DIFFERENCES IN AGE STRUCTURE OF WHITE-TAILED DEER IN MISSISSIPPI PRODUCED BY TWO AGING-TECHNIQUES

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Abstract: Two hundred twelve white-tailed deer (*Odocoileus virginianus*) were aged by tooth wear and replacement and by sectioning the incisors. Aging by cementum annuli placed 67.8% of the animals in an older age class, 7.2% in a younger age class, and 24.9% in the same age class as aging by wear and replacement. Of deer with 3 cuspid 3rd premolars aged by cementum annuli, 17.3% were aged as 1.5 years, 69.2% as 2.5 years, 9.6% as 3.5 years, and 3.8% as 4.5 years. Five fawns were aged as 1.5 years by the annuli technique. Aging by cementum annuli produced a significantly older age structure than that produced by wear and replacement aging ($p<0.001$). Life table calculations on the age structure produced by wear and replacement and by cementum annuli aging yielded annual mortality rates (m_a) of 0.615 and 0.378, respectively.

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A study of the dynamics of a population depends heavily on the ability to age individuals accurately. Severinghaus (1949) developed a method based on tooth wear and replacement for aging white-tailed deer in New York. This technique has received widespread use throughout North America, although several investigators have reported inconsistencies with the method (Severinghaus and Cheatum 1956, Leuth 1963, and Bell 1974). These studies suggested that the variation in ages assigned by tooth wear may be due to nutrition, grit on vegetation and soil type.

Histological examination of cementum annuli of the primary incisors also has been used to age white-tailed deer (Bell 1974, Sauer 1973, Lockard 1972. and Gilbert 1966). The annuli technique has been reported as being more accurate than the Severinghaus technique (Bell 1974, Sauer 1973). Also, the ease of collecting incisors allows the establishment of extensive data bases without operating check stations since sportsmen can easily collect the samples for histological examination.

A study was initiated in 1976 to estimate the age structure and mortality patterns of selected deer herds in Mississippi. The purpose of that portion of the study reported here was to detect differences in age structure and resulting vital statistics produced by the 2 aging techniques. The study was not designed to ascertain the accuracy of either technique, because none of the specimens was of known age. This research was supported by Federal Aid Project No. 2-48-25, Job No. VII-A.

METHOD

To examine possible differences in age structures produced by the tooth wear and replacement (WR) and the cementum annuli (CA) techniques, hunter check stations were established on state operated wildlife management areas during the 1976-77 season. All deer brought to hunter check stations were aged by experienced biologists using the WR technique. Both incisors were collected from all deer field aged greater than 1.5 years. Both incisors were also collected from approximately 20% of fawns and yearlings. Incisors were not collected from all fawns and yearlings because it was assumed these age classes were correctly identified using tooth eruption as defined by the WR technique. the incisors were stored in individual envelopes at room temperature for 3-5 months and then processed and aged by the CA technique by Matson's Microtechnique Laboratory, Milltown, Montana.

The CA technique involved decalcification of the primary incisors, moutning the root in paraffin, sectioning the root mid-sagitally to a thickness of 12 microns and staining with Giemsa. The sections were mounted on slides and examined microsopically to count cementum annuli for age determination. Matson's laboratory was not informed of WR technique age assignments.

The sign test (Conover 1971) was used to detect differences in the ages assigned by the 2 techniques. Three groups of data were tested: all deer aged by both techniques; those deer aged as yearlings by the WR technique and also aged by the CA technique; and those deer aged as fawns by the WR technique and also aged by the CA technique.

Time-specific life tables (Deevy 1947) were calculated to examine the possible effects of aging technique on the average annual mortality rate (m_a). Since yearling deer were not represented in the same proportion in the sample processed for CA aging as in actual harvest data, proportional adjustment of the yearling age class was made for life table calculations involving CA data. Differences in this distribution and that produced by the WR technique were tested by the X^2 test (Conover 1971). The distribution of assigned ages was treated as mortality (d_x) data to simplify life table calculations since we were only interested in ascertaining differences in population statistics due to the 2 aging techniques rather than drawing inferences about the actual dynamics of the population. To further simplify calculations, the rate of increase of the population was assumed to be 0.

RESULTS

A total of 409 deer were examined at the hunter check stations. Incisors were collected from 52 of 239 deer aged as yearlings and 165 deer aged as 2.5 years or older by the WR technique. Incisors from 5 deer aged as fawns by the WR technique were also collected.

There were highly significant ($p<0.001$) differences between ages assigned by the WR and CA techniques (Table 1). Of those deer aged as yearlings by the WR technique, only

TABLE 1. The percentage of deer assigned to different age classes by the WR and CA techniques.

WR technique	Number aged	Overaged by CA	Underaged by CA technique	Aged the same by CA technique
All age classes	211	67.9%	7.2%	29.9%
Yearlings	52	82.7%	0.0%	17.3%
Fawns	5	100.0%	0.0%	0.0%

17.3% were aged as yearlings by the CA technique. Most deer aged as yearlings by the WR technique were assigned to the 1.5 year-old age class by the CA technique, and some wre placed in the 3.5 and 4.5 year-old classes (Table 2). All 5 specimens aged as fawns by the WR technique were aged as yearlings by the CA technique.

A highly significant difference ($p<0.001$) in the distribution of ages for antlered deer (f_x) produced by the 2 techniques was indicated (Table 3). The differences in age structure are reflected in the resulting d_x (probability of dying during the age interval x, x + 1), l_x (probability at 1.5 of surviving to the exact age x), and q_x (proportion of animals alive at age x that die before age x + 1) schedules. The magnitude of these differences is illustrated by the calculation of the average annual mortality rate (m_a) over all age classes. The m_a generaged for the WR technique was 0.615 and that for the CA technique was 0.381.

TABLE 2. Ages assigned by the CA technique to the 52 deer aged as yearlings by the WR technique.

Age class:	1.5	2.5	3.5	4.5
No. assigned:	9(17.3%)	36(69.2%)	5(9.6%)	2(3.8%)

TABLE 3. Time-specific life table calculations based on the distribution of ages assigned by the WR and CA techniques for 404 antlered white-tailed deer in Mississippi.

	Age class	Ages assigned by WR				Ages assigned by CA[a]			
Age	x	f_x	d_x	l_x	q_x	f_x	d_x	l_x	q_x
1.5	1	239	0.592	1.000	0.592	48	0.119	1.000	0.119
2.5	2	112	0.277	0.408	0.677	216	0.534	0.881	0.607
3.5	3	38	0.094	0.131	0.717	64	0.159	0.347	0.457
4.5	4	7	0.017	0.037	0.467	35	0.087	0.188	0.461
5.5	5	0	0.000	0.020	0.000	15	0.037	0.101	0.365
6.5	6	4	0.010	0.020	0.500	8	0.019	0.064	0.307
7.5	7	4	0.010	0.010	1.000	18	0.045	0.045	1.000
Total		404	1.000	1.626		404	1.000	2.626	
$m = \frac{\Sigma d_x}{\Sigma l_x}$			0.615				0.381		

[a]The 187 yearlings (3 cuspid third premolar) not aged by the CA technique were placed in age classes in accordance with the percentages in Table 2.

DISCUSSION

The discrepancies in the distributions of ages produced by the WR and CA techniques raise serious doubt about the use of the CA technique for aging white-tailed deer in Mississippi. The CA technique age assignments in the fawn and yearling age classes create the greatest doubt, for it is reasonable to assume that these 2 groups can be accurately aged by the WR technique.

It appears that white-tailed deer in Mississippi may deposit more than 1 cementum layer annually. This implies that deer may encounter more than 1 stress period in some years. This hypothesis is supported by Castle et al. (1979) who reported that seasonal patterns in body and organ weights of deer in Mississippi indicated probable stress periods in late summer and late winter. Others (Spinage 1967, Grimsdell 1973, Sinclair 1977) have related the deposition of double annuli in African ungulates to stress during the 2 dry periods that normally occur there.

Gwynn (1978) and this study support the possibility of double annuli deposition in the Southeast. However, others report the contrary. Bell (1974), working with 28 known-age der from Louisiana, found the accuracy of the CA technique to be 93.5%, whereas, biologists using the WR technique achieved an accuracy of only 78.1%. Cook (1979), using Matson's Microtechnique Laboratory, found that 25 known-age white-tailed deer from Texas were consistently underaged using the CA technique. Eighty-three percent of these deer were aged incorrectly by the CA technique and, of those aged incorrectly, 92% were underaged.

CONCLUSIONS

The CA technique is questionalbe for assigning ages to white-tailed deer in Mississippi and other areas in the Southeast. The questions appear to be more with the physiology of "annuli" deposition than with the microtechnique. Throughout this study, the authors were very satisfied with the services of Matson's Microtechnique Laboratory. Those who consider using the CA technique for aging deer in the Southeast should do so only after verifying the technique with known-age specimens from the area under study. This conclusion is especially true if age structure data are to be used for inferences about the dynamics of a population.

LITERATURE CITED

Bell, B.C. 1974. A comparison of age determination techniques for white-tailed deer (*Olocoileus virginianus*, Zimmerman) from differing Louisiana soils. M.S. Thesis. L.S.U., Baton Rouge. 156 pp.

Castle, L.E., H.A. Jacobson, and D.C. Guynn, Jr. 1979. Stress periods of the white-tailed deer in Mississippi. Abstracts of Tech. Papers. Second Annual Southeast Deer Study Group. p. 6.

Cook, R.L. 1979. Ages assigned known age Texas white-tailed deer: tooth wear versus cementum analysis. Proc. Ann. Conf. S.E. Assoc. Fish and Wildl. Agencies. 33(In Press).

Conover, W.J. 1971. Practical nonparametric statistics. John Wiley and Sons, New York. 462 pp.

Deevey, E.S., Jr. 1947. Life tables for natural populations of animals. Quart. Rev. Biol. 22:282-314.

Gilbert, F.F. 1966. Aging white-tailed deer by annuli in the cementum of the first incisor. J. Wildl. Manage. 30:200-202.

Grimsdell, J.J.R. 1973. Age determination of the African buffalo (*Syncerus caffer*, Sparrman). E. Afri. Wildl. J. 11:31-54 (cited by Sinclair 1977; not seen).

Gwynn, J.V. 1978. A comparison of aging 1.5 and 0.5 year classes of Virginia white-tailed deer by tooth wear and replacement with cementum analysis. Proc. Fourteenth Northeastern Deer Study Group. (In Press).

Lockhard, G.R. 1972. Further studies of dental annuli for aging white-tailed deer. J. Wildl. Manage. 36:45-55.

Lueth, F.X. 1963. A comparison of some aging techniques for Alabama deer. Proc. Ann. conf. S.E. Assoc. of Game and Fish Comm. 17:31-37.

Sauer, P.R. 1973. Seasonal variation of physiology of white-tailed deer in relation to cementum annulus formation. Ph.D. Dissertation. Cornell University, Ithaca, N.Y. 93 pp.

Severinghaus, C.W. 1949. Tooth development and wear as criteria of age in white-tailed deer. J. Wildl. Manage. 13:195-215.

______________ and E.L. Cheatum. 1956. Life and times of the white-tailed deer. Pages 57-186 *in* W.P. Taylor, ed. The Deer of North America. Stackpole Co., Harrisburg, PA, and the Wildl. Manage. Inst., Washington, D.C. 668 pp.

Sinclair, A.R.E. 1977. the African buffalo, a study of resource limitation of population. The Univ. of Chicago Press. Chicago. 355 pp.

Spinage. C. 1967. Aging the Uganda defassa waterbuck (*Kolus defussa ugandae,* Nueman). E. Afr. Wildl. J. 5:1-15 (Cited by Sinclair 1977: not seen).