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Physical Characteristics
of
COLORADO MULE DEER
In Relation to their Age Class

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Acknowledgement . . .

MR. H. L. SPENCER began this work in 1938. In 1939 the writer and Mr. Spencer decided that our work was so similar that it was agreed the paper on completion would be a co-authorship. However, the untimely death of Mr. Spencer made it necessary for the writer to complete the paper. Mr. Spencer's excellent advice and untiring work was greatly missed in the following years, and it is hoped that the paper is a tribute to his ability in the field of Game Management.

The assistance of Mr. Jack C. Culbreath and Mr. Theodor R. Swem in the preparation of this manuscript is appreciated.

PHOTOGRAPHS BY C. E. HAGIE

INTRODUCTION

A SYSTEM of age determination of mule deer founded upon constant external physical characteristics that are easily measured by mechanical means has long been desired by game managers. The old system of age classification by points has been definitely proven to have too large a percentage of error to be of value. The most positive method for determining age groups of mule deer is still found by using the dental formula, but this system requires extensively experienced personnel in order to produce a high degree of accuracy. With organizations the size of the State and larger, it is impracticable to adequately train a crew large enough to give proper reliable coverage of the management area. Studies reveal a simple system incorporating the use of mechanical measurement of the diameter and length of beam to the first fork, and used in conjunction with the length of head, will provide a sampling method with a reasonable percentage of error.

In 1938 an intensive study of the life history of Rocky Mountain mule deer in Colorado was started by the late H. L. Spencer, Wildlife Specialist, U.S. Forest Service, with special emphasis being placed on age characteristics of that species. Much of the data for this study was obtained between December 10, 1938 and March 31, 1939, from 225 deer killed by trains and 25 killed by motor vehicles in the vicinity of Hot Sulphur Springs, Colorado. Certain cranial and antler measurements of these animals not broken too badly were made. These measurements were recorded on the removed lower jaw of the animal concerned. Ages were then determined from a correlation of the dentition and characteristics. An additional 50 sets of jaws and measurements were obtained from animals which had died of old age or malnutrition on winter deer range during the months of March and April. Data was also secured on 60 buck heads at the Jonas Bros. Taxidermist Shop, Denver, Colorado. Thus a total of approximately 360 dentition sets were prepared and tabulated from the first winter's observations. During the 1939, 1940, and 1941 hunting seasons the writer made the same cranial and antler measurements on 1,827 specimens; in addition weights and girth measurements, as well as other antler measurements, were made.

All sets were judged from dentition standards and separated into two-year groups, the aim being to find one or more simple exterior measurements that could be used to determine both the ages of male and female deer with a fair degree of accuracy. When approximately 400 heads had been analyzed, a tentative table was prepared based on the measurements of beam diameter one inch above the burr, the distance from the base of the burr on the outside curve to the vertex of the first fork of the antler, and the head lengths. Head length measurements were made on both male and female deer. Using this tentative table, the next 100 subjects studied were classified by their exterior measurements. These subjects were checked by dentition formula for accuracy, and it was found that the ages determined by measurements were 97% in accordance with the ages determined by dentition. On this basis 2,187 specimens were classified.

PROCEDURE AND TECHNIQUE

IN ORDER that information gathered would be representative of Colorado, measurements were made of animals killed in different localities by the use of mobile checking stations. Dentition of all animals measured was checked by the writer so there would be no variation in reading the teeth.

Antler diameter measurements were made one inch above the base of the burr on the main part of the beam with a six-inch metal caliper graduated in sixteenths of an inch. Figure No. 1.

Measurements of the length of the first antlered fork were taken on the outside curve of the beam from the base of the burr to the vertex of the first fork. Antler length was measured along the outside curve of the beam from the base of the burr to the end of the most distant point. Antler spread was measured between perpendiculars at the extreme width of the antlers at right angles to the center line of the skull. Diameter and lengths of the right and left antlers in most cases were uniform. Measurements were generally taken from the antler that was most convenient to measure. See Table No. 1. In those cases where the antler measurement approached the next age group classification, both antlers were measured and the average measurement of both antlers was used. When positive abnormal antler growth was found on either the right or left antler, the measurement was taken from the normally developed antler. Girth measurements were made of animals that had not been split at the ribs by placing tape around animal's body directly back of the front legs. All these measurements were made with an automatic winding linen or steel tape graduated in sixteenth inches. Figures 2 to 4 inclusive. Both types of tapes were satisfactory. When a linen tape is used it should be of good quality, otherwise moisture will have a tendency to stretch it. If a tape, graduated in tenths, can be obtained, its use is recommended, as it simplifies the computation of data. A calibrated wheel was tried, but it was not satisfactory, as it would slip as it ran along the curve of the antler. Head measurements were obtained from caliper measurements made between the occipital crest and the end of the nose. Figure No. 5.

For studying dentition, a common valve lifter was used. This instrument proved very useful, as it could be inserted between the incisors and pre-molars of the lower jaw and the roof of the mouth; the jaws could then be pryed open and held with little difficulty.

Hog-dressed weights were taken on a platform scale. In order to facilitate the handling of the carcass, a six-foot stretcher-type platform was constructed to fit the scale. This stretcher proved very useful, especially where it was necessary to pack the carcass some distance to the scale.

DENTITION STUDY

IN ORDER to establish the simplified method of age determination, it was necessary that dentition be used as the basis for a check. The dentition classification used for this purpose was developed by Mr. Spencer and the writer after a detailed study had been made of dentition sets of 360 deer. As 1,827 deer were studied during the fall and winter seasons, the method as given applies to subjects taken during those periods of the year. Fawns in Colorado are generally born during the latter part of June and the first part of July. Therefore, at the time of the first hunting season they were $3\frac{1}{2}$ to 4 months old, and they are $15\frac{1}{2}$ to 16 months at the time of the second hunting season, etc. To simplify and to avoid classifying by months, animals 15 to 16 months old were considered $1\frac{1}{3}$ years old and the animals 27 and 28 months old were considered $2\frac{1}{3}$ years old. After considerable study it was found more practical to classify deer in two-year age groups with the exception of fawns and deer $9\frac{1}{3}$ years old or older. Fawns are readily classified as to age. Deer older than $9\frac{1}{3}$ years constitute less than 5% of the herd, and as too few specimens would be obtained to warrant further age group classification, six major age groups were considered. These groups were $3\frac{1}{2}$ to 4 months; $1\frac{1}{3}$ to $2\frac{1}{3}$ years; $3\frac{1}{3}$ to $4\frac{1}{3}$; $5\frac{1}{3}$ to $6\frac{1}{3}$; $7\frac{1}{3}$ to $8\frac{1}{3}$; and $9\frac{1}{3}$ years plus.

From these studies it was determined that the cutting of teeth in the Rocky Mountain mule deer is exceedingly irregular. The first permanent incisors are not cut until the deer is around one year old. Two, four, six or in rare cases eight, may be cut between the ages of 12 and 16 months.

The milk pre-molars are usually shed between the ages of 30 and 32 months. Rare instances have been noted where the milk pre-molars have not been shed until the deer is $3\frac{1}{3}$ years old. A simple method by which to differentiate between milk and permanent pre-molars is to examine the third pre-molar from the front. If this tooth has three horizontal serrated cutting edges, it is a milk pre-molar tooth. If there are only two such edges, it is a permanent pre-molar. See Figure 9. Generally speaking, a deer has a full mouth when he is $3\frac{1}{3}$ years old. In studying the dentition of 2,187 animals, six cases were seen in which deer had eight permanent incisors at $1\frac{1}{3}$ years old and all the pre-molars were still milk teeth.

TABLE No. 1

COMPARISON OF THE AVERAGE FALL AND WINTER MEASUREMENTS AND WEIGHTS, BY AGE CLASS, OF
THE ROCKY MOUNTAIN ANTLERED MULE DEER IN FOUR SEPARATE AREAS OF COLORADO
ALL MEASUREMENTS IN INCHES, AND WEIGHTS IN POUNDS

LOCATION OF AREA	No. Sub.	Average No. Antler Points		No. Sub.	Length of Beam Right	No. Sub.	Length of Beam Left	No. Sub.	Length of First Fork	No. Sub.	Diam. of Beam 1" Above Burr	No. Sub.	Antler Spread	No. Sub.	Length of Head	No. Sub.	Hog-Dressed Weight
		Right	Left														
Age Group 1 1/3 to 2 1/3																	
Piceance—Northwest Colorado	41	2.10	2.20	27	10.55	26	10.31	37	6.44	41	.71	38	10.69	40	11.35	2	89.00
Meeker—Northwest Colorado	104	2.03	2.16	104	11.80	102	10.76	96	6.44	104	.75	100	11.05	99	11.35	20	100.50
Gunnison—Central West Colorado	57	1.98	1.93	32	10.86	30	10.60	49	6.65	57	.73	56	10.55	55	11.14	—	—
Poudre—Northeast Colorado	159	2.23	2.20	83	11.42	105	11.72	157	6.23	158	.74	149	11.18	153	11.51	14	99.75
Total Average 1941	361	2.12	2.12	246	11.42	263	11.56	339	6.38	360	.74	343	10.99	347	11.39	36	100.20
Age Group 3 1/3 to 4 1/3																	
Piceance—Northwest Colorado	34	3.50	3.56	24	18.69	18	19.28	34	8.39	34	1.13	34	19.04	33	12.48	1	123.00
Meeker—Northwest Colorado	100	3.55	3.59	98	17.84	100	17.86	100	7.81	100	1.05	100	17.49	95	12.31	4	151.80
Gunnison—Central West Colorado	40	3.13	3.25	27	17.67	15	18.53	40	7.92	40	1.08	39	16.79	39	12.31	1	130.00
Poudre—Northeast Colorado	130	3.50	3.46	82	18.10	69	19.67	130	8.12	130	1.14	125	18.67	120	12.35	19	152.10
Total Average 1941	304	3.48	3.49	231	18.00	202	18.38	204	8.02	204	1.10	298	18.07	287	12.34	25	152.00
Age Group 5 1/3 to 6 1/3																	
Piceance—Northwest Colorado	29	4.14	4.14	16	24.41	16	23.45	29	10.04	29	1.38	27	23.70	27	12.96	4	201.9
Meeker—Northwest Colorado	33	3.80	4.10	32	23.21	33	22.93	33	9.35	33	1.32	32	22.89	33	12.86	1	187.00
Gunnison—Central West Colorado	17	3.34	4.06	10	25.56	9	22.83	17	9.57	17	1.41	17	23.82	17	12.65	2	188.00
Poudre—Northeast Colorado	33	4.00	4.10	24	23.05	12	23.59	33	9.84	33	1.35	32	23.82	32	12.99	10	200.60
Total Average 1941	112	3.96	4.12	82	23.68	70	23.12	112	9.72	112	1.36	108	23.37	109	12.89	17	199.34
Age Group 7 1/3 to 8 1/3																	
Piceance—Northwest Colorado	17	4.53	4.33	9	25.05	10	25.85	17	10.82	17	1.47	17	26.73	16	13.23	—	—
Meeker—Northwest Colorado	23	4.50	4.70	23	24.10	23	23.95	23	9.88	23	1.39	23	25.22	23	13.16	1	175.00
Gunnison—Central West Colorado	10	4.10	3.80	8	25.14	5	24.84	11	10.24	11	1.49	11	24.23	9	13.23	—	—
Poudre—Northeast Colorado	11	4.80	4.80	6	25.25	7	25.25	11	10.88	11	1.57	11	27.22	11	13.02	3	207.00
Total Average 1941	61	4.51	4.46	46	24.62	45	24.62	62	10.55	62	1.49	62	26.24	59	13.16	4	206.00
Age Group 9 1/3 Plus																	
Piceance—Northwest Colorado	11	4.72	4.45	7	26.09	5	25.20	11	11.23	11	1.55	10	26.65	11	13.06	2	218.00
Meeker—Northwest Colorado	13	4.60	4.85	12	25.74	13	26.02	13	10.52	13	1.53	13	27.63	12	13.27	1	216.00
Gunnison—Central West Colorado	10	4.11	4.44	6	24.80	5	24.38	9	10.22	9	1.55	9	24.33	9	13.15	—	—
Poudre—Northeast Colorado	8	4.30	4.70	7	25.38	3	23.71	8	11.12	7	1.55	7	27.68	8	13.43	4	203.00
Total Average 1941	42	4.47	4.65	32	25.56	26	25.39	51	10.76	40	1.54	39	26.37	40	13.22	7	209.00

DENTAL FORMULA FOR COLORADO ROCKY MOUNTAIN MULE DEER

Fawns (3½ to 4 months)

All are milk teeth but the first permanent molar. Figure 6.

1⅓ to 2⅓ Age Class (16 to 28 months)

Two to eight permanent incisors which are generally rounded in appearance. The pre-molars are all milk teeth. There are two permanent molars with a third usually partially erupted. The third pre-molar has three serrations on the edges. Figures 6, 7, 8, 9.

3⅓ to 4⅓ Age Class (40 to 52 months)

Complete dentition of this age group shows enamel ridges sharp and plain. Incisors are losing their rounded edge appearance and show a tendency to wear straight across. Third pre-molar has two serrations on the edges. Figure 10. Wear caused by type of forage eaten should not be confused with cupping.

5⅓ to 6⅓ Age Class (64 to 76 months)

This age group shows complete permanent dentition as described for age class 3⅓ to 4⅓, but enamel ridges of incisors show definite wear and very little ridging remains. The inner side of the incisors appear and feel smooth and the edges are straight with no rounded appearance. The teeth are worn to a noticeable degree compared to the 3⅓ to 4⅓ year class. Cups in the teeth are sometimes visible through the clear dentition, but are not hollowed until the succeeding age class. Figure 11.

7⅓ to 8⅓ Age Class (88 to 100 months)

This age group is characterized by incisors that are narrow, cupped and with enamel ridges worn very smooth. Molars also show considerable wear. Figure 12.

9⅓ plus Age Class (112 months and over)

In this maximum age class the mouth is characterized with short narrow cupped incisors that are loose. The gums are definitely receding. There is no appreciable enamel ridging remaining. The crowns of pre-molars and the molars rise approximately ⅛ of an inch above the gums; the grinding surfaces are worn quite smooth. Figures 13 and 14.

DEVELOPMENT OF THE SIMPLIFIED MEASUREMENT METHOD FOR DETERMINING THE AGE OF COLORADO ROCKY MOUNTAIN MULE DEER

Antlered

IN DEVELOPING this simplified method for determining the age of mule deer, many different types of measurements were taken. Tables 1, 2, and 3. Some of the measurements, such as antler length and spread, and body girth, do bear a relation to age, but are not the most reliable indicators. These particular measurements and their relationship to age class will be discussed later. Measurements that do bear a direct relation to age were found to be the diameter of the antler beam, taken one inch above the burr, the length of the first fork, taken on the outside curve from the base of the burr to the vertex of the first fork, and the length of the head. For relationship of these measurements to age class, see Figure 15. The reliability of these three measurements varies in importance by age classes. Further, one measurement may be the important indicator in judging a particular age class, while the same measurement used in judging another age group may be of secondary importance. In other cases it was found necessary to use a combination of two or three measurements to obtain the desired degree of accuracy in determining a deer's age.

With deer in the older age classes, such as the $7\frac{1}{3}$ to $8\frac{1}{3}$, and the $9\frac{1}{3}$ plus, external measurements were not a reliable indicator and teeth were used as a basis of age determination.

Analysis of the subjects by age classes indicated that in the $1\frac{1}{3}$ to $2\frac{1}{3}$ year old group, 97.7% of the animals in this bracket classified by dentition had a beam diameter of less than .90 of an inch. In addition, 90.6% of the $1\frac{1}{3}$ to $2\frac{1}{3}$ year old group had fork measurements of 7.4 or less. By using a combination of both the fork and the beam diameter measurement in judging a deer's age of this group, it was found that 97% of the animals were properly classified as to age by this combination of measurements.

Therefore, as 97.7% of the animals in the $1\frac{1}{3}$ to $2\frac{1}{3}$ year old class had a beam diameter of less than .90 of an inch; the other measurements for the age group were discarded in lieu of the accuracy of the beam diameter measurements.

As previously stated, too much confusion results in trying to divide deer into one year age classes, based on antler measurements. Therefore, all age classes were considered in two year groups for definite differentiation by classes. The yearling age class is of extreme importance to the game manager. The $1\frac{1}{3}$ age class measurements are worthy of separate mention and are represented by a wide extreme of the beam diameters .50" to .875" with the greatest percentage of $1\frac{1}{3}$ age class represented by beam diameters found between .625" and .750".

In the $3\frac{1}{3}$ to $4\frac{1}{3}$ age class, it was found that two measurements were necessary to give the desired accuracy in judging a deer's age. These measurements were the beam diameter and the length of the first antler fork. Study revealed that should the diameter of the beam be .125" above the range of measurements allowed for this group (beam diameter .92 to 1.25"), and if the fork measurement taken was between 7.5" and 9.00", the animal still remained in the $3\frac{1}{3}$ to $4\frac{1}{3}$ age group. In this age group 88.7% of the beam diameter measurements were in accord with the age classification by teeth as well as 72.6% of the fork measurements. However, when both measurements were considered as the factor for determining age, 98.7% of the deer of this age group had measurements within the range of measurements allowed above.

As the animals grow older, there is a greater variation in the measurements of the beam diameter, fork and head. In the $5\frac{1}{3}$ to $6\frac{1}{3}$ age group, using a range of measurements on the beam diameter of 1.30 to 1.50 inches, a fork measurement between 9.1 inches and 10 inches, and a head length of 12.6 to 13 inches, it was found that 76.4% of the beam diameters, 51.6% of the fork lengths and 46% of head measurements were within the range allowed and checked with dentition classification.

When a combination of diameter and fork measurements were taken, 82.7% of the deer were properly classified as to age. When a combination of diameter and head measurements were taken, 85% were properly classified, and 80% were properly classified when fork and head measurements were taken. However, when a combination of diameter, fork and head measurements were made, 91.6% of the deer were properly classified as to age.

In the next two succeeding age groups, there was not enough correlation between diameter, fork, and head measurements to judge age. Therefore, teeth were used as the prime factor in judging age of these groups. See dentition characteristics of the $7\frac{1}{3}$ to $8\frac{1}{3}$ and $9\frac{1}{3}$ plus age groups.

Antlerless

THIS GROUP includes does and fawns, and the only reliable exterior measurements that has any direct relation to age was the length of the head. The nubbins on male fawns can be used as an age indicator insofar as they are generally 1 inch or less in length, but this factor can be disregarded, as male fawns head lengths fall well within the range of measurements allowed for all fawns.

For relation of head measurements to age, see Figure No. 16. Antlerless head measurements were taken in the same manner as that of antlered deer.

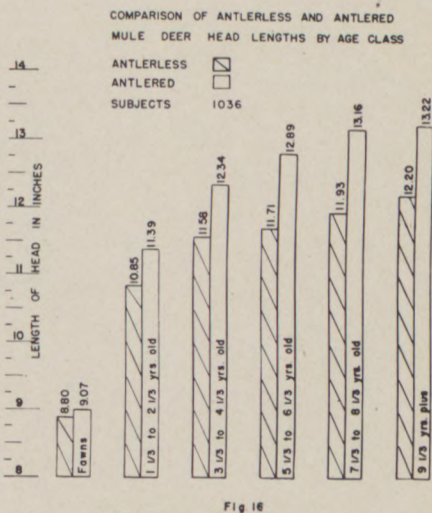
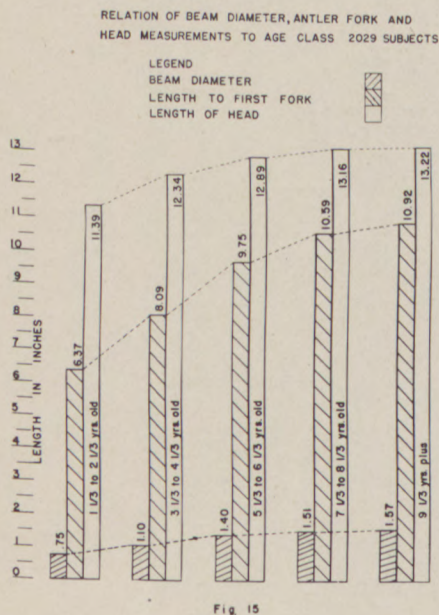


TABLE No. 2

**COMPARISON OF THE AVERAGE FALL AND WINTER
MEASUREMENTS TAKEN AT THE POUDBRE STATION
OVER A THREE-YEAR PERIOD**

Subjects	Length of First Fork	Beam Diameter 1" Above Burr	Head Length	Average Weight
1$\frac{1}{3}$ to 2$\frac{1}{3}$ Years				
528	6.32	.758	11.51	104.47
3$\frac{1}{3}$ to 4$\frac{1}{3}$ Years				
313	8.17	1.12	12.35	150.00
5$\frac{1}{3}$ to 6$\frac{1}{3}$ Years				
112	9.80	1.423	12.99	191.78
7$\frac{1}{3}$ to 8$\frac{1}{3}$ Years				
56	10.70	1.556	13.02	208.08
9$\frac{1}{3}$ Plus Years				
44	11.11	1.600	13.43	212.00

TABLE No. 3

COMPARISON OF THE AVERAGE FALL AND WINTER MEASUREMENTS AND WEIGHTS, BY AGE CLASS, OF THE ROCKY MOUNTAIN ANTLERED MULE DEER FOR 1939, 1940, AND 1941
ALL MEASUREMENTS IN INCHES, AND WEIGHTS IN POUNDS

Number Subjects	Diameter	Number Subjects	Fork	Number Subjects	Head	Number Subjects	Weight	Number Subjects	LENGTH — Outside Curve			Number Subjects	Spread	Number Subjects	POINTS	
									Right	Number Subjects	Left				Right	Left
Age Class 1 1/3 to 2 1/3																
730	.75	681	6.37	618	11.39	185	102.5	407	11.33	423	11.36	529	10.98	583	2.13	2.17
Age Class 3 1/3 to 4 1/3																
487	1.10	486	8.09	407	12.34	101	149.6	296	18.16	247	18.45	375	18.23	386	3.57	3.52
Age Class 5 1/3 to 6 1/3																
191	1.40	190	9.75	164	12.89	59	192.3	100	23.69	90	23.18	129	23.50	135	4.00	4.14
Age Class 7 1/3 to 8 1/3																
106	1.51	105	10.59	86	13.16	25	206.8	64	24.55	64	24.31	86	25.67	83	4.42	4.32
Age Class 9 1/3 Plus																
77	1.57	77	10.92	60	13.22	31	212.0	47	25.84	45	25.56	59	26.27	63	4.27	4.32



Figure No. 1
Illustrating the method of taking
beam diameter measurements 1"
above the burr.

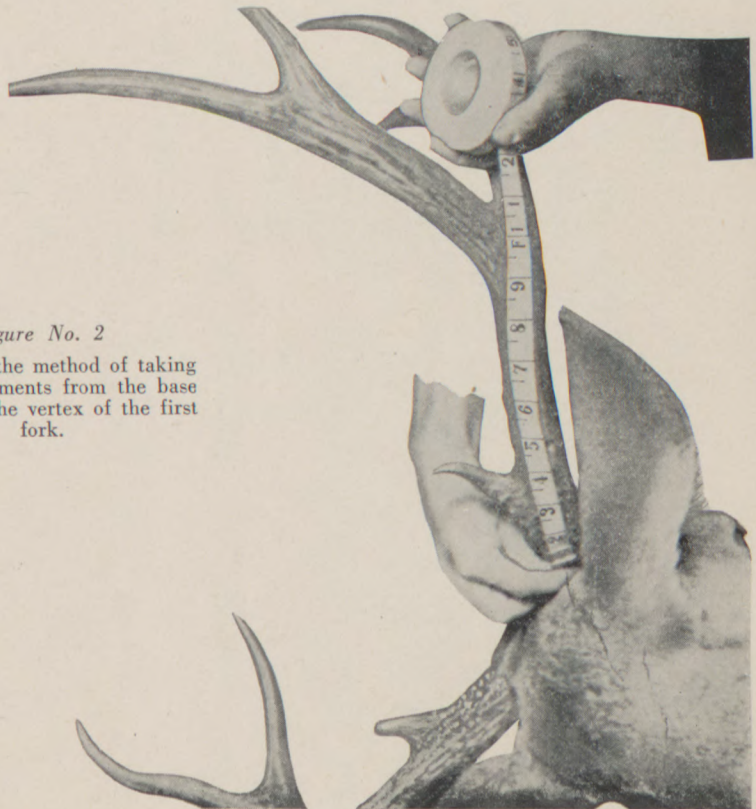


Figure No. 2
Illustrating the method of taking
the measurements from the base
of burr to the vertex of the first
fork.



Figure No. 3

Illustrating the method of taking the beam length on the outside curve.



Figure No. 4

Illustrating the method of taking the antler spread.

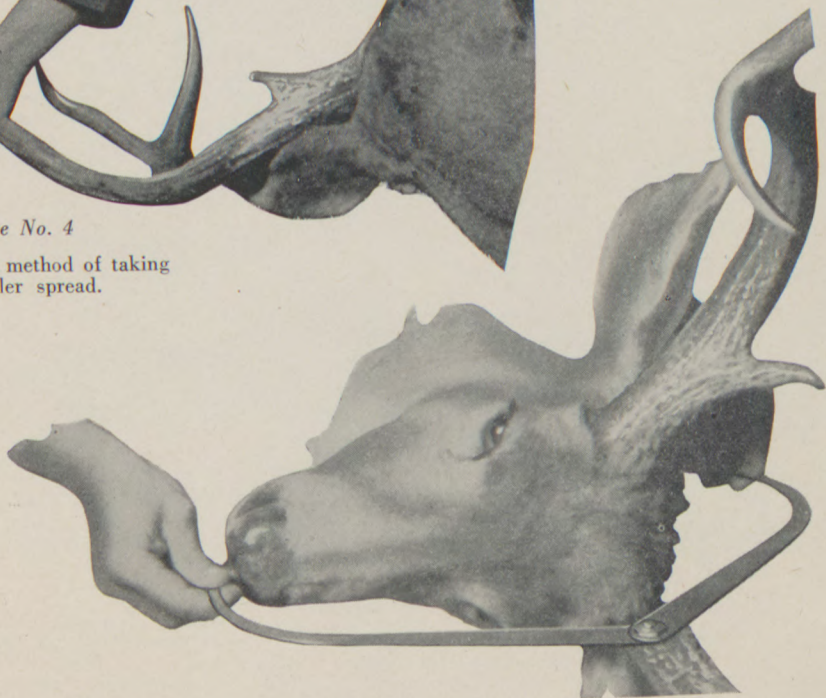


Figure No. 5

Illustrating the method of taking head lengths.

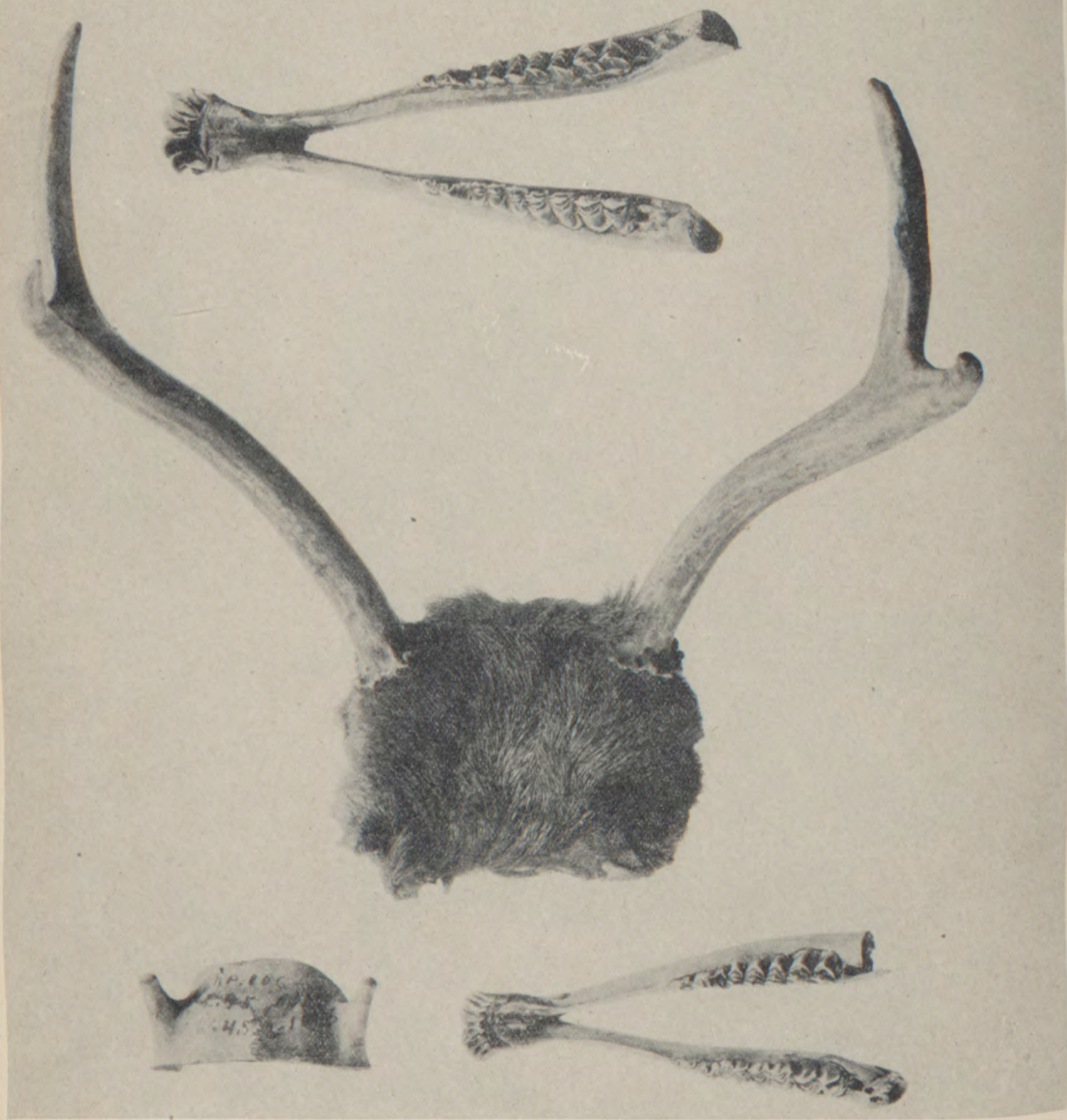


Figure No. 6

Upper cut shows a $1\frac{1}{3}$ year old animal. Note six permanent incisors.
 Lower cut shows the lower jaw and skull of an eight months old fawn.

Antler Measurements are:

Diameter—right $11/16''$ Diameter—right $10/16''$

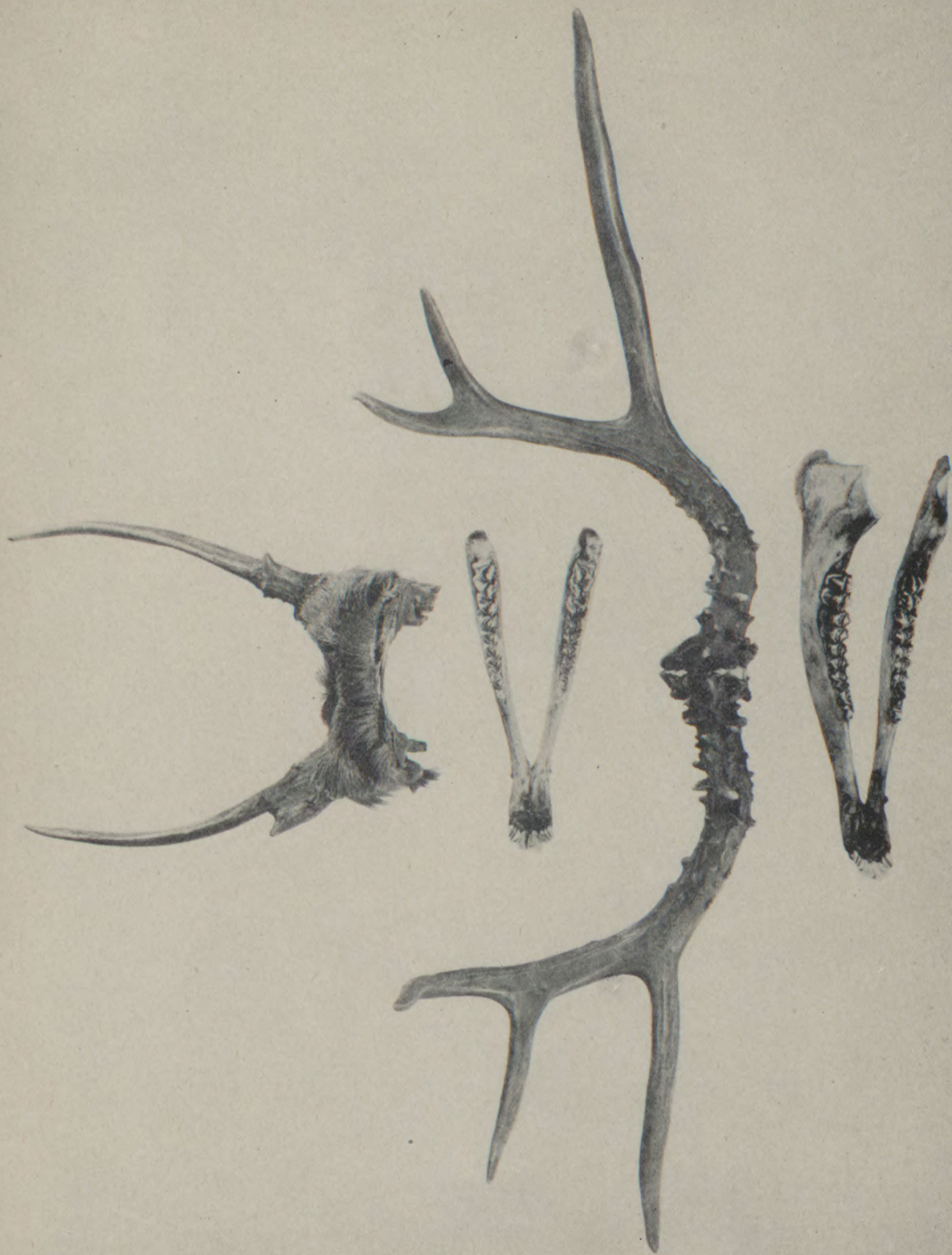


Figure No. 7

This illustrates the fallacy of trying to estimate a deer's age by points. Both lower jaws have two permanent incisors, while one set of antlers has three points and the other is a spike. Both animals are $1\frac{1}{3}$ years old.

Right cut antler measurements are:

Diameter—right..... $\frac{15}{16}$ "

Diameter—left..... $\frac{3}{4}$ "

Left cut antler measurements are:

Diameter—right..... $\frac{9}{16}$ "

Diameter—left..... $\frac{9}{16}$ "

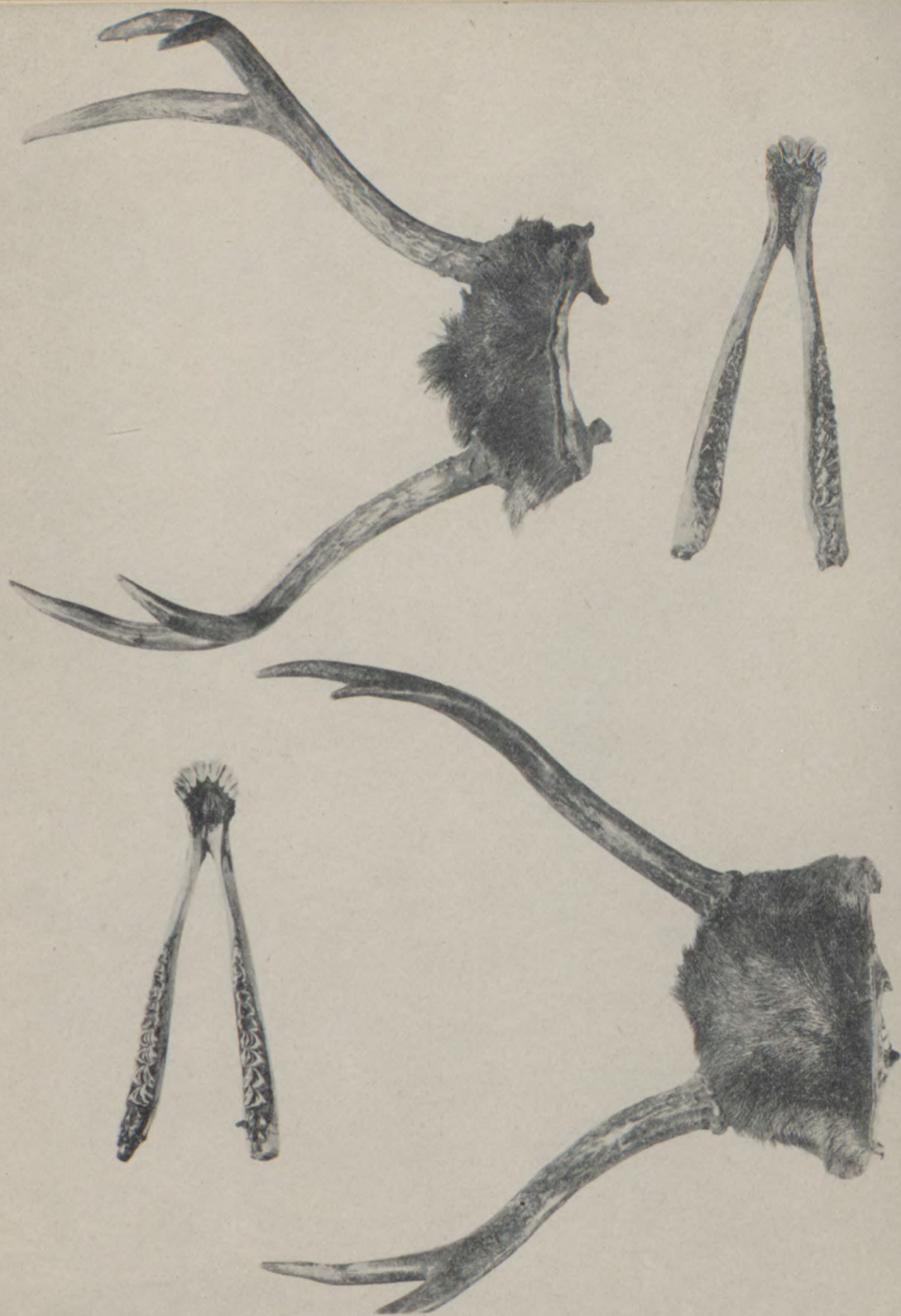


Figure No. 8

Note lower jaw in upper left hand corner of cut. This particular animal has a full set (8) of permanent incisors, even though he is $1\frac{1}{8}$ years old. Jaw in lower right hand side of plate, the animal has four permanent incisors and is $1\frac{1}{8}$ years old.

Lower cut antler measurements are:

Diameter—right..... $\frac{3}{4}$ " Diameter—left..... $1\frac{11}{16}$ "

Upper cut antler measurements are:

Diameter—right.... $1\frac{11}{16}$ " Diameter—left.... $1\frac{11}{16}$ "



Figure No. 9

Illustrating the lower jaws and antlers of a $2\frac{1}{8}$ year old animal. Right cut are the jaws of a $2\frac{1}{8}$ and $3\frac{1}{8}$ year old. Antler measurements are: Diameter—right..... $15/16$ " Diameter—left..... $15/16$ ".

The lower jaws shown in this cut particularly bring out the change of pre-molars that occurs prior to the time the animal is $3\frac{1}{2}$ years old. On jaw marked 1-3, the pre-molars are still milk teeth and the third pre-molar shown in the front of the jaw has three serrations on the edges. After the animal is in the $3\frac{1}{2}$ year age class, the milk pre-molars are discarded and replaced by permanent pre-molars. You will note on jaw marked 4-5 that the premolar has only two serrations on the edges.

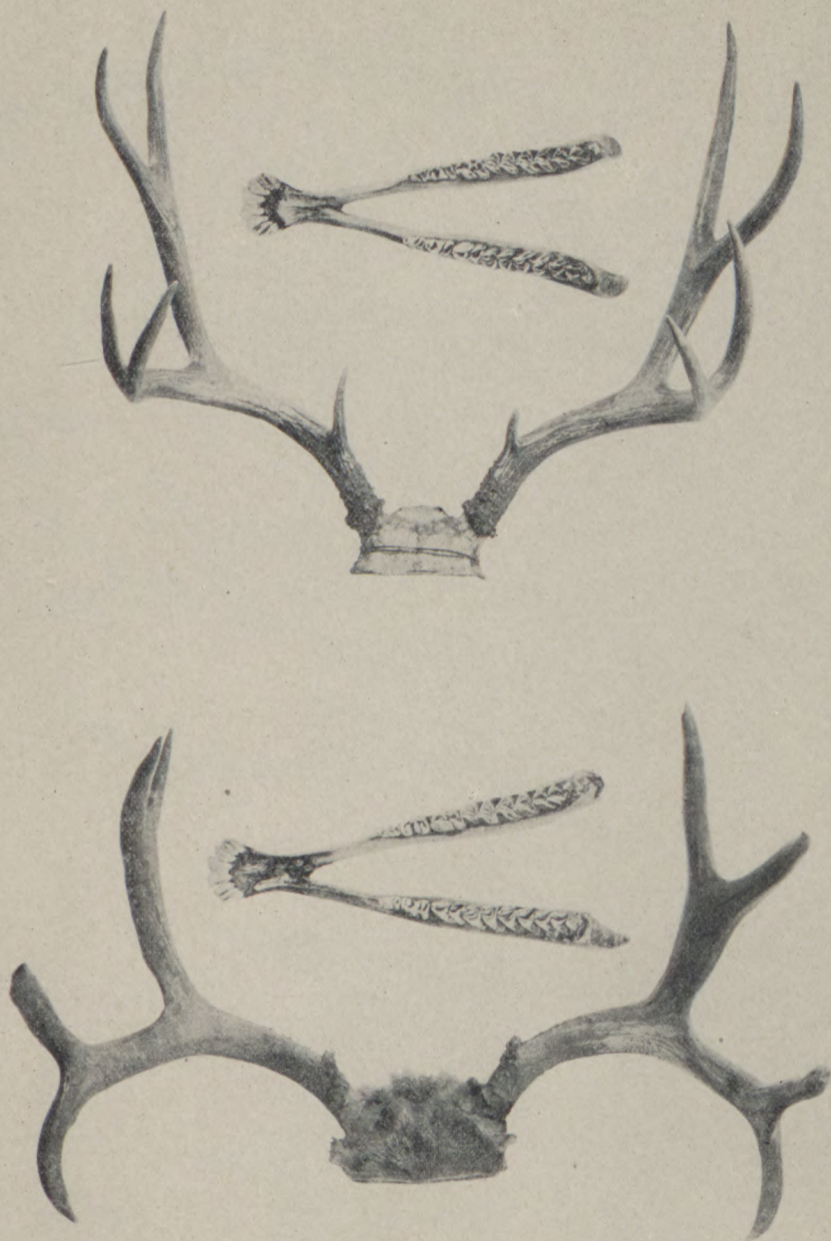


Figure No. 10

This cut illustrates the head and jaws of the $3\frac{1}{8}$ to $4\frac{1}{8}$ year age class. Note the incisors have a notched appearance and the enamel ridges are very pronounced.

Upper cut antler measurements are:

Diameter—right..... $1\frac{1}{4}$ "	Diameter—left..... $1\frac{1}{4}$ "
Fork—right..... $8\frac{1}{2}$ "	Fork—left.....9"

Lower cut antler measurements are:

Diameter—right..... $1\frac{3}{8}$ "	Diameter—left..... $1\frac{1}{4}$ "
Fork—right..... $8\frac{3}{4}$ "	Fork—left..... $8\frac{7}{8}$ "



Figure No. 11

This illustrates antlers and lower jaws of the $5\frac{1}{8}$ to $6\frac{1}{8}$ year age class. Note jaw in lower part of picture, enamel ridges are worn quite smooth, while in the upper cut of jaw they show wear. However, ridges can plainly be seen.

Lower cut antler measurements are:

Diameter—right..... $1\frac{1}{2}$ " Diameter—left..... $1\frac{1}{2}$ "
 Fork—right.....10" Fork—left.....10"

Upper cut antler measurements are:

Diameter—right.... $1\frac{7}{16}$ " Diameter—left.... $1\frac{7}{16}$ "
 Fork—left..... $9\frac{1}{2}$ " Fork—right..... $9\frac{5}{8}$ "



Figure No. 12

This illustrates lower jaw and antlers of the $7\frac{1}{3}$ to $8\frac{1}{3}$ year old group. Note the cupping is beginning to appear in the incisors of both jaws shown. Enamel ridges have disappeared and the teeth are taking on a narrow looking appearance.



Figure No. 13

This illustrates the jaws and antlers of two animals $9\frac{1}{3}$ years old and over. However, the upper cut is that of an animal approximately ten years old. You will note cupping is very definite on both jaws and wear on molars is very pronounced.



Figure No. 14

Lower cut illustrates antlers of a typical decadent buck, while the second set of antlers shown are those taken from an animal in which the sex organs had been destroyed. Jaws represented are those of a very old doe and one in which decayed teeth are evident.

A METHOD FOR DETERMINING THE AGE OF COLORADO ROCKY MOUNTAIN MULE DEER

Antlered

AGE DETERMINATION based on measurements taken during the Fall and Winter:

1. Antler beam diameter measurements are taken one inch above the burr, on smooth part of beam. Care must be used so diameter measurement is not taken on the small protuberances of the antler.
2. Antler fork measurements are taken on the outside curve of the antler from the base of the burr to vertex of first fork.
3. Measure only normally developed antlers. If antler measurements approach the division allowed between age classes, measure both antlers and use the average measurement.
4. Head measurements are taken point to point from occipital crest to the tip of the nose, as measured across the span of the calipers.
5. Dentition formula is used to determine $7\frac{1}{3}$ to $8\frac{1}{3}$ and $9\frac{1}{3}$ plus age classes.

Fawns (3½ to 4 months old)

1. Measure head. Include all deer that have head measurement between 8" to 9.875". Small antlers (nubbins) approximately 1" or less in length.

1⅓ to 2⅓ Age Class (16 to 28 months old)

1. Measure antler beam diameter 1" above burr.
2. Include all male deer except fawns that have beam diameter less than .90 inches.

3⅓ to 4⅓ Age Class (40 to 52 months old)

1. Measure antler beam diameter 1" above burr. Include all male deer having beam diameter measurements between .92" and 1.25" inclusive.

2. If beam diameter is .125" greater than 1.25", measure fork; if fork measurement is between 7.5 and 9.00", animal still is in this group. If both measurements greater, check next age class.

5 $\frac{1}{3}$ to 6 $\frac{1}{3}$ Age Class (64 to 76 months old)

1. Measure antler beam diameter 1" above the burr and first fork. If beam diameter between 1.30" and 1.50" and fork between 9.1" and 10", animal is in this age group.
2. Should either one or both of the above measurements be .125" above or below the range of measurement allowed, measure the head.
3. If head is between 12.6" and 13", animal still remains in the group. If head is under 12.6", check preceding group; if over 13", check succeeding group.

In older age groups, teeth are the prime factors, as there is not enough correlation between diameter, fork, and head measurements to judge age.

Measure beam diameter and if greater than 1.50": Check teeth for next two succeeding age classes. If teeth do not apply to either of these groups, check all measurements of preceding class.

7 $\frac{1}{3}$ to 8 $\frac{1}{3}$ Age Class (88 to 100 months old)

1. This age group is characterized by incisors that are narrow, cupped with enamel ridges worn very smooth. Molars also show considerable wear.

9 $\frac{1}{3}$ plus Age Class (112 months and over)

1. In this maximum age class the mouth is characterized with short narrow and cupped incisors that are loose. The gums are definitely receding. There is no appreciable enamel ridging remaining. The crowns of pre-molars and the molars rise approximately $\frac{1}{8}$ of an inch above the gums, with the grinding surfaces worn quite smooth.

Antlerless

1. Head measurements are taken point to point from occipital crest to the tip of the nose, as measured across the span of the calipers.
2. Dentition formula is used on $7\frac{1}{3}$ to $8\frac{1}{3}$ and $9\frac{1}{3}$ plus age classes.

Fawns ($3\frac{1}{2}$ to 4 months old)

1. Include all deer with head measurements between 8" and 9.875".

$1\frac{1}{3}$ to $2\frac{1}{3}$ Age Class (16 to 28 months old)

1. Include all antlerless deer with head measurements between 10.0" and 11.25".

$3\frac{1}{3}$ to $4\frac{1}{3}$ Age Class (40 to 52 months old)

1. Antlerless head measurements between 11.30" and 11.6".

$5\frac{1}{3}$ to $6\frac{1}{3}$ Age Class (64 to 76 months old)

1. Antlerless head measurements between 11.61" and 11.9".

In the following age groups, teeth are the primary factor, as head lengths could not be correlated with age.

$7\frac{1}{3}$ to $8\frac{1}{3}$ Age Class (88 to 100 months old)

1. This age group is characterized by incisors that are narrow cupped and with enamel ridges worn very smooth. Molars also show considerable wear.

$9\frac{1}{3}$ plus Age Class (112 months old and over)

1. In this maximum age class the mouth is characterized with short narrow and cupped incisors that are loose. The gums are definitely receding. There is no appreciable enamel ridging remaining. The crowns of pre-molars and the molars rise approximately $\frac{1}{8}$ of an inch above the gums, with the grinding surfaces worn quite smooth.

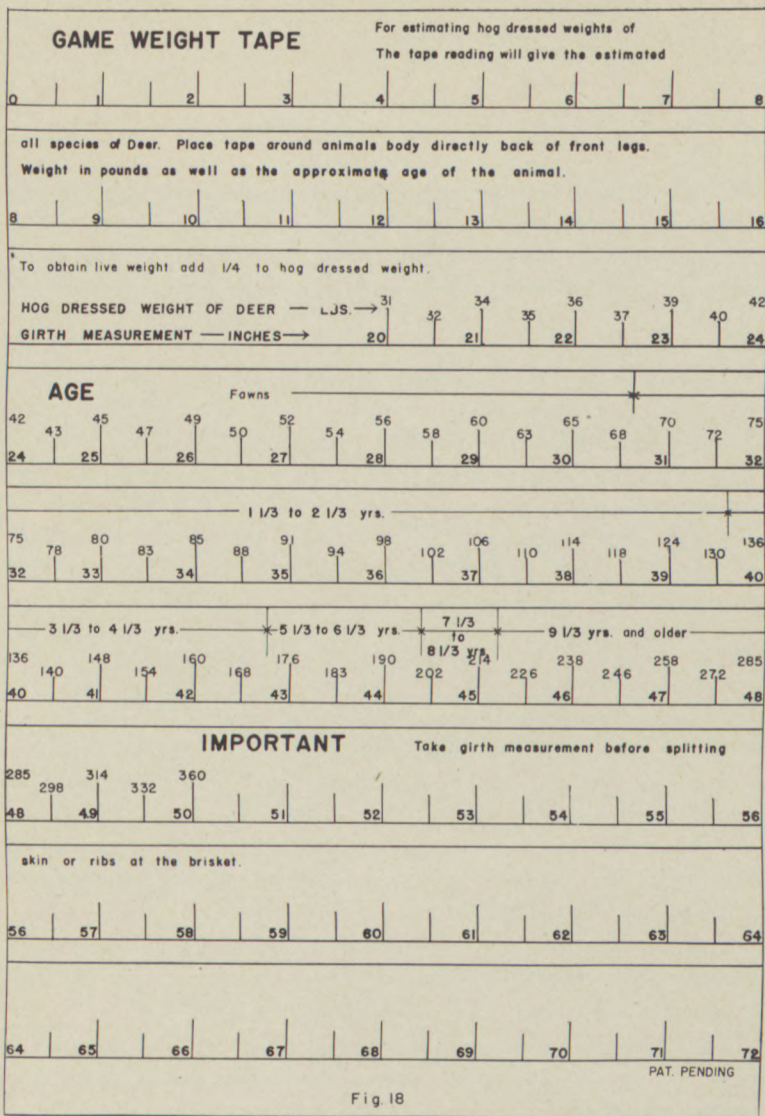
THE RELATION OF WEIGHTS, BROW TINES AND ANTLERS TO AGE CLASS

Weights

IN THE COURSE of this study weights were found to be a fairly accurate indicator of age and can be used to a fair degree of accuracy when the other measurements, as outlined in the "Method of Determining Age" cannot be obtained. Weights during the hunting season appear to be quite uniform by age class. This can be accounted for by the fact that in Colorado there is sufficient summer range for all our deer herds. Table No. 1, under caption "Hog-Dressed Weights," shows the average weights taken at various sections of the deer country throughout the State for the year of 1941, while Table No. 2 shows the average weights taken at one station over a period of three years. Table No. 3, under caption 4, as well as Figure No. 17, shows the average weights by age classes over a three-year period. In comparing these three tables, weights in each age class appear quite uniform and the weight increase between age classes is quite pronounced. Under normal conditions it is only natural that weight should increase with age. The difference of weight between the older age classes is not as great as that of the animals in the younger classes. Referring to Table No. 3, it will be found that the average weight of the $7\frac{1}{3}$ to $8\frac{1}{3}$ year old male deer is 206 pounds, while the average weight of a $9\frac{1}{3}$ plus male deer is 212 pounds. Generally it can be said that any male deer that weighs 212 pounds or better, is a $9\frac{1}{3}$ year old deer or better. In checking the relation of weight to ages, a correlation between girth and weight was found and from this a game weight tape was developed by C. N. Feast and the writer. This tape indicates the age, as well as the hog-dressed weight, based on girth measurements before brisket has been cut. See figure 18 for copy of tape and explanation of its use. *Note:* The game weight tape in figure 18 has been cut into 9 consecutive segments for convenience.

The following rule may be followed with a fair degree of accuracy in determining a male deer's age by weights. Weights are hog-dressed and taken on platform scale.

Fawns	Weight under 70 pounds, generally about 50 pounds.
$1\frac{1}{3}$ to $2\frac{1}{3}$ Age Class	Weight 70 to 132 pounds inclusive.
$3\frac{1}{3}$ to $4\frac{1}{3}$ Age Class	Weight 133 to 172 pounds inclusive.
$5\frac{1}{3}$ to $6\frac{1}{3}$ Age Class	Weight 173 to 200 pounds inclusive.
$7\frac{1}{3}$ to $8\frac{1}{3}$ Age Class	Weight 201 to 211 pounds inclusive.
$9\frac{1}{3}$ plus Age Class	Weight 212 pounds or better.



AVERAGE HOG DRESSED WEIGHTS
BY AGE CLASS, SUBJECTS 401

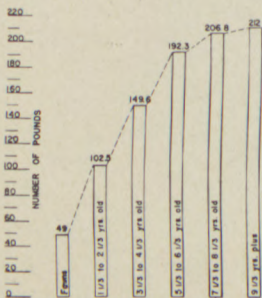


Fig 17

AVERAGE NUMBER OF BROW TINES
BOTH ANTLERS BY AGE CLASS
SUBJECTS 880

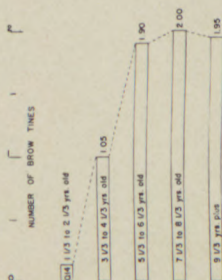


Fig 19

Brow Tines

THE STUDY of brow tines in relation to age revealed very little information that was not already known. The results of the study can best be illustrated in Table No. 4 and Figure No. 19. This table and figure shows the brow tine development and the average number of tines by age class.

TABLE No. 4

OCCURRENCE OF BROW TINES BY AGE CLASS

Age Class	O-Tines	0-1	1-1	2-1	3-1	2-2	2-3	2-4	3-3	3-2
1½ to 2½.....	89.0%	9.2%	1.7%	0.1%	—	—	—	—	—	—
3½ to 4½.....	41.5	17.4	38.8	1.1	—	0.7%	0.3%	—	—	—
5½ to 6½.....	4.4	10.7	77.7	3.6	0.6%	1.8	—	0.9%	—	—
7½ to 8½.....	6.6	8.2	75.4	3.3	—	—	3.3	—	1.6%	1.6%
9½ plus.....	14.7	12.2	58.5	4.9	—	7.3	—	2.4	—	—

In summarizing the findings shown in this table, 89% of the 1½ to 2½ year old deer do not have any tines; 58.5% of the 3½ to 4½ age class have one or more. 95% of the 5½ to 6½ age class have one or more tines; of the deer having tines in this class, 84.9% had two or more. About the same proportion appears in the next succeeding age class (7½ to 8½), as 93% had one or more tines, and of this number 85.2% had two or more brow tines.

Apparently as the deer grows older the tine development decreases, as 85.2% of this class (9½ years plus) had one or more tines, but only 73.2% had two or more.

The only conclusion reached was that about 94% of the animals between the ages of 5½ to 8½ years old will have two or more tines, generally evenly divided on each antler, and that the largest number of brow tines occur when a deer is between 5½ and 6½ years of age.

Antler Points

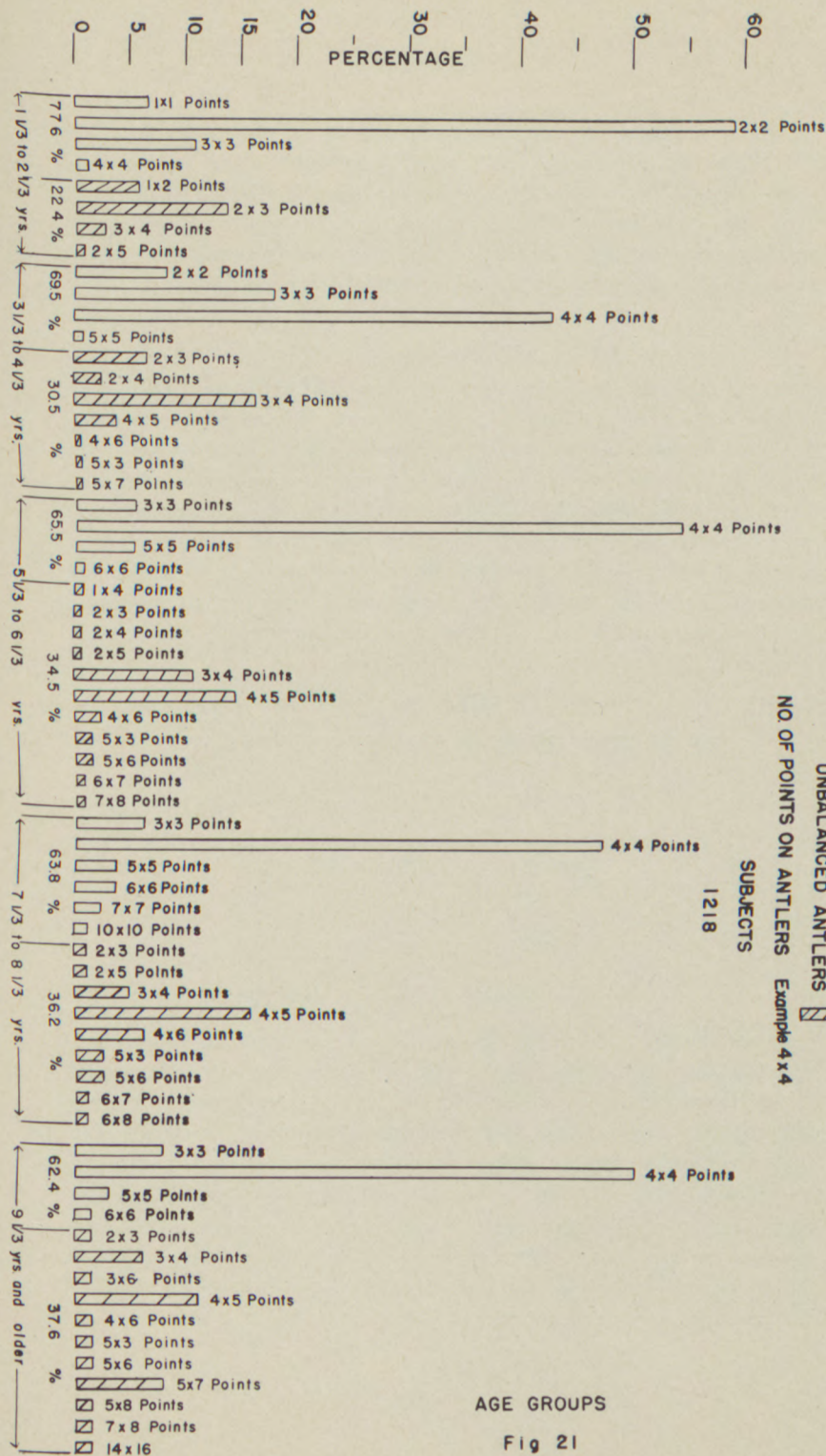
70.5% OF ANTLERED mule deer have a balanced or even number of points on each antler and the largest point development, as to number, occurs between $5\frac{1}{3}$ to $8\frac{1}{3}$ years. The number of balanced points on the antler decreases as the mule deer grows older, as 62.4% of the $9\frac{1}{3}$ plus age class have an even number of points, whereas 77.6% of the $1\frac{1}{3}$ to $2\frac{1}{3}$ age class have an even number of points. See Figures No. 20 and 21 and Table No. 5. The use of antler points in determining age appears very limited. However, in the $1\frac{1}{3}$ to $2\frac{1}{3}$ age class, 59% of the deer have two points on each antler; 19.3% have two points on at least one antler, or 78.3% of this age class have two points on one or the other antler. In addition, 6.7% of the $1\frac{1}{3}$ to $2\frac{1}{3}$ age class were spikes, therefore 85% of the $1\frac{1}{3}$ to $2\frac{1}{3}$ age class have one or two points on an antler. Many exceptions to the foregoing rule will be found, such as the point development illustrated in Figure No. 7. Furthermore, a number of four point bucks, 17 months old, have been seen, as well as some $9\frac{1}{3}$ and $12\frac{1}{3}$ year old bucks with two and three points. In these instances, the size of the antler readily distinguishes the young deer from the old.

TABLE No. 5

POINT CLASSIFICATION BY AGE GROUP BASED ON
STUDY OF 1,218 SUBJECTS

NUMBER OF POINTS	1 $\frac{1}{8}$ - 2 $\frac{1}{8}$ Years		3 $\frac{1}{8}$ - 4 $\frac{1}{8}$ Years		5 $\frac{1}{8}$ - 6 $\frac{1}{8}$ Years		7 $\frac{1}{8}$ - 8 $\frac{1}{8}$ Years		9 $\frac{1}{8}$ Years	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	38	6.7	---	---	---	---	---	---	---	---
2	335	59.0	31	8.3	---	---	---	---	---	---
3	61	10.7	66	17.8	7	5.3	5	6.0	5	7.8
4	7	1.2	158	42.6	72	54.2	39	47.0	32	50.0
5	---	---	3	.8	7	5.3	3	3.6	2	3.1
6	---	---	---	---	1	.7	3	3.6	1	1.5
7	---	---	---	---	---	---	2	2.4	---	---
8	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	1	1.2	---	---
Percent of Balanced Heads	77.6		69.5		65.5		63.8		62.4	
1-2	32	5.6	---	---	---	---	---	---	---	---
1-4	---	---	---	---	1	.7	---	---	---	---
2-3	77	13.5	24	6.5	1	.7	1	1.2	1	1.5
2-4	---	---	9	2.5	1	.7	---	---	---	---
2-5	1	.2	---	---	1	.7	1	1.2	---	---
3-4	15	2.7	60	16.1	14	10.6	4	4.9	4	6.3
3-6	---	---	---	---	---	---	---	---	1	1.5
4-5	2	.4	14	3.8	19	14.4	13	15.7	7	11.0
4-6	---	---	2	.5	3	2.3	5	6.0	1	1.5
5-3	---	---	1	.3	2	1.5	2	2.4	1	1.5
5-6	---	---	1	.3	2	1.5	2	2.4	1	1.5
5-7	---	---	2	.5	---	---	---	---	5	7.8
5-8	---	---	---	---	---	---	---	---	1	1.5
6-7	---	---	---	---	1	.7	1	1.2	---	---
6-8	---	---	---	---	---	---	1	1.2	---	---
7-8	---	---	---	---	1	.7	---	---	1	1.5
14-16	---	---	---	---	---	---	---	---	1	1.5
Percent of Unbalanced Heads	22.4		30.5		34.5		36.2		37.6	

*Balanced head indicates even number of points on both left and right antler.



AGE GROUPS

Fig 21

Four points are the most common number on older mule deer. In the $3\frac{1}{3}$ to $4\frac{1}{3}$ age class, 65.5% have four points on one or the other antler and 82.9% of the $5\frac{1}{3}$ to $6\frac{1}{3}$, and 68.8% of the $9\frac{1}{3}$ plus age class, also have four points on one or the other antler. Therefore, it would appear that the only use of points in classifying mule deer to age would be the separation of the young animals from the old.

Antler Length (Outside Curve)

ANTLER LENGTH measurements were made on 811 deer. The antler lengths were then grouped according to age determined by dentition formula. A tentative table was then prepared, which classified the antler length by age class. Using this table, 973 additional antler lengths were taken and each animal measured was checked for age by dentition formula. The errors found were so large, as indicated in Table No. 6, that the use of antler length as an age indicator is not recommended. During this analysis, it was found in the younger age classes the left antler was slightly longer, while in the older deer the right antler was longer. Figure No. 22.

TABLE No. 6
RELATION OF ANTLER LENGTH TO AGE



Subject	Age Group	Range of Measurement	Percent of Error Based on Dentition Check
394	$1\frac{1}{3}$ to $2\frac{1}{3}$	0. to 14.50	9%
345	$3\frac{1}{3}$ to $4\frac{1}{3}$	14.75 to 20.50	18%
101	$5\frac{1}{3}$ to $6\frac{1}{3}$	20.75 to 23.50	43%
78	$7\frac{1}{3}$ to $8\frac{1}{3}$	23.75 to 25.50	50%
54	$9\frac{1}{3}$ plus	25.50 and over	50%

Antler Spread (Tables 1 and 2)

THE RELATIONSHIP of antler spread to age was made in conjunction with the analysis of antler length. The percent of error was so large that this measurement is also of limited value in age determination. During this analysis it was found that the antler development in length and spread showed a constant ratio by age class, as indicated in Figure 23.

Summarizing the value of antler length and spread as an age indicator, it can be said that there is a continued development of the antler through the age classes, but the degree of variation is so large within the particular age class that the use of these measurements for age determination is not recommended.

AVERAGE NUMBER OF POINTS
BY AGE CLASS SUBJECTS 1591

RIGHT ANTLER 
LEFT ANTLER 

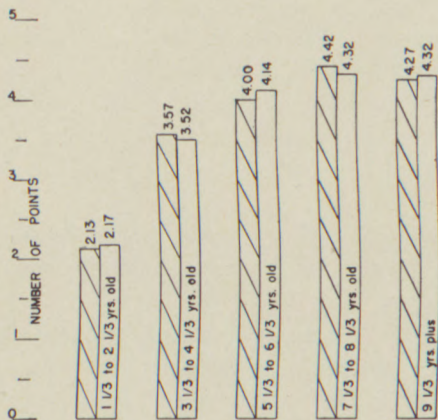




Fig. 20

AVERAGE LENGTH OF RIGHT AND LEFT
ANTLERS BY AGE CLASS SUBJECTS 1783

RIGHT ANTLER 
LEFT ANTLER 

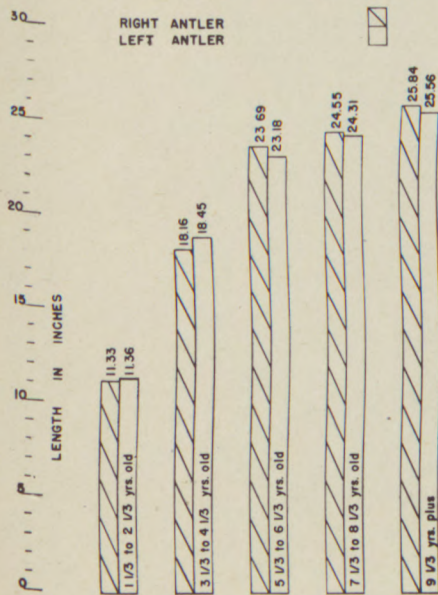




Fig. 22

RELATION OF ANTLER LENGTH TO SPREAD
SUBJECTS 1176

ANTLER LENGTH 
ANTLER SPREAD 

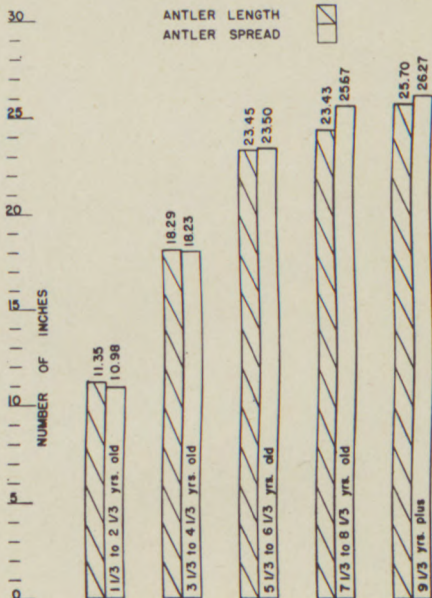


Fig. 23

CONCLUSION

THIS METHOD of simplified external physical measurements for determining a male deer's age was developed primarily as an aid to the game managers. With a crew of semi-skilled field assistants using this method, the game managers will have available large samples by age class of the deer in his management area. This information will clearly indicate the number of each age class to be harvested in order to balance the herd for maximum production or, in extreme cases, limit the productivity of a herd.

The particular value of this system can be illustrated by Figure 24, which is indicative of a kill from a normally balanced Colorado Mule Deer herd.

As long as the youngest age classes support the principal kill, breeding stock for maximum production is not jeopardized. Assuming that a deviation from the normal curve shows excessive kill of the older age classes, the principal breeding stock, protective restrictions must be devised. With this information known, as well as the other related management factors pertinent to range conditions, etc., sounder management programs for mule deer can be developed.

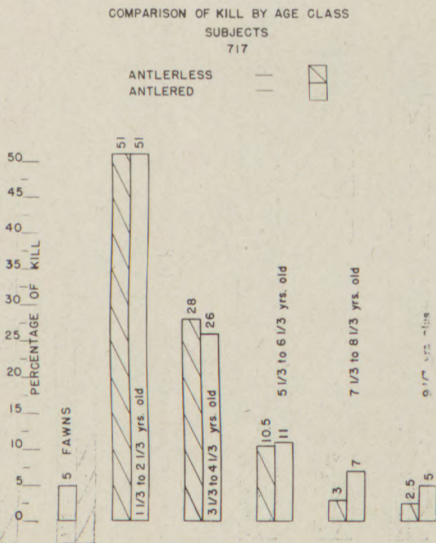


Fig 24

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