Dentition and Deer Ages

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When wildlife biology emerged as a recognized scientific field during the first half of the last century, our predecessors concluded that the ability to study and manage animal populations would require refined methods of age determination. Some of these pioneering members of the profession observed, as stockmen have known for centuries, that grinding surfaces of teeth wear over time. One researcher, Ian McTaggart Cowan, developed dental aging standards for mule and blacktail deer. He described his ground-breaking results in the *California Fish and Game Journal* in 1936. An internationally renowned wildlife scientist at the University of British Columbia, Dr. Cowan is one of our organization's longest serving members. He became a regular Boone and Crockett Club member in 1964 and was awarded emeritus member status in 1977.

Perhaps the name most widely recognized in the description of tooth replacement and wear in whitetail deer is that of C.W. Severinghaus, who published his findings in the *Journal of Wildlife Management* in 1949. Acclaimed for his field work studying the natural history of wintering deer in the Adirondack Mountains of upstate New York, he had access to mandibles of known-age deer housed in a facility belonging to the New York State Conservation Department. I met Bill Severinghaus in Wilmington, North Carolina, during a 1985 meeting of biologists involved in deer management and research. I was fascinated by descriptions of his late 1930s and 1940s field work, in which he recounted covering up to 20 miles per day on foot over difficult terrain. Remarkably, he accomplished this wearing snowshoes, often in subzero weather; clearly an endeavor beyond the physical ability of most of us in today's electronic world.

Tooth Replacement

As with many other species of mammals, deer are born with milk or deciduous teeth, similar to "baby teeth" in humans. Looking at one side or half of a mandible or lower jaw, a fawn's deciduous teeth include three incisors, one canine tooth, which is also an incisorform tooth next to the medial incisors, and three premolars. These deciduous teeth are replaced by permanent ones in a predictable sequence. In whitetail deer, the incisors and canines **(Figure 1)**, sometimes called pincers, are shed and replaced by newly erupting

About the Author
Retiring in 2003 as a regional wildlife biologist, the author was employed for over 33 years by the South Carolina Department of Natural Resources. Becoming a professional member of Boone and Crockett Club in 2004, he has been an Official Measurer since 1976 and had the privilege of serving on several Judges Panels. His interests include tree and shrub plantings, bird watching, wood duck nest boxes, fish pond management, and he is an avid shooter and handloader.

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permanent teeth during the fawn's first year. At 18 months, the premolars are replaced. In mule deer, this process is completed by about two years, and in elk by two-and-a-half years **(Figure 2)**. Tables and illustrated charts in some references label premolars as numbers 2, 3, and 4 because of the presumed evolutionary loss of premolar number one, but for our purposes, they will be described as the first, second, and third premolars.

Severinghaus, in his 1949 paper, indicated that three permanent molars also erupt predictably; this being age two to six months for the first molar, seven months to one year for the second, and age 18 to 20 months for the third molar. By age 19 to 20 months, a whitetail deer's adult dentition is thus said to be complete, and in mule deer and elk, 24 and 30 months, respectively **(Figure 3)**. Eruption of permanent molars completes the row of six molariform or grinding teeth found in all cervids or members of the deer family. The relatively long gap between the incisorform (front teeth) and molariform (jaw teeth), called a diastema, is normal in artiodactyls (even-toed hoofed mammals) and not a situation of teeth "worn down to the bone" as an occasional observer might be persuaded.

With these predictable sequences, age determination in young deer up to age two is acceptably accurate and fairly straightforward. In addition to professionally trained wildlife biologists, a reasonably well instructed landowner or hunter should be able to separate deer mandibles into categories of six months, yearlings, and two-and-a-half years and older.

Fawning taking place during the spring to early summer with hunter harvest in the fall, age classes are expressed on the half year. Thus, young-of-the-year animals killed during their first fall would be classified as fawns in the one-half-year age class. Males at this age are button or "nubbin" bucks and legal only during periods designated for either-sex harvests. Although some hunters in the southern states refer to fawns as yearlings, wildlife biologists always use this term to describe the 1-1/2-year age class. Males during their second fall are typically spikes or forkhorns, and thus legal bucks in most jurisdictions. Yearling whitetail bucks on fertile soils often develop small "basket racks" with as many as eight or more points. Lacking the wariness of older deer and unless provided protection from moderate to heavy hunting pressure, yearling males usually comprise a sizable portion of each season's harvest.

Despite documented sequences of tooth replacement in young deer, the technique requires experience and attention

Figure 1
Incisors of adult mule deer (left) and whitetail deer (right). Note the greater width, especially the "spade-shaped" medial incisors characteristic of mule deer. The fourth or outboard front teeth technically are canines.

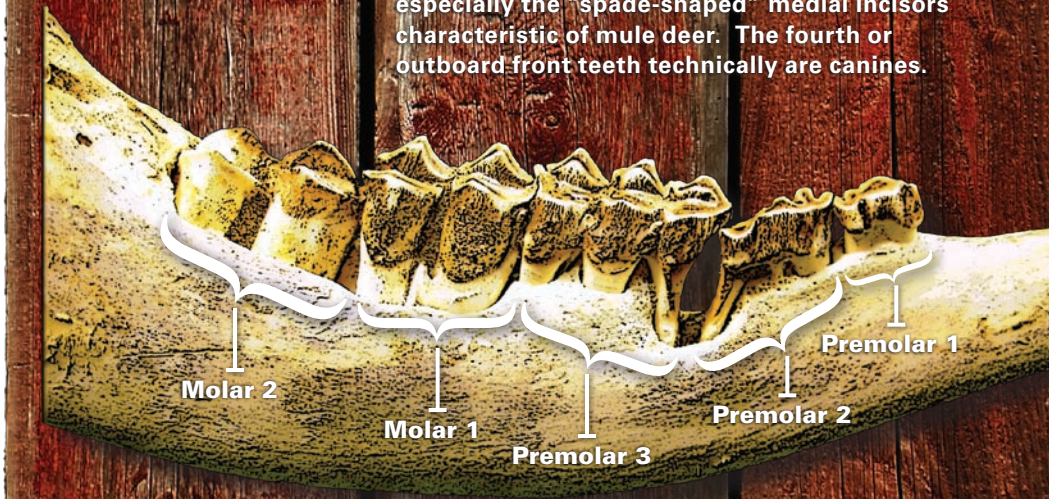
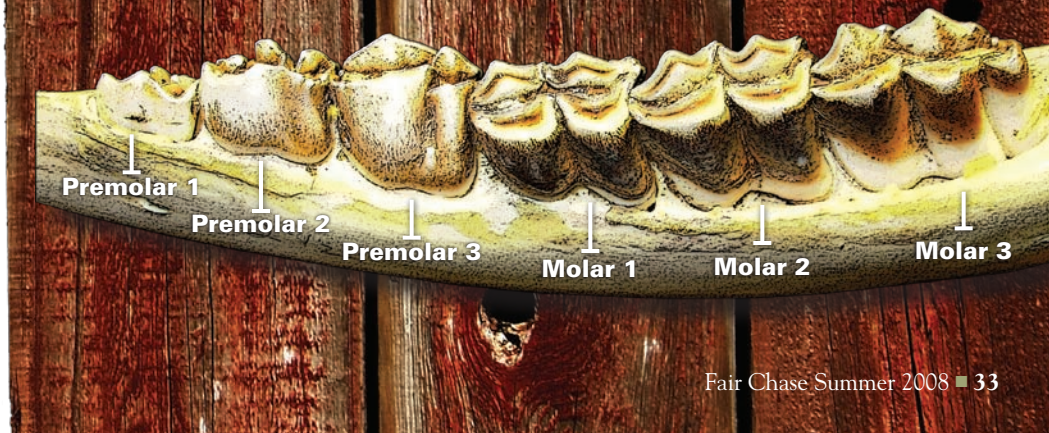


Figure 2
The larger size of this 1-1/2 (yearling) age class elk mandible makes it easier to illustrate the deciduous premolars, especially the third one with three cusps or crests. The second molar is not quite fully erupted, comparable to a six month age class deer. Replacement of the premolars and eruption of a third molar would have been one year in the future.

Figure 3
New, lightly stained premolars with sharp crests, are characteristic of this 2-1/2 year age class mule deer buck. The third or last molar with sharp lingual crests and only a slight hint of a dentine line, is a recently erupted tooth. Young adult bucks under quality management guidelines on private lands would be allowed to walk.



to detail. In the South, extended breeding and fawning periods, combined with very liberal hunting season lengths, make for a more complicated picture. In the yearling age class, a late-born fawn taken early in the season of the following year might only be 13 to 14 months at harvest; conversely, an early born fawn taken late during the following year's season could be 20 to 21 months of age. Both would be classified as yearlings. In the former case, separation from the six-month age class should not be overly difficult, with easily recognizable replacement of milk pincers and full eruption of the second molar. In the latter case, differentiating between yearling and 2-1/2 year age classes could be unwieldy, and there is agreement among deer specialists that some older "long yearlings" are misidentified as 2-1/2 year olds.

Severinghaus maintained that the critical marker for yearling age class whitetail deer is the replacement of a deciduous third premolar with three cusps or crests and showing considerable wear and staining, with a permanent two-cusped tooth with sharp lingual crests and little staining. A mandible with well-worn milk premolars with a readily recognizable three cusped third premolar is said to be a 17-month yearling. When one or more of the premolars have been shed—and the new permanent replacements are quite obvious as they erupt, pushing out their predecessors, suggests an 18-month yearling. Complete eruption of the permanent premolars including the third one with two cusps, along with a nearly complete to completely erupted third molar, would signify a 19-month yearling.

Highly evolved harvest strategies require commitment of resources and dedication, but program objectives should be based upon the best factual evidence. Obtaining reliable age estimates on harvested animals is regarded as essential by capable landowners and managers.

Researchers from Auburn University used mandibular impressions and measurements of molariform tooth row lengths to separate yearling deer by age and gender. They suggested that their findings were applicable within localized populations and regions due to large size variation in deer across their geographic range.

Although separating yearlings into 17-, 18-, and 19-month categories may strike some as delving into excessive detail, it requires more care and attention to detail in the evaluation of evidence, and it may also be useful. In the process of providing deer management assistance to hundreds of landowners and hunting clubs during the 1970s and 1980s, tens of thousands of deer mandibles were examined. A sizable data set collected from a large hunting club in coastal South Carolina afforded an opportunity to study the effects of estimated fawning date on weights and antler development of yearling male whitetail deer.

Progressive Wear

Going beyond the yearling 19-month category to the 2-1/2 year-and-older age classes requires the evaluation of progressive wear criteria of dark, inner dentine relative to adjacent hard, outer enamel, and associated structures and features **(Figure 4)**. Anyone needing additional information can obtain an excellent poster titled *Jawbone Removal and Aging* from the Quality Deer Management Association (QDMA) in Bogart, Georgia. With color illustrations and accompanying text, it provides more detailed information on this aging technique than is provided in

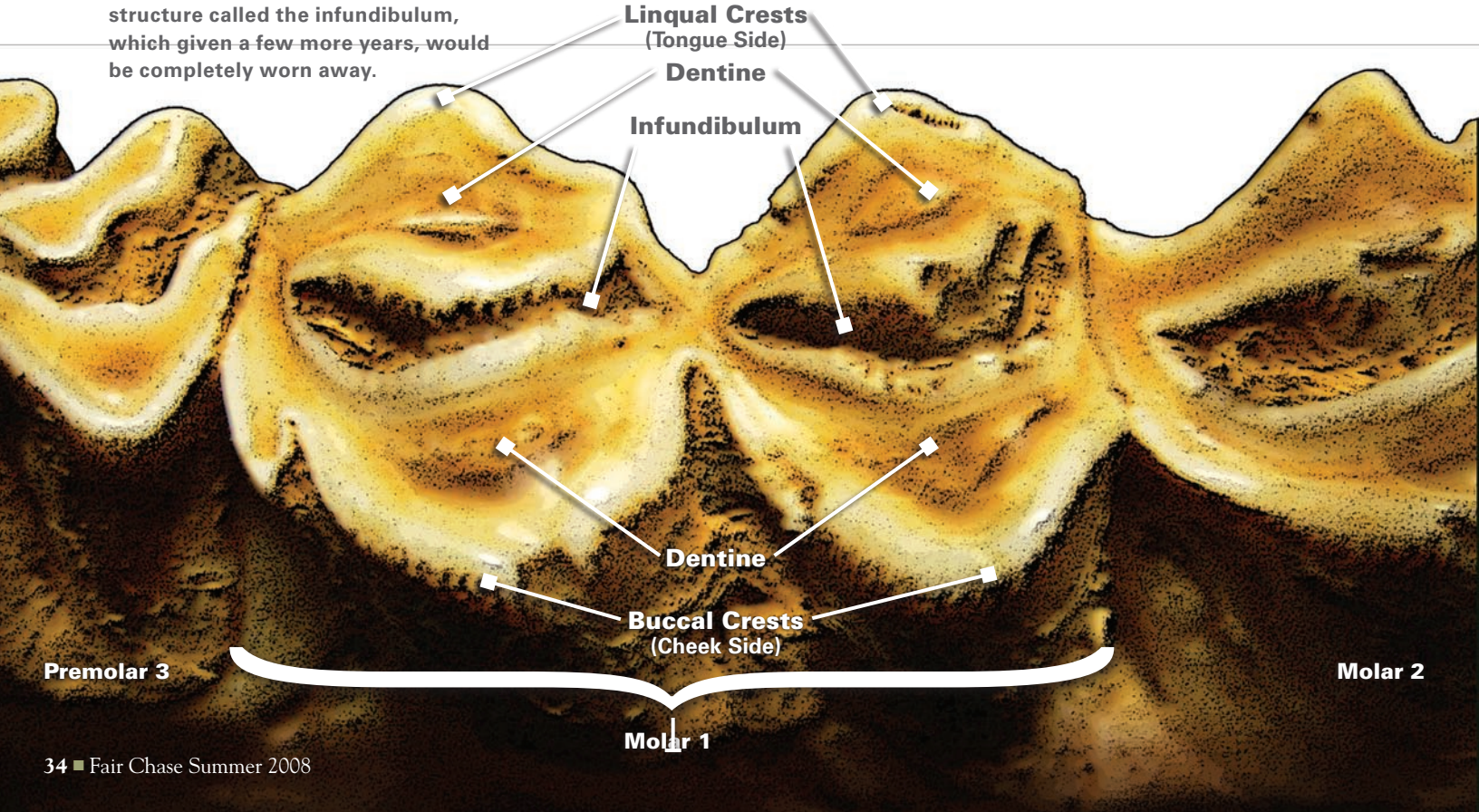


Figure 4
Tooth Nomenclature. This image illustrates the lighter and harder enamel on the lingual and buccal crests. Darker and softer dentine in the center lie on either side of a structure called the infundibulum, which given a few more years, would be completely worn away.

the *Wildlife Management Techniques Manual* and is widely regarded as the most up-to-date, educational resource on the subject.

Progressive wear criteria and their application have come under increasing scrutiny and review. Thousands of deer fawns have been captured and tagged, especially during the last two decades as research projects have been designed and conducted to investigate numerous aspects of deer biology including: behavior, fawn survival, predation, diseases and parasites, movements, and habitat relationships. Marked animals, surviving to older age classes and recovered through hunting or other mortalities, have permitted several researchers to accumulate sets of known age deer mandibles. Review of these collections revealed that tooth wear does not necessarily progress in an expected and consistent manner, perhaps due to variations in soils, vegetation, and regional differences, along with other, possibly unknown factors. Wear pattern variations have been reported as two directional, some mandibles from known-age deer showing wear patterns exceeding and others less wear than expected. It has also been suggested that methodologies have not always been applied consistently, and in conjunction with wear pattern variability, there is a tendency to underage deer 3-1/2 years and older.

Those familiar with wear patterns can attest that when examining right- and left-side mandibles from the same animal, they will not necessarily mirror each other **(Figure 5)**. Perhaps some deer tend to chew their cuds on one side more than the other much as tobacco users reaching for their favorite chew. Markers suggestive of more than one age class on the same mandible are not at all unusual **(Figure 6)**. In such instances, one has to strive to achieve the best fit by combining subjective judgments with experience. Critical review and accumulation of additional data have permitted a better understanding of progressive wear processes and refinement in their application. Tooth replacement and wear criteria are useful for reliable separation into fawn, yearling, and adult classes. The latter group can be subdivided into young adults with molars showing little wear as would be expected in 2-1/2 and 3-1/2- year-old deer, and older adults with considerable tooth wear consistent with 4-1/2 year and older deer.

Cementum Annuli

On all but the most intensively managed properties with highly evolved trophy buck programs, tooth replacement and wear criteria will enable most managers to successfully

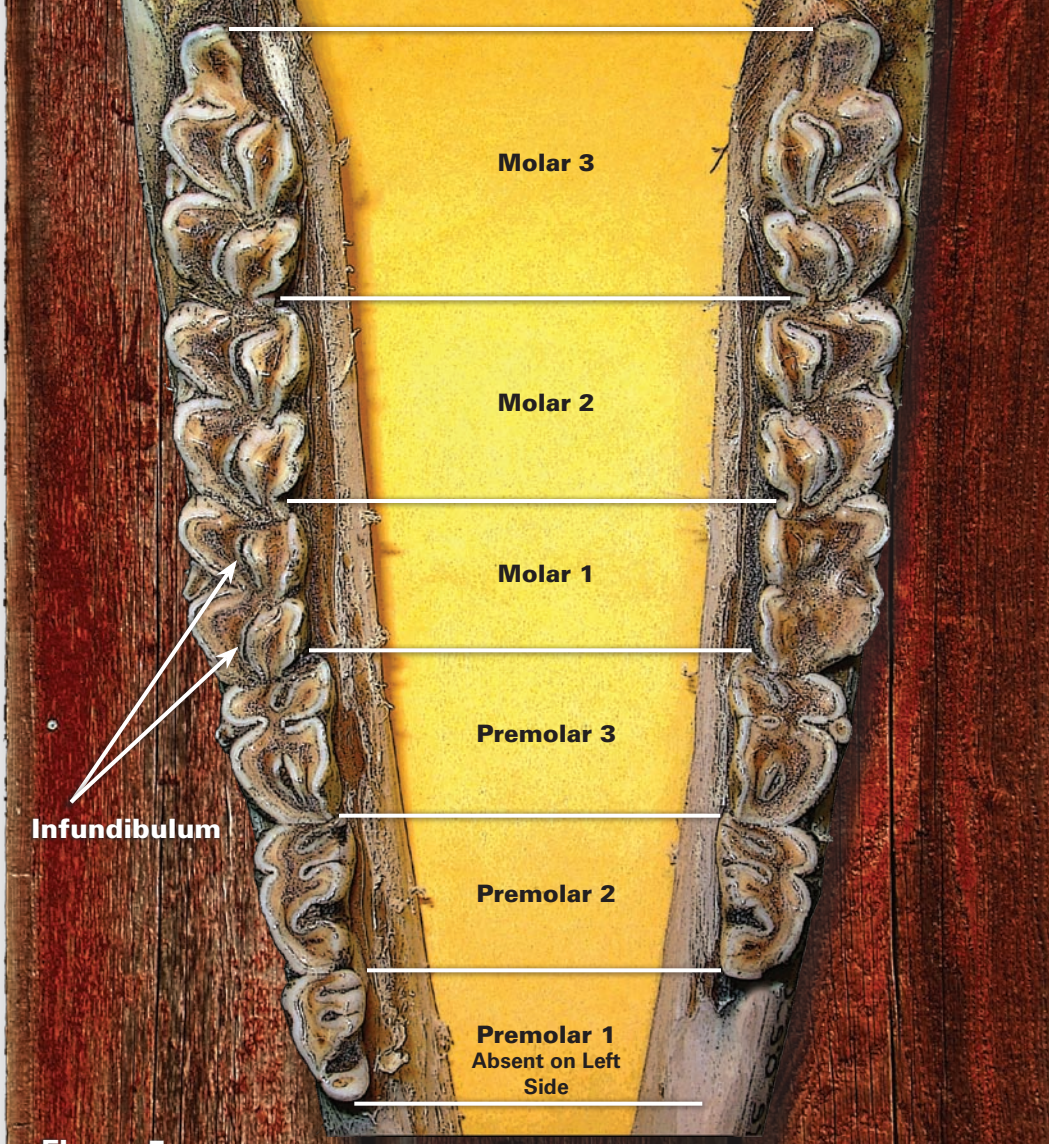
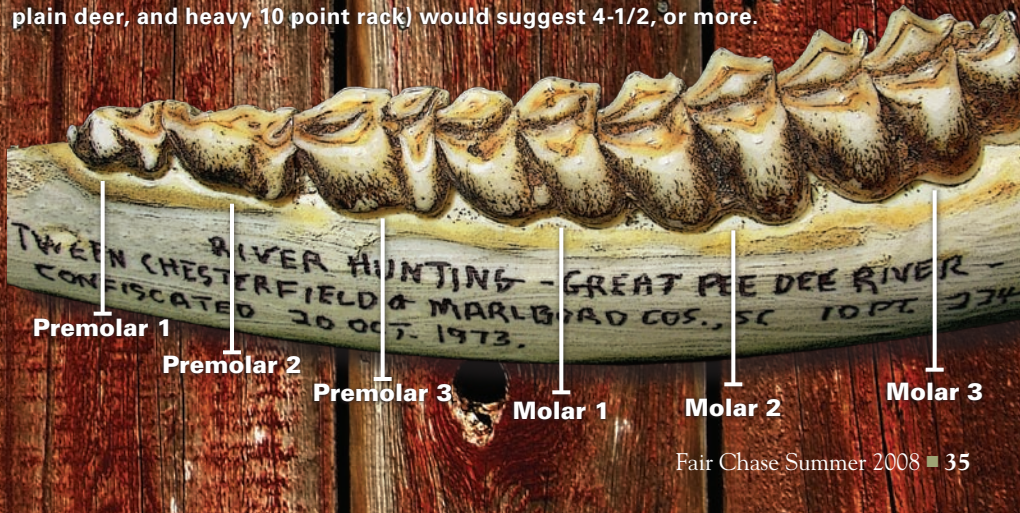


Figure 5
Note the relatively greater wear and missing first premolar on this adult white-tail buck's left side. Age estimates could vary by a year with these side to side differences. The infundibulum is almost completely worn away on the left side first molar. This is suggestive of at least 6-1/2 and probably the 7-1/2 year age class. Whether the actual age was 7-1/2 or something more or less would not be significant on a private lands trophy program. This animal survived long enough to achieve its potential for antler development, and in fact was measured at 176 0/8 non-typical by the author.

Figure 6
The light wear on the last molar as evidenced by relatively sharp lingual crests and narrow dentine line would barely be suggestive of the 3-1/2 year age class. On the other hand, wear on the premolars and first molar, along with the animal's size (224 lbs. whole body weight, quite large for a southeastern coastal plain deer, and heavy 10 point rack) would suggest 4-1/2, or more.



pursue their herd-management objectives. When greater accuracy is required by researchers, managers, and for purposes of harvest analyses and population reconstruction, there is a trend toward greater use of the cementum annuli technique to determine ages. Involving decalcification, sectioning, staining, and microscopic examination of the two primary or medial incisors and their roots, annular rings are counted much in the manner of tree rings or annuli on fish scales **(Figure 7)**. In many species of mammals, the substance comprising the outer layer of the tooth root—cementum— grows in an annual cycle. During the spring through early fall seasons, growth is abundant and characterized by the presence of plump cells in the cementum layer. During the winter season, growth is slow and the thinned cementum layer lacks cells. When calcium is removed from the tooth and it is thinly sliced and stained with a dye, these restricted growth layers appear as "annuli" analogous to rings in trees. The cause of restricted growth may be nutritional, hormonal, environmental or genetic and is likely a combination of these factors. Several researchers began investigating this technique during the late 1950s and early 1960s, including Dr. Cowan, who co-authored a paper on the topic in 1963.

In addition to expenses for shipping and laboratory work, age determination by cementum annuli, like tooth replacement and wear, has been criticized as not being reliable. As early as the 1960s and 1970s, investigators began comparing the two methods. One of these was B&C Professional Member Bob Cook, the senior author of a paper presented during the 1979 Southeastern Wildlife Conference. Those most familiar with cementum annuli suggest greater accuracy for northern deer in regions of severe winters. Supplemental feeding, however, may result in less distinct annuli and more difficult interpretation, even in northern regions. Indistinct and false annuli may also result in southern states where late summer drought periods and/or supplemental feeding may add to the influence of winter stress.

One of the most experienced in cementum annuli preparation and analyses (since 1969) is Matson's Laboratory in Milltown, Montana. Gary Matson advises that he sometimes sees problems with broken tips, incorrect cleaning, and misidentified teeth. With properly submitted samples, he suggests an accuracy level of 85 to 90 percent or two to three out of a sample of 20 being incorrect by one year; exceeding tooth replacement and wear accuracy for deer in the older age classes. This methodology is also preferred for carnivores.

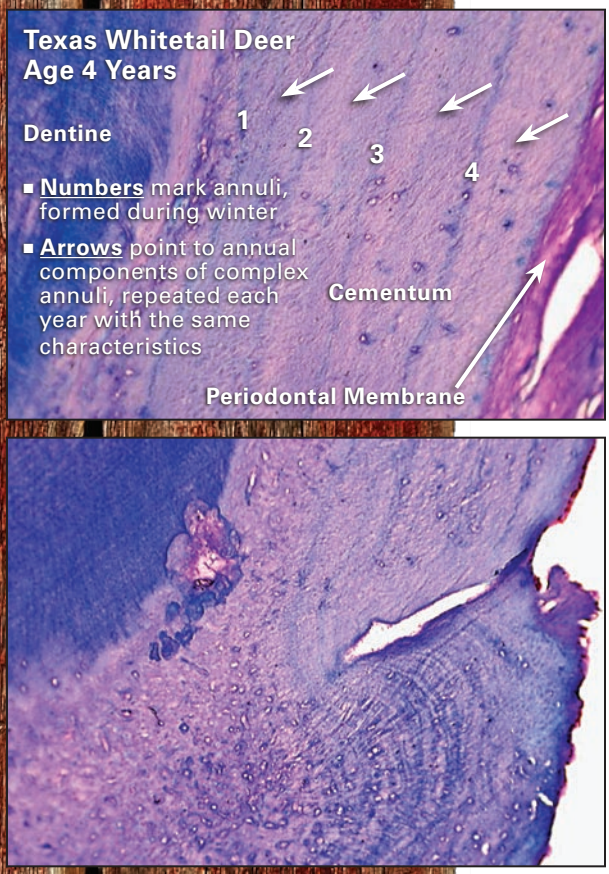
Recent Developments

In one recent investigation (2005) supported by the University of Georgia, Quality Deer Management Association, and the South Carolina Department of Natural Resources, near-infrared spectroscopy (NIRS) measurements were used to measure bone density and hardness of jawbones from South Carolina. In another investigation, researchers from the institutions mentioned above collaborated with anthropologists at the University of Arkansas, using a digital scanner and a program called ArcView to develop color enhanced topographical images of occlusal surfaces, which permitted precise dentine and enamel width and height measurements. Wide areas of overlapping measurements made placement into specific age classes difficult. While recent innovations are exciting and may show some promise; requirements of time labeling and shipping specimens, precise extraction of lower jaws without damaging them, and the expense of laboratory procedures, will probably limit practical application of these developments.

Summary

Despite problems and uncertainties, wildlife workers familiar with both tooth replacement and wear and cementum annuli suggest that the latter is better for deer 3-1/2 years and older, especially where a higher level of accuracy is required, and that tooth replacement and wear is as good or better than cementum annuli for younger deer. As more landowners are developing programs emphasizing quality, record keeping becomes vitally important. Notations on body weights and antler development are interesting, but much more so when accompanied by good age estimates. Highly evolved harvest strategies require commitment of resources and dedication, but program objectives should be based upon the best factual evidence. Obtaining reliable age estimates on harvested animals is regarded as essential by capable landowners and managers. To this I would add that age determination techniques are best used advisedly and by knowledgeable personnel. ■

Figure 7
Rectangular portion of the circumference of a first incisor tooth root showing distinct annuli. The cementum age of this Texas whitetail deer is 4 years. The cementum age of the deer in the bottom picture from the same population is also 4 years but the complexity and arrangement of indistinct annuli make the count problematic.



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Interested in having your deer aged?

Hunters who would like to have their trophies aged by the cementum annuli method can do so by contacting these labs for instructions on submitting teeth and pricing information.

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