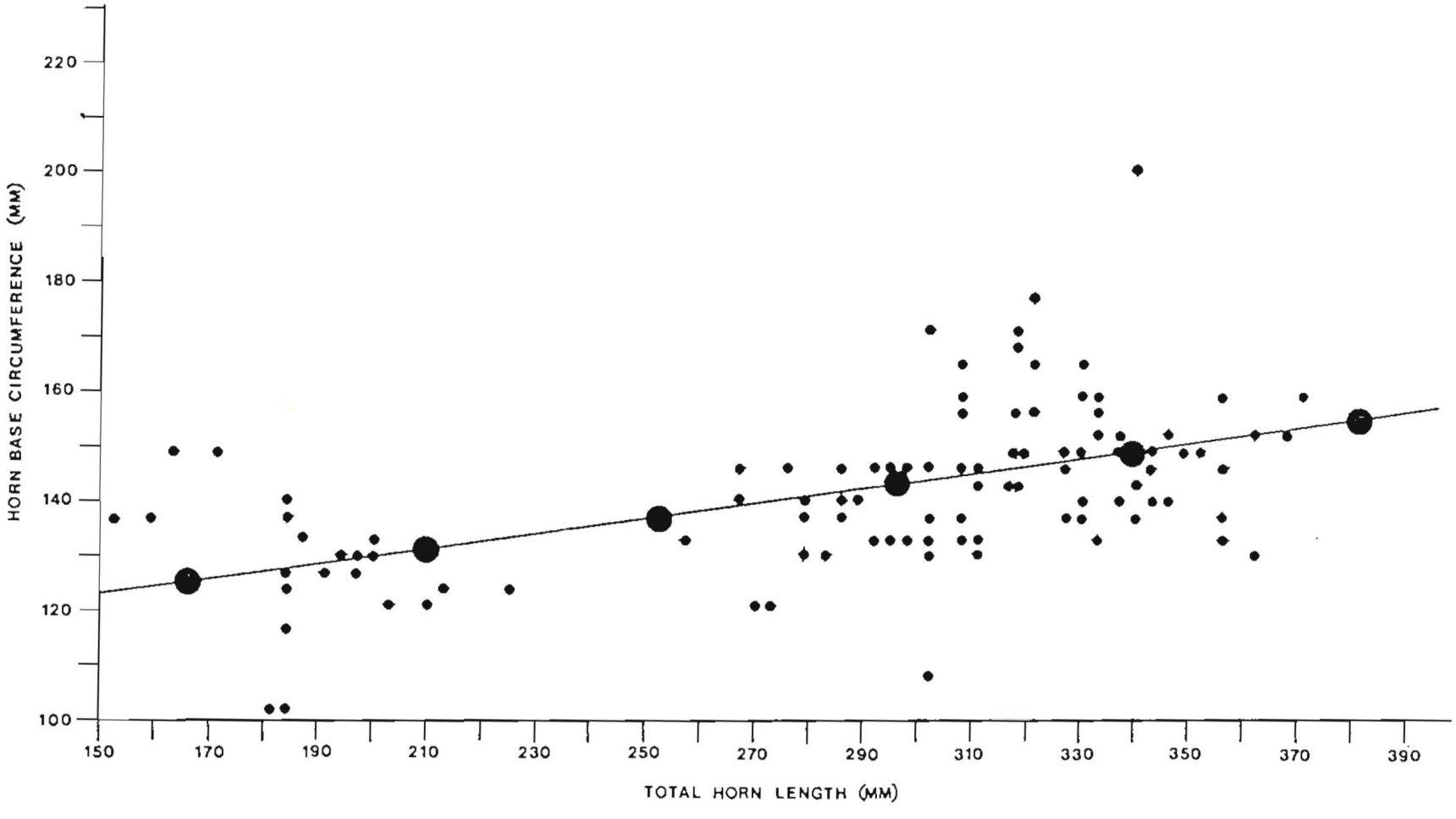

HORN BASE CIRCUMFERENCE (MM)
220
200
180
160
140
120
100
150
170
190
210
230
250
270
290
310
330
350
370
390
TOTAL HORN LENGTH (MM)

Table 4. Computed horn lengths and corresponding computed prong lengths and base circumferences for index numbers representing 1/4 ear lengths, from zero through three.

	Computed Measurements (mm)		
Ear Lengths	Horn Length	Prong Length	Base Circumference
0.00	124.5	39.6	119.7
0.25	167.4	54.2	125.4
0.50	210.3	68.7	131.2
0.75	253.2	83.3	137.0
1.00	296.1	97.8	142.8
1.25	339.1	112.4	148.6
1.50	382.0	127.0	154.3
1.75	424.9	141.5	160.1
2.00	467.8	156.1	165.9
2.25	510.7	170.6	171.7
2.50	553.6	185.2	177.5
2.75	596.5	199.7	183.2
3.00	639.5	214.3	189.0

the individual to determine the number of ear lengths present from the tip of the ear to the top of the horn curve.

During the 1980 Kansas firearms pronghorn season, an attempt was made to test the accuracy of this method. Every successful permit applicant received a copy of the form (Figure 20) along with their pronghorn hunting permit. The table in Figure 20 was compiled from data collected at check stations during the 1979 firearms season. It was hoped that pronghorn hunters would use the method and thereby provide hunter-input on the actual usage of the method.

Of the 120 successful pronghorn permit applicants, a total of 86 (72 %) returned the cards as requested. Nine (10 %) of the 86, indicated that they used the method to determine which animal to harvest. Of these nine hunters, seven indicated that horn measurements were what they expected and two indicated that horn lengths were shorter than they expected.

Since only 8 % of all 1980 Kansas firearms pronghorns hunters indicated that they used the method, no conclusion as to the actual field accuracy of the method of determining horn lengths from ear lengths of pronghorns can be made at this time.

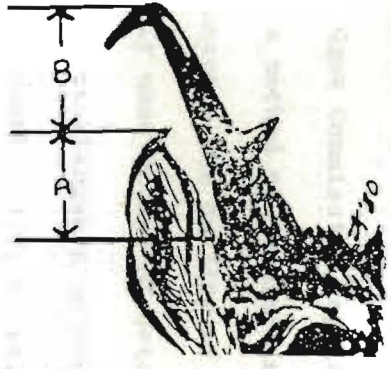
Use of data presented in this study to determine horn lengths, prong lengths, and horn base circumferences of pronghorns should be limited to those subspecies of Antilocapra where statistical tests indicate that there was no significant difference between ear lengths determined by this study and those of the subspecies in question.

Figure 20. Form sent to all successful 1980 Kansas firearms pronghorn permit applicants.

INSTRUCTIONS

To determine approximate total measurements of the horn, prong, and horn base circumference, first estimate the number of ear-lengths of horn from the ear tip to the top of the horn curve (distance A into distance B in illustration).

This number is then found in the left-hand column, and by reading to the right the approximate measurements of the horn, prong, and horn base circumference are found.



For example: It is determined that there are 1½ ear-lengths of horn from the ear tip to the top of the horn curve. After finding 1½ in the left-hand column and by reading to the right the approximate total measurements are found. In this case the horn is found to be 15 inches, the prong 6 inches, and the horn base circumference to be 6 inches.

TABLE

Estimated number of ear-lengths from ear tip to top of horn curve	Approximate measurements in inches		
	Horn Length	Prong Length	Base Circum.
0	5½	2	5
½	9	3	5
1	12	5	5½
1½	15	6	6
2	18	7	6½
2½	21	9	7

QUESTIONS

Please complete this side and return to checkstation operators

Did you use this card in determining which antelope to harvest?

Yes No

If you did use this card in determining which antelope to harvest, were the horn, prong, and horn base circumference measurements what you expected?

Yes No

If the horn measurements were not as you expected:

Were they longer? Or shorter?

Comments: _____

_____

_____

_____

_____

_____

_____

SUMMARY

1. The present Kansas pronghorn population is a product of trapping-transplanting efforts of the Kansas Fish and Game Commission after a 1962 summer survey indicated a total of 56 animals residing in the northwest portion of the state (Hlavachick, 1966b). During trapping-transplanting efforts from 1964 through 1979, a total of 705 pronghorns were trapped in four states and released at 10 sites in nine Kansas counties.

2. Only those animals from Montana released in Wallace and Sherman counties in 1964 have produced a huntable population. From the first Kansas firearms season in 1974 through the 1980 season a total of 3,861 sportsmen have applied for 700 available permits and have harvested 632 pronghorns for a 90 % success (Funk, 1980).

3. Since firearms applicants exceed permits available, Kansas pronghorn hunters are limited to one Kansas pronghorn hunt every four years by Kansas Fish and Game Commission regulations (Funk, 1979). Because of this limitation a method of determining the trophy qualities of a pronghorn should increase the quality of the sportsmens pronghorn hunt.

4. The most commonly used method of determining the trophy qualities of a pronghorn is a size relationship between the ears and horns of the animal (O'Gara, 1980; Adams, 1979; Milek, 1979; Farmer, 1974; Barrus, 1974, and Strung, 1971).

5. The purpose of this study was to statistically evaluate the pronghorn ear and horn size relationship and determine their suitability for use in estimating total horn length, prong length, and horn base circumference.

6. Data consisted of two ear and four horn measurements, from both

right and left sides, of 96 male pronghorns legally harvested during the 1979 and 1980 Kansas firearms pronghorn seasons.

7. To facilitate data analysis, a subsample of 30 animals was selected from each years total. This subsample was selected in a manner which assured an ageclass percentage equal to that of each years total sample.

8. Student's t-test indicated no significant difference between right and left ear measurements of the total sample and subsample, between right and left ear measurements of the subsample, between subsample right and left Front of Ear and Back of Ear measurements, or between Back of Ear measurements of this study and those reported by Bear (1973), or by Buck (1947).

9. Student's t-test indicated a significant difference between Back of Ear measurements of this study and ear measurements reported by Bear (1963) and by Mason (1951).

10. An index number for right and left sides of each animal was determined by dividing the distance from the ear tip to the top of the horn curve by the mean Front of Ear length. Index numbers ranged from 0.132 to 1.636.

11. Linear regressions were performed to determine if a linear relationship exists between index numbers and total horn length ($r = + 0.93$), between prong lengths and total horn lengths ($r = + 0.77$), and between horn base circumferences and total horn lengths ($r = + 0.54$). Total horn lengths, prong lengths, and horn base circumferences were determined for index numbers representing one-quarter mean Front of Ear lengths from zero through three.

12. During the 1980 firearms season an attempt was made to determine the feasibility of the ear/horn size relationship in actual field use by

sportsmen. This attempt was deemed unsuccessful when only eight percent of 1980 Kansas pronghorn firearms hunters responded.

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LITERATURE CITED

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APPENDIX I

APPENDIX I. Subsample data collected during the two years of this study. A = Index Number, B = Front of ear length, C = Back of ear length, D = Distance from ear tip to top of horn curve, E = Total horn length, F = Base circumference, and G = Prong length. R indicates right side and L indicates left side.

ANIMAL NO.		A	B	C	D	E	F	G
1	R	0.884	156	160	127	321	165	102
	L	0.884	159	155	127	308	165	105
2	R	0.132	133	145	19	181	102	44
	L	0.132	140	145	19	184	102	48
3	R	0.884	133	135	127	298	133	102
	L	1.058	140	135	152	283	130	95
4	R	1.372	149	145	197	371	159	121
	L	1.413	152	145	203	362	152	76
5	R	1.260	149	148	181	368	152	140
	L	1.149	149	148	165	346	152	127
6	R	1.058	146	155	152	286	140	95
	L	1.086	165	157	156	286	140	89
7	R	0.884	130	140	127	302	133	95
	L	0.954	127	130	137	295	133	98
8	R	1.017	140	145	146	308	133	111
	L	0.975	146	145	140	302	130	108
9	R	0.174	146	148	25	200	133	64
	L	0.306	159	153	44	194	130	70
10	R	0.996	133	130	143	286	137	102
	L	0.926	127	127	133	279	137	89
11	R	1.107	152	158	159	330	140	70
	L	1.058	156	155	152	330	165	83
12	R	1.191	143	145	171	337	140	89
	L	1.239	140	145	178	343	140	79
13	R	1.191	146	150	171	330	149	92
	L	1.281	152	150	184	337	149	102
14	R	1.372	133	143	197	302	137	121
	L	1.330	152	145	191	292	133	105

APPENDIX I. (Continued)

ANIMAL NO.		A	B	C	D	E	F	G
15	R	1.191	133	145	171	318	149	73
	L	1.107	140	145	159	311	146	73
16	R	1.107	140	145	159	318	143	102
	L	1.149	143	140	165	318	143	108
17	R	1.191	140	144	171	337	149	114
	L	1.330	140	135	191	343	146	114
18	R	0.265	149	155	38	165	149	48
	L	0.223	156	155	32	171	149	0
19	R	0.710	156	149	102	273	121	51
	L	0.578	146	147	83	270	121	79
20	R	1.330	133	146	191	321	175	130
	L	1.260	140	145	181	318	168	127
21	R	0.355	140	150	51	187	133	60
	L	0.355	149	145	51	191	127	60
22	R	0.174	143	158	25	184	137	54
	L	0.223	152	155	32	184	140	60
23	R	1.191	140	140	171	333	156	137
	L	0.975	146	140	140	333	159	140
24	R	0.265	140	140	38	159	137	79
	L	0.223	140	140	32	152	137	67
25	R	1.058	146	145	152	308	137	121
	L	0.884	159	145	127	311	133	105
26	R	1.281	146	152	184	343	140	111
	L	1.239	152	148	178	346	140	98
27	R	1.058	133	148	152	311	143	95
	L	1.058	133	148	152	318	171	108
28	R	1.239	152	145	178	349	149	117
	L	1.239	143	145	178	343	149	117
29	R	0.926	165	144	133	292	146	114
	L	0.773	152	143	111	295	146	105
30	R	1.058	133	144	152	302	171	121
	L	0.975	137	140	140	298	146	117

APPENDIX I. (Continued)

ANIMAL NO.		A	B	C	D	E	F	G
31	R	0.446	150	140	64	197	130	67
	L	0.335	145	140	51	197	127	60
32	R	1.462	145	145	210	356	146	102
	L	1.462	145	150	210	352	149	108
33	R	1.281	145	140	184	327	149	127
	L	1.372	140	150	197	333	152	102
34	R	1.107	140	130	159	308	165	140
	L	1.149	140	130	165	318	168	133
35	R	0.975	150	140	140	279	140	95
	L	0.975	145	150	140	279	137	79
36	R	1.372	135	140	197	321	149	102
	L	1.302	140	145	187	337	140	92
37	R	1.413	135	135	203	343	149	86
	L	1.462	125	135	210	343	149	89
38	R	0.975	150	145	140	286	146	117
	L	0.954	150	155	137	302	146	108
39	R	0.641	145	150	92	225	124	67
	L	0.578	145	155	83	225	124	57
40	R	0.962	145	145	133	267	146	83
	L	0.962	150	160	133	267	140	89
41	R	1.058	150	150	152	327	146	102
	L	1.128	145	155	162	292	146	86
42	R	0.620	139	140	89	184	124	87
	L	0.529	139	140	76	184	117	64
43	R	1.107	150	139	159	308	159	130
	L	0.996	145	149	143	308	156	124
44	R	1.170	153	150	168	327	137	124
	L	1.218	151	165	175	333	137	117
45	R	0.508	145	138	73	213	124	60
	L	0.550	143	145	79	213	124	64
46	R	0.578	131	135	83	200	130	76
	L	0.529	130	135	76	184	127	76

APPENDIX I. (Continued)

ANIMAL NO.		A	B	C	D	E	F	G
47	R	1.149	134	125	165	330	159	127
	L	1.239	131	125	178	311	130	114
48	R	0.975	150	139	140	308	146	127
	L	0.884	149	145	127	311	143	124
49	R	1.504	148	143	216	356	159	130
	L	1.636	146	150	235	362	130	124
50	R	1.504	140	130	216	340	143	105
	L	1.330	140	140	191	343	140	98
51	R	0.842	138	135	121	257	133	76
	L	0.842	138	134	121	257	133	83
52	R	1.017	140	145	146	289	140	86
	L	0.884	137	143	127	279	130	89
53	R	1.594	135	130	229	356	133	114
	L	0.989	133	142	210	356	137	124
54	R	0.884	154	140	127	276	146	95
	L	0.842	153	140	121	273	143	102
55	R	1.191	150	148	171	346	152	127
	L	1.281	150	153	184	337	149	124
56	R	1.149	133	140	165	321	156	124
	L	1.107	147	150	159	318	156	121
57	R	1.260	148	150	181	340	137	114
	L	1.239	148	148	178	343	140	*
58	R	1.149	142	140	165	333	133	89
	L	1.107	143	140	159	330	137	89
59	R	1.330	133	130	191	337	152	108
	L	1.191	134	123	171	340	200	108
60	R	0.599	143	135	86	210	121	67
	L	0.599	143	145	86	203	121	57

* Broken

APPENDIX II

APPENDIX II. Official Boone and Crockett Club scoring form for pronghorn.

OFFICIAL SCORING SYSTEM FOR NORTH AMERICAN BIG GAME TROPHIES

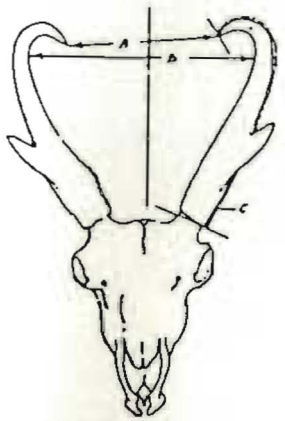
RECORDS OF NORTH AMERICAN BIG GAME COMMITTEE

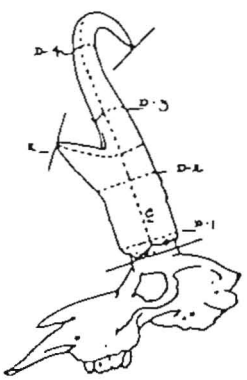
BOONE AND CROCKETT CLUB

RETURN TO:
N.A.B.G. Awards Program
1600 Rhode Island Ave., N.W.
Washington, D. C. 20036

Minimum Score
Pronghorn: 82

PRONGHORN





SEE OTHER SIDE FOR INSTRUCTIONS	Supplementary Data	Column 1 Right Horn	Column 2 Left Horn	Column 3 Difference
A. Tip to Tip Spread				
B. Inside Spread of Main Beams				
IF Inside Spread of Main Beams exceeds longer horn length, enter difference.				
C. Length of Horn				
D-1. Circumference of Base				
D-2. Circumference at First Quarter				
D-3. Circumference at Second Quarter				
D-4. Circumference at Third Quarter				
E. Length of Prong				
TOTALS				

ADD	Column 1		Exact locality where killed
	Column 2		Date killed By whom killed
	Total		Present owner
SUBTRACT	Column 3		Address
			Guide's Name and Address
			Remarks: (Mention any abnormalities)
FINAL SCORE			

I certify that I have measured the above trophy on 19
at (address) City State
and that these measurements and data are, to the best of my knowledge and belief, made in accordance with the instructions given.

Witness: Signature:

Boone and Crockett Official Measurer

APPENDIX II. (Continued)

INSTRUCTIONS

All measurements must be made with a flexible steel tape to the nearest one-eighth of an inch. Wherever it is necessary to change direction of measurement, mark a control point and swing tape at this point. To simplify addition, please enter fractional figures in eighths.

Official measurements cannot be taken for at least sixty days after the animal was killed. Please submit photographs.

Supplementary Data measurements indicate conformation of the trophy.
None of the figures in Lines A and B are to be included in the score.
Evaluation of conformation is a matter of personal preference.

A. Tip to Tip Spread measured between tips of horns.

B. Inside Spread of Main Beams measured at right angles to the center line of the skull at widest point between main beams.

C. Length of horn is measured on the outside curve, so the line taken will vary with different heads, depending on the direction of their curvature. Measure along the center of the outer curve from tip of horn to a point in line with the lowest edge of the base.

D-1. Measure around base of horn at right angles to long axis. Tape must be in contact with the lowest circumference of the horn in which there are no sierrations.

D-2-3-4. Divide measurement of LONGER horn by four, mark BOTH horns at these quarters even though one horn is shorter, and measure circumferences at these marks. If the prong occurs at approximately D-3, take this measurement immediately above the swelling of the prong.

E. Length of Prong – Measure from the tip of the prong along the upper edge of the outer curve to the horn; thence, around the horn to a point at the rear of the horn where a straight edge across the back of both horns touches the horn. This measurement around the horn from the base of the prong should be taken at right angles to the long axis of the horn.

. . . . . .

TROPHIES OBTAINED ONLY BY FAIR CHASE MAY BE ENTERED IN ANY BOONE AND CROCKETT CLUB BIG GAME COMPETITION

To make use of the following methods shall be deemed UNFAIR CHASE and unsportsmanlike, and any trophy obtained by use of such means is disqualified from entry in any Boone and Crockett Club big game competition:

I. Spotting or herding game from the air, followed by landing in its vicinity for pursuit;

II. Herding or pursuing game with motor-powered vehicles;

III. Use of electronic communications for attracting, locating or observing game, or guiding the hunter to such game.

. . . . . .

I certify that the trophy scored on this chart was not taken in UNFAIR CHASE as defined above by the Boone and Crockett Club.

I certify that it was not spotted or herded by guide or hunter from the air followed by landing in its vicinity for pursuit, nor herded or pursued on the ground by motor-powered vehicles.

I further certify that no electronic communications were used to attract, locate, observe, or guide the hunter to such game; and that it was taken in full compliance with the local game laws or regulations of the state, province or territory.

Date_____ Signature of Hunter_____