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

combined effort has paid big dividends as shown by the steady increase of game harvested each year.

Wildlife management on the National Forest is the joint effort of the Virginia Commission of Game and Inland Fisheries and the U. S. Forest Service.

Two State game biologists are assigned to the Forest and work closely with seven District Rangers on this million-acre public hunting area.

Each Ranger District is divided into two game management units, containing between 30,000 to 50,000 acres. A State-financed game manager is assigned to each wildlife management area on the Forest. Meeting once a month, the Biologist and Ranger plan the work of the game manager and coordinate all wildlife management practices with other forest uses.

Several years ago the Forest Service in Region Seven began a system of wildlife inventory mapping.[1] This system, developed by Virginia Game Commission and U. S. Forest Service, is now adopted as standard throughout the northeastern region of the Forest Service. Under this system a series of overlay maps were prepared upon which the location of all existing wildlife clearings, sources of water, access roads, and camping sites were shown. Adjacent to each was drawn a colored area which indicated the zone of influence that each structure had on the surrounding area. For example, clearings were shown to have an influence of one-half mile, a waterhole influenced the habitat for one-half mile in all directions, while a road allowed hunter penetration of at least one mile adjacent to it. By drawing all such existing improvements and plotting their zones of influence — it soon became apparent where future clearings, waterholes, or access roads were needed. This inventory system, now in use in Region Seven of the Forest Service, serves as the starting point for planning all wildlife improvement work on the George Washington National Forest.

Approximately 663,000 acres or 73 per cent of the George Washington National Forest is classified as commercial forest land, that is, land capable of growing a commercial timber tree. From this acreage a cut of 10 million board feet of sawtimber and 40,000 cords of pulpwood are removed annually.

On this commercial portion of the Forest the habitat for fish and game is annually influenced by on-the-ground programs of the Forest Service — commercial timber sales, an extensive timber stand improvement program, and stand conversion.

State game biologists have been quick to realize that the "man who squeezed the paint gun" — the timber marker — alters the habitat for wildlife far more than any other person. Both the Biologist and Forester saw the importance of coordinating wildlife and timber management plans.

For ease of management the George Washington National Forest is divided into 1,500 timber compartments. These compartments may contain an entire watershed or portion thereof. One-tenth of these compartments are scheduled for on-the-ground examination each year. This is done before any cutting is scheduled in that compartment.

To begin with, each timber compartment is cruised by trained foresters to determine the volume of sawtimber or pulpwood available. Location of access roads, drainage problems, and other hazards in logging are noted.

State game biologists participate with foresters in the field survey of these compartments. They prepare a map showing key areas, available forest openings, cover, roosting sites, available water, wildlife sign, and make specific management recommendations for that compartment. All this information is retained in permanent compartment files in the District Ranger's Office.

When a large timber sale is scheduled in a compartment the Game Biologist is asked to participate with the Forester in preparing a Pre-Sale Report of the sale area. All sales above $2,000 stumpage valuation require this sales report.

In the Pre-Sale Report the Biologist can make specific recommenda-

[1] Shaw, Samuel P., "Overlay Maps For Projecting Needs In Forest Game Management," U. S. Forest Service, Upper Darby, Pa., April, 1963.

tions for the creation of wildlife clearings by clear cutting or "daylighting" old logging roads through pulp sales, seeding roads and log landings, or retaining groups of valuable trees for dens, feeding, or roosting purposes. Guided by these recommendations the District Ranger can then modify his marking of the area to provide for the needs of wildlife.

On the smaller timber sales (usually sales of $2,000 or less) wildlife guidelines have been prepared by the State Biologist to guide the timber marker. These guidelines in card form are always kept handy, usually in their scale book, and indicate to the timber marker the minimum number of den trees, mast trees, and other wildlife management recommendations to be applied on the ground.

Periodic field inspections by Biologist and Forester assure that wildlife values are considered in all timber marking.

A total of 10,000 acres are clear-cut or thinned through sales each year. This represents a small portion of the available commercial forest acreage.

In the early 1950's the Forest Service started a timber stand improvement program to improve the future stands of timber. It largely involves thinning pole-sized stands and release of conifer species from competing hardwoods. This program has been expanded each year.

At the present time the TSI program affects more acreage than any other Forest Service program and as such exerts a great impact on the wildlife resource. For example, in Region Seven, over $1,000,000 will be spent on TSI in 1964. During 1963, $120,000 was spent in treating 11,000 acres on the George Washington National Forest. A total of $130,000 is planned to treat 12,300 acres in Fiscal Year 1964.

Game biologists soon recognized that the TSI program offered great opportunities for improvement of habitat for game — especially deer. The normal TSI procedure of thinning pole-size stands by girdling unwanted trees and treating with 2,4,5,T resulted in very little stump sprouting. By omitting the 2,4,5,T and girdling only, sprout production was greatly increased.

Dave Patton [2] of the Virginia Cooperative Wildlife Research Unit, working on the Broad Run Area, a representative pole-size stand, found that browse production averaged 10 pounds per acre for uncut areas of this type. This was increased to 60 pounds per acre in one year by removing 50 per cent of the basal area. This removal would represent about the minimum amount of basal area taken from a typical pulpwood sale. The pounds per acre of browse produced increases as the per cent of basal area removed is increased.

Further modifications were made in the original TSI procedure to increase deer browse in critical areas. Instead of girdling trees to thin a stand, a partial cut was made and the tree allowed to fall over. This was called "hinge-falling." A tree so cut would sprout the full length of the trunk as well as around the base of the tree. In addition, the tops of the trees afforded considerable browse since the tree remained alive for several years. On critical deer range producing about 10 pounds of browse per acre, game biologists recommended this practice of hinge-falling. This emergency procedure was recommended only for critical deer browse areas which were not scheduled to receive any timber or pulpwood sales for the next decade. In such areas where TSI was scheduled Forest wildlife money was used to hire an additional man to work on the regular TSI crew. This man, working behind the TSI crew, would hinge-fall a minimum of 20-25 six-inch trees of the primary browse species, such as red maple, dogwood, poplar, etc. Hinge-falling this number of trees placed 60-80 pounds of available deer browse in the feeding zone, providing approximately 20 additional days of deer use per acre. Cost per acre averaged $2.60.

It should be emphasized that this deer food is in addition to that normally provided through regular TSI practices. We believe that through the modifications of omitting 2,4,5,T and in hinge-falling we are making available about 100 pounds of browse per acre. The hinge-fall trees also provide cover and food for small game, notably rabbits and grouse, so the benefits are not all for deer.

[2] Patton, David R., "The Influence of Forest Cutting on Browse Availability," Master's Thesis, Virginia Polytechnic Institute, Blacksburg, Virginia. 1963.

Stand conversion through pulpwood sales is another Forest Service program of interest to the State Game Biologist. Considerable acreage of the forest is annually involved in pulpwood clear cuts in which the Forester's objective is converting an inferior hardwood stand to a more valuable pine stand. Or converting a poorly stocked stand to a better stocked stand.

Game biologists are kept informed of such projects at planning meetings and work closely with the District Ranger on such projects to protect the wildlife resource.

In the above we have discussed how timber sales, timber stand improvement, and stand conversion all affect the commercial acreage of the National Forest and directly alter the wildlife habitat.

In addition, 244,000 acres of the George Washington National Forest is classified as noncommercial forest land. This vast acreage is incapable of producing a tree of size and quality for commercial sale. Probably half of this acreage is composed of Scrub Oak (*Quercus ilicifolia*), Mountain Laurel (*Kalmia latifolia*), and Mountain Pine (*Pinus pungens*) cover-type. Considerable food is provided in these areas. Usually the area is made up of dense, impenetrable growth that limits both game and hunter using the area. So our management has been directed to opening this type of country. Biologists and foresters cooperate in making detailed plans for improving these areas and use heavy bulldozers to ride down and wind-row the dense growth to create needed wildlife openings. These areas create small game cover, sprouts for deer browse, and are an additional benefit in providing travel lanes for both game and hunter. The cost of creating these openings was $20 per acre.

There is a continual search to find ways to manage wildlife on as many acres as possible without increasing the cost of doing the work. The use of herbicides and soil sterilants to do this shows some promise. Such chemicals as Monuron, Fenuron, and Ammonium sulfamate have been used experimentally in Virginia to establish or maintain wildlife areas. The cost was lowest with Fenuron at $28.35 per acre.[3] This compares favorably in cost with bulldozing and hand-clearing methods, and may prove to be a practical and economical method to create forest clearings and maintain established open areas.

There is no doubt about the value of coordinating timber management and wildlife management production. Timber sale clear-cuts create openings in the forest canopy. Pulpwood sales allow light to reach the floor of the forest and benefit the low-growing plants and shrub. Crop trees remaining after thinning a pole-size stand by TSI will develop larger crowns. This will increase acorn production. Conifer release will provide additional cover. Stand conversion areas provide more edge effect. Light reaching the low-growing shrubs will make them produce more fruit. The benefits to game are many.

Coordination is a key word in the relationship of forestry and wildlife management. On National Forest land in Virginia we have been following the concept that forestry practices should be applied with a view of providing a beneficial effect on fish and game habitat. The Biologist and Forester must function as a team if the wildlife resource is to be managed most effectively.

We have followed this team concept for 25 years in managing wildlife on the George Washington National Forest. We feel it is paying off.

[3] Trumbo, H. C., "Techniques Involved In The Use Of Chemicals In An Attempt To Establish Wildlife Clearings." M. S. Thesis, Virginia Polytechnic Institute, Blacksburg, Virginia. 1963.