AGES ASSIGNED KNOWN-AGE TEXAS WHITE-TAILED DEER: TOOTH WEAR VERSUS CEMENTUM ANALYSIS

ROBERT L. COOK, Texas Parks and Wildlife Department, Kerrville, TX
RAYMOND V. HART, Texas Parks and Wildlife Department, Tennessee Colony, TX

Abstract: Incisors and jawbones were collected from known-age Texas white-tailed deer (*Odocoileus virginianus texanus*) which had been captured, ear-tagged, and released as fawns and harvested during public hunts in subsequent years. Incisors from 25 known-age whitetails were aged by Matson's Commercial Microtechnique Laboratory using the cementum analysis technique. The jawbones from these same 25 deer were aged using the tooth replacement and wear technique by wildlife biologists/wildlife technicians of the Texas Parks and Wildlife Department. Matson correctly aged 4 (16.0%) of the 25 known-age incisors. Nineteen (90.5%) of the incorrect ages assigned by Matson were younger than the known age. Biologists/technicians correctly aged 242 (66.7%) of 363 possible assigned ages using the tooth replacement and wear technique. Ninety-two (76.0%) of the incorrect ages assigned by the biologists/technicians were older than the known age.

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Wildlife managers have long recognized the importance of accurate age determination in studying wildlife populations. Alexander (1958) summarized the development and application of aging techniques and stated that population fluctuations are basically controlled by the size and age composition of the population.

Development of aging techniques for white-tailed deer was hindered in early studies due to the absence of marked, known-age animals (Cahalane 1932). However, working with known-age white-tailed deer in New York, Severinghaus (1949) developed a reliable method of age determination based on tooth replacement and wear.

Widespread use of the Severinghaus tooth replacement and wear technique has resulted in many researchers questioning the validity of the technique in their area. Severinghaus and Cheatum (1956) indicated that tooth wear was increased by abrasion depending upon soil types in various areas of North America and that malnutrition was associated with retardation in the deer's tooth replacement patterns. Studies have substantiated that variation in tooth wear may be due to grit on the vegetation and soil type (Bell 1974, Ludwig 1967). In addition, Leuth (1963) and Ryel et al. (1961) demonstrated the inconsistency of the tooth wear method.

Development of techniques to age big game species by annual rings of the dentine or cementum in moose (*Alces alces*) (Sergeant and Pimlott 1959), caribou (*Rangifer tarandus*) (McEwan 1963), mule deer (*Odocoileus hemonius*) (Low and Cowan 1963), and white-tailed deer (Ransom 1966) created new interest in methods of aging deer. Gilbert (1966) reported that histological preparations of the primary incisors of 10 known-age Michigan deer revealed the presence of layers in the cementum corresponding to yearly growth. Lockard (1972) reported that the 19% differences among ages of older deer from 15 states and 1 Canadian province, as determined by tooth wear and as determined by dental annuli, were too great for tooth wear to be used, particularly since the tendency was to overestimate age by wear. In his study, Lockard examined ground and histological sections of teeth from 46 animals of known age, from 11 of minimum known ages and from 320 whose ages were estimated by eruption and wear. He consistently found annual growth rings in the cement of incisor roots when the histological technique was used. Lockard's study failed to support data and findings of previous work by Gilbert and Stolt (1970) in which they showed a strong linear relationship between the tendency to underage Michigan deer by tooth wear

characteristics and the age of the animal by annuli count. They reported that overaging was a more important factor than underaging only in the yearlings and 2 1/2-year age classes and recommended utilizing a combination of the two techniques in Maine. Sauer (1973) reported that the number of layers in tooth cementum was highly accurate for assigning ages to white-tailed deer in New York.

In addition, refinements of cementum aging techniques of other species have been made for black-tailed deer (*O. h. columbianus*) by Thomas and Bandy (1975), pronghorn antelope (*Antilocapra americana*) by Kerwin and Mitchell (1971) and McCutchen (1969), elk (*Cervus canadensis*) by Keiss (1969). Fogel and Mosby (1978) encountered difficulties aging dry stored teeth of gray squirrel (*Sciurus carolinensis*) using razor-sectioned teeth.

The primary purpose of this study was to determine the accuracy and acceptability of the tooth-wear method in aging wild Texas white-tailed deer. The secondary purpose was to evaluate aging known-age wild Texas white-tailed deer by the tooth section-cementum analysis method. The study was funded under Texas Federal Aid (P-R) Projects W-74-R and W-109-R.

MATERIALS AND METHODS

This study was conducted by the Texas Parks and Wildlife Department. Complete lower jawbones were collected from marked, wild, known-age white-tailed deer harvested on the Kerr Wildlife Management Area (KWMA) and the Engeling Wildlife Management Area (EWMA) from 1962 to 1977. The KWMA is a 2,630 ha research facility in Kerr County of the Edwards Plateau Ecological Region of central Texas. The EWMA is a 4,428 ha research facility in Anderson County of the Post Oak Savannah Ecological Region of northeast Texas.

The deer from which jawbones were collected had been captured, ear-tagged and released as fawns of 1-10 days of age. Therefore, when the marked deer were harvested by hunters during public hunts, it was possible to determine the exact age within a few days.

After extraction, the jawbones were cleaned of excess tissue, soaked in warm-hot water and cleaning completed. The jawbones were labeled, dated and stored dry for future use and reference. The primary incisors were later removed intact and packaged for shipment to Matson's Commercial Microtechnique Laboratory in Milltown, Montana.

Experienced wildlife biologists and wildlife technicians of the Texas Parks and Wildlife Department assigned ages to the 25 known-age jawbones using the Severinghaus tooth replacement and wear technique (TRWT) following a brief examination of each jawbone. Twelve biologists/technicians aged 16 known-age jawbones from the KWMA in September 1977. Nineteen biologists/technicians aged 9 known-age jawbones from the EWMA in July 1978.

Matson assigned ages to the incisors from these same known-age jawbones using the cementum analysis technique (CAT) which involved decalcification of the primary incisor, mounting the root in paraffin, sectioning the tooth root mid-sagitally to a thickness of 12 microns and staining with Giemsa. These sections were mounted on slides and examined microscopically to count cementum annuli for age determination. Matson assigned ages to the sectioned incisors in March 1977.

The biologists/technicians and Matson did not know the age of the jawbones/incisors before assigning estimated ages. The frequencies of the age classes of the 25 known-age jawbones by age class were: Fawn or 0.5 years = 1; 1.5 years = 2; 2.5 years = 8; 3.5 years = 7; 4.5 years = 2; 5.5 years = 3; and 6.5 years = 2.

RESULTS

Wildlife biolgogists/technicians, using TRWT and Matson, using CAT assigned ages to 25 known-age jawbones and incisors from Texas white-tailed deer (Table 1).

TABLE 1. Age assignments by CAT and TRWT for 25 known-age white-tailed deer.

Jawbone Incisor Code Numbers	Known Age	Matson's Assigned Ages Cementum Analysis	Ages Assigned by Biologists Technicians Correct	Incorrect	Wrong Low	Wrong High
Kerr WMA						
1K	3.5	2.5B*	10	2	1	1
3K	3.5	2.5B	11	1	0	1
4K	3.5	2.5A	7	5	1	4
5K	2.5	1.5A	12	0	0	0
6K	2.5	1.5B	5	7	0	7
8K	2.5	1.5B	8	4	0	4
9K	3.5	2.5A	5	7	0	7
10K	5.5	3.5A	9	3	2	1
11K	6.5	3.5B	9	3	3	0
12K	5.5	2.5B	4	8	1	7
13K	3.5	2.5A	8	4	0	4
14K	4.5	2.5A	3	9	0	9
16K	2.5	2.5B	3	9	0	9
17K	2.5	1.5B	11	1	0	1
18K	1.5	1.5B	11	1	1	0
19K	2.5	3.5B	9	0	3	3
			—	—	—	—
	CORRECT	2(12.5%)	125(65.1%)	67(34.9%)	9(13.4%)	58(86.6%)
	INCORRECT	14(87.5%)				
Engeling WMA						
11E	2.5	1.5B	13	6	0	6
12LE		3.5C	14	5	0	5
13E	0.5	1.5B	19	0	0	0
14E	1.5	0.5B	19	0	0	0
15E	2.5	1.5B	17	2	0	2
16E	3.5	3.5A	11	8	4	4
17E	4.5	3.5B	8	11	3	8
18E	5.5	4.5B	7	12	12	0
19E	6.5	4.5B	9	10	1	9
			—	—	—	—
	CORRECT	2(22.2%)	117(68.4%)	54(31.6%)	20(37.0%)	34(63.0%)
	INCORRECT	7(77.8%)				
			COMBINED RESULTS TRWT			
	TOTAL CORRECT	4(16.0%)				
	TOTAL INCORRECT	21(84.0%)	242(66.7%)	121(33.3%)	29(24.0%)	92(76.0%)

*The letter following Matson's age assignment indicates his degree of confidence in the age.
A = results nearly certain
B = some error possible
C = error likely

Tooth Replacement and Wear Technique

Wildlife biologists technicians of the Texas Parks and Wildlife Department correctly aged 242 (66.7%) of 363 possible as assigned ages using TRWT. Ninety-two (76.0%) of 363 possible as assigned ages using TRWT. Ninety-two (76.0%) of the incorrect ages assinged were older than the actual known-age. Twelve of the incorrect ages assigned (3.3% of the entire sample) were incorrect by more than one year.

Biologists/technicians were equally adept at aging deer jawbones from the EWMA and the KWMA, 66.7% and 65.1% correct, respectively.

Biologists/technicians were least accurate using TRWT when assigning ages to 4.5 and 5.5 year-old jawbones. They assigned correct ages to only 35.5% of the 4.5 year-old jawbones and 46.5% of the 5.5 year-old jawbones (Table 2).

TABLE 2. Summary of biologists'/technicians' ability to age white-tailed deer jawbones using TRWT.

Age Class	Number Jawbones	Number Possible Age Estimates	Correct Ages Assigned	Incorrect Ages Assigned
0.5	1	19	19(100%)	0
1.5	2	31	30(96.8%)	1(3.2%)
2.5	8	110	78(70.9%)	32(29.1%)
3.5	7	98	66(67.3%)	32(32.7%)
4.5	2	31	11(35.5%)	20(64.5%)
5.5	3	43	20(46.5%)	23(53.5%)
6.5	2	31	18(58.1%)	13(41.9%)
TOTAL	25	363	242(66.7%)	121(33.3%)

The 25 known-age jawbones used in this study were carefully examined by the senior author and compared to the detailed description provided by Severinghaus (1949) as an additional evaluation of TRWT. Jawbone 18E from the EWMA, which was known to be 5 years, 7 months, 14 days of age appeared to be 4.5 years old by TRWT criteria. Jawbone 12K from the KWMA, which was known to be 2 years, 8 months, 13 days of age appeared to be 3.5 years old by TRWT criteria. An additional 32 known-age jawbones from the EWMA and 14 known-age jawbones from the KWMA were compared to the criteria listed for the TRWT. One EWMA jawbone, Number 192E, which was known to be 4 years-6 months of age appeared to be 3.5 years of age. The remainder of the known-age jawbones from the EWMA and the KWMA fit the TRWT criteria.

Cementum Analysis Technique

Matson correctly aged 4 (16.0%) of the 25 known-age incisors using CAT. Nineteen (90.5%) of the 21 incorrect ages assigned using the CAT were estimated to be younger than the actual known age. Five of the incorrect ages assigned (20.0% of the entire sample) were incorrect by more than one year; all were underaged.

DISCUSSION

While the overall degree of aging accuracy by biologists/technicians using TRWT may be sufficient for the present level of white-tailed deer management in Texas, it is essential to be aware of its weaknesses. Biologists/technicians were least accurate using TRWT when aging 4.5 and 5.5 year old jawbones. This could become an important factor under intensive deer management programs with emphasis on trophy buck production.

It is recommended that biologists/technicians participate in annual in-service training sessions to practice the art of aging deer jawbones using TRWT prior to each hunting season. This should improve their familiarity with the aging criteria and therefore, their accuracy.

Matson was cooperative and thorough throughout this study. Following reexamination of the tooth sections with knowledge of the known-ages he indicated that

he would make similar errors again because of indistinct or "condensed" annulus pattersn (Pers. Comm.). This statement is justified upon examination of a 60X photograph of the sectioned Incisor Number 14K (Fig. 1). This incisor was extracted from a 4.5 year-old known-age deer from the KWMA. Matson's assigned age for the incisor from this deer was 2.5A (A = results nearly certain). Another example of "condensed" annulus is seen in the 60X photograph of Incisor Number 18E (Fig. 2). This incisor was taken from a 5.5 year-old known-age deer from the EWMA. Matson's assigned age for this incisor was 4.5B (B = some error possible). Another 60X photograph provided by Matson, Incisor Number 5K (Fig. 3), shows some of the difficulties he faced. This incisor was taken from a known-age deer jawbone 2.5 years old. It has one annulus and Matson's assigned age was 1.5A Matson used his certainty code "C" = error likely, only once on the 25 teeth sectioned, a 3.5 year-old that he aged correctly.

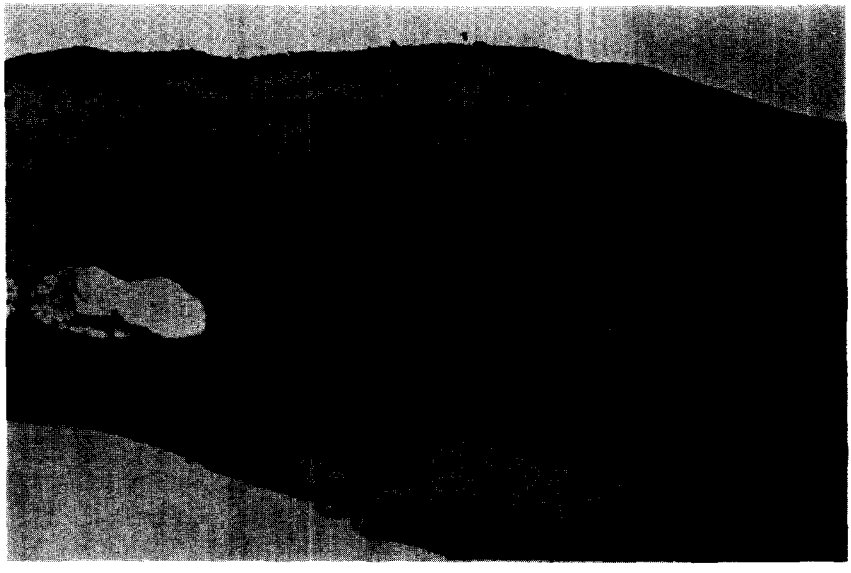

Fig. 1. Incisor 14K, known-age wild 4.5 year-old male Texas white-tailed deer. Assigned age by cementum analysis 2.5A. X60.

The authors consider the quality of the sectioned teeth slides good to excellent. Some proponents of CAT for aging deer will say and have said "inferior work" or "lack of experience" or "poor technique." However, the clarity of the examples shown in this report refute these accusations. The results of Matson's efforts in this study are considered commendable.

Texas biologists and other researchers should be careful in tooth extraction, cleaning, handling and shipping of incisors. Possibly some of Matson's difficulties in aging these incisors were a result of poor handling and preparation in the field, even though recommended procedures were followed.

Matson has made several improvements and refinements in his methods and procedures since this study was completed. Continued improvements in laboratory techniques will eliminate many potential sources of error. The cementum analysis technique is apparently accurate in some regions, but this should be proven or disproven through use of known-age animals. The degree of accuracy and the acceptability of the technique can be finally determined only by tests with known-age teeth.

Fig. 2. Incisor 18E, known-age wild 5.5 year-old female Texas white-tailed deer. Assigned age by cementum analysis 4.5B. X60.

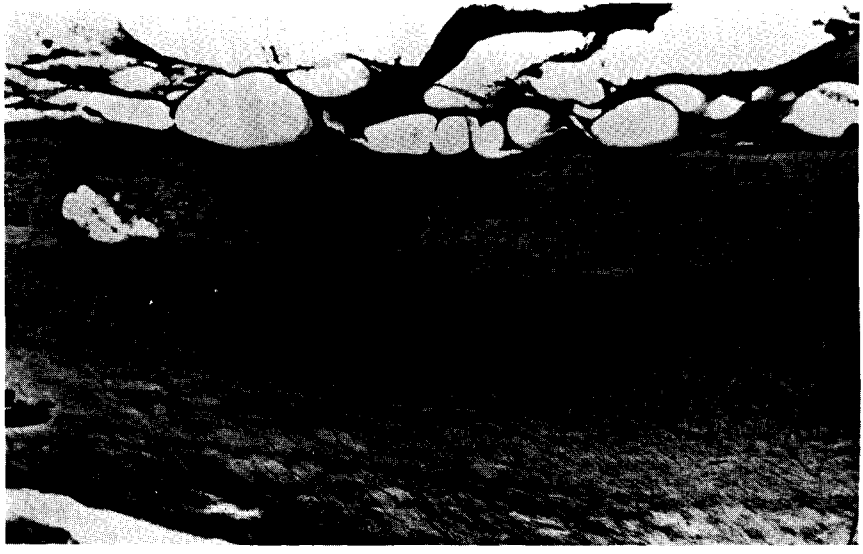

Fig. 3. Incisor 5K, known-age wild 2.5 year-old male Texas white-tailed deer. Assigned age by cementum analysis 1.5A. X60.

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