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An Evaluation of the Dental Annuli Technique for Determining Age of White-tailed Deer in Iowa¹

ARNOLD J. SOHN²

Abstract. During 1965-66, 47 molars from deer (*Odocoileus virginianus*) of Iowa and adjoining states were sectioned and examined. An exposure of the cementum pad of the first lower molar of each deer was examined to determine if the gross-sectioning dental annuli method is suitable for determining age of Iowa whitetails. Six bison molars and one elk molar were also examined. Variations in both thickness and clarity of annuli in teeth from Iowa deer made accurate age determination impossible in most cases. Teeth from deer from the Upper Peninsula of Michigan showed more distinct annuli in the root pad of the first lower molar than did those taken from Iowa deer. The bison and elk molars showed much clearer annuli formation in the pad than did the molars of Iowa deer. Further research is needed to interpret the variations in annuli formation in Iowa deer, and to seek the relationships between these variations and the quality of the deer habitat.

During 1965-66 experimental work on the use of dental annuli for determining age of Iowa white-tailed deer (*Odocoileus virginianus*) was conducted at Iowa State University through an undergraduate research grant from the National Science Foundation. This paper reports the findings of that work.

Previous work in aging mammals through use of dental annuli has been conducted along two major lines. One of these methods consists of decalcifying incisors or canine teeth, thin sectioning and staining a portion of the tooth, and examining the sections with a compound microscope to count the annuli present in the cementum around the tooth. Laws (1952) used this technique in pioneering work for aging seals. Sergeant and Pimlott (1959) used a similar method for age determination of moose, and Mc Ewan (1963) aged barren ground caribou by thin section examination. The method has also been used to determine age of black bears (Stoneberg and Jonkel, 1966) and white-tailed deer (Gilbert, 1966).

The other method that has been developed consists of making a transverse, vertical cut through a molariform tooth, grinding the surface of the tooth to expose the thickest portion of the cementum root pad found beneath the tooth, and counting the annuli present on this surface by using a binocular microscope. This

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method was used by Mitchell (1963) for Scottish red deer. Ransom (1966) used a method identical to that of Mitchell and mine for aging white-tailed deer from Michigan and Minnesota.

Both Ransom and Gilbert used deer taken from the Upper Peninsula region of Michigan, and from their reports, it would seem that the thin section examination of incisors is the more dependable of the two methods.

METHODS AND MATERIALS

The first lower molar from each deer was sectioned using a lapidary diamond saw blade. The lapidary outfit used is available

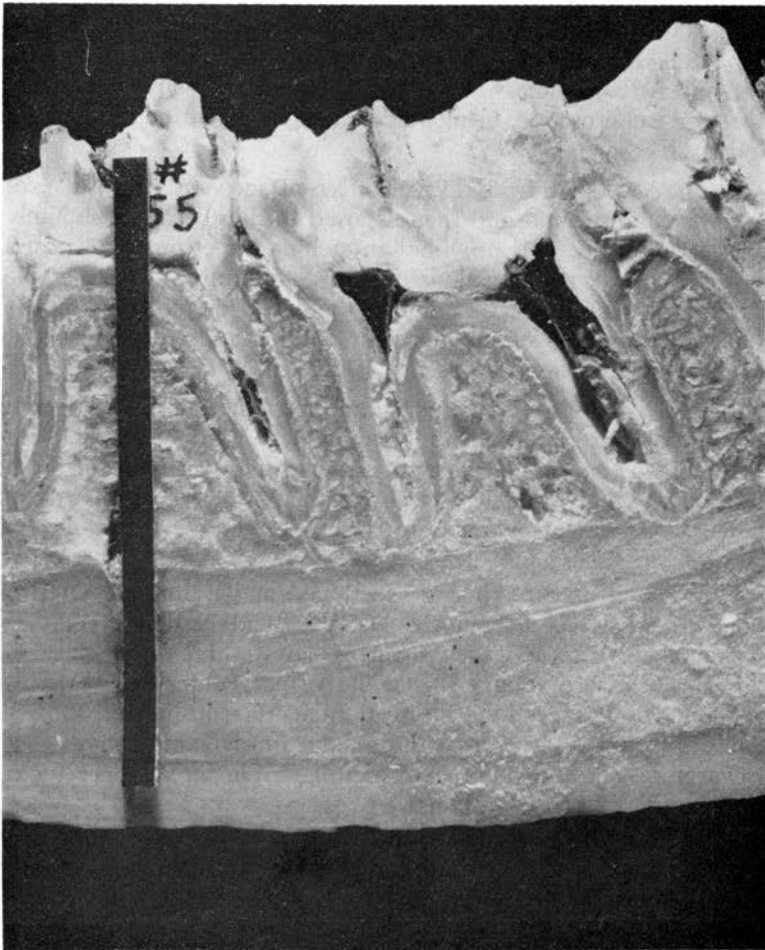


Figure 1. A longitudinal section of the first and second lower molars of an Iowa white-tailed deer. For examination of cementum annuli, the first lower molar was sectioned vertically along the dark line and then ground and polished. The dark line of the root pad appeared to be reached.

from Star Diamond Industries, Inc., 22608 Avalon Blvd., Wilmington, Calif., and sold for \$130. A water soluble metal-working oil was used as a coolant to prevent heat cracking of the teeth during cutting. Several cutting blade coolants are available. The grinding wheels were cooled by running water.

Saw blade dimensions were 6"x0.032". The blade and grinders were operated at 2,070 revolutions per minute or 3,050 surface feet per minute. The grinding wheels were of two grades, fine (100 grit) and coarse (220 grit).

To view the area of maximum root pad thickness, the tooth was cut in a transverse, vertical plane slightly posterior to its center (Fig. 1) and alternately ground and examined until the visibility of pad and annuli were believed optimal for each particular tooth. The surface was then wet with 75% alcohol and viewed under a dissecting microscope, using reflected light of various intensities and angles.

Ten molars taken from deer of different ages and of both sexes were cut and ground and then exposed to dilute (approximately 10%) formic acid. This provided an etching effect on the exposed root pad surface and was done in hopes of accentuating either the summer or winter growth annuli in the pad. Opaque layers in the root pad represent summer growth periods and the translucent layers are winter depositions.

Iowa deer jaws used for cutting and examination were selected from many parts of the state (Table 1). Variations in diet, climate and the consequent growth patterns may occur in different parts of the state, and it was hoped that these variations in regional environments would result in a detectable difference in annuli formation.

Forty-seven deer teeth were sectioned and examined. Of this total, 18 were taken from the DeSoto Bend National Wildlife Refuge near Missouri Valley, Iowa. Six jaws (three of which were known age) were obtained from the Upper Peninsula of Michigan; one from Necedah Wildlife Refuge, Wisconsin; and the remainder from scattered areas throughout Iowa. Table 1 gives age, sex, area taken, and number of annuli visible for all deer teeth examined.

In addition, 6 bison molars and 1 elk molar were examined in a similar manner to determine the presence and clarity of annuli in these species.

RESULTS

Cementum annuli were visibly present to some degree in nearly all the teeth sectioned. In a few teeth, the individual annuli were easily counted and appeared to indicate the animals' ages

Table 1. Age, sex, date and locality of kill of deer from which molars were secured for the study on dental annuli.

Sex	Number opaque annuli visible	Age years (estimate*)	Date killed	Locality
Female	0	1½	24 Oct. '65	Story Co., Iowa
Female	0	1½	23 Oct. '65	Boone Co., Iowa
Female	2	2½	13 Dec. '58	Kossuth Co., Iowa
Female	2	2½	13 Dec. '58	Emmet Co., Iowa
Female	3	2½	13 Dec. '58	Jackson Co., Iowa
Female	0	2½	19 Dec. '60	Van Buren Co., Iowa
Female	1	2½	7 Dec. '57	Jasper Co., Iowa
Female	2	2½	13 Dec. '58	Woodbury Co., Iowa
Male	4	3½	13 Dec. '58	Kossuth Co., Iowa
Male	4	3½	11 Dec. '58	Jackson Co., Iowa
Female	3	3½	14 Dec. '58	Winneshiek Co., Iowa
Female	4	3+	11 May '58	Sac Co., Iowa
Female	1	3	12 April '58	Sioux Co., Iowa
Female	1	4	5 July '59	Monroe Co., Iowa
Female	2	4½	14 Dec. '58	Delaware Co., Iowa
Male	3	4½	13 Dec. '58	Kossuth Co., Iowa
Female	1	4½	13 Dec. '58	Greene Co., Iowa
Male	3	4½	13 Dec. '58	Kossuth Co., Iowa
Female	2	4½	14 Dec. '58	Kossuth Co., Iowa
Unknown	4	5+	12 Dec. '57	Allamakee Co., Iowa
Male	2	5½	13 Oct. '59	Tama Co., Iowa
Female	3	6½	29 Nov. '59	Warren Co., Iowa
Female	0	½	18 Dec. '65	DeSoto Bend Refuge, Neb.
Male	0	1½	18 Dec. '65	"
Male	1	2½	19 Dec. '65	"
Male	1	2½	19 Dec. '65	"
Female	1	3½	18 Dec. '65	"
Female	3	3½	18 Dec. '65	"
Female	2	3½	16 Dec. '62	"
Male	3	3½	19 Dec. '65	"
Male	1	3½	19 Dec. '65	"
Male	0	3½	18 Dec. '65	"
Male	3	4½	19 Dec. '65	"
Female	5	4½	15 Dec. '62	"
Female	0	4½	18 Dec. '65	"
Female	5	5½	15 Dec. '62	"
Female	5	6½	15 Dec. '62	"
Male	5	9½	Unknown	"
Female	6	10+	15 Dec. '62	"
Male	1	1½	Nov. '58	Cusino, Michigan
Female	3	2½	(known age)	"
Unknown	3	3½	Nov. '58	"
Unknown	3	3½	Nov. '58	"
Female	3	3½	(known age)	"
Male	4	4½	(known age)	"
Female	3	2½	4 Dec. '65	Necedah, Wisconsin
Unknown	0	7½	Unknown	Unknown

* Age was estimated from tooth wear, except where indicated as being known age material.

as determined by estimates based on tooth wear. However, there was much variability in thickness and clarity of the annuli, a factor that did not appear to correlate with geographic location within the state.

When teeth taken from deer of the Upper Peninsula of Michigan were compared with the teeth of Iowa deer, the Michigan specimens from wildland habitat in which region winter food commonly is in short supply usually showed a more distinct annuli formation (Fig. 2). Only a small percentage of the Iowa deer examined showed annuli equally well. The remainder of the Iowa deer showed much variation in the clarity of annuli formation, even among deer from the same area of the state.

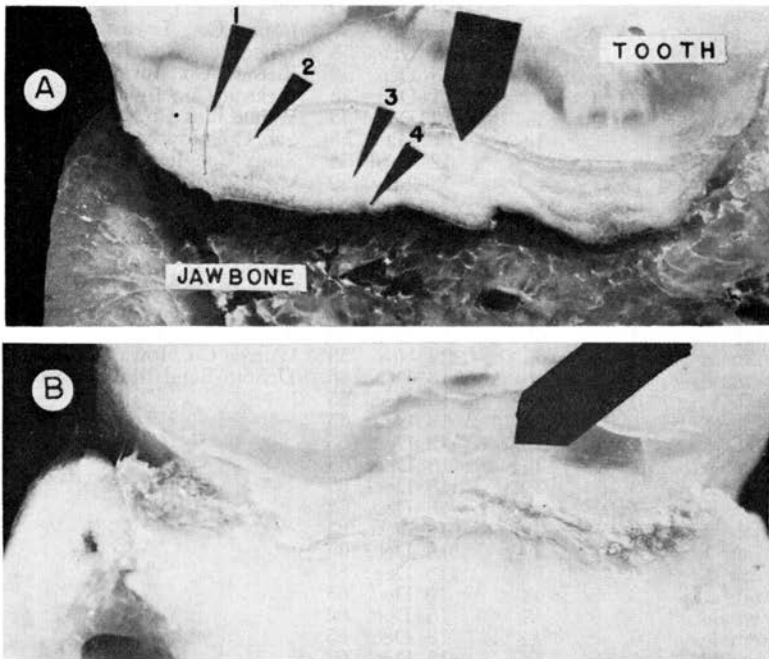


Figure 2. A. Root pad exposure of the first molar of a 4½-year-old male deer from the Upper Peninsula of Michigan. The cementum root pad, located at the tip of the large pointer, is composed of four discernible opaque annuli, representing periods of summer growth. B. The root pad of a 3½-year-old deer from Kossuth County, Iowa, shows three opaque annuli which are less distinct than those in the Michigan deer. Both the Michigan and the Iowa specimens shown have one less opaque layer in the pad than would be expected for deer of their ages.

Formic acid etching made annuli more visible in some instances and reduced the surface level of the translucent winter growth layers and left ridges of opaque summer layers. However, those teeth in which annuli were indistinct and difficult to count before acid etching remained so after being treated. Those teeth on which the acid had a favorable effect showed a series of countable layers before acid etching.

The variation in annuli formation made a definite age deter-

ined. In most cases inability to be sure of a deer's age was caused by the vagueness of layering in the cementum pad. When annuli were apparent, an age estimate based on the number of annuli corresponded with age estimates based on tooth wear.

CONCLUSIONS

Of the 47 molars examined, a total of only seven showed the correct number of identifiable or countable annuli in the cementum pad, based on estimates from wear of the teeth. Of these 7 specimens, 5 were does and 2 were bucks.

In general it was found that male deer showed layering more distinctly than did does. However, even in bucks, little consistency between age-by-wear estimates and annuli count was found. In most cases, with both does and bucks, the number of distinguishable annuli were fewer than should have been present for the given age-class deer.

Age determination of Iowa deer based on a count of annuli in the root pad of the first lower molar therefore appears impractical. In addition to the variability of annuli development found between individual deer, the time required to prepare and examine a tooth (about 15 minutes) is excessive for the degree of accuracy attained.

Further research is needed to interpret the variations in annuli structure of Iowa deer. If these variations are related to the high-quality nutritional level history of the animals or other physiologically related factors in individual deer, the time spent sectioning and examining the teeth might be well justified.

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