Very little work has been done in special management on these specii as they are very seldom found in our mowed woods openings. Fertilizing experiments have been started but no conclusion can be drawn as to the practical results.

Other fruit trees and shrubs — In an effort to find plants that require a minimum of maintenance as a source of food for deer and wild turkey, trees and shrubs that produce a heavy mast are being used in trial plantings in several of the management areas. As yet, none of these plant materials are being used in quantity.

To date, our cheapest way of supplementing the natural supply of food is by improving the native plant material using basic slag and a rotary mower.

Under certain conditions it is still necessary to use the more expensive agricultural crops. If it is desirable to concentrate either deer or wild turkey for a short time for trapping operations, the use of such crops as chufa, small grains or peas will do a good job.

There are times when this type of planting may be necessary for public relations. A few good fields in easy access during hunting season will endear you to many hunters. These "agricultural patches" may also be used to help alleviate deer damage on valuable farm crops on adjoining lands.

Agricultural crops are also utilized in developing areas for public dove shooting. Suitable fields in the management areas are planted to Brown Top millet in the summer so the grain will mature in September. Fields with the heaviest stand are combined for a source of seed for future plantings.

When the food and clover are in good supply and we have a satisfactory stocking of game, there are still two important "troubles" that we must control before we have to start worrying about overpopulation.

With deer, loose-running dogs are probably more detrimental than everything else combined. Here again, your public relations in a community are very important. Before the time of game management areas, it was generally considered that all forest land, either national forest or private, was open to coon, fox, and rabbit hounds. Unless the majority of the natives are in favor of the areas, it is almost impossible to control the dog situation. However, interested persons can be a great help in convincing a few "diehards" that they can hunt or "train" their dogs just as well in other parts of the county. The question of stray dogs still has to be solved. Enthusiastic hunters are a great help along this line. But, actual control will vary with different situations. With sympathetic natives, I don't believe human predation will greatly endanger an established deer herd; but, just a few "turkey baiters" can rapidly destroy a turkey population.

We have found that the excellent cooperation of the law enforcement division of the South Carolina Wildlife Resources Department is not only desirable but absolutely necessary for the success of our game management program. Enforcement personnel are extremely helpful in maintenance operations and assisting in the control of harvest, in addition to their normal law enforcement duties.

The answer to game management at a bargain is complete cooperation of man and nature.

A COMPARISON OF SOME AGING TECHNIQUES FOR ALABAMA DEER

FRANCIS X. LUETH
Game Biologist - Deer Investigations
Alabama Department of Conservation
(A Contribution of P. R. Project W-35-R)

Technicians of the Alabama Department of Conservation have used the jaw method for aging deer since 1952. A few deer were aged that year using the procedures described by C. W. Severinghaus (1949, Tooth

Development and Wear as Criteria of Age in White-tailed Deer, Jour. Wildl. Mgmt., 13(2): 195-216). In 1953, many of the deer examined at checking stations were aged by this method. Jaws were collected and sent to Severinghaus for verification. Later these jaws were placed on "jaw boards" and used for reference on aging animals in the field.

The Game Biologists and Refuge Managers in Alabama act as a team in gathering deer kill data. Personnel and students at the Alabama Cooperative Wildlife Research Unit at Auburn University also assist in getting this information. The assistance of these technicians is appreciated and gratefully acknowledged.

The jaw method of aging deer has been used in Alabama for the past ten years. However, when three or more biologists age the same deer, they might disagree with one another as much as 30 per cent of the time, especially on some of the older specimens. How can such an apparently inaccurate method be justified? Perhaps many such errors could be eliminated if it was known what types of errors were being made.

In Alabama, it has been found that when a jaw is collected and aged in the laboratory, the animal is nearly always placed in the same age group as when aged in the field, provided it is aged in both instances by the same person. Of course, there are a few exceptions.

Some animals in the 1½-year class are erroneously field-aged as 4½ or 5½ and less frequently the 4½ or 5½ are aged as 1½. The technicians can correct the above errors when jaws are collected. Such errors can be attributed to carelessness rather than to any inherent error in the method. In addition, there are errors in recording and errors of omission. These errors can be reduced by proper training and supervision, or by a method described later in this paper.

There is another type of error in the jaw method of aging. I like to call this the "error of the intermediates." This occurs when a specimen does not correspond with the jaws on the board being used as a standard, but appears to have characteristics of two adjoining age classes. No two jaws are exactly alike, and no two technicians use the same characteristics for aging jaws.

Dr. Arnold Haugen, former leader of the Alabama Cooperative Wildlife Research Unit, and the author examined a number of jaws and aged them independently. The specimens were collected from two different areas in the State. Haugen field-aged and collected jaws from the Choccolocco Management Area and the author field-aged and collected jaws from the Oakmulgee Management Area. When the jaws from both areas were examined in the laboratory, there was no disagreement when the specimens were aged as 1½ years. However, there was disagreement on some jaws that were aged as 2½ and older.

After laboratory examination, these jaws were sent to Severinghaus and associates in New York for authoritative confirmation of this aging technique. When the jaws were returned, it was found that Dr. Haugen had properly aged nearly 95 per cent of those from Choccolocco, but had improperly aged over 15 per cent of those from Oakmulgee. Also in the laboratory, the author had correctly aged over 95 per cent of those from Oakmulgee, but had incorrectly aged 20 per cent of those from Choccolocco. In the total of 120 specimens, the field age agreed with the age given by John E. Tanck (who did the aging in New York) over 90 per cent of the time.

Biologists in some other states have reported that the tooth development and wear of deer from their states varies somewhat from that described by Severinghaus, and they have revised the characteristics for age groups.

In Alabama, it has been found that if sufficient numbers of jaws were collected from any one area, they could be divided into definite groups with few intermediates. This grouping is done without consulting any reference board. When the jaws have been separated, it is assumed that they are divided into definite age groups and a jaw board is constructed with a typical jaw from each age group. This reference board appears to have a high degree of accuracy for the area for which it was constructed. However, it is often inaccurate for other areas in the State.

The tooth development method of aging is a fast field method. In

Alabama where few, if any, of the 1½-year class have permanent premolars during the legal hunting season, it has a very high degree of accuracy in the ½-year and 1½-year age classes. It does have a disadvantage in that its use depends upon the proper training and interest of a number of individual field men. There appears to be no way to correct the error of placing an animal in an adjoining age group. It is often difficult to obtain material to check the man in the field, since jaws cannot always be removed from heads that are suitable for mounting.

Since the publication of a paper by Rexford D. Lord, Jr. (1959, The Lens as an Indicator of Age in Cottontail Rabbits, Jour. Wildl. Mgmt. 23 (3): 321-358) there has been considerable interest in using the weight of the eye lens as an indication of age in many species of animals, including white-tailed deer.

During a 3-year period, the Game Biologists of Alabama obtained eyes from over 700 deer. Most of these were taken from legally killed animals in various parts of the state. However, some were obtained from illegally shot females and others that were sacrificed for parasite and reproductive studies. An additional 50 specimens were obtained from a taxidermist who provided both eyes and jaws.

Both eyes were available from 200 deer. These 400 eyes and single eyes from an additional 200 deer were treated and weighed as descr bed by Lord. The dry weights of the lenses from paired eyes that had been preserved in 10 per cent formalin were nearly identical, but those that had been preserved in an alcohol formula often varied a great deal. Observations indicated that many of the lenses preserved in alcohol cracked open in the drying bottle and small portions were lost and not weighed. Therefore, the weights from all alcohol specimens, plus the formalin specimens that had been severely damaged, were discarded.

The lenses from eyes collected during the 1962 season were removed, rolled over blotting paper, and weighed without being dried. Preliminary testing had shown that the wet weight of lenses averaged about 2.3 times the dry weight. The wet weight, therefore, was divided by the conversion figure 2.3 to obtain the dry weight. The first weights were recorded to the nearest .1 milligram, but later weights were to the nearest milligram.

Where both eyes and jaws from an animal were available for study, it was relatively simple to divide the jaws into age groups and show that the lens weights fell into these groups, except for considerable individual variation. It was not possible to take the weight data and divide it into groups since there appeared to be no definite peaks in the distribution of lens weights. It should be noted that a high percentage of these specimens were in the older age groups.

The eye lens weights of over 600 different deer collected on nine different areas of Alabama were available for study. These lens weights were divided into age classes by using the ages derived from the jaw method as a basis of division. Mean weights were computed as were the standard deviations. At first, the lenses from males and females were considered separately, but it was soon apparent that there was little difference between sexes.

The results of the computations are given in Figure 1 (left graph). Although the mean weights appear as a relatively smooth curve, only in the ½-year class (fawns) was it feasible to use the lens weight as a reliable indication of age.

The lens weight is a measurement of growth; however, there are other measurements that are more readily obtained that can be used in the same manner. The live weight of the animal itself can be treated in exactly the same manner as the lens weight.

Live weights were recorded on deer from the same areas and in the same years that the lens data were obtained, and they also were arranged in age classes as determined by the jaw method. In this instance, however, data were tabulated only on buck deer. Again, the means and standard deviations were computed. Figure 1 (center graph) shows the growth curve of live weights based upon jaw ages. It is very similar to the curve derived from lens weights. We obtained live weights for 1,975 deer on the nine areas where we obtained useable data for lens

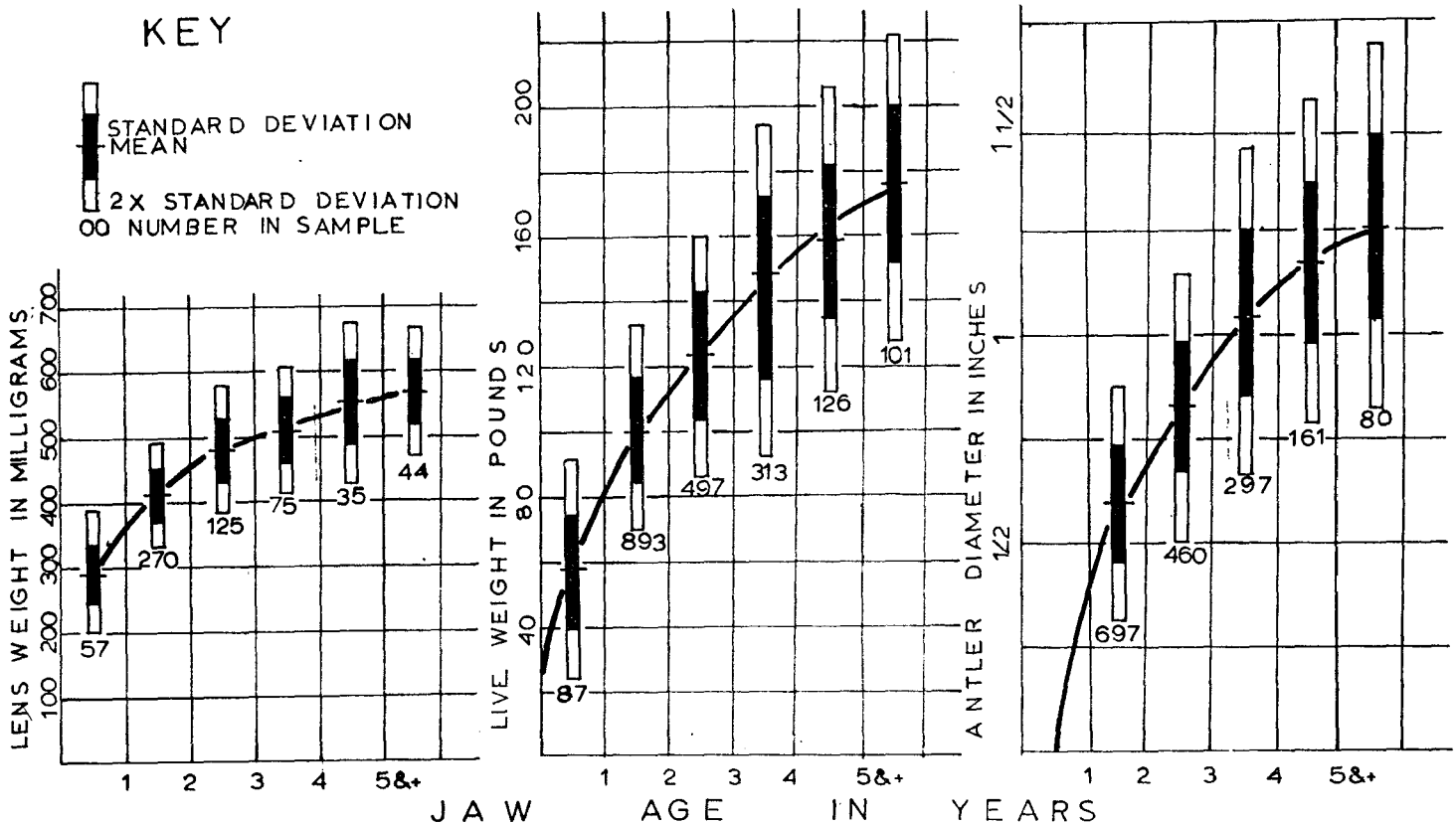

FIG. 1 Comparison of some growth-rate curves. Alabama deer.

weights for only 600 deer, and the live weights were much easier to obtain.

The beam diameter of antlers is another measurement that can be used as an indication of age. A majority of deer in the ½-year age class can be separated from all other age classes by the absence of antlers. However, there have been at least two instances in Alabama where fawns of the year (as aged by the jaw) have "visible antlers above the hairline." There also have been a number of instances where the animals were at least 1½ years old and did not have visible antlers during the hunting season. We have tagged a few fawns of the year which were recovered a year later without antlers.

Antler diameter data from 1,700 deer and eye data from 600 deer were obtained from the same areas and during the same years. Antler diameter measurements were grouped according to the jaw age and means and standard deviations were computed. Figure 1 (right graph) shows the growth curve based on antler diameter, which indicates a correlation of antler diameter and age. It also shows considerable variance and overlap in the older age classes.

A comparison of the growth curves in the three graphs in Figure 1 shows that the fawn class can be accurately separated from all other age groups by any of these methods. In some instances, the 1½-year group can be separated from other age classes with a high degree of accuracy. There is, however, a great deal of variance and overlap in the older age classes. Measurements of the neck, hind leg, and other parts of the deer can be treated in the same manner, and again there usually is a division of the fawn class, and sometimes of the 1½-year class. However, these are the classes most easily aged by the jaw method.

No method of aging is accurate 100 per cent of the time. Inevitably, there will be human errors and animal abnormalities which cannot be entirely eliminated. The deer technician may, however, compensate for some of these errors by confining his work to a particular herd of deer, or to a small geographic area, rather than an entire state.

As previously stated, the computations made in this paper are based upon nine different areas in Alabama. The areas were recorded separately, and the data collected suggested how the material should be analyzed.

On one of the management areas, we have weighed a number of illegally taken buck deer during the regular hunting season. On this area, the fawns weighed from 45 to 65 pounds. Legal bucks from this area have never weighed less than 85 pounds. However, on some areas we have found ½-year old deer (fawns) that weighed as little as 23 pounds and on other areas they weighed as much as 95 pounds when killed during the hunting season. We also have checked antlered 1½-year old deer that varied in weight from as little as 57 pounds on one area to as much as 165 pounds on another area.

Such variances in weight suggest that growth curves should be computed for each area of study in order to use live weights as an indication of age. An example of this is shown in Figure 2. The left graph in this figure shows the growth curve of live weights for the Oakmulgee Management Area. It is one of several game management areas in Alabama where an over-population of deer probably has existed for some time. The rate of growth is relatively slow at Oakmulgee.

The right graph in Figure 2 shows the growth curve of live weights for the Westervelt Game Preserve, which is a private area owned and managed by the Gulf States Paper Corporation. There is no indication of an over-population of deer on this area at the present time, and there is no history of over-population. The rate of growth is relatively fast on this area.

Lord, who proposed the lens technique for aging, later suggested that it could be used to determine nutrition (1962, Aging Deer and Determination of Their Nutritional Status by the Lens Technique, Proceedings of 1st National White-tailed Deer Disease Symposium, 89-93). Due to many complicating factors of nutrition, he suggested that caution should be used in the application of the lens technique for aging.

In Alabama, the lens data suggested that there was somewhat less variance between lens weights in deer of the same age and from the same area than between lens weights in deer the same age but from

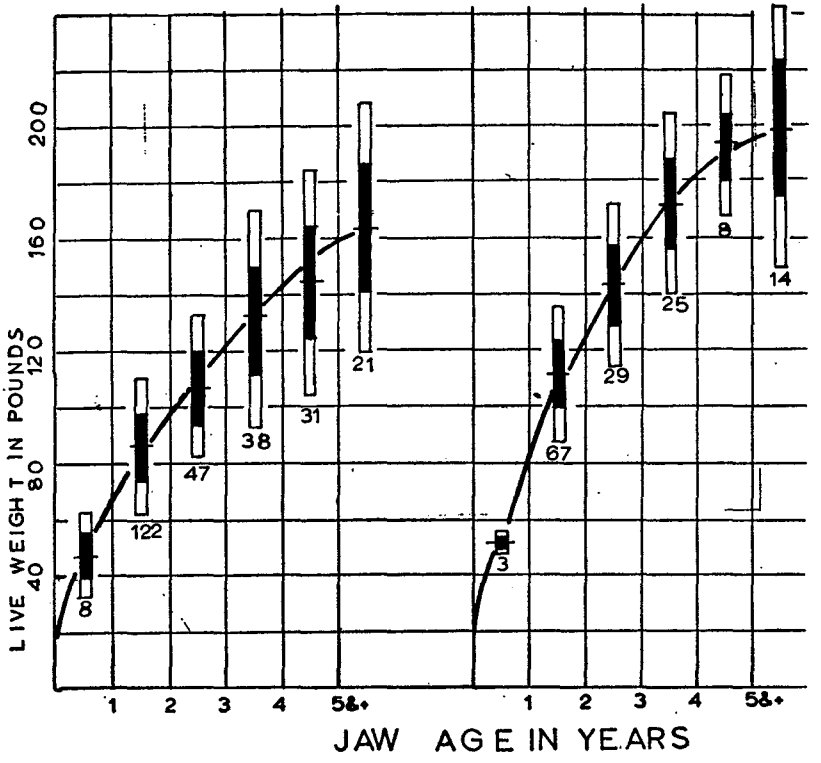

FIG. 2 Comparison of growth-curves based on live weights. Two areas in Alabama

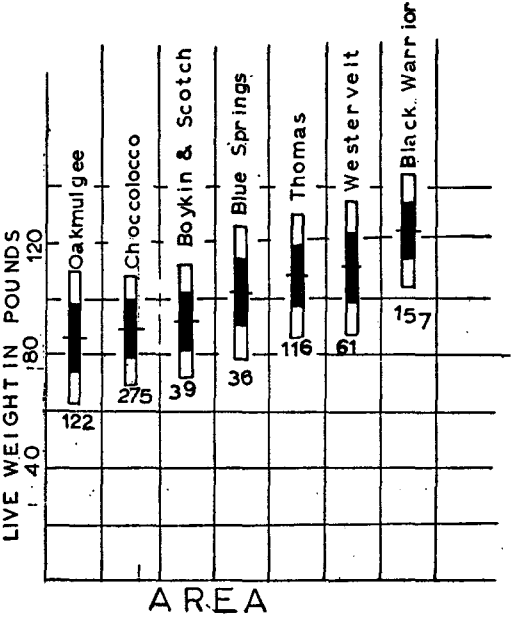

FIG. 3

Comparison of live weights of 1½ year old deer from different areas of Alabama.

different areas. Perhaps the use of the lens as an indicator of nutrition should be explored further.

Live weights of deer also can be treated in exactly the same manner as lens weights. Figure 2, for example, indicates better nutrition on Westervelt than on Oakmulgee. It appears that it might be more practical to use live weights since they are more readily obtainable than lens weights.

In Alabama, we have an age class that can readily be determined by the jaw. This is the 1½-year class. Comparison of live weights of this class indicates the nutritional levels on different areas. This is shown in Figure 3 (Two areas are combined due to the relatively small sample and similarity in weights). Antler measurement data from deer in the 1½ year age class also might be used to determine nutritional levels.

In Alabama, we have been able to best utilize the information obtained from deer by separating the data into relatively small units such as counties or management areas. In grouping weights by age classes and by small areas, it is more readily apparent when an animal deviates from the normal. For example, a deer aged as 1½ years may be much heavier than other animals from the same locality. If that animal also has a much larger rack than others from the same locality, it is likely that the animal was incorrectly aged in the field. Likewise, a 4½ or 5½-year field-aged animal that weighs much less than other animals and shows poorer antler development than others in that age group probably belongs in a younger age group. By working with small units and using all available data, such errors might be recognized and corrected. Errors of omission (failure to record age) can sometimes be corrected at this stage.

CONCLUSIONS

1. The tooth development method of age determination is not infallible. However, it can be used with a high degree of accuracy if reference jaw-boards are prepared from specimens collected in the vicinity of the study area.
2. In Alabama, the eye lens weight technique of aging apparently is not accurate beyond the ½-year age class. It may be a fair to good indication of nutrition.
3. Live weights, antler diameters and perhaps other measurements of growth are equally as good indicators of nutrition as are lens weights.
4. In order to effectively and efficiently utilize all available deer kill data, it should be separated and analyzed according to individual herds, or relatively small geographical areas, rather than on a statewide basis.

CORRELATION OF TIMBER MANAGEMENT AND WILDLIFE MANAGEMENT ON NATIONAL FOREST LAND IN VIRGINIA

MAX CARPENTER
Game Biologist, Commission of Game and Inland Fisheries
AND
E. V. RICHARDS
Wildlife Staff Assistant
George Washington National Forest

INTRODUCTION

The George Washington National Forest in Virginia covers nearly one million acres and contains some of the finest hunting land in the East. Its sprawling acres lie north of the James River and extend over the northwestern tip of the State with several large valleys intersecting the mountains.

The State of Virginia and the U. S. Forest Service have been partners in managing game on this National Forest since 1938. We are celebrating the 25th anniversary of this cooperative venture this year. Many problems have been met and overcome through the years and this