Biology and Management of White-tailed Deer in Alabama

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Wildlife Biologists

Alabama Department of Conservation and Natural Resources
Division of Wildlife and Freshwater Fisheries

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PREFACE

White-tailed deer (*Odocoileus virginianus*) are some of the most familiar and recognizable animals in Alabama. They are common sights along roadsides, in fields, and even in some backyards throughout the state. Deer are common residents of most rural parts of Alabama, as well as many of the urban and suburban areas of the state.

This has not always been the case. Not all that long ago deer were rare in most areas. In the early 1900s, it was estimated only about 2,000 deer existed in the entire state of Alabama. After decades of restocking and management efforts, Alabama's deer population reached an estimated 1.75 million animals in 2000. In fact, many areas in Alabama are overpopulated with deer and have been for many years. As a result, crop damage, deer/vehicle collisions, and other negative deer/human interactions have become more common.

Despite the problems deer cause in some areas, the fascination with this magnificent animal is almost universal. Hunters and non-hunters alike still marvel at the sight of deer, even though they are now more common than ever. In the 2001-02 hunting season, over 213,000 deer hunters spent over 3,900,000 man-days in pursuit of deer. Those hunters harvested 410,700 deer. Deer hunting is now one of the major industries in Alabama—generating hundreds of millions of dollars in the state each year.

Recognizing and understanding the economic impact of deer hunting is important. However, the economic impact of the deer hunting business cannot be the primary determinant of deer management policy. A sound approach considers a variety of factors, including deer herd health, impacts on other species, and deer/human conflicts. Suc-

cessful deer restoration in Alabama has long been completed. Managing simply for hunting opportunities is shortsighted and problematic. A more holistic management strategy includes managing for normal deer herd structure, protection of habitat integrity, and maintaining appropriate deer density.

In Alabama, hunters, landowners, and deer managers form the front lines of deer management and determine the future of the white-tailed deer. The Wildlife and Freshwater Fisheries Division only can provide a regulatory framework and set management objectives for the state's deer herd. This book was produced in part to provide deer hunters/managers with timely and factual information that will aid them in properly managing their deer herds. For the individual hunter or the professional deer manager, it offers a sound basis for management decisions. For those with only a casual interest in the white-tailed deer, the book makes an excellent reference tool.

Francis Leuth worked as a wildlife biologist with the Alabama Game and Fish Division from the early 1950s through 1977. He truly was one of the pioneers of deer management in Alabama.

This publication is dedicated to those who have worked diligently to restore, protect, and manage this beautiful symbol of Alabama's native fauna. In particular, it is dedicated to the memory of Francis X. Leuth, who was in many ways a man ahead of his time.

TAXONOMY

The white-tailed deer is one of 37 species in the family Cervidae and shares the genus Odocoileus with only one other species, the mule deer and black-tailed deer (*Odocoileus hemionus*; Baker 1984). Approximately 38 subspecies of white-tailed deer have been described in North, Central, and South America. Thirty of these subspecies are found in North and Central America alone (Baker 1984).

Historically in Alabama, the predominant subspecies of whitetail was the Virginia subspecies (*O. v. virginianus*), with the subspecies *O. v. osceola* inhabiting the extreme southern edge of the state. Following the near extirpation of whitetails from the state in the early 1900s, the Alabama Department of Conservation, along with some private individuals and groups, began restocking deer throughout the state in the 1930s. Most restocking occurred during the 1950s and 60s. The majority of deer restocked in Alabama were from sources within the state and is assumed to have been *O. v. virginianus*. Deer from several other states, including Arkansas, Georgia, Michigan, North Carolina, Ohio, Texas, and Wisconsin, were used to a much lesser degree in restocking of several areas around Alabama (McDonald and Miller 1993). Those restockings included deer from as many as six different subspe-

cies of whitetails, including *O. v. borealis*, *O. v. macrourus*, *O. v. osceola*, *O. v. seminolus*, *O. v. texanus*, and *O. v. virginianus* (McDonald and Miller 1993). Due to the variety of stocking sources, many locations in Alabama may contain deer with a combination of ancestries that cannot be placed in a single subspecies. As a whole, it is assumed the majority of deer in Alabama are of the Virginia subspecies since 56 of the state's 67 counties were stocked using this subspecies (Davis 1979).

BASIC DEER BIOLOGY

PHYSICAL CHARACTERISTICS

SIZE AND PELAGE OF DEER

Female deer typically are smaller framed and weigh less than male deer of the same age. At shoulder height, an adult female is about 36 inches tall, with males of similar ages being slightly taller. In Alabama, weights of healthy adult does may range from less than 90 to 140 pounds or more, while healthy adult males may range from 140 pounds to more than 200 pounds, depending on age and habitat quality. At birth, most fawns weigh four to eight pounds and stand about 12 inches from the ground at belly level.

The hairs of a deer's winter coat are hollow and provide excellent heat retention by trapping body heat next to the skin. These hairs are longer and larger in diameter than those of the summer coat. During summer, deer will shed their thick, brownish-gray winter coat for a thinner, reddish coat. This summer coat allows body heat to escape more easily and reflects more sunlight away from the animal than the

darker winter coat. Fawns are born with spotted coats that presumably help conceal them from predators. Fawns lose their spots when they are approximately three to four months old—about the time of year the summer coat is being shed for the winter coat.

Deer, like many other animals, are "counter-shaded". They are not one solid color. A deer's coat is a darker color along the back, sides, and on most of the head and legs. However, a deer's belly, chest, throat, and chin are white. The underside of the tail also is white. This pattern helps to conceal deer from predators and makes them more difficult to see—particularly at long distances.

Deer with aberrant color phases are not uncommon in Alabama. A pure white (albino) or black (melanistic) deer is indeed rare. However, harvest of piebald deer is fairly common throughout Alabama. Piebald deer are characterized by having an almost all-white coat with some brown splotches present. These abnormal color phases are genetic in origin.

SENSES OF DEER

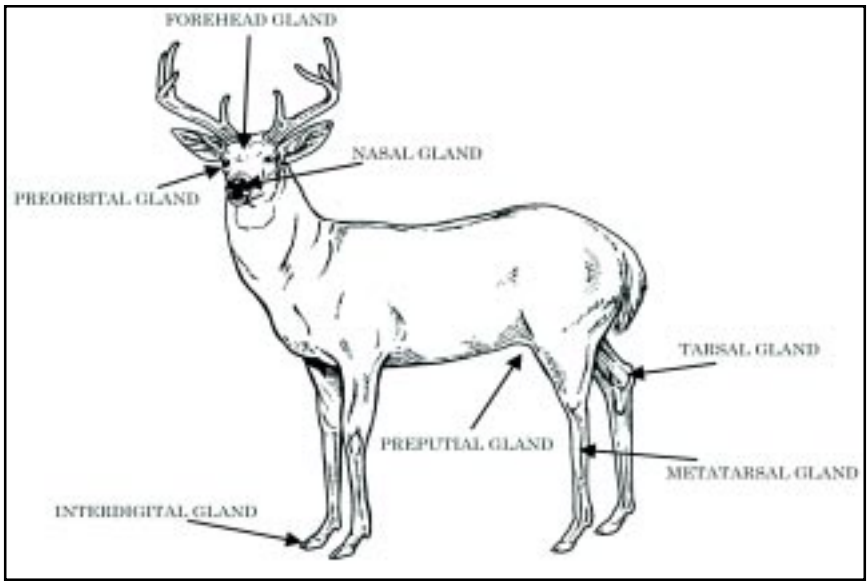
Eyesight plays an import role in a deer's sensory perception. Deer primarily depend on motion and depth perception to identify objects by sight. With eyes located more to the sides of their heads, deer can even detect motion behind them along their flanks. Deer are better suited for seeing in low-light conditions than in bright sunlight. As in human eyes, the eyes of a deer contain structures called rods and cones. Rods enable vision in low light conditions and cones enable vision in brightly lit conditions. Unlike humans, the eyes of deer contain more rods than cones—thus affording excellent vision in low light. Research

has found color perception in deer is much like that of a human who is red-green color blind (Jacobs et al. 1994). A deer's sense of hearing is very acute. Large, moveable ears allow them to detect sounds at great distances and pinpoint the direction of these sounds.

Perhaps most important to deer is their sense of smell. Relative to most other species of wildlife, deer have extremely elongated noses. Within this nose is an intricate system of nasal passages that provides a large surface area for olfactory (smell) perception. The tissue lining the nasal passages contains millions of olfactory receptor sites. Among wildlife species, deer have one of the keenest senses of smell. This extraordinary sense of smell is the primary method deer use to avoid predators—including humans. Other important functions of smell include identification of other deer, identification of food sources, and identification of individual deer relative to reproductive status. For example, bucks may use smell to identify does that are receptive to breeding.

Scent communication is probably the most important aspect of a deer's sense of smell. Researchers now have identified seven glands in white-tailed deer, most of which are used for some type of scent communication (Miller 1997). Three of these glands are located on the legs. The interdigital glands are located between the hooves of all four feet. The metatarsal glands are located on the outside of the hind legs and the tarsal glands are located on the inside of the hind legs.

The tarsal gland is perhaps the most important of these glands. This structure consists of a patch of elongated hairs underlain by an area of large sebaceous glands. The sebaceous glands secrete a fatty lipid that adheres to the hairs of the tarsal gland. This area gives off a



Deer have many glands that are used for scent communication with other deer. Drawing by Bruce Cook.

strong, musky odor. This odor is the result of urine being deposited on these glands and mixed with lipids during a behavior known as rub-urination in which a deer rubs the two tarsal glands together while urinating over them. All deer engage in this rub-urination behavior throughout the year; however, this process is much more frequent during the breeding season—particularly among males. Deer use this gland to recognize other individuals in the herd and to give information relative to their sex, social status and reproductive condition.

Other glands include the preorbital glands located in small pockets in the corners of the eyes; the forehead gland located on the entire area between the antlers and eyes; the nasal gland located inside the nose; and the preputial gland located in the penile sheath. The function and importance of several of these glands are unknown at this time.

ANTLER DEVELOPMENT

Deer have antlers, not horns. Unlike horns, antlers are shed and regrown each year. Antlers grow from button-like structures called pedicles located on the frontal bones of the skull. Growing antlers are comprised primarily of protein, while hardened antlers are essentially bone—comprised primarily of calcium and phosphorous. Male whitetails grow antlers each year. However, on occasion a doe may grow a set of antlers. This phenomenon is generally the result of abnormally high testosterone levels in a female deer.

The secretion of several hormones, primarily testosterone, ini-

Whitetail bucks grow a new set of antlers each spring/summer. In late winter, the hardened antlers are cast and the process begins anew. Photos by Harry Jacobson.

tiates antler growth. The secretion of these hormones is triggered by photoperiod (day-length). There are two phases in the antler cycle. First is the antler genesis, or growth period, in which the antlers are growing, living structures encased by a soft covering called "velvet". The second phase is the death, or hardening, of the antlers. In this phase, the antlers ossify and the buck rubs off the velvet covering. Antlers typically begin growing in April and mature by September. In late winter and early spring, in response to dropping hormone levels, antlers are shed and the whole process begins anew. Mature bucks use their antlers as a sexual display to receptive females and, to a lesser extent, to defend themselves against predators. They also use them to create rubs associated with breeding and to fight and spar with other bucks.

Antler size is dependent upon nutrition, age, and genetics. Healthy bucks with access to good nutrition will grow a larger set of antlers than bucks on lesser quality diets each year until they reach their prime (5-1/2 to 7-1/2 years of age). While antler volume may increase with age, the number of points may not. There is little correlation between antler points and age in most regions. Other measures, such as main antler beam length, antler spread, and antler circumference, usually are better indicators of a buck's age.

The debate continues among deer biologists, managers, and hunters as to whether spike antlers in yearling bucks are an indicator of poor antler potential. This controversy stems from research conducted with captive deer in Texas suggesting antler quality is primarily governed by genetics (Harmel 1982). Based on this research, the removal of spike antlered bucks is commonly practiced throughout much of Texas. Removing all spikes is not an appropriate management strat-

This ear-tagged buck was photographed over a four-year period. Antler size of male white-tailed deer usually increases with age up to about 6-1/2 or 7-1/2 years of age. Photos courtesy of Harry Jacobson.

egy in Alabama. In a recently completed study, biologists in Alabama observed a significant relationship between physical development of yearling bucks and date of birth (Gray et al. 2002). In this study, average weights and antler development for earlier born bucks were significantly greater than for later born bucks. Other studies in the Southeast have clearly shown spike antlered yearlings can develop exceptional antlers given enough time and proper nutrition (Causey 1991, Jacobson 1997).

DEER BEHAVIOR

VOCALIZATION AND COMMUNICATION

Deer also use audible calls to communicate with each other. Several different vocalizations have been analyzed and identified as uniquely specific calls. The snort is probably the most recognized of these calls (Miller et al. 1997). Deer usually make this shrill whistling/blowing sound when alarmed and often stomp a front hoof. Most hunters probably have heard this call at one time or another. Deer emit a high-pitched bawl in situations of extreme distress. The bawl is a high-pitched, intense call often given by injured or traumatized deer.

Other calls include deep guttural grunts issued by dominant deer of both sexes in an apparent effort to displace subordinates. Combinations of grunting, snorting, and wheezing are much more aggressive in nature and are typically issued by dominant males during the breeding season. Bucks attempting to court a doe in estrous may give a low, repeated tending grunt. Hunters may mimic this sound in an effort to call in a buck.

Several calls are issued between does and their fawns. A low maternal grunt call is given by a doe to communicate with her fawn and a series of mews, bleats, and whines are issued from fawns attempting to suckle their mothers or communicate some form of distress.

In addition to scent and vocal communication, deer use body language and posturing to communicate. Most body language occurs within the context of the social position an individual deer occupies in the herd. Subordinate members of the herd, both male and female, generally avoid physical contact with dominant members. Direct eye

contact also is avoided. Dominant animals may use various postures to signal their intentions. A common posture is a direct stare coupled with dropping the ears back along the neck. When a dominant animal makes this posture, the subordinate usually will retreat from the area or refrain from the behavior that elicited this signal.

Researchers have categorized body language into two postures. These are "high head" postures and "low head" postures (Hirth 1973). High head postures indicate willingness to rear and flail at another deer, while a low head posture indicates willingness to confront and chase. Among does, when two deer of the same social standing fail to back down in the face of threat postures, both may rear and flail at each other violently. Does also use the rearing and flailing behavior to drive away yearlings during the breeding season and fawning period.

Bucks of similar age and social ranking may engage in intense fighting in an attempt to assert their dominance. The frequency of these confrontations increases during the breeding season. Photo by Jeff Shaw.

Among bucks, two males of equal status confronting one another may face off with heads lowered and ears pinned back. The hair along their backs usually is bristled as well. Often these males walk stiff-legged toward one another or circle several times. If the confrontation escalates, the hardened antlers often are used to charge and attack each other. These incidents may involve some light shoving, or on rare occasions, may result in a violent or lethal fight. Outside the breeding season, it is common for one buck to decline serious combat and accept the role of subordinate. Bucks also will rear and flail at one another.

DEER MOVEMENT PATTERNS

Deer are considered crepuscular animals (most active at dawn and dusk). However, new research suggests deer may be most active at night (Jacobson 1996). Deer do move during daylight hours, but not as much as they move at night. Interestingly enough, in this study, greatest daylight activity was reported in the late fall and winter months—most of which coincides with the deer hunting season in the South.

Daily movement patterns also are affected by weather, availability of food, various disturbances, sex and age of the animal, and reproductive considerations. Bucks increase daily movement during the rut while does often reduce movement during estrus and late in the gestational period. The effect of moon phase on deer movement is poorly understood by biologists, but there seems to be general agreement that moon phase and position does influence the daily movement patterns of deer.

Hunger is one of the most powerful factors affecting daily move-

ment. A hungry deer will move to find food. Deer may be seen out foraging for food at all times of the day and night in heavily overpopulated areas. Deer movement is increased due to increased travel time between cover and feeding areas in habitats where cover and forage areas are poorly interspersed.

HOME RANGE SIZE

The total amount of space a deer occupies during most of its life is termed its home range. A deer will conduct its normal activities such as feeding, breeding, and caring for fawns within this home range. Adequate home range is large enough to provide the basic essentials for life and reproduction, yet small enough to allow the deer a survival advantage through familiarity with the range.

Does typically have much smaller home ranges than bucks. Studies in the Southeast have reported home range sizes of 300 to 600 acres for does; home range sizes for bucks have been reported at two to four times that size (Demarais and Strickland 1999). One reason for larger home range sizes in bucks is to accommodate breeding concerns. A buck with a home range encompassing multiple doe home ranges increases his chances for mating success.

DISPERSAL

Dispersal can be defined as the movement away from a deer's original home range and the establishment of a new and permanent home range. The original home range is typically the area in which a particular deer was born. Reasons for dispersal are varied. For the most part, dispersal is in response to social pressures within a deer herd and is not correlated with a lack of food. Several studies through-

out the Southeast have reported dispersal rates among yearling bucks as high as 85% (Holzenbein and Marchinton 1992). These studies have shown dispersal distances among yearling bucks ranging from two miles to greater than six miles (Kammermeyer and Marchinton 1976). While the actual percentage of yearling males that disperse great distances is debatable—it is certain a significant proportion of yearling males do disperse.

Maternal aggression (directed at immature bucks by their mothers) during the breeding and fawning season has been identified as a primary cause for dispersal among yearling bucks. Additionally, studies have shown temporary dispersal among 40 to 50% of 1-1/2 and 2-1/2 year old bucks during the rut. Thus, pressure from adult bucks is a primary factor in these events (Downing and McGinnes 1976). Compared to bucks, yearling does display very little dispersal with the exception of the breeding/fawning periods. Much of this dispersal among young does is temporary.

Dispersal of buck fawns or "button bucks" typically occurs during the breeding and fawning seasons when they are forcibly driven away by their mothers.

BREEDING PERIOD OR RUT

Throughout Alabama, some breeding takes place from as early as mid-November to as late as the end of February or early March. For most of the state, peak-breeding activity occurs around mid- to late January. Research conducted by state biologists has documented average conception dates around Thanksgiving, mid-December, early January and even into early February. Causes for such highly variable breeding dates are discussed later in this book (see **EFFECTS OF ADULT SEX RATIO AND BUCK AGE STRUCTURE, page 49**).

During the breeding season, or "rut", whitetail bucks undergo hormonal changes. Adult bucks become much more aggressive and often are less cautious than normal. Physically, rutting bucks are characterized by large, swollen necks and a strong, musky odor resulting from increased rub-urination behavior. During this time, bucks mark and defend breeding territories. Territories are established by creating numerous rubs and scrapes within the area. A buck attempts to saturate an area with his scent and sign. Rubs are "sign-posts" made by rubbing the antlers and forehead against small trees and saplings. Deer often choose aromatic species like cedar, pine, sassafras, and bay trees for rubs. The unique scent of a particular buck is deposited on these rub trees through the forehead gland.

Scrapes are important calling cards of adult bucks. A buck creates these areas of bare earth by pawing beneath an overhanging limb. Urine is deposited in the scrape by means of the rub-urination behavior. The urine is infused with scent from the tarsal glands while the buck rubs his face, forehead, and antlers on the overhanging limb. Bucks

check their scrapes regularly to detect whether a receptive doe has visited the site and deposited urine as well. If so, the buck will use his sense of smell to trail the doe and attempt to breed her.

Large rubs are not an uncommon sight before and during the breeding season, particularly in areas managed for mature bucks.

Does remain in heat or estrous and are receptive to breeding for about 24 hours. During that time, a courting buck will stay close to an estrous doe—even feeding and bedding with her. During her period of estrous, the buck may mate with her several times. If a doe is not bred during this period of receptiveness, she will come into estrous again about every 28 days until she is bred or until the breeding season is over. In some herds, does may be bred on second, third, or even fourth estrous cycles. This is not desirable and leads to a long and protracted fawning period—a problem associated with deer herds having sex ratios/age structures heavily skewed in favor of adult females and immature bucks.

Yearling does (1-1/2 years old) are sexually mature and capable of breeding. Research in Alabama has documented pregnancy rates for yearling does as high as 100 percent in healthy herds. State researchers have documented doe fawns that were bred and had conceived.

However, doe fawns do not contribute significantly to production and recruitment in Alabama.

Yearling bucks also are capable of breeding. These bucks usually are excluded from breeding in herds with a normal buck age structure and adult sex ratio. Mature bucks are believed to do nearly all of the breeding in these herds. In unbalanced herds, however, younger bucks make up the bulk of the antlered portion of the herd and often are heavily involved in breeding.

GESTATION AND FAWNING PERIOD

Fawns are born approximately 200 days after conception. In Alabama, most fawns are born from late-July to mid-August. Studies in Alabama have shown births occurring as early as April and as late as November. Extremely late births may result from does being bred during their second, third, or later estrous cycles.

The number of fawns produced depends on the age and physical condition of the doe. Generally, yearling does have a single fawn, but twins are not uncommon. Data from statewide reproduction studies indicate an overall production of 1.2 fetuses per yearling doe. Healthy adult does (2-1/2+ years old) usually will have twins each year. Triplets have been documented with some regularity and, on rare occasions, quadruplets have been found. Deer herds in poor habitats that are grossly overpopulated may exhibit poor fawn production and survival. Often pregnancy rates for does in poor condition may be below 75 percent. Production may only average one fetus per doe (or less) and fawn survival may be reduced as well. Production averages of 1.8 fetuses per doe or higher can be expected in herds in good health.

A fawn's spots help conceal them from predators. Fawns lose their spots three to four months after birth. Photo by Jeff Shaw.

The sex ratio of fawns at birth is typically 1:1. Herd and habitat conditions may affect this ratio. Within a few hours after birth, a fawn is able to stand. About one week after birth, fawns are able to run swiftly. Fawns remain hidden for the first two to three weeks of life, while the doe searches for food. At about one month of age, fawns begin to accompany the doe in her daily movements. Fawns usually are weaned at about three to four months of age, but some fawns in Alabama may nurse until they are six months old.

DISEASE, PARASITES, AND PREDATION

DISEASES AND PARASITES

Microorganisms such as bacteria, viruses, and protozoans cause many diseases in deer. Larger organisms such as ticks, lice, flukes, and tapeworms may cause disease and infections as well. Usually these organisms pose a significant health threat only when deer are stressed from poor nutrition, overpopulation, or a particularly severe winter.

Chronic health problems in a deer herd are usually the result of poor habitat and/or severe overpopulation. Biologists use a technique called an abomasal parasite count (APC) to examine relative parasite loads in a deer herd and its correlation to the habitat quality/herd density relationship. The APC is a count of the number of parasitic worms in a deer's abomasum (fourth stomach compartment). A high APC number generally indicates too many deer on a given unit of habitat.

Hemorrhagic disease is the most prevalent infectious disease found in Alabama deer. Hemorrhagic disease (HD) is caused by one of two viruses—epizootic hemorrhagic disease (EHD) or bluetongue (BT) virus. These viruses are transmitted by biting midges (i.e., "no see-ums"). HD is common throughout Alabama and the Southeast. HD related mortality rates generally do not exceed 25 percent, but can reach 50 percent or greater (Davidson and Nettles 1997). Not all deer infected with HD die. Many deer survive the infection and are effectively immunized against subsequent outbreaks. This "immunization" is known as antibody prevalence. Outbreaks are more pronounced with greater mortality in years where overall antibody prevalence in a deer herd is low.

Symptoms of HD include internal hemorrhaging, sloughing hooves, and lesions in the mouth and on the tongue. Other health problems may include a swelling of the head, neck, and tongue. Respiratory distress and blood in the urine and saliva are common symptoms as well. Deer that have succumbed to HD often are found dead near streams and ponds. Infected deer often seek water in an apparent attempt to relieve fever and dehydration associated with the disease. Outbreaks seem to occur in late summer, when numbers of the disease vector

(midges) are highest. To date there is no evidence that HD is a density dependent disease. Overpopulated herds may show more evidence of HD simply because there are more animals in the herd to be affected.

A typical symptom of chronic hemorrhagic disease is interrupted hoof growth and sloughing hoof walls. Photo courtesy of the Southeastern Cooperative Wildlife Disease Study.

Diseases other than HD can have more long-term effects on white-tailed deer populations. Diseases such as bovine tuberculosis have the potential to infect domestic livestock, as well as free-ranging deer. Chronic wasting disease also has the potential to infect free-ranging wildlife and is a real threat to local deer populations once introduced. So far, neither of these diseases has been reported in Alabama, but both have been found in free-ranging white-tailed deer in other areas of the United States. The risk of introducing these and other diseases into deer and other animal populations, both wild and domestic, is one of the primary reasons for Alabama's long-standing law banning the importation of wildlife from other states.

PREDATION

With the extirpation of red wolves and cougars, humans are the only truly efficient deer predator left in Alabama. Although deer do fall prey to bobcats and coyotes, neither of these predators has been identi-

Predation is not a limiting factor of white-tailed deer populations in Alabama. Contrary to popular belief, free-ranging dogs (top left) are more widespread and destructive deer predators than coyotes (top right) or bobcats (bottom).

fied as a limiting factor on deer populations in Alabama. Deer make up a small portion of the annual diet of coyotes and bobcats in Alabama. Instances of high predation tend to be site specific and tend to be more frequent during the fawning period. A healthy adult deer of either sex

is extremely unlikely to fall prey to either of these predators. Instead, these predators take the old, the sick and the newborn.

Free ranging dogs may be the most widespread deer predators at present. In the Southeast, dogs rarely are able to catch and kill adult deer. They may chase deer, however, to the point of injury or exhaustion. Pregnant does close to fawning and newborn fawns are far more susceptible to predation by dogs. In the whitetail's northern ranges, dogs often are efficient predators during periods of heavy snow where deer movement may be hindered.

FEEDING HABITS AND NUTRITION

FOOD SELECTION AND FEEDING HABITS

By nature, deer are very selective feeders. They are browsers, not grazers. Their mouths are long and pointed for picking out specific food items, as opposed to being wide and shovel-like for consuming sheer quantities of forage. Deer utilize the leaves, twigs, fruit, and shoots of a variety of trees, shrubs, and vines. Deer also feed on many weeds, grasses, agricultural plantings, and several species of fungi. Hard mast (acorns, etc.) is highly preferred when available. Unlike cattle, deer do not feed exclusively on a limited variety of forages. Deer are very specialized feeders and may only eat significant quantities of a small percentage of the total plant species occurring in their habitat. Certainly, when deer are nutritionally stressed by overpopulation, they will eat larger quantities of a wider variety of second and third choice foods. Deer have no other option in such instances.

Deer hunters and managers often confuse *quantity* of food with

quality of food. There is no shortage of greenery that deer may use as food in most habitats in Alabama. However, the amount of nutritious, quality food often is limited. The relationship between quality and quan-

A deer's diet consists of a variety of food items. Some common deer foods in Alabama include Japanese honeysuckle (top left), muscadine (top right), blackberry (bottom left), and acorns (bottom right). Top right and bottom right photos by Rick Claybrook.

tity is simple. In areas where an abundance of *quality* foods is available, overall physical indices—weights, antler development in bucks,

and even fawn production—will be, on average, significantly greater than in areas that provide only *quantities* of reduced quality forage.

Deer managers must remember deer feed to heights of about four feet and below. Deer rely heavily on low growing plants, grasses, and forbs for food, as well as certain forest understory tree and shrub species. Deer select food items by smell and deer range through their habitat smelling, tasting, and eating the most preferred food items. Deer prefer the young, tender leaves, buds, and shoots of newly emerging spring plants. These plants are higher in nutritive value and more digestible during this initial growth stage. As these plants mature, they become less palatable to the deer. Often, in the late summer when native browse species have become dry and tough, deer shift their feeding activity to agricultural crops if available. Deer also feed in wet areas where plant species may still be tender and succulent.

In late summer and early fall, deer often begin feeding on the berries and fruits of various plant species. These fruits often are higher in nutritive value and far more palatable than the leaves and twigs of the plant. Deer use taste to discriminate among acorns of certain oak species. Acorns from white oak species seem to be preferred over acorns from the red or black oak family. White oak acorns usually have less tannic acid than those of the red or black oaks and are thought to be more palatable. However, deer readily will use the mast of almost any oak species.

Below are some common deer browse species found in Alabama:

Browse Species	Preference/ Usage Rating	Season Most Utilized
Japanese honeysuckle	high	year-round
strawberry bush	high	year-round
common persimmon	high	fall
crabapple	high	fall
oaks	high	fall (acorns)/spring (leaves)
blackberry/dewberry	high	year-round
greenbriar (*Smilax* spp.)	high	year-round
wild grape/muscadine	high	spring
peppervine	high	year-round
rattan vine	high	spring-summer
honey locust	high	spring-fall
yellow jessamine	medium	year-round
red maple	medium	spring-summer
trumpet creeper	medium	spring-fall
American beautyberry	medium	spring-fall
sassafras	medium	spring-summer
yaupon	medium	fall-winter
mimosa	medium	spring-fall
Eastern red cedar	low	year-round
boxelder	low	spring-fall
rhododendron	low	year-round
sparkleberry/blueberry	low	year-round
sourwood	low	spring-fall

Information on fertilizing native vegetation to improve production and nutrition is found in **HABITAT MANAGEMENT** beginning on **page 103**.

NUTRITIONAL REQUIREMENTS

On average, deer eat four to six pounds of forage daily for each 100 pounds of body weight. An average sized deer consumes more than a ton of forage per year. Deer are ruminants (cud-chewers), and like cattle, have a compound, four-chambered stomach. However, deer have a mix of bacteria in their gut that is different from bacteria in cattle. These bacteria aid in the digestion of food and its conversion to energy

and living body tissue. Many of the foods that cattle can efficiently digest are unsuitable and inefficient for deer—fescue is a prime example.

The daily nutrient requirements of deer are very complex and still not properly understood by researchers. Nutritional requirements of deer include water, protein, carbohydrates, lipids (fats), minerals, and vitamins. These nutritional requirements change throughout the year and also vary with age and sex of the animal. Deer need about three to six quarts of water per day (Brown 1985). Much of this water requirement is met by moisture in the food they consume. The water found in plant cells is known as "preformed water". Deer may use "free water" from ponds, streams, and even dew. Deer also use "metabolic water" produced in their cells during metabolism. Most deer habitats in Alabama have adequate sources of free water. Rivers, streams, and drainage areas abound throughout most of the state. Deer may use puddles of accumulated rainwater during periods of rain.

Protein in a deer's diet is important for several things, including fawn production and antler development. Bucks need a diet of at least 16 percent protein for optimum antler growth. At fawning, does need increased protein levels to promote sufficient lactation (milk production). Deer are able to survive the winter months with very little protein in their diet and with reduced total food intake. Carbohydrates and fats are found in acorns and other hard mast, which allow deer to store fat reserves for the winter. This process is far less critical in Alabama than in other regions of the whitetail's range, where harsh winter conditions require an abundance of stored body fat.

Research on mineral requirements relative to antler growth has yielded conflicting reports. This may be due to small sample size and

Deer readily use salt--especially in late summer. Many deer manager's incorporate mineral supplements in established salt licks.

genetic influence on antler growth. Two of the most recent studies involving mineral supplementation suggest protein and energy, not mineral abundance, have the greatest effect on antler development (Shultz and Johnson 1992, Causey 1993). Calcium and phosphorous are two of the most important minerals in a deer's diet and are necessary for bone and antler growth. These minerals also are important to milk production, muscle contraction, blood clotting, efficient digestion, and general metabolism.

The importance of vitamins and micronutrients in a deer's diet also is poorly understood. Bacteria in the deer's rumen (stomach) are able to produce sufficient daily amounts of vitamins K and B complex (Brown 1997). Vitamin D is necessary to the process of calcium absorption and metabolism in all animals. No vitamin D deficiencies have been identified in Alabama whitetails to date, so it is assumed sufficient vitamin D is obtained in the diet. Deer readily use sodium in salt licks, but it is unknown if this use is related to taste or a deficiency in the diet. Selenium, potassium, iodine, sulfur, cobalt, copper, and other

trace elements are important to a deer's overall health. It is unknown at this time what amounts of these trace elements are needed.

HABITAT REQUIREMENTS

DEER HABITAT IN ALABAMA

Contrary to popular belief, deer are not an interior forest species. Ideal deer habitat does not consist of vast, unbroken hardwood forests and pristine streams. In reality, deer are creatures of edge and interspersion of habitat types. No single homogenous habitat type is ideal for deer, whether mature hardwoods or pine plantations. Simply put, deer need food, water, and cover in a suitable arrangement. Good deer habitat consists of a variety of components. Life and nutritional requirements of deer vary throughout the year. Therefore, good deer

Extensive agricultural areas (above left) are typically characterized by fewer deer in excellent physical condition. Conversely, extensive, unbroken forest lands (above right) often support high numbers of deer in suboptimal physical condition. Left photo courtesy of Rhett Johnson.

habitat has sufficient quantity and quality of each component throughout the year.

The majority of deer habitat in Alabama is located on privately owned lands that are managed for agriculture and/or timber production. Often, these areas lack adequate diversity of habitat types, particularly on some industrial forest lands where deer habitat may consist of thousands of acres of even-aged pine stands. In large pine plantations, deer have fared well in terms of overall population levels. These areas provide good cover and, in certain stages of production, provide an adequate forage base for most of the year. Overall physical condition of deer in these areas often is below the collective herd's potential. This largely is due to a lack of abundant, quality forage. Conversely, large blocks of cleared agricultural land do not usually support dense deer populations. However, deer in these areas often are in excellent physical condition due to low numbers of deer sharing an abundance of high quality forage.

For the deer manager, ideal habitat will be found in the middle of these two extremes. Timberland, cover, and high quality foraging habitat—all combined in a given area—provide optimal deer habitat. The degree to which a deer manager can provide these habitat components depends on available resources, equipment, and labor. Optimally, the deer manager has the authority to make significant habitat changes through ownership or under the auspices of the owner, and long-range objectives of the landowner are compatible with deer management objectives.

Although few properties in Alabama are managed solely for ideal deer habitat, significant habitat improvements can be achieved which

are compatible with other objectives, such as timber or crop production. Such improvements require an understanding of deer habitat management and proper planning. Specific habitat management techniques will be addressed later in this book (see **HABITAT MANAGEMENT, page 103**).

FOOD – SEASONAL FORAGING HABITATS

SPRING

In Alabama, most deer begin the spring in marginal physical condition. While harsh winters are not a factor in the Deep South, most deer in Alabama have endured a period when abundant, high-quality forage has been unavailable. During this time, bucks are still stressed from the rigors of the breeding period. In the spring, bucks are beginning antler growth and does are carrying fawns. Deer need an abundance of high quality forage during this time. Good deer habitat consists of areas where quality native forages are produced in sufficient quantities.

Vast expanses of mature hardwood forests are devoid of quality spring forages, as are closed canopy pine plantations. Thinned and burned pine plantations, as well as open mature pine timber stands and clearcut areas, provide good browse production. Areas maintained in stages of early plant succession are critical habitat components during this time. In areas with intensive agriculture, cultivated crops provide good forage, often to the dismay of farmers. Certain management practices, such as planting clovers and other spring legumes/ forages, can provide good nutrition when available in sufficient quantities.

SUMMER

The need for quality forage is no less critical during summer. Bucks are still growing antlers and does are carrying or nursing fawns. Unfortunately, most of the young, succulent browse species found in the spring have become tough, unpalatable, and hard to digest. Supplemental warm-season plantings, such as cowpeas, lablab, and soybeans, can provide excellent forage if planted in sufficient quantities. Agricul-

Vegetation and/or fruits of many plants, including common persimmon (top left), American beautyberry (top right), greenbriar (bottom left), and white oak (bottom right), are consumed by deer at different times of the year, depending on availability and palatability.
Top left, top right, and bottom right photos by Rick Claybrook.

tural crops may be used heavily as well. During this time, deer will utilize the fruits of many browse species such as muscadine, blackberry, and dewberry. Selecting for these species in habitat management efforts is important to ensure sufficient quantities of these food items. Late summer is probably the most critical stress period. It is during this time when protein requirements are highest, yet habitat quality is at its lowest. Periods of drought may serve to further reduce habitat quality during this time.

FALL

In Alabama, there often is no clear delineation between the late summer and early fall in terms of weather and climate. Consequently, there generally is no reprieve relative to browse quality. Honeysuckle, jessamine, rattan vine, and greenbriar often are heavily browsed during this period. However, some soft mast, such as persimmons, crabapples, black gum fruits, and honey locust pods, become available and are fed upon heavily. This also is the time when acorns begin to fall. White oak species usually produce abundant acorns in years with adequate rainfall. Red or black oak species also produce to some degree. While red oaks have a two-year fruiting cycle, there are generally a substantial number of these oaks producing in any given year. Deer may utilize acorns almost exclusively when found in abundance in late fall and early winter.

Streamside management zones (SMZs) can provide adequate hardwood mast during the fall in managed forests. SMZs are corridors of uncut timber along streams, creeks, and drainage areas. SMZs are used to control erosion and stream sedimentation following timber har-

Streamside management zones (SMZs) reduce erosion, protect water quality, and provide hardwood mast for deer and other wildlife.

vest, but also have proven to be valuable habitat components for many wildlife species. Mast producing hardwoods often comprise the majority of species found in these locations. Hardwood timber stand improvement cuttings can also increase mast production. Selecting for dominant mast producers and important mid-story species is a good way to enhance this particular habitat component when developing forest management plans.

WINTER

Food shortages and starvation generally are not a problem with the mild winters occurring in most of Alabama. However, this can be a stressful period for deer in terms of availability of quality foods. Deer are able to utilize acorns and other mast well into the winter in years of abundant hardwood mast. However, in years having poor mast crops, deer must rely heavily on native winter forbs, honeysuckle, greenbriar, and cool-season plants and grasses. Cool-season forage crops become very important during years of a mast failure. For the deer manager,

providing nutritious cool-season forage plantings can help sustain deer through the winter in relatively good condition.

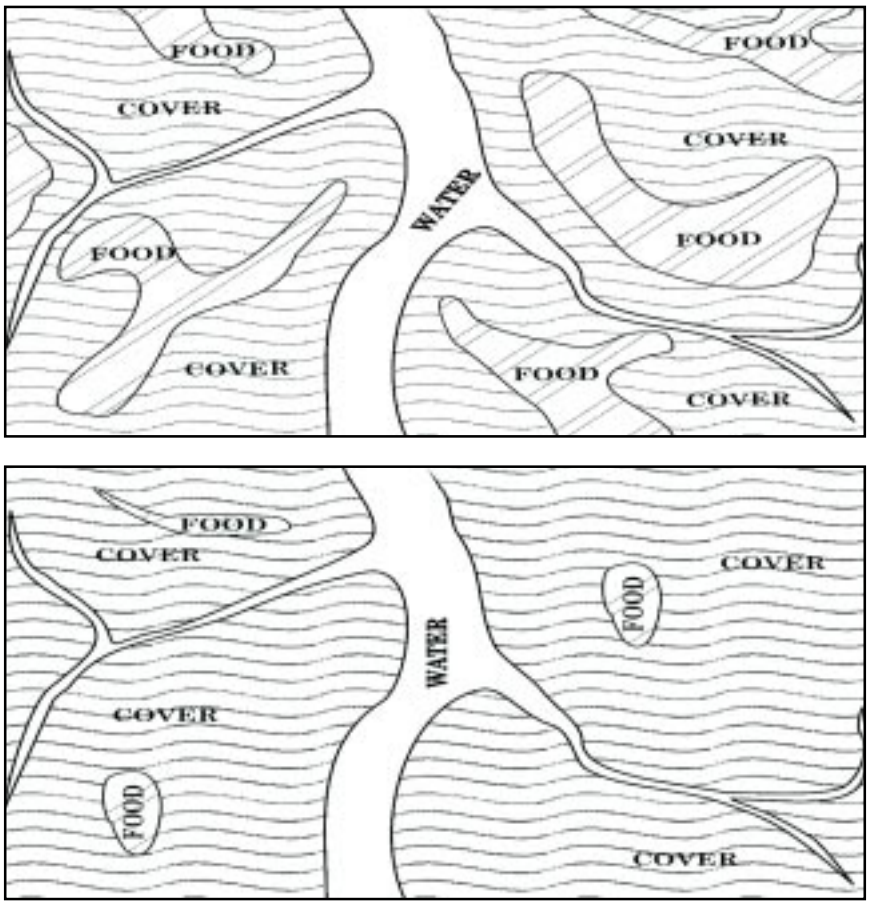
Wildlife openings can provide nutritious forage during the winter months, aid in deer harvest, and provide an area for wildlife viewing.

Reproduction is a major objective of the deer herd during the winter. Bucks may go long periods without food during the rut. Does must be in good condition when they are bred to ensure good fawn production. Having access to quality native forage, plus supplemental cool-season plantings, can increase buck survival after the rut. It also increases reproductive output and gives deer a head start toward body and antler growth in the spring.

COVER

Cover can be defined as any habitat component that affords an area of escape, safety, and comfort from predators and/or weather conditions. Cover may be a dense briar thicket or a young, 50-acre pine stand. Cover can provide areas in which does can hide their newborn fawns. Mature hardwood bottoms provide cool areas to escape from the summer's heat. Pine plantations can serve as a windbreak during ex-

tremely cold periods. Lack of sufficient cover can be a limiting factor in retaining mature, older aged bucks on a given property. These deer are particularly desired by many deer hunters and managers.



Proper arrangement of habitat components is often the difference between excellent deer habitat (top diagram) and poorer deer habitat (bottom diagram).

SPATIAL ARRANGEMENT OF HABITAT COMPONENTS

The best deer habitat is where all habitat components are found in close proximity to one another. The largest field of lush deer forage is of little use if escape cover is not available nearby. In human terms, one can envision a house with the bedrooms, bathrooms, and living quarters all located in a small, easily accessed area. However, if the kitchen (and all the food) is located across the street, the occupants have a very inefficient and undesirable living arrangement. For the deer manager, good habitat management consists of providing a diversity of readily accessible habitat types and then duplicating this arrangement multiple times over a given area.

THE IMPORTANCE OF EDGE

Creating good deer habitat often involves creating edge. Edge is an area where one or more different habitat types come together. It can be an area where a mature forest or pine plantation stops and an open field begins. Edge also can be more subtle than the sharp delineation between timber and open land. An area of transition where bottomland hardwoods gradually give rise to a mixed pine-hardwood

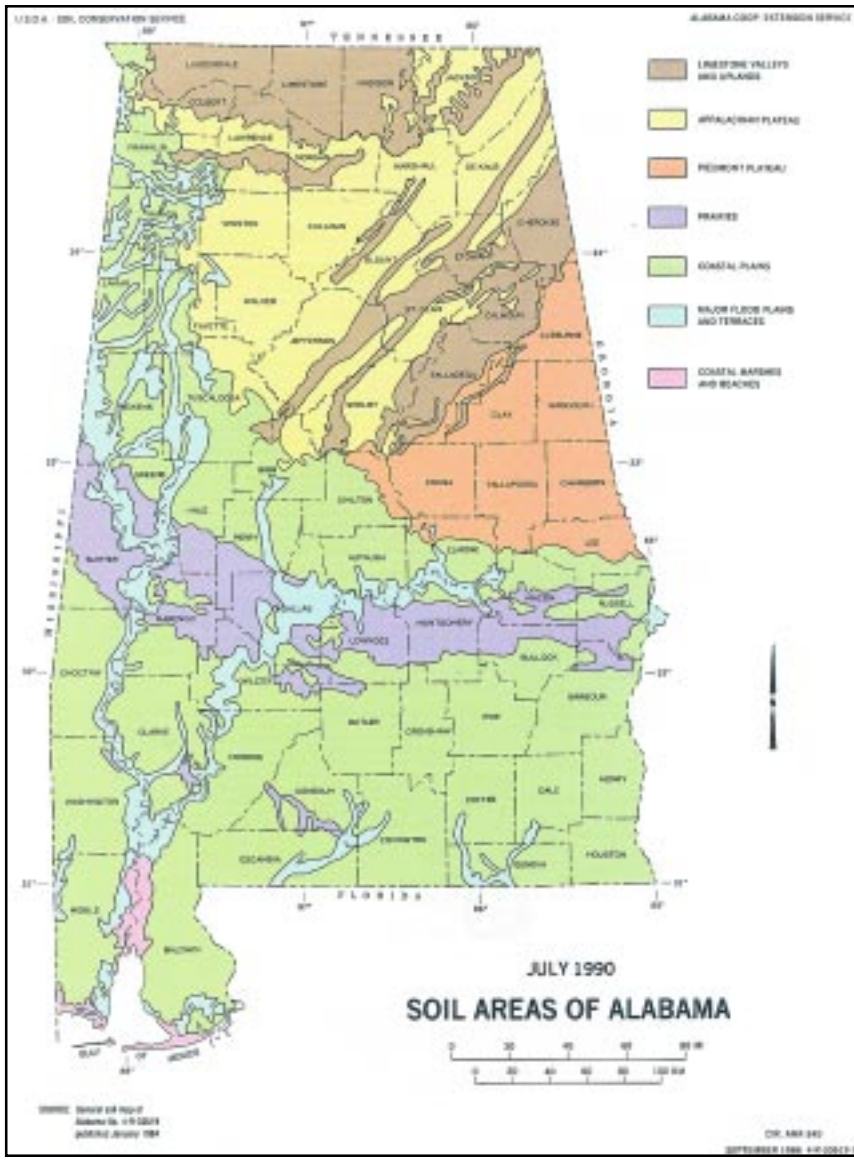
Edge areas often provide enhanced plant diversity and excellent foraging areas for deer and other wildlife species. Photo by Stan Stewart.

stand also is an example of edge. Diversity is provided by the creation of edge, where one relatively homogenous habitat type meets a markedly different habitat type. These areas promote the growth of diverse plant communities, provide cover and travel corridors, and may provide excellent foraging habitat.

IMPACT OF SOIL FERTILITY ON HABITAT QUALITY

Habitat quality is influenced greatly by the nutritive value of the plants growing in an area. The amounts of protein, energy, minerals, and trace elements contained in plants are directly related to the fertility of the soil in which they grow. Six major soil provinces have been defined in Alabama: soils of the Limestone Valleys and Uplands; soils of the Appalachian Plateau; soils of the Piedmont Plateau; soils of the Prairies (Black Belt soils); soils of the Coastal Plains (Upper and Lower); and soils of the Major Flood Plains and Terraces. Soils in each of these major regions have markedly different characteristics relative to moisture-holding capability, composition, and natural fertility. Soil characteristics within a particular soil province will vary from site to site as well.

Cultivated areas throughout these provinces may require the addition of lime and fertilizer to address and correct soil fertility and pH deficiencies. However, soil deficiencies on the vast majority of uncultivated deer habitat found in these provinces cannot be so easily corrected. **Thus, it is important to note relative soil fertility will create a ceiling of performance with respect to physical indices in deer populations.** In areas where deer rely primarily on native



Soil quality has a significant impact on overall physical condition of deer throughout Alabama. Some of Alabama's soil regions have greater potential for growing heavier deer with better antler development than other regions of the state.

forage for their nutritional requirements, indices such as body weight and antler development are a function of the nutritive value of the plants deer eat. Again, the nutritive value of these plants is a function of natural soil fertility.

In certain areas of highly fertile soils, such as the Black Belt Prairies and the Major Flood Plains and Terraces regions, deer harvest data indicates better overall physical indices than in areas of low soil fertility. Average deer weight and antler development are lower in the deep sands of Alabama's lower tier counties than in more fertile soil regions of the state. However, deer of exceptional physical condition may be found in areas of low soil fertility where there is an abundance of agriculture and where deer density is relatively low. Conversely, even in the most fertile soil areas, many deer exist in poor physical condition as a result of overpopulation. Providing nutritious forage in poor quality habitats through intensive habitat management can help offset the limiting effects of poor soil fertility. Proper population management helps ensure deer realize the full benefit of high soil fertility.

CARRYING CAPACITY OF DEER HABITAT

For the purposes of this discussion, carrying capacity (CC) is defined as the number of animals a given unit of habitat can sustain in good physical condition without causing damage to the habitat. The term CC, as used in this section, should not be confused with the terms absolute CC or CC *K*. These later definitions of CC are used by population biologists to describe the maximum number of animals a unit of habitat can support (the theoretical point in a population growth model in which births equal deaths and the population stops growing).

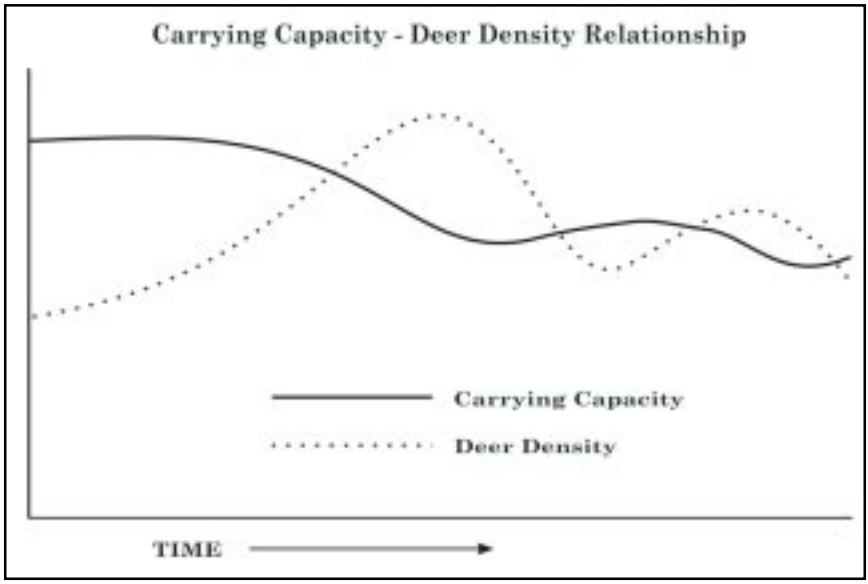
Determining CC for deer habitat can be useful when attempting to formulate management strategies. Developing a CC estimate gives the deer manager a ceiling with respect to the maximum population size that should be carried on a given unit of habitat. As with population estimates, the exact number of animals in a CC estimate is not precise. For example, if an estimated population of 500 animals occupy a given unit of habitat and these animals are in excellent condition, then it may be assumed the given unit of habitat has a CC of at least 500 animals.

Deer managers often assume the maximum CC can be determined by noting the number of the total estimated population at the point when physical indices begin to deteriorate. At this point, deer managers may infer the herd is at or slightly above the CC. The danger of this assumption is often a deer herd can exist at and periodically exceed CC for several years before physical indices show signs of severe overpopulation. The actual CC may, in fact, be substantially lower than the point at which a decline in physical condition is first observed.

When a deer herd has been allowed to exceed CC for any period of time, habitat quality is adversely affected. The most nutritious forage species in the habitat are the first to be depleted. A deer herd can eliminate some of these species from the habitat entirely. If no seed source or rootstock is left, some of these species may never be re-established naturally. The long-term effects of such overpopulation on habitat quality, deer quality, and CC are severe. The CC may actually be reduced to a point much lower than it had originally been. Once the quality of habitat has been significantly reduced and measures are then taken to reduce the population to within the CC, the total number of

animals that can be supported in good condition may be much lower than before overpopulation occurred.

Some deer herds in Alabama have existed beyond carrying capacity for many years. Natural mortality remains too low in many of these cases to return these herds to CC. As these populations are allowed to exceed CC, habitat quality is further diminished and actual



The relationship between carrying capacity and deer density is relatively simple—when deer density exceeds carrying capacity (CC) for a significant period of time, both CC and deer density often are reduced.

CC is lowered. Deer managers in many areas of Alabama are faced with this dilemma, particularly on sites with poor to marginal habitats. Deer populations have not been kept at levels low enough to allow for habitat quality to recover. This may be due to either pressures from user groups or the sheer inability to implement an adequate harvest. In some cases, habitat quality may never recover regardless of how low population levels are reduced. Exceeding CC can lead to a repetitive

cycle of poor deer herd and habitat conditions. This cycle is not easily interrupted and often cannot be stopped.

FACTORS INFLUENCING CARRYING CAPACITY

Carrying capacity fluctuates throughout the year depending on habitat conditions, rainfall, and various habitat changes, such as timber and farming operations. Supplemental feeding and planting often are employed in an attempt to increase CC for a particular unit of deer habitat. These activities are seldom of sufficient scale to affect CC significantly. Such practices may only serve to compound problems associated with gross overpopulation. In these instances, attempts to reduce herd density are more desirable than attempts to increase carrying capacity.

Actual biological CC for deer may not coincide with a social or ecologically based carrying capacity. An area where deer/human interactions are a primary concern may have a much lower CC based on factors such as deer/vehicle collisions or deer damage to crops and ornamental plants. This may be referred to as social carrying capacity. A case involving endangered or fragile plant communities may have an acceptable CC for deer much lower than is biologically practical. In many cases, social CC is greater than biological CC as people often desire to have more deer than the habitat can support.

Rainfall usually is the only climatic factor affecting CC in the Deep South. Habitat quality may be improved in the form of abundant mast crops and increased amounts of native browse in years with abundant rainfall. Physical indices may show corresponding improvements resulting from increased rainfall in herds maintained below CC. In

cases where population levels are at CC, increases in habitat quality are generally negated because coinciding reproductive increases may add additional deer to the herd, further compounding the problem of too many deer.

POPULATION BIOLOGY

Many factors of population dynamics affect deer populations—sex and age structure, mortality, reproductive success, and dispersal. There are contributing variables for each of these factors. For example, physical condition and age of a doe affect reproductive output. Overall sex and age structure are influenced by selective mortality factors, primarily in the form of hunting. Deer hunters and managers can significantly influence many of these factors, while others are more or less beyond their control.

POPULATION STRUCTURE

With the exception of the breeding season, adult males and females have little contact throughout the year. Bucks typically form small bachelor groups, while does tend to be less social than bucks, rarely forming associations with unrelated herd members of similar age and standing. The bachelor groups of bucks remain intact until the onset of the breeding season. Then the groups temporarily disband until the breeding season is over. During late summer and fall, doe groups typically include an adult doe, her female offspring from the previous year, and her fawns of the year. Several doe groups may feed together. Shortly before the birth of her fawns, a doe may forcibly drive away her fawns from the previous year. Yearling does may rejoin their

dam and her new fawns later in the fall. Yearling bucks, on the other hand, almost never rejoin this group.

Doe groups often consist of a matriarchal doe and several generations of her female offspring. Photo by Jeff Shaw.

Sex ratio among fawns in a deer herd is typically 1:1. Due to higher natural mortality among bucks, however, the overall population is generally slightly skewed to favor female deer. Adult sex ratio and age structure vary from one population to another. These aspects of population structure depend primarily on selective mortality factors influenced by management objectives or philosophies. **Age structure and adult sex ratios are more natural in properly managed deer herds and include more older age class bucks in the population. Poorly managed herds, where hunting mortality selects heavily against antlered bucks, often are heavily skewed to favor female deer.**

SOCIAL ORGANIZATION AND HIERARCHY

A strict dominance hierarchy is observed among both sexes. With females, dominance is closely related to age. Older does tend to

occupy the best habitat and generally have the best fawning success. The basic social unit in females consists of a dominant matriarchal doe, several generations of her female offspring, and fawns occupying an ancestral home range (Miller et al. 1995). Several of these matriarchal associations may comprise the female segment of a given deer population.

Age, size, and strength determine dominance among males. Mature dominant bucks subordinate younger bucks and do most of the breeding. In herds where age structure among bucks is poor, 1-1/2 and 2-1/2 year age class animals comprise the majority of antlered bucks and do most of the breeding. In such herds, a natural dominance hierarchy among males does not exist, and many natural behaviors and socio-biological relationships break down.

In naturally structured deer herds, mature bucks occupy the upper echelon of a herd's social organization. Photo by Jeff Shaw.

POPULATION DENSITY

The number of animals per unit of area is defined as population density. There are many methods used to census deer populations. These techniques typically arrive at a deer per unit area estimate, such as "*X*" number of deer per square mile. The precise number of animals in a particular population is nearly impossible to determine and is of little importance. What is important is the relationship between **herd density** and **habitat quality.** Simply put, a given unit of habitat will only support a certain number of deer in good physical condition. Both habitat quality and deer condition will deteriorate whenever herd density exceeds the bounds of this relationship.

Deer managers use a number of techniques to arrive at population size or density estimates. Spotlight surveys, camera censuses, track counts, hunter observation data, and population reconstruction/modeling are often employed to estimate deer numbers. Population estimates derived through these techniques generally yield a minimum number of animals in the population. While these techniques cannot yield a precise number of deer, they can be useful in terms of monitoring overall population trends. It is important for the deer manager to know if a population is increasing, decreasing, or remaining stable. This information can provide a basis for decisions relative to harvest management.

Examining harvest data is an effective method of determining whether herd density exceeds the habitat's ability to support the herd in good condition. Specific physical indices can be used to analyze how a relative deer density fits into a given unit of habitat. Among males, average weights and antler development by respective age class can indicate whether total density exceeds habitat quality. Among females,

weights by respective age class and lactation rates prove useful in assessing deer densities. Biologists must consider influences such as soil fertility, habitat type, and past management practices when using harvest data to evaluate deer densities for a given area.

Other techniques, such as the abomasal parasite count (APC), kidney fat index (KFI), and reproductive data collection, also assist in determining relative deer densities. High APC counts generally indicate overpopulation, as does a low volume of kidney fat. Reproduction studies showing reduced pregnancy rates and low fetal production usually are indicative of excessive deer densities.

Poor physical condition is normally the result of an inadequate food supply. Deer often are not able to reach their full potential in terms of body size, antler development, and reproductive success in overpopulated herds. Each deer competes for a limited amount of nutritious forage in overpopulated herds. The majority of deer in this situation are not afforded the full benefit of the habitat's nutritional plane. Without adequate nutrition, a deer cannot express its genetic potential for attributes such as antler or body size. In extreme cases, over a long period of time, nature may select for smaller body size.

While it is common for those with an interest in deer to want to know the exact number of deer on their lands, a precise number is irrelevant and would be erroneously determined unless each deer could be rounded up and counted. **It is the job of the deer manager to use a variety of techniques to determine if the relative deer density exceeds relative habitat quality. In terms of population management, this relationship is far more important than**

determining exactly how many individuals are in the population.

EFFECTS OF ADULT SEX RATIO AND BUCK AGE STRUCTURE

Research literature on the effects of adult sex ratio and buck age structure on deer populations is extensive. Among biologists, it is commonly accepted that both of these population factors have significant influences with regard to reproductive considerations, such as timing and duration of the breeding season. For the deer manager, manipulating these population characteristics through selective harvest management is of great importance.

ADULT SEX RATIO

As previously stated, an unhunted or properly managed deer herd will have a substantial proportion of mature males. Adult sex ratios in these populations will be relatively tight at approximately 1.0 male for every 1.5 to 3.0 females. Adult sex ratio is important for several reasons. In an unbalanced, female-heavy population, there are too many does for the available bucks to breed. Consequently, some adult does are not bred and will not be a productive part of the herd. Some of the does that are bred may have conceived on a later estrous cycle due to an insufficient number of bucks in the herd to breed them on the first estrous cycle. The result is a long, drawn-out breeding period.

The fawning period also is extended under these conditions. Instead of all fawns being born in a relatively compressed time frame, fawning will occur over a two to three month period. Fawns of the same age class are separated by several months in actual age. Does bred on

later estrous cycles will have fawns at a time when habitat conditions are at their poorest. As a result, later born fawns often have lower weights and poorer antler development than their earlier born cohorts. It may take several years for late born fawns to catch up with respect to physical condition.

In populations heavily skewed toward females, population density often is excessive and out of balance with existing habitat conditions.

Excessive deer numbers and few antlered bucks often are problems associated with deer populations heavily skewed toward female deer.

Attempts to control overall herd density through harvest becomes increasingly difficult as sex ratio becomes more skewed toward females. Does have different habitat requirements and preferences than do bucks outside the breeding season. Poor growth rates among younger deer and poor reproductive success for does generally are associated with increased competition for food and cover. These negative impacts are typically the result of too many does, rather than too many bucks (Miller et al. 1995).

In herds with doe-heavy sex ratios, bucks have to do very little

searching for breeding opportunities. This means hunters have less opportunity to encounter a buck out searching for a receptive doe. Having too many does in a herd also appears to contribute to the suppression of many natural buck behaviors, such as rubbing and scraping. Bucks simply do not have to expend the energy on such behaviors in order to ensure breeding opportunities.

BUCK AGE STRUCTURE

Buck age structure is of equal importance to a deer population. The term age structure refers to the proportion of animals in differing age classes for both sexes. There is a good proportion of mature deer (3-1/2 years old and older) in the buck segment of a normal deer herd. The total number of mature bucks in such a population generally is fewer than the number of younger age class bucks (1-1/2 and 2-1/2 year animals). This can be attributed to greater competition for breeding opportunities and higher natural mortality for older bucks.

As mentioned earlier, deer of both sexes have well defined dominance hierarchies. In herds where adequate numbers of mature bucks exist, the older bucks do most of the breeding and suppress breeding activity in younger, immature bucks. Breeding is an extremely stressful period for white-tailed bucks. Mature bucks are more physically suited to handle these stresses than are immature bucks. Well proportioned buck age structures result in immature bucks being spared the rigors of the breeding period. Consequently, these animals often enter the spring in much better condition.

When coupled with balanced adult sex ratios, the effects of proper buck age structures also are manifested in the form of increased

natural breeding behaviors. Studies in the Southeast have shown the abundance of rubs and scrapes is directly proportional to the abundance of mature males in the herd. In areas where buck age structure is poor due to heavy harvest of immature males, rub densities may range from 500 to 1,500 per square mile (Miller et al. 1987). In areas managed to produce a good proportion of mature males, rub densities of more than 6,000 per square mile have been reported (Woods 1997).

Protracted breeding periods result in fawns of the same age class being separated by several months in actual age. Photo by Joe Hamilton.

These signposts (rubs and scrapes) are important in that they play an important role in the natural reproductive cycle of deer. Many researchers believe signposts left by mature bucks have a priming effect on the estrous cycle of does. Mature buck sign is thought to possibly bring does into estrous earlier and to synchronize estrous cycles. As a result, does are bred earlier and in a more compressed time frame. Subsequently, fawning also will occur during an earlier period when habitat conditions are better. Further, fawning will occur over a much shorter time period, ensuring all fawns begin life under relatively uniform conditions.

Competition among males for breeding opportunities often be-

comes intense with improved buck age structure. This is a desirable situation for the deer hunter, as techniques such as hunting near scrapes or rubs, rattling, and grunting become more effective for harvesting a mature buck. Because mature bucks spend more time making and checking scrapes, leaving rubs, and searching for receptive does, they are more vulnerable to harvest than those under conditions where such behaviors are suppressed.

As with adult sex ratio, selective harvest pressure through hunting has the greatest influence on buck age structure. Most bucks are removed from the herd before maturity under traditional harvest practices, resulting in a buck segment comprised primarily of immature animals. Research has shown ritualized courtships and prolific signpost/scent marking behaviors are not characteristic of immature bucks. In one study, yearling bucks were found to make only 15 percent as many scrapes and 50 percent as many rubs as mature bucks (Ozoga and Verme 1985). This study also indicated yearling bucks made scrapes only one week before the first doe was bred, while mature bucks made scrapes up to two months before the first doe was bred.

If signposts associated with mature bucks contribute to earlier and shorter breeding periods, signpost behavior of immature bucks (in the absence of mature bucks) is not sufficient to elicit a normal breeding cycle. This relationship should be of particular importance to the deer manager. **Implementing harvest strategies designed to produce a normally functioning deer population should be the primary concern of those charged with managing deer herds.**

REPRODUCTION STUDIES IN ALABAMA

State wildlife biologists examine deer reproduction through a statewide study that includes the collection of pregnant does. These collections yield a valuable data set with respect to overall reproductive indices in Alabama. With these collections, biologists are able to analyze reproductive data from a broad spectrum of herd and habitat conditions.

Biologists observe tremendous variability among many of these collections with respect to average conception and parturition (fawn drop) dates. Average breeding dates consistently occur in mid-November in some areas of the state, while collections from other areas document average breeding dates as late as early February. Most areas in Alabama have mean conception dates around mid- to late-January. To understand the possible reasons for this variability, historic restocking practices must be examined.

Biologists use fetal measurements to determine dates of conception and parturition (fawn drop) for whitetails in Alabama.

Numbers of white-tailed deer in Alabama were extremely low at the turn of the century. During the period after World War II through

the 1960s, deer were restocked in many locations throughout the state. Most of the deer used in this restocking effort came from southwest Alabama, along the Tombigbee River and its associated swamps. For reasons yet to be fully explained, these deer have a relatively late breeding period when compared to those in other southeastern states which were restocked with deer from Midwestern and Northeastern sources. Deer from Texas, Michigan, Wisconsin, North Carolina, and other states also were stocked in some areas of Alabama. Along the Chattahoochee Valley region, present deer populations are thought to be the result of past immigration of deer from Georgia.

In areas where present populations originated from non-native stock, mean conception and parturition dates range from one to two months earlier than in areas where populations were originated from native stock. Intuitively, genetic origin and influence must be considered a major factor in these markedly different breeding/fawning periods. Often, these deer are managed under identical harvest regimes, yet the discrepancy in reproductive patterns remains unaffected.

While most of Alabama's deer herd appears to be predisposed to a later breeding period, the vast body of evidence gathered to date indicates most breeding occurs within the confines of the regulated deer hunting season. However, some user groups contend much of the breeding occurs in February. Since Alabama's deer hunting season closes at the end of January, these groups feel hunters are being deprived of peak rut hunting opportunities. Biologically, there appears to be little basis to this claim.

To be accurate, a small percentage of the reproductive collections do document mean conception dates in February. Only 20% of all

does taken in reproductive collections were bred in February or later. However, most of these cases appear to be site specific and most likely the result of years of poor management practices. Sex ratios are unbalanced and buck age structure is often very poor on most sites where herds exhibit late breeding trends. Other indices, such as pregnancy rates and overall fawn production, tend to be poor as well. Conversely, on areas where genetic influence is not a factor (inherently favoring early breeding), well managed herds typically have mean conception dates in January—often with several animals in the sample having conception dates in late-December and none with conception dates beyond the month of January. Additionally, many of these well-managed herds display peak breeding times in early- to mid-January.

Data from these reproductive collections suggest a correlation between harvest management and deer reproductive patterns. Presumably, deer reproduction is influenced by factors related to population structure and genetics. Many biologists contend genetic origin dictates a preset window of time in which breeding will normally take place. Whether breeding takes place early, in the middle, or late in this window is the result of deliberate management strategies or lack thereof.

Data collected over a 15-year period at Auburn University's deer research facility suggests no relationship between herd structure and reproductive patterns. Captive deer maintained at a 1:1 adult sex ratio did not show any shift in mean conception dates. Mean conception dates for these deer were in early to mid-February (Carroll and Causey 1995). However, in a 5-year study of free-ranging deer in Alabama, biologists observed a two-week advance in mean conception date under an inten-

sive quality deer management program. Mean conception shifted from January 14 to December 29 (Wood and Gray 2002).

Despite this conflicting data, results from reproductive collections conducted on free-ranging deer continue to suggest harvest management does influence reproductive patterns. The possibility must be considered that deer in a captive setting may not display normal breeding patterns. Captive animals may gain no advantage in implementing strategies that provide earlier breeding opportunities. Breeding opportunities are more or less inevitable among captive deer. Under these conditions, it would be a waste of energy for bucks to engage in behaviors that may elicit earlier reproductive patterns (e.g., prolific rubbing and scraping).

Many biologists involved with this study believe native deer in Alabama may never be managed into October/November breeding periods as is common in many southeastern states. However, it is believed most native herds in Alabama can be managed to breed and fawn during the earliest part of their genetically predetermined reproductive windows. What is unclear at this time is just how early the limits of this window are. Continued reproductive collections in areas managed to produce more "natural" deer herds may help answer this question in time.

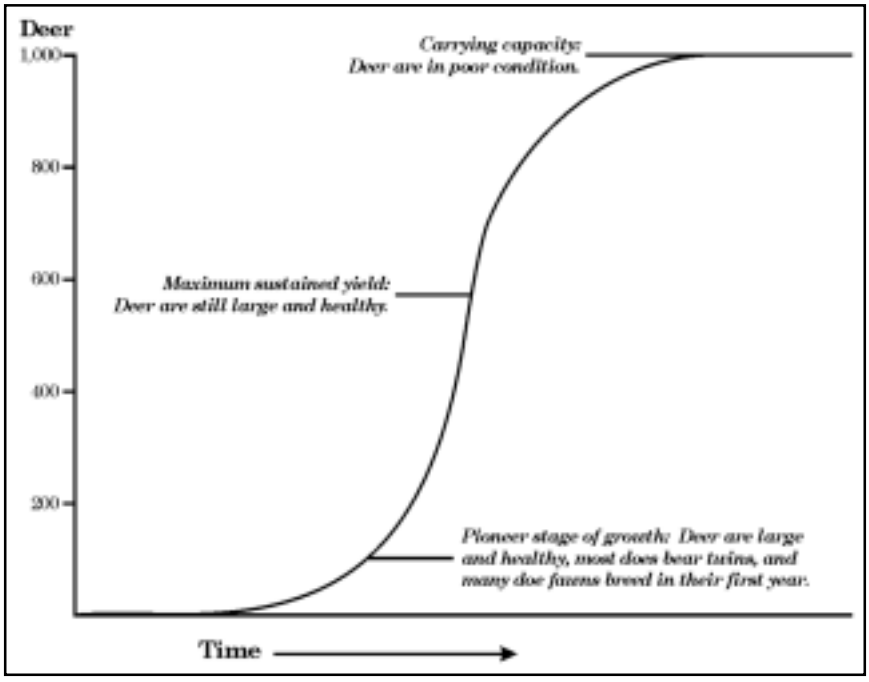
HERD MANAGEMENT

POPULATION GROWTH POTENTIAL

Deer have the ability to reproduce and expand their numbers at an almost exponential rate. A classic example of deer herd growth

potential is documented at the George Reserve in southern Michigan. This area is a 1,200-acre tract enclosed by an eleven-foot deer-proof fence. In 1928, six deer (2 bucks and 4 does) were released inside the area. Six years later, a drive count yielded a minimum population of 160 deer (Hickie 1937). The growth of the George Reserve herd reflects a mathematical model known as the logistical equation (Caughley 1977).

This model is characterized by an S-shaped curve reflecting how



In this hypothetical population growth model, during the early stages of population growth, deer numbers are low and food is abundant. Reproductive output is high and physical condition of the herd is excellent—consequently the population grows rapidly. As the population reaches carrying capacity (CC), reproductive output is slowed and births equal deaths in the population. At this point, physical condition of the herd is poor and chronic disease is prevalent. Population levels maintained between 50 to 60 percent of CC are at the point of maximum sustained yield. At this point, the maximum number of fawns are born (and survive), deer are in excellent physical condition, and annual harvest of deer is maximized.

factors such as reproductive success and mortality affect a population. During the early stages of population growth, deer numbers are low and quality forage is abundant. Consequently, mortality is low and reproductive output is high. As the population increases, so does competition for quality forage and other habitat components. This increased competition leads to lower reproductive output and fawn survival. The fawn recruitment rate eventually reaches a point where it equals the mortality rate and the population stops growing. Physical condition of the herd is usually poor and disease problems may be chronic. A deer herd at this point has reached **absolute carrying capacity or CC *K***.

The population level at absolute or CC *K* consists of the maximum number of animals the habitat can support. At any level above CC *K*, plants in the habitat are utilized at a rate greater than they can sustain. In terms of deer management, the term ***reasonable carrying capacity* (RCC)** may more accurately describe the maximum number of animals acceptable relative to herd quality, habitat integrity, and other social constraints. **RCC is reached at a population level that is lower than CC *K*.** At RCC, the population level is at the upper limits of the habitat's capacity to sustain the population in good condition throughout the year. RCC takes into consideration seasonal fluctuations in habitat quality, impacts to other wildlife species, and human considerations.

THE NECESSITY OF HERD MANAGEMENT

The example of the George Reserve relays the importance of controlling deer population levels. Deer managers should be cautioned that maintaining a deer population at carrying capacity is a risky and

often costly proposition. The levels at which deer populations should be maintained depend on land use objectives, human dimensions, and overall herd management objectives. It may be desirable to keep deer numbers low in order to reduce problems associated with crop damage, disease, and accidents. Independent of these considerations, deer populations should always be managed to meet some goal relative to management objectives, herd health, and the protection of habitats and ecological integrity.

In the absence of sufficient predator populations, the work of maintaining deer populations at appropriate levels has shifted to the modern hunter. **The most effective way to regulate deer populations is through hunting.** Failure to control deer numbers always results in overpopulation and habitat degradation that affects not only deer, but also many other animals. For example, many species of neotropical migrant birds are impacted by excessive deer herd densities and the resulting overbrowsing of important food and nesting flora. Proper

Excessive deer populations negatively impact other wildlife species, such as neotropical migrant birds, by overbrowsing important food and nesting flora.
Photo courtesy of Rhett Johnson.

regulation of deer populations ensures critical habitat components are protected for numerous wildlife species. Hunting should be appreciated for the cultural and societal benefits it provides, as well as the effective management tool it has become.

As with any tool, hunting can be applied improperly or inefficiently. It is the job of state wildlife agencies and biologists to provide the regulatory framework and, along with research universities, the management information that ensures the most efficient application of hunting as a management tool. In the years since subsistence hunting largely disappeared, there have been numerous advances in the field of scientific wildlife management. There also are numerous approaches to the management of deer through legal hunting. Some of these approaches have served the public and the deer herd very well, while other methods have resulted in poorly managed and unnatural deer herds. Today the principles of proper deer management are well defined and effective. Implementing these management techniques often entails overcoming the obstacles of popular deer lore, people's resistance to change, and user groups with conflicting objectives.

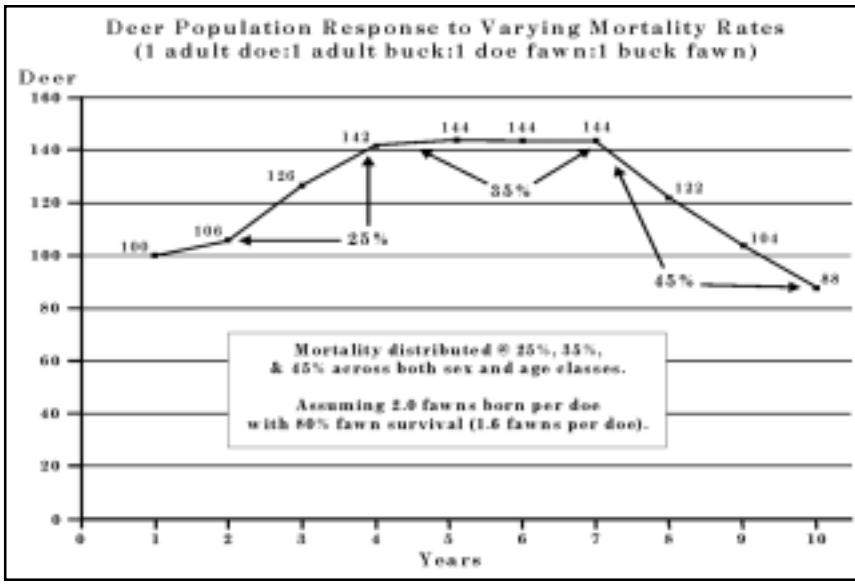
THE BASICS OF HERD MANAGEMENT

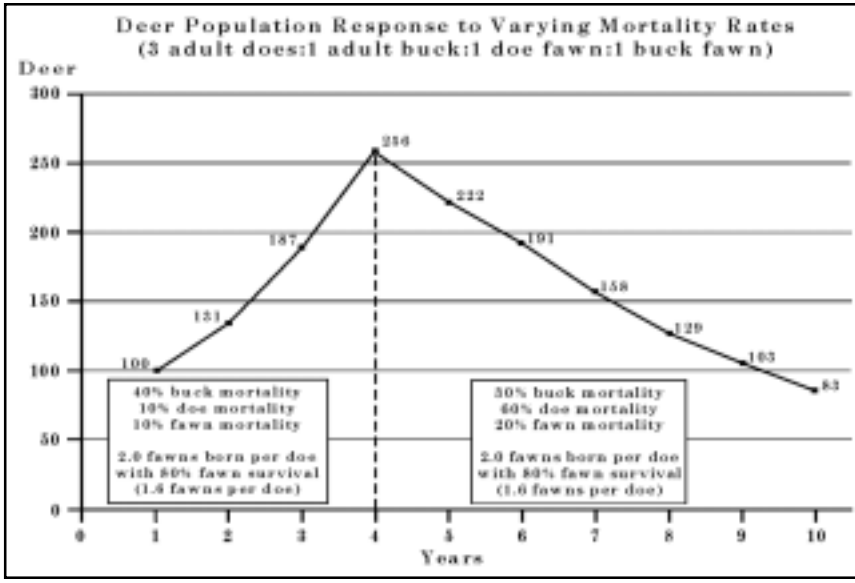
The primary objective of deer managers should be to maintain a deer population within the bounds of the reasonable carrying capacity. Beyond this, management objectives may include the production of mature bucks, balancing adult sex ratios, or maintaining a maximum deer harvest. Deer harvest data is most effective in determining whether a population is within the reasonable carrying capacity. If harvest data indicates too many deer for a unit of habitat, an aggressive harvest of

A visible browse line and heavy utilization of poor quality food items, such as Eastern red cedar, are clear signs of gross overpopulation.

deer—especially does—should be implemented to reduce the population to a more compatible level. Continued monitoring of harvest data will assist in determining when the population has been reduced to the appropriate level.

Often, an aggressive doe harvest is the fastest and most efficient method to reduce overall herd densities. In addition to simply removing excess deer numbers, harvest of female deer limits reproductive output and works to balance adult sex ratios. In cases of gross overpopulation, greater numbers of deer should be removed regardless of sex. **Once a population has been reduced to a level within reasonable carrying capacity (RCC), approximately one-third of the herd must be harvested each fall to maintain this population level.** Within the annual one-third harvest, at least half of the deer taken should be females. Any significant departure from this basic harvest regime will result in population growth and herd densities that exceed RCC.





The above graphs represent the hypothetical population growth of a deer herd. The projected number of animals in the population does not represent a precise number of deer, but serves to illustrate growth trends under different population structures and harvest regimes.

Deer populations respond to varying mortality rates by decreasing, increasing, or remaining stable. A deer herd will continue to grow with annual mortality rates of less than 35 percent. The rate of growth will depend on how far below 35 percent the annual mortality rate actually is. For example, an annual mortality rate of 20 percent allows for rapid population growth while at 30 percent, population growth may be more gradual. With approximately 35 percent annual mortality, a population will generally remain stable. With a 40 percent annual mortality rate, the total population will decline; at rates greater than 40 percent this decline becomes more pronounced. The effect annual mortality has on a population also depends on how the population is structured with respect to adult sex ratio and on how the annual mortality is distributed between both sexes. Reproductive output and recruitment also influences the net effect of annual mortality rates.

Population models have shown deer herds produce the greatest sustained yields when maintained at approximately 40 to 80 percent of the estimated carrying capacity (Downing and Guynn 1985). At these herd densities, the highest harvest rates may be achieved without compromising habitat integrity. Reproduction and recruitment will exceed natural mortality significantly at these levels, thereby providing the optimum range for a sustained annual harvest of deer. Studies have shown peak harvest rates are achieved at deer densities of 50 to 60 percent of carrying capacity (Downing and Guynn 1985). At this level, allocation of resources in habitat and fawn production/recruitment is maximized. All deer in the herd will develop to the potential of the habitat's nutritional ceiling. In areas of suboptimal habitats with inherently lower carrying capacities, this level may be too low to provide

acceptable hunting satisfaction because deer sign and sightings may be reduced.

HERD MANAGEMENT OBJECTIVES AND OPTIONS

There are three manageable characteristics of a deer population—adult sex ratio, age structure, and the herd density/habitat quality relationship. Selective mortality in the form of modern hunting plays the primary role in shaping these deer herd parameters. **Each time a hunter harvests a deer, a management decision is made. Without a doubt, hunters are the front line of deer management. Deer biologists and managers have little impact on overall herd management in comparison to the collective impact of deer hunters. When a particular animal is harvested or passed up, the effects of that decision shape the overall structure and health of a particular deer herd. Therefore, it is important that hunters fully understand the importance of their role in managing Alabama's deer herd.**

A professional wildlife biologist can provide the best assistance regarding deer habitat and harvest management.

Key to this educational process is defining and explaining the various deer management options available to deer hunters. Within these options, the benefits and potential drawbacks of each approach must be addressed. Reasonable goals and realistic expectations also must be established in order to achieve management success and hunter satisfaction. **Deer management endeavors that fail are generally the result of unreasonable and/or unrealistic goals and expectations, not some inherent flaw in the management approach.** In Alabama, there are three general management options available to the deer hunter/manager—traditional (restoration) deer management, quality deer management and trophy deer management.

TRADITIONAL DEER MANAGEMENT

Traditional deer management is practiced in many areas of Alabama. This approach also can be referred to as restoration deer management (RDM; Woods 1999a). This type of management helped restore the abundant deer populations we enjoy today. After deer were restocked throughout the state and as the resulting populations began to grow, RDM was used to provide recreational buck-only hunting while protecting reproductive output through the prohibition of doe harvest. Through RDM, deer herds were allowed to expand while still providing hunting opportunities.

Hunters involved in early post-stocking hunts can certainly attest to "the good ol' days" when large antlered, heavy-bodied bucks were taken regularly. The reasons for such harvests are no mystery. These newly established populations had access to an abundance of nutritious forage, total deer numbers were low, and buck age structure was well

proportioned. Clearly, all the elements necessary to produce large, healthy deer were in place.

Over time, RDM resulted in the harvest of most of the mature bucks initially found in these fledgling populations. When mature bucks became scarce and hunters' appetites for deer hunting increased, the brunt of the harvest pressure fell on the younger age class bucks—primarily yearlings and 2-1/2 year old animals. With many of these new deer populations continuing to expand rapidly, more young bucks were available for harvest each year. The heavy harvest of young bucks, coupled with virtually no harvest of does, eventually led to an extremely unbalanced and unnatural deer herd in many parts of Alabama.

Large bucks were frequently harvested in the early days of post-restocking deer hunting.

As RDM continued to be used to manage our deer herds, populations began to exceed the habitat's carrying capacity. Reproductive output began to decline while incidents of crop damage, poor physical condition of deer, and habitat damage became common occurrences. To alleviate these problems, biologists recommended the harvest of doe

deer in some areas. These recommendations were met with staunch resistance from many hunters and landowners. Although these recommendations were correct, the reluctance to implement a significant doe harvest at the time was somewhat understandable. Hunters and landowners feared returning to a time when deer populations were sparse to nonexistent. In the process of restoring deer in Alabama, state wildlife personnel oversold the message of doe protection far too well. This "don't shoot does" message became an obstacle that only recently is being overcome in many parts of the state.

A modified form of RDM is widely practiced today. Some biologists refer to this as maximum harvest deer management (MHDM; Woods 1999a). The objective of this management scheme is to maximize the number of deer that can be harvested annually. Under such an approach, bucks are harvested indiscriminately and, in *theory*, the doe harvest will consist of enough does to maintain current population densities. In *practice*, under MHDM, doe harvest often is insufficient and total deer densities are excessive. With MHDM, young bucks are harvested heavily and consequently, buck age structure is very poor. Additionally, adult sex ratios are heavily skewed to favor does.

The result of this new twist on RDM is an unbalanced and unnatural deer herd that often exists beyond the bounds of the habitat's reasonable carrying capacity. In these herds, natural reproductive behaviors, dominance hierarchies, and socio-biological relationships are compromised. Often, herds managed under MHDM are characterized by poor reproductive output, poor physical condition, and long, protracted breeding and fawning periods. **On the other hand, MHDM provides ample harvest opportunities and enhances the opportunity for**

hunters to see numbers of deer while afield. However, it must be realized such enhanced opportunities normally come at the expense of herd and habitat quality.

QUALITY DEER MANAGEMENT

Recently, the phrase "quality deer management" has become a buzz word of sorts in Alabama and other parts of the country. The concept of quality deer management (QDM) as practiced today was brought to the forefront in 1975 by two Texas biologists, Al Brothers and Murphy Ray. Much work and research on QDM has been done since these biologists published the book *Producing Quality Whitetails*. Many hunters and deer managers practice some form of self-described quality deer management. **A proper definition of QDM is the voluntary use of restraint in the harvesting of young bucks combined with an appropriate antlerless deer harvest to maintain a healthy deer population in balance with the habitat (Hamilton et al. 1995). Any management program that does not incorporate all of these principles is not true QDM.**

Restraint in the harvest of younger age class bucks (1-1/2 and 2-1/2 year old animals) improves the herd's buck age structure. An adequate harvest of does balances adult sex ratio and ensures herd density does not exceed the habitat's capacity to produce nutritious browse on a sustained basis. Overall, the QDM approach strives to produce a healthy, natural deer herd. Under QDM, natural deer behaviors, sociobiological relationships and reproductive indices are enhanced.

Often, QDM is used synonymously with the term "trophy deer management". The two terms are not interchangeable. There are dis-

tinctive differences between these two management options. As will be discussed later, bona fide trophy deer management (TDM) is a labor and resource intensive approach that is not a viable option for the majority of deer managers in Alabama. Large antlered bucks can be a

Mature bucks with well-developed antlers often are a by-product of quality deer management (QDM).

by-product of QDM. These animals are the result of improved buck age structures and deer densities maintained within the reasonable carrying capacity of the habitat. However, production of these animals is not the primary purpose of QDM.

In suboptimal habitats, body weights and antler development may not respond as desired under a QDM program. If these indices are the only measures of success, then QDM must be considered a failure in some areas of Alabama. Often the successes of this approach cannot be measured in pounds and inches since there are many other benefits associated with QDM. Many times, the gains made under QDM come in the form of increased sign associated with the breeding season (rubs and scrapes), timely and compressed breeding/fawning periods, and greater reproductive output. In short, QDM can produce a deer herd that behaves and functions naturally, with all animals afforded the full benefit of the habitat's nutritional plane. This alone makes QDM a worthwhile endeavor.

Under QDM, greater sustained harvests of deer can be achieved. These deer herds are typically maintained at 50 to 75 percent of the habitat's carrying capacity (Woods 1999a). At these densities, reproduction and recruitment rates are highest. Consequently, more deer are produced and can be harvested. In fact, at least 35 percent of the herd must be harvested annually to maintain proper herd density. Ideally, about 50 percent of the annual harvest would be comprised of does to maintain balanced adult sex ratios. Often, doe harvest must be considerably higher to offset the heavily skewed sex ratios resulting from restoration deer management or MHDM.

QDM is not a panacea. This approach is based on sound deer management principles and it requires deer hunters to become active deer managers through their harvest decisions. Often, QDM requires several years of an extremely heavy doe harvest to correct sex ratios and to bring total densities to a level more compat-

ible with available resources. While doe harvest may taper off over time, it is not a one-time proposition. QDM requires a sufficient doe harvest on an annual basis. Unfortunately, in some areas of the state, deer densities are so excessive the doe harvest required under QDM is difficult to implement. In these cases, many attempts at QDM result in frustration and an abandonment of the program.

Before attempting QDM, hunters and managers must realize there is a cost associated with this type of management. Passing up bucks logically results in fewer bucks harvested annually. This loss in harvest opportunity can be offset with increased doe harvest opportunities. Passing up bucks does not yield a 100 percent return. There is no guarantee a young buck passed up today will result in a mature buck harvested on some tomorrow. Natural mortality, dispersal, poaching, and, in some cases, neighboring hunters work to lower returns on this management approach. However, passing up young bucks will yield more return than the heavy harvest of young bucks. **Dead deer do not grow—of this we are certain.**

Another consideration is mature bucks produced under QDM often become difficult to harvest. Hunters often have the perception mature bucks are not present simply because they do not see them. Ironically, many hunters who practice RDM imagine there are numbers of mature bucks on their hunting lands when their harvest decisions ensure there are none. When a QDM program is implemented, there often is a time lag between initiating the program and observing significant results. During this period, dissention may occur among those participating in the program. Patience by all involved in QDM is necessary. Many times, five years or more may be required before significant

changes occur in herd structure and habitat quality. **Herd structure and habitat conditions do not deteriorate over a short period of time nor will improvements occur over a short time.**

Over time, does often become more difficult to harvest under QDM. Increased pressure on the female segment of the herd causes these deer to become more wary than under a more traditional management approach. Hunters often fall into a routine of setting up on planted wildlife openings in a manner and at times that become predictable to the does using these areas. In many cases, these does may simply wait until dark to feed or they may feed at odd hours of the day. Often hunters new to QDM erroneously arrive at the conclusion that increased doe harvest has detrimentally affected the deer herd. To enjoy a successful QDM program, hunters must often adopt new hunting strategies to effectively adapt to changes in deer behavior resulting from increased doe harvests.

Other limitations and influences on the success of QDM are land base size, neighbors with conflicting harvest goals, and land use considerations. Small tracts of land limit the degree to which a deer manager can make significant changes to herd density and structure. Larger landholdings help insulate against the effects of dispersal and neighboring hunters that harvest bucks indiscriminately. Large blocks managed for maximum pulp fiber production often are difficult to hunt effectively. Again, soil fertility and habitat quality will produce a ceiling of performance with respect to physical indices. All of these factors must be considered when implementing and evaluating a QDM plan. Deer hunters and managers should consult with a professional wildlife

biologist when assessing the feasibility and expected results of any QDM plan.

TROPHY DEER MANAGEMENT

Trophy deer management (TDM) possibly is the most unattainable of management options available to the deer manager in Alabama. Many hunters refer to themselves as "trophy hunters" or refer to their hunting lands as "trophy managed". In theory, trophy management is relatively simple, yet in practice is realistically impossible for most landowners and hunting clubs. The time, labor, and resources required for bona fide TDM make this option unfeasible for all but a handful of deer managers.

Each hunter's definition of a trophy is subjective, hence the designation of "trophy buck" is highly subjective. However, to truly manage for trophy animals requires a clearly defined profile of a trophy buck. A trophy animal is an atypical animal. This animal has produced antlers well beyond what most well nourished deer of his age class will produce. In a sense, the trophy animal is a freak. Some biologists define a trophy animal as one scoring at least 85 percent of the best Boone and Crockett score recorded for the county in which it was taken (Woods 1999a). This is a good working definition to use when attempting TDM.

When making comparisons of QDM and TDM, a clear delineation between a trophy buck and a mature buck is usually the most overlooked difference between these two management options. Quality deer management is designed to produce a natural deer herd in which there will be a good number of mature bucks. Of these mature bucks, some may produce exceptional antlers. However, this is merely a by-

product of QDM and not a major goal of this management technique. Under TDM, the goal is to produce a predominantly male population in which those males reach the upper echelons of age class and antler development. Many bucks harvested under QDM criteria would not be harvested under a highly selective TDM harvest regime.

The goal of trophy deer management (TDM) is to produce bucks of exceptional size. Only the oldest age classes of bucks (5-1/2 years old and older) are harvested under this type of management.

Few, if any, bucks are harvested annually under TDM. Considering the criteria used to define a trophy buck, there should be no surplus of these animals in any given population. TDM also requires total deer densities be kept well below the habitat's carrying capacity. In many cases, the herd density must be reduced to around 50 percent of the carrying capacity (Woods 1999a). This ensures optimum forage conditions. At these densities, fawn production and recruitment will be highest. Harvest restrictions imposed under TDM ensure the greatest number of bucks will survive to maturity.

Reduced deer densities are maintained by implementing a heavy harvest of does. In fact, one goal of TDM is to leave only enough does in

the population each year to produce a sufficient buck cohort. This heavy harvest of does produces sex ratios that favor bucks and ensures these bucks will be afforded the full benefit of the habitat's nutritional plane.

Under TDM, no bucks should be harvested until they reach at least 5-1/2 years old or older. Bucks do not begin to express full antler potential until reaching these ages. Yearlings and 2-1/2 year bucks cannot accurately be judged for antler potential and should not be culled. Mature bucks that do not produce the desired antler characteristics should be removed from the herd. The difficulty with selective removal of undesirable bucks is most hunters cannot tell an exceptional quality 2-1/2 or 3-1/2 year old buck from a lesser quality mature buck. Techniques such as observing body conformation can aid with culling undesirable bucks, but these skills take time to develop. Many times undesirable antler characteristics result from an injury during antler growth. Such deformities or deficiencies may disappear after a year or two, thus, making effective culling all the more difficult.

In addition to intensive herd management, significant habitat improvements must be implemented and maintained under TDM. Some of these improvements include prescribed burning, timber stand manipulation, and large-scale supplemental plantings, particularly warm-season forages. Large-scale supplemental feeding programs are often employed as well. All these improvements demand tremendous labor and capital resources, as well as the ability (through ownership of the land) to implement these improvements. Land base size is another major consideration when evaluating a TDM program. Only large blocks of land, generally 5,000 acres or more, lend themselves to a successful attempt at TDM. Smaller tracts do not provide the buffer necessary to

offset the influences of dispersal and neighboring hunters who do not share in the TDM philosophy.

Deer managers attempting to produce trophy bucks must realize soil fertility produces a ceiling of performance with respect to body weights and antler development. This ceiling cannot be exceeded with any regularity in the absence of large scale supplemental feeding or planting. In situations where land is leased and not owned, hunters often have few options available to make major habitat improvements. In these cases, TDM often requires a re-evaluation of goals and expectations on the part of deer managers and hunters.

Consistently harvesting bucks with Boone and Crockett scores ranging from 130 to 135 in an area that has never recorded a buck with a score over 145 could certainly be considered a success. If expectations are to harvest 150 to 160 class bucks consistently in this same area, attempts at TDM will result in frustration and failure. In the latter example, expectations, not TDM, are incompatible with the existing habitat conditions.

Another drawback of TDM is increased natural mortality rates for mature bucks. Competition for available does during the breeding season is fierce. Many bucks die from fighting injuries and from post rut stress. Often, mature bucks lose a substantial portion of their body weight during an intense rutting period. Some of these animals never recover from the physical stress endured in such a competitive breeding arena.

Although the principles of TDM are relatively simple, in practice, this option is a painstaking and intensive process few deer managers can successfully implement. Total deer densities required under TDM

often are so low most hunters in Alabama would not find this system acceptable. Even if land base and resources necessary for TDM are available, the effort required to maintain proper herd density is often prohibitive. For those who have the ability and resolve to implement TDM, it can be a rewarding and worthwhile management option. True TDM requires constant monitoring and fine-tuning of harvest and habitat management. Consultation with a professional wildlife biologist should be the first step in initiating a TDM program.

GENETICS AND ANTLER DEVELOPMENT

It is widely accepted among deer managers that there are three major factors ultimately deciding a buck's antler size. These factors are nutrition, age, and genetics. Management of the first two parts of this puzzle—nutrition and age—is straightforward. Bucks given adequate amounts of high quality food and allowed to reach at least 5-1/2 years of age will usually have large antlers.

Management of the third part of the puzzle—genetics—is much less understood. Several factors related to genetics and antler development require further scientific investigation. Deer managers understand a buck cannot grow antlers larger than his genetic potential allows. This means a buck will not grow antlers measuring 180 inches if his genetic potential is limited to 150 inches of antler. Deer managers also understand the other two pieces of the antler puzzle—age and nutrition—greatly influence how much of a buck's genetic potential will be expressed. An immature deer or a deer under nutritional stress will not be able to realize his full antler growth potential.

Two controversial questions related to deer genetics are: (1) How does someone evaluate a deer's genetic potential on the hoof?, and (2) How should genetics for antler size be managed in a free-ranging deer herd? The controversy primarily stems from two long-term research projects focusing on the relationship between a yearling buck's antler size and the buck's potential for antler development at maturity. One study was conducted in Texas at Kerr Wildlife Management Area (WMA) and the other in Mississippi at Mississippi State University (MSU). Both studies examined how accurately a buck's antlers at 1-1/2 years of age predicts that same buck's antler size at maturity.

Although the two studies appear to have been very similar, their final results were very different. After many years of research using penned deer of known lineage (i.e., pedigree) on high quality diets, researchers at Kerr WMA concluded: (1) antler quality at maturity can be predicted based on yearling antler size: spikes will not produce as good antlers at 4-1/2 years of age as bucks with six or more points as yearlings, (2) antler formation is genetically controlled and environmentally influenced, and (3) selection for antler quality based on yearling antlers can improve overall antler quality in future buck cohorts (Harmel et al. 1998, Ott et al. 1998). Based on these findings, researchers concluded deer managers could improve overall antler quality of their deer herds over time by removing all yearling spikes. By removing the undesirable deer (yearling spikes), superior bucks are left to breed and, over time, the average antler size of bucks on the property will increase solely due to genetic manipulation according to the Texas researchers.

On the other hand, researchers at MSU conducted a similar long-term study using captive deer and got very different results. The

Mississippi study found most yearling spikes were not inferior and if allowed to mature, developed antlers at least as large as forked antlered yearlings. Researchers also concluded nearly all antler characteristics appear to have low heritability from sire to male offspring, so culling of the smaller antlered yearlings should not improve overall antler size of a deer herd over time (Demarais 1998, Jacobson and Lukefahr 1998). They also concluded many other factors, such as birth date, birth type (single or twins), milk production, etc., all appear to have a much more pronounced effect on the size of a buck's first set of antlers than his sire's antler size (Jacobson and Lukefahr 1998). Based on these results, the MSU researchers felt deer managers should not expect to improve overall antler quality on a piece of property by removing genetically inferior yearling spikes. Rather, if improvement in average antler size is the management goal, deer managers should protect yearling bucks to maximize the recruitment of these bucks into the older age classes.

So which one of these approaches is correct? In short, no one really knows. In Alabama, where most breeding occurs in January and most fawns are born in August, it seems likely most yearling spikes are a result of late birth dates rather than poor genetics. Instead of having 15 or 16 months to grow before developing their first set of hardened antlers, most yearling bucks in Alabama are only 13 to 14 months old when their first set of antlers are fully developed. They simply have not had enough time to grow a larger set of antlers. If these spikes are removed as culls in an attempt to improve the antler genetics of a deer herd, deer managers could potentially be removing 80 percent or more of a single age class of bucks.

It appears removing spike antlered yearling bucks to improve antler quality of a deer herd is not a wise management practice for most properties in Alabama. Too many factors affect antler growth to condemn a yearling spike as an "inferior" deer. If allowed to get older, most yearling spikes will grow antlers at least as big as forked antlered yearling bucks of the same age.

These two pictures show the same free-ranging buck at 1-1/2 and 3-1/2 years old. The buck obviously had the genetics to grow large antlers; he just needed the time to express more of his potential. Photos courtesy of Harry Jacobson.

Some deer managers and hunters will continue to use selective buck harvest to remove bucks believed to have limited antler growth potential. These deer will be culled in an attempt to improve the overall antler genetics of a deer herd. In most cases, allowing such harvest

only opens up the door for higher buck mortality from hunting. Removing these deer may actually be self-defeating if the manager's goal is producing more adult bucks (3-1/2 years old and older). Potential cull deer may have been injured during the previous year or during antler development and their small or malformed antlers may not be genetically caused at all. Even if bucks with smaller antlers are removed, no conclusive research exists to prove the better bucks that are protected will pass on genes for big antlers to their male offspring.

With so much uncertainty about heritability of antler traits, when, if ever, is removal of limited potential, or cull, bucks recommended? The only situation where this may have some applicability is in a very healthy deer herd being managed for trophy deer. This herd should be well below carrying capacity (50 percent or less) and have very high quality food available throughout the year (excellent habitat). Bucks in this setting should be expressing as much of their genetic potential for antler growth as possible in a free-ranging deer herd. Only in this type of situation would the idea of culling bucks be even remotely advisable. If culling is to work, it will have to focus on selection for desired antlered traits among mature (5-1/2 to 7-1/2 year old) bucks, as well as removal of undesirable traits among mature bucks (Jacobson 1998). This means deer managers would remove the mature bucks with undesirable antler traits and protect the mature bucks with the largest antlers. They also would hope the protected bucks are able to pass their desirable antler traits on to their male offspring. This correct approach to genetic management has little chance of working because few hunters are willing to pass up the biggest buck they likely have ever seen so it can remain as a breeder buck. Also, there is no

guarantee the superior bucks hunters pass up are actually doing the majority of the breeding and passing their genes on to their male offspring.

Even if the biggest antlered bucks are protected and the smaller antlered bucks are removed, the time required for any measurable improvement in antler quality solely through genetic manipulation would be far longer than the average deer manager or hunter can persevere (i.e., several decades). The primary reasons are: (1) antler traits do not appear to be highly heritable, (2) there is no guarantee the mature bucks with the best antlers will do the majority of the breeding, and (3) the culling of bucks only addresses at best one-half of a buck fawn's antler genes. Remember, a buck's dam contributes half of his genetic makeup, including genes for antler characteristics. There is no way to identify which does carry the superior genes and which ones carry the inferior genes.

The bottom line concerning antler genetics and its role in deer management is still unclear. For the great majority of deer hunters, culling of inferior bucks should not be of concern. **If better antler quality is a deer manager's goal, then the majority of their effort and resources should focus on improving the quality of the habitat, improving buck age structure (letting bucks mature), and maintaining the deer herd at a level well below carrying capacity through doe harvest. While most wildlife biologists agree these three practices can be effective at improving deer quality on most properties, very few have seen examples where culling resulted in an increase in the average antler size of a free-ranging deer herd.**

DEVELOPING A DEER MANAGEMENT PLAN

Interest in deer management, quality deer management (QDM) and trophy deer management (TDM) in particular, has grown significantly during the last few years. As a result, an increasing number of hunting clubs and landowners are implementing new deer management programs on their properties. Most of these sportsmen undertake these new approaches to deer management because they are looking for something better. They want a healthier deer herd, more adult bucks, and/or a higher quality hunting experience. Unfortunately, many of these programs are doomed for failure from the start. The primary reason for most of these failures is the lack of a plan detailing how to achieve the desired objectives. Taking the time to develop a sound deer management plan can minimize the headaches experienced when managing a deer herd.

An assessment of both the habitat and deer herd must be made before an appropriate deer management plan can be developed. Collecting deer harvest and observational data provides insight into the condition of the deer herd. An assessment of habitat quality shows what components of the habitat are limiting. Without this information, it is impossible to determine the practices needed to achieve success. Furthermore, it is impossible to assess the program's progress in future years.

Short- and long-term goals should be established once an assessment of the herd and habitat have been made. These goals should focus on the numbers and/or size of deer to be harvested, as well as the

Perhaps the most common cause of disappointment in a deer management program is the unrealistic expectation of the size and/or number of deer to be produced and killed. Evaluating the potential of the site to be managed and the commitment of all involved will help in establishing realistic management goals.

time frame in which these goals are to be achieved. Too often hunting clubs enter into QDM or TDM with unrealistic expectations about what will be achieved. Participants do not fully understand the many limiting factors ultimately determining their level of success. Due to the lack of understanding and frustration, many individuals give up after a fairly short period of time. By understanding these limitations up front and developing a management plan accordingly, many of the disappointments can be avoided.

Perhaps the most common cause of disappointment in a deer management program is the unrealistic expectation of the size or number of bucks to be harvested. Hunting magazines and videos bombard deer hunters with images of huge whitetail bucks har-

vested from the midwestern U.S., the western Canadian provinces, and Texas. Hunters see these huge deer and have visions of regularly producing similar sized bucks scoring 150 or more Boone and Crockett (B & C) points on their property in Alabama. Several deer of this quality are killed in Alabama each year, but hunters should not expect to kill deer of this size in large quantities, on a regular basis, or in all parts of Alabama. Such false expectations typically lead to disappointment. By gathering the necessary data beforehand, hunters can establish attainable goals for the area to be hunted. Depending on habitat quality and productivity of the property, a realistic goal for 4-1/2 year old and older bucks may be 140 B & C points or it may only be 110 B & C points. Over the years, some bucks likely will be harvested that exceed these goals and some will surely fall short. By understanding the limitations at the onset, everyone involved will be more likely to stick with the program.

Hunters also should realize time constraints affect what can be achieved with their management practices. Some areas are capable of appreciable improvements in deer quality in a relatively short time (i.e., 2 to 3 years). However, many areas may take five or more years before the deer herd responds and the desired objectives begin to materialize. A history of severe exploitation of bucks, particularly yearlings, or habitat damage resulting from an overpopulated deer herd, will prolong the time needed to realize improvements in herd quality.

Before an effective deer management plan can be initiated, all of the limiting factors for the property need to be identified (Woods 1999b). These limiting factors may be directly associated with the deer herd or its habitat. In most cases, it is both. These may include past harvest practices, current herd conditions, habitat quality, and produc-

tivity of the property (Woods 1999b). Other factors, such as size and shape of the property, current land use practices, activities on neighboring properties, and monetary constraints of the hunting club or landowner, also will determine what steps need to be taken to achieve the management objectives (Woods 1999b). If too many limiting factors are at work on the property, it will be necessary to reevaluate the long-term goals or search for another piece of property.

Once the limiting factors have been identified, a deer management plan can be developed. When formulating a plan, it often is useful to view the deer herd as a water bucket and each of the limiting factors as holes in the bucket. For the bucket to hold water, the holes on the bottom must first be patched. Once the bottom holes are patched, holes farther up the bucket can be repaired, until all deficiencies have been repaired and the bucket is capable of remaining full of water. The management plan should be designed to address the most serious limiting factors or holes (e.g., overharvest of bucks, overpopulation) first so the chosen objectives can be achieved in a reasonable amount of time. In most parts of Alabama, this means implementing both herd and habitat management practices from the beginning.

In most situations, deer herd management is limited to one technique—legal hunting. By shooting or passing deer as directed by the management plan, hunters are able to manage age and sex ratios of the deer herd, as well as keep deer numbers in balance with the available habitat (Woods 1999b). Since herd management is such an important component of any deer management plan, all hunters involved need to be aware each time they decide to shoot or not to shoot, they are making a management decision. Once this is under-

stood, the management process can progress without an excessive number of mistakes or lapses in judgment. To further expedite achievement of deer management objectives, both doe harvest and buck restrictions should be as aggressive as the participating hunters can tolerate.

Currently there are many more management options available to correct shortcomings in deer habitat than exist for herd management (see **HABITAT MANAGEMENT, page 103**). Very few areas in Alabama lack cover or water suitable for whitetails, but most areas are short on quality food. For this reason, most habitat management practices should be directed at improving both the quantity and quality of deer food. As with herd management, a more aggressive approach to improving the deer habitat will bring quicker changes. Of course, the amount of habitat improvement that can be achieved will be limited by the available resources (money, equipment, etc.), location of the property, current land use, and land ownership.

Once the management plan has been implemented, it will be necessary to monitor the deer herd's progress on a regular basis. To ensure proper management decisions are made, accurate and complete deer harvest and observational data must be collected (see **DATA COLLECTION, page 89**). By reviewing these data on an annual basis, fine-tuning of the herd and/or habitat management practices can be made to ensure continued progress.

The ultimate goal of most deer management plans is the satisfaction of the people involved. If the people involved are not satisfied with the program's progress, the chances of them continuing to support the management practices being used are small. Just as the deer data may dictate a change in management strategies, hunter dissatisfaction

The satisfaction level of the participants is probably the best gauge of a deer management program's success or failure. Hard work and commitment has paid off for these hunters. Photo by Jean Watson.

may justify a modification of the deer management plan. Once positive results are seen, however, hunters and others involved typically become more enthusiastic and willing to continue working toward their goals. This enthusiasm can quickly spread to adjoining properties, which, in many cases, greatly improves everyone's chances of succeeding.

DATA COLLECTION

HARVEST DATA

One of the most important parts of any long-term project is the periodic evaluation of the project's progress. This is especially important when the project is the management of a herd of white-tailed deer.

A deer population is dynamic and to be properly managed, it must be continually monitored. The collection of specific biological data from hunter-harvested deer and the interpretation of these data allow the wildlife biologist or manager to evaluate the effectiveness of the management program to date. The biologist or manager then can adjust recommendations as needed. For the manager to get the full benefit of the data and, in turn, use the data to the best of his ability, the person collecting the data needs to know what information to collect and how it should be collected.

The types of information that can be collected from a deer herd are wide ranging, including basic physical information (weight, antler points, etc.), reproductive information (fetuses per doe, breeding dates, etc.), and hunter observation data (fawn to doe ratios, doe to buck ratios, deer sighted per hour of hunting, etc.). When this information is collected on an annual basis, the wildlife manager is able to monitor trends in certain physiological indi-

Having the proper tools and instruction on how to use them makes data collection simple. Scales, pruning shears, jawbone puller, measuring tape, and data sheets are about all that is needed to collect most deer harvest data.

ces and make management recommendations in response to these trends.

Hunters serious about managing their deer herd should at least be collecting harvest data. The minimum information to be collected is the deer's sex, body weight, antler dimensions, and lactation information. In addition, a lower jawbone should be removed from each deer so its age can be estimated using tooth eruption and wear patterns.

A few basic tools are needed to collect data. These include: a set of accurate, quality scales, a mechanism to hoist a deer, a pair of long handled pruning shears, a 1/4-inch wide metal measuring tape, a jawbone extractor, data sheets (see **APPENDIX 6, page 154**), an indelible marker and/or jawbone tags, and a collapsible fish basket or some other container to store jawbones. All of these tools and data sheets should be kept readily accessible to everyone hunting on the property being managed, such as at a skinning shed, camp house, etc. This makes it more likely the data will be collected before the deer is carried off the property.

JAWBONE EXTRACTION

It is necessary to know the age of each deer harvested to accurately assess the condition of deer on any property. Determining a white-tailed deer's age using tooth replacement and wear is the most common technique employed by wildlife biologists and managers today. This technique was first described by C. A. Severinghaus in 1949. The accuracy of this technique has been called into question in recent years. Gee et al. (2002) found even experienced wildlife biologists had difficulty accurately aging deer beyond 2-1/2 years old using

Severinghaus' tooth replacement and wear technique. Even with its shortcomings, this technique has proven to be useful, and most experienced deer managers can classify deer into one of four age classes (i.e., 1/2 year, 1-1/2 years, 2-1/2 years, and >2-1/2 years) using this technique. While not exact, these age classes are specific enough to make sound management decisions on most properties. Other methods, such as body size, antler size, etc., appear to be more subjective and less reliable aging techniques.

Jawbones should be taken from all deer harvested, regardless of size. Most hunters do not have a problem getting jawbones from adult does or small bucks. However, many are apprehensive about removing jawbones from large bucks, especially ones to be mounted, for fear of damaging the buck's cape. If done properly, jawbones can be removed quickly and without damaging the deer's cape. Taxidermists also can remove the jawbones from deer to be mounted, but steps should be taken to ensure the correct jawbone is received. On properties managed for better quality deer, the relative ages of the better bucks being harvested are very important data. These data allow the manager to establish harvest limits to protect the correct age classes of bucks and still allow harvest of the target group of bucks. It also is important to get jawbones from the smallest deer as well. Many hunters do not feel it is necessary to remove jawbones from fawns because their small size is a good enough indicator of the deer's age. This may be true in some situations. On many areas, especially late in the season, the size difference between fawns and young adult does becomes less substantial. For these reasons, collecting jawbones from each deer harvested should be a top priority.

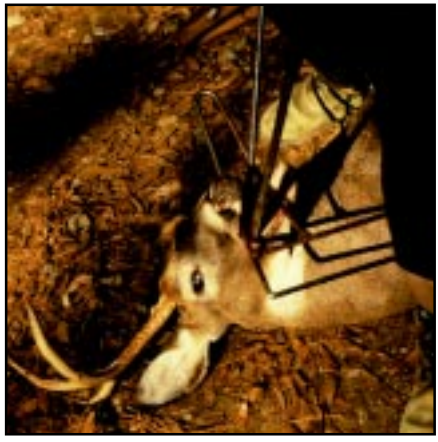
A method for removing jawbones that is easy, causes less mess, and does not damage a mountable deer's cape uses a set of long handled pruning shears and a jawbone extractor. Metal handled shears usually work better than wooden handled shears because they are slimmer and are easier to fit into a deer's mouth. Shears with longer blades are much easier to use and cause less damage to the teeth cusps than shears with short blades. A jawbone extractor can be made easily from a 48-inch long piece of 5/16 or 3/8-inch cold-rolled steel or 1/4-inch stainless steel (see **APPENDIX 8, page 156**). Jawbone extractors also can be purchased from many forestry equipment suppliers, farm supply stores, and sporting goods stores.

It is much easier to remove a jawbone using the extractor if the deer's head is still attached to the body and before the deer has had time to stiffen up. To extract a jawbone, follow these steps:

Step 1 - With the deer's nose pointed up, insert the small end of the extractor into the mouth perpendicular (cross ways) to the deer's teeth. Rotate the tool and pry the mouth open. This loosens the jaw hinges in preparation for removal. Once the mouth has been opened, remove the extractor.

Step 2 - Push the small end of the extractor between the deer's cheek and jawbone. Push the extractor until it reaches the area just past the back edge of the jawbone. Twist and push the extractor to loosen any connective tissue and muscle between the cheek and jawbone. Do this only on the side from which the jawbone will be extracted.

Step 3 - Place the extractor in the deer's mouth as in Step 1, except this time use the wide end of the extractor. With the extractor still in place, insert the shears into the deer's mouth. Keep the bottom edge of the shears facing the deer's cheek and insert the shears as far into the deer's mouth as possible. Holding the shears parallel to the roof of the mouth, cut through all of the bone and connective tissue at the jawbone joint. Be careful to avoid the teeth when cutting through the bone. Once the cut is made, remove the shears and the extractor.



Step 4 - Insert the small end of the extractor into the mouth and pass it through the cut in the jawbone that was made with the shears. Work the extractor down through the cut until it is behind and below the jawbone. Hold the deer's head firmly and pull the

extractor towards the deer's nose. Once the extractor reaches the deer's chin, twist the extractor to separate the two lower jawbones. The cut jawbone can now be removed easily by hand.

Once the jawbone has been removed, it should be labeled. The simplest way to mark a jawbone is with an indelible (permanent) marker. Dry the jawbone with a paper towel or cloth and then write the corresponding number from the harvest data sheets (1,2,3...) directly on the bone. The other method for marking a jawbone is to use a paper or aluminum tag. The deer number from the data sheets should be written on the tag and the tag should be securely attached to the jawbone using wire or string. Whatever method is used, make sure the number on the jawbone or tag corresponds with the number on the data sheets.

After marking, the jawbone should be properly stored. The two most common ways to store jawbones are in a collapsible fish basket or a customized jawbone box. In either case, be sure the container keeps the jawbones dry and allows air to circulate around the jawbones. The container should be placed where varmints cannot get to it and where it is readily accessible to all of hunters on the property. Never store jawbones in a refrigerator, freezer, or plastic bag. This causes the jawbones to become putrid and rancid. This also can cause numbers on jawbones or tags to be illegible.

WEIGHTS

Weights can be collected as live weights (body completely intact) or dressed weights (guts removed). Never estimate weights. Make sure the weight is clearly identified as live or dressed weights on the data sheet. Data sheets should have a column for both weights, but in most situations only one or the other is needed. Live weights are preferred because there is only one way to get this weight. Techniques for measuring dressed weights can vary. One hunter may consider a deer dressed after removing the stomach and intestines only, while another hunter may remove stomach, intestines, liver, lungs, heart, etc. For most purposes, if dressed weights are taken, they should be taken with all internal organs removed from the chest and abdomen. Leave all other body parts (head, feet, etc.) intact.

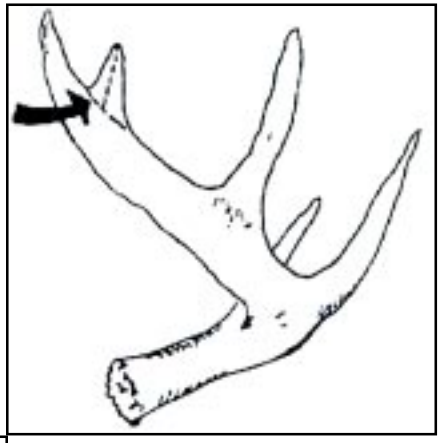
The most common scale used to weigh deer is the 300-pound spring scale commonly sold at farmers' co-ops and forestry equipment supply houses. Any accurate scale will work fine. To check for accuracy, weigh something of known weight on the scales. Calibrate to the correct weight if the scales are off. Most scales have an adjustment screw for making corrections. Do not round weights off to the nearest five or ten pound increment. Weights should be recorded as accurately as possible to the nearest pound.

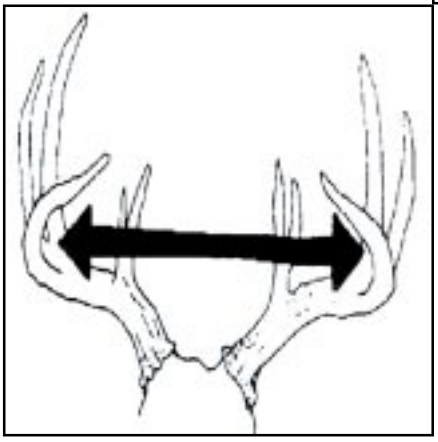
ANTLER MEASUREMENTS

Nearly everyone who keeps harvest records makes a note of the total number of antler points on harvested bucks. Although useful, several other measurements give a better impression of a rack's true size. In addition to the number of points, a buck's maximum inside

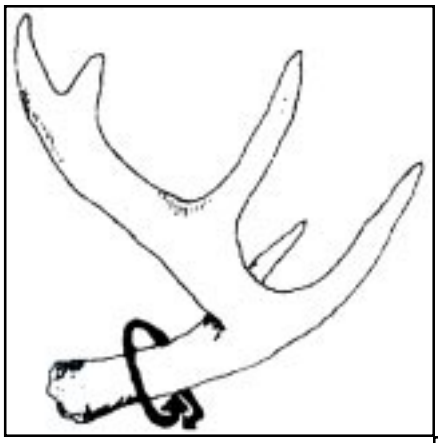
spread, basal circumference, and main beam length also should be recorded. Measurements should be taken on both antlers on all bucks, including spikes. If the main beam is broken, record the basal circumference and make a note about the broken antler on the data sheet. In the case of broken antlers, note the number of points on the full antler and the number of points on the broken antler (e. g., 5 x 1). All antler measurements should be recorded to the nearest 1/8-inch using a flexible, 1/4-inch steel measuring tape as follows:

1 - Even if a ring can be hung from a knob on an antler, it does not necessarily qualify as a point. **Points** should be recorded only if they are at least 1-inch long.



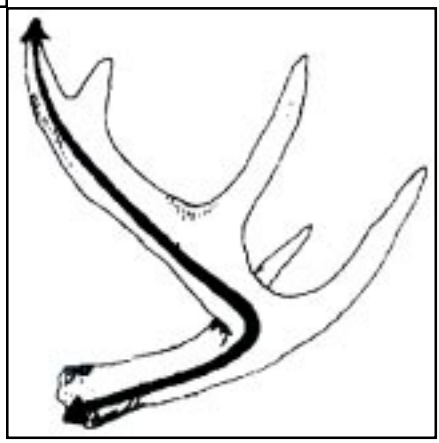


2 - **Inside Spread** is the widest point between the two main beams, measured at a right angle to the center of the skull. If the majority of one of the main beams is broken off, do not record this measurement.



3 - **Basal circumference** is the distance around the main beam approximately halfway between the burr and the brow tine. If the deer does not have a brow tine, take this measurement 1-inch above the burr. Measure both antlers.

4 -**Main beam length** is measured along the outside curve of the main beam from the burr to the tip of the antler. Measure both antlers. If the majority of one or both of the main beams are missing, make a note of this on the data sheet.



Some managers find it useful to record more in-depth antler measurements. Many measure all aspects of a buck's rack and determine a Boone and Crockett score for all racked bucks. These measurements include tine lengths and several circumference measurements, in addition to the measurements mentioned above. Depending on the type of deer management being practiced on a piece of property, this may or may not be necessary.

LACTATION

Checking a doe for the presence of milk (lactation) may be one of the most important aspects of data collection. Unfortunately, it also is one of the most overlooked. Checking for milk may seem less respectable than measuring the rack on old "Mossy Horns", but it is probably more important. By recording lactation information, managers are able to estimate the percentage of does that produced a fawn during the previous year. A high lactation rate should be viewed in a positive light—high fawn production means high buck production. Looking at lactation in this way should make its importance more obvious.

OBSERVATIONAL DATA

Although it is not included in many management programs, observational data can prove very helpful when trying to evaluate the condition of your deer herd. For observational data to be accurate, hunters need to record their observations as soon as they return from the field. The longer the delay in recording this information, the more likely some mistakes will be made. All observations should be recorded on an observation log (see **APPENDIX** 7, **page 155**). This ob-

Hunter field observation data gives a more complete picture of a herd's health than using deer harvest data alone.

servation log should be kept at the same location as the harvest data log.

Another important point to remember about observational data is all hunters should be truthful when recording their observations. Just as estimating harvest data is of little value, failing to record all deer seen or inflating the number of deer seen while hunting can greatly reduce the usefulness of a group's observational data. If some club members do not want to share what they are seeing during the hunting season, each hunter can keep a log throughout the season which can then be summarized at the end of the season. Another option is to maintain a locked box with a slot on top at the data collection station. Hunters can fill out cards indicating field observations while hunting and then place the cards in the locked box. The key for the lock should be given only to one person—the club president, the landowner, or some other trustworthy person. At the end of the hunting season, the contents of the box can be removed and the season's observations can be summarized.

The most basic observational data that should be recorded are the hours hunted and number of deer seen while hunting. Hours hunted should be recorded as the actual hours spent in the woods hunting. This should not include the time spent socializing with other hunters before and after the hunt or the time spent driving to and from the stand. Including all of this extra time will distort the data by inflating the number of hours spent in the field.

How the deer observations are recorded can be as simple as the number of antlerless and antlered deer seen. To get the most benefit from recording the observations, it is better to further break down the

deer seen into more specific classifications. As a minimum, these classifications should include adult does, fawns, antlered bucks, and unidentified (age and/or sex unknown). By grouping deer into these categories, an estimate of doe to buck ratio and fawn to doe ratio can be determined.

Just as harvest data can be more complicated, observation data also can include more detailed information. In addition to the number of hours spent hunting, the actual times hunted (e.g., 5:30 AM – 10:30 AM), stand hunted, and date hunted also can be recorded. This enables hunters to determine what time of day and time of year each stand was most productive. Buck observations also can be more detailed. Bucks can be classified as spikes or forked antlered, by overall antler size (e.g., gross B & C score), or by age class (e.g., yearling or adult; 1-1/2 years old, 2-1/2 years old, 3-1/2+ years old; etc.). While not an exact count, these data can give a hunting club or a landowner a reasonable idea of the number of bucks in the different age classes using their property.

The main difficulty associated with observation data is making sure all hunters know how to record what is seen. Some hunters might incorrectly count all antlerless deer as does. Just as not keeping track of the actual time spent hunting can affect the observational data, lumping all antlerless deer in the adult doe category can greatly distort the final interpretation of the hunters' observations. The same goes for unidentified deer. A deer not clearly identified as an adult doe, fawn, or antlered buck should be placed in the unidentified class.

Other useful types of observational data include the general physical appearance of deer observed in the field and of harvested deer. Things such as unusual skin lesions, unusually poor body condition,

damaged appendages, sloughing hooves, or any other type of physical injury should be recorded. This information proves useful and may give clues to past exposure to potentially harmful diseases for the deer herd, such as hemorrhagic disease. These notes also allow biologists or managers to exclude these deer in their analyses to prevent biasing the harvest data.

Without question, data collection is one of the most beneficial and important things a hunting club or landowner can do when managing deer. This task should be viewed as an integral part of the deer management process, not a dreaded chore. Without these data, there is no way to evaluate the current condition of a deer herd or monitor its progress over time.

ALABAMA'S DEER MANAGEMENT ASSISTANCE PROGRAM

Alabama's Deer Management Assistance Program (DMP) is a technical guidance program offered by the Division of Wildlife and Freshwater Fisheries. Started in 1984, this program offers landowners, hunting clubs, and others interested in managing deer on their property the opportunity to get assistance from a wildlife biologist. Participants or cooperators in the program choose a management objective and are required to collect harvest data from all deer killed on their property. These data must be submitted to their assigned biologist immediately following the hunting season. The biologist then analyzes the harvest data and prepares a report for the cooperators. This report contains the biologist's evaluation of the past year's harvest

and harvest recommendations for the upcoming year. These recommendations are based on the harvest data, the quality of the habitat, and the cooperator's deer management objective. Participants also can arrange on-site visits with their biologist and receive recommendations on how to improve the deer habitat on their property. Anyone interested in the DMP can contact the nearest Alabama Division of Wildlife and Freshwater Fisheries Office for more information (see **APPENDIX 11, page 171**).

HABITAT MANAGEMENT

LIMITATIONS ON DEER HABITAT

Alabama is a diverse state in terms of deer habitat type and quality. Some deer habitat in portions of Alabama is as good as any found in the Southeast, while habitat in other parts of the state is as poor as any found in other parts of the country. This variation in habitat potential is due primarily to soil type and land use practices.

There are six major soil provinces in Alabama—the Coastal Plains, the Prairies (Black Belt), the Major Floodplains and Terraces, the Piedmont Plateau, the Limestone Valleys and Uplands, and the Appalachian Plateau. Within each of these soil provinces are many different soil types. Soils of extremely high quality and others of extremely poor quality may exist in the same soil province. In general, areas such as the Black Belt and the Major Floodplains and Terraces have much more fertile and productive soils than other regions such as the Coastal Plain and Appalachian Plateau. Plants take the nutrients from the soil and pass them on to the deer and other animals that feed

on them. Since soils found in the Black Belt and the Major Floodplains and Terraces are more fertile, plants that grow in these areas typically have higher levels of protein and minerals, such as phosphorous and calcium—all of which are important components in growing big, healthy deer. Properties located in these high quality areas typically have higher carrying capacities and are capable of supporting higher numbers of deer in optimum condition than other poorer quality regions. The potential of these sites, either good or bad, plays a major role in determining how deer should be managed on the property and what can ultimately be achieved using various management practices.

Regardless of soil type, land use practices can either enhance or hinder to varying degrees a property's potential for maintaining a healthy, productive deer herd. White-tailed deer do best in areas with more diverse habitat types. Deer habitat quality is compromised when land is converted into a homogeneous habitat. These homogenous habitat types may be even-aged pine plantations, mature hardwood forests, large agricultural fields, or any other singular cover type. A closed canopy forest located in the Black Belt has similarly poor quality deer food throughout most

Poor habitat is poor habitat, regardless of the soil type. A closed canopy forest provides very little food or cover for deer during most of the year.

of the year as a comparable type forest located in the Coastal Plain. Likewise, a property with a diversity of cover types and ages in the Coastal Plain may have a much higher carrying capacity for whitetails than a mature hardwood forest in the Major Floodplains and Terraces. Fortunately, many habitat management techniques are available that can improve the quality of deer habitat in almost any situation.

White-tailed deer are browsers. This means they feed primarily on the leaves and twigs of shrubs, woody vines, and young trees (seedlings). When available, deer also will feed heavily on weeds, various grasses, mushrooms, and assorted soft and hard mast (fruits). The large majority of these preferred deer foods are considered early or mid-successional plant species. Many are not found at all or are only found in small numbers in more mature forests. Sunlight must be able to reach the forest floor for these important food plants to exist in significant quantities. Many habitat management techniques used to improve deer habitat focus on allowing more sunlight to reach the ground, which results in greater production of the more desirable deer foods. As discussed earlier, the quantity, quality, and species of plants available following any habitat improvement depends largely on the property's soil types.

Another thing to remember when managing deer habitat is a food source is of no value to a deer if it is much over four feet above the forest floor. Some preferred browse species, such as Japanese honeysuckle, greenbriar, and rattan vine, may be present in large quantities in a middle-aged forest. Browse growing ten to twelve feet up the trunks of the trees are well out of a deer's reach. By implementing one of a variety of habitat improvement techniques, not only can the productiv-

ity of these preferred plant species be improved, but the food also will be returned to a level within reach of the deer.

HABITAT MANAGEMENT TECHNIQUES

PRESCRIBED FIRE

Historically, fire was a natural occurrence in southern forests. Many of the plants that grow in these forests require periodic fires to survive. Other plant species flourish following a fire due to the reduction in competition from other plants, scarification of seeds, and exposure of mineral soil. Many of the plants that grow well following a burn also are excellent deer foods. Although natural fires are not nearly as common as they once were, the use of prescribed fire still can give the same benefits when managing deer habitat.

Using prescribed fire in open pine stands on a regular rotation can greatly improve the quality of these habitats for white-tailed deer, as well as many other game and non-game animals. Photo by Bobby Watkins.

A fairly cool-burning fire is desired when deer habitat improvement is the goal. This means burning during the late winter months, usually from January through early March. Prescribed fire can be used

during the spring and summer, but the risks of destroying bobwhite quail and wild turkey nests or killing some of the recently hatched young are very real possibilities. The risk of having a fire that is too hot also is greater at this time. This can result in the damage or even death of mature trees.

Not all sites are suited for prescribed fire. Many species of hardwoods, such as the various oaks (*Quercus* spp.) and other important mast producers, are only moderately tolerant of fire and some may be lost if a hot fire is allowed to burn around them. To protect these valuable trees, plowed fire lines or some other type of firebreak should be placed around streamside management zones (SMZs) and other areas containing mast-producing hardwoods.

Areas best suited for prescribed fire are pine stands with fairly open canopies, such as recently thinned stands. The various pine species (*Pinus* spp.) found in Alabama all are tolerant of fire and thinning allows sunlight to reach the forest floor. Many high quality food plants are able to flourish once these thinned stands have been cleaned up with a prescribed fire. On the other hand, burning in a closed canopy pine stand is usually ineffective. Even if the ground litter is removed and mineral soil is exposed following a fire, most plants are not able to grow because of the lack of sunlight reaching the forest floor in closed canopy forests.

Most pine stands can be burned once the trees reach about eight to ten years of age (Yarrow and Yarrow 1999). Burning sooner can kill many of the young pines. For deer habitat management purposes, stands should be burned on a three to five year rotation or when the woody vegetation reaches a height of four to six feet. Burning more frequently

will not allow some of the woody plants to reach fruit production age. This delay also allows the woody shrubs and vines to produce more vegetative growth and more deer browse. Burning on a longer rotation allows these same woody shrubs and trees to begin shading the ground, which will begin a decline in the quantity and quality of deer browse. It is best to avoid burning adjacent stands in the same year. Staggering the burn schedules on adjacent stands creates a patchwork of different stages of plant growth. This provides a broader diversity of food plants for deer to utilize throughout the year.

Abandoned agricultural fields and natural forest openings both are very attractive to white-tailed deer. Many preferred food plant species flourish in these openings. If left alone, grasses, shrubs, and other woody vegetation can quickly reduce the availability of these food plants in these openings. Using prescribed fire in these openings reduces the competition from the less desirable plants, removes dead vegetation, scarifies dormant seed, and exposes mineral soil, all of which encourages new growth of preferred food plants.

Before using prescribed fire, it is advisable to consult with someone experienced with this practice. In Alabama, it is illegal to burn without first acquiring a burn permit from the Alabama Forestry Commission. The Alabama Forestry Commission also can provide information on topics such as weather conditions and special burning rules for a particular area. It is very important to take all necessary precautions prior to starting a prescribed fire. Even fires on small tracts can quickly escape and turn into much larger forest fires without proper planning and implementation.

HERBICIDE TREATMENT

Another technique that can do a good job of improving deer food production in forested areas is the application of certain types of herbicides. Many herbicides are now very plant specific. They control the unwanted trees and saplings (poor quality hardwoods), woody shrubs, and grasses, while not harming the more desirable wildlife food plants or the managed timber.

Herbicides can be applied at the time of stand regeneration or at any time during the stand's rotation. They usually are applied with sprayers attached to helicopters, tractors, skidders, and ATVs, or with a backpack-type sprayer. As with prescribed fire, the best results are attained when herbicides are applied to stands with open canopies, such as following a thinning or other type of timber harvest. This allows more sunlight to reach the forest floor and promotes the growth of the desirable plants not killed by the herbicide. If there is a significant amount of mid-story trees to be controlled by the herbicide, it is best to follow treatment by the herbicide with a prescribed fire. This removes the dead plant material and allows more sunlight to reach the ground.

Applying herbicides can greatly improve the quality of deer habitat in some forest stands. Photo by Bobby Watkins.

In the right location and under the right conditions, the use of

herbicide can greatly improve the quality and quantity of deer forage in a forested stand. Use of herbicides in unsuitable areas or under unfavorable conditions by persons inexperienced in their use can result in the loss of many valuable trees and other desirable plants. As with any forest management technique, herbicides only should be applied by professionals trained and experienced in their use. A professional can determine if the site to be treated is suitable for herbicide and then can make the application without causing harm to the non-target trees and plants.

MOWING/DISCING

Limitations due to location, money, or available equipment may not allow the use of fire or herbicides in some situations. In these cases, other methods can be used to control plant succession, remove accumulated plant matter, and encourage the growth of quality deer foods. Techniques such as mowing or discing are great ways of improving food production in abandoned agricultural fields, natural forest openings, roadsides, utility right-of-ways, etc. Using these techniques just prior to the growing season encourages new plant growth during the spring and summer months and in many cases, normal farm implements can be used to maintain these openings. As with prescribed fire, mowing and discing should be done on a regular basis (two or three year cycles) to maintain the desired plant species. When managing larger openings, it is best to mow or disc only part (1/2 or 1/3) of the opening each year. This provides deer with more of a variety of food plants in various stages of development.

TIMBER HARVEST

Periodic removal of trees can do a great deal to improve deer habitat. This removal can be in the form of thinning or clearcutting. Taking out these trees opens the forest canopy and allows more sunlight to reach the forest floor. The harvest also improves habitat diversity by creating plant communities of different ages and transition areas from harvested stands to unharvested stands. The type of harvest used will depend on several factors, including tree species, tree age, site quality, rotation length, and economics. Timber thinning not only improves deer habitat, it also can improve growth rates on timber, which can increase future economic returns.

Thinning opens the forest canopy and allows more sunlight to reach the forest floor. The production of deer foods improves as a result.

In general, pine stands usually are more conducive to thinning than hardwood stands. The first thinning of pine stands should occur at 12 to 20 years of age, depending on the site and growth rate of the trees (Yarrow and Yarrow 1999). Stands then should be thinned as needed to keep the trees growing at an adequate rate and to keep the canopy sufficiently open until the end of the stand's rotation. When managing deer habitat, stands should be thinned to a basal area of 60

to 70 square feet per acre (Yarrow and Yarrow 1999). This allows enough sunlight to reach the ground to greatly improve food production in these stands, especially when combined with prescribed fire, herbicide treatment, mowing, and/or discing.

Clearcutting small blocks of trees is another forest management practice that improves deer habitat by opening the forest canopy and creating more plant and habitat diversity. Clearcutting works equally well in hardwood and pine stands. Deer make greatest use of the first 300 feet inside a clearcut (Kammermeyer and Thackston 1995). For this reason, clearcutting for deer habitat improvement should be limited to smaller blocks, usually no more than 40 acres in size. These smaller cuts also create a patchwork of habitat types which increases the amount of habitat diversity. When possible, clearcuts should be linear in shape (long and narrow), with irregular boundaries. This maximizes the amount of edge created by these openings (Kammermeyer and Thackston 1995). Most clearcuts produce a tremendous amount of deer browse during the first four or five years following harvest. Portions of these openings can be maintained in an early stage of succession by using prescribed fire, herbicides, mowing, discing, etc.

FERTILIZATION

Another technique that increases both food production and food quality is fertilization of native plant species. Fertilizer can be applied over very large areas, such as entire stands of timber following thinning, or in smaller areas, such as a patch of a preferred food plant. Either approach can greatly improve the quality and quantity of deer

foods in any area. Fertilizer increases production, as well as protein and nutrient levels of these plants.

In recent years, some forest products companies and larger landowners have begun fertilizing pine stands following thinning to increase the rate of growth of the trees. The fertilizer is usually applied aerially by helicopter. An added benefit of this fertilization is its effects on the deer foods found in these stands. Highly preferred food plants, such as Japanese honeysuckle and greenbriar, respond to the fertilizer with increased productivity and higher protein levels. This process is expensive, but if it can be incorporated into a timber management plan, its benefits to deer can be tremendous.

A more economical way to benefit from fertilizing naturally occurring deer foods is to apply the fertilizer on a smaller scale. For example, studies have shown productivity and nutrient content of Japanese honeysuckle, a highly preferred deer browse plant, can be significantly improved by periodically applying fertilizer during the growing season. In a study conducted by Auburn University researchers, protein levels in honeysuckle were increased

Applying lime and fertilizer to naturally occurring browse plants, such as Japanese honeysuckle, can greatly improve the plant's productivity and palatability.

from 11 percent to 17 percent following fertilization (Stribling 1994a). Other plants, such as greenbriar, should respond similarly to fertilization.

Lime and fertilizer should be applied during the growing season. The first application should be right at the beginning of spring green-up (late-March or early-April) and should consist of 400 pounds per acre of 13-13-13 and enough lime to bring the soil pH to the 6.5 to 7.0 range. A follow-up application of 100 pounds per acre of ammonium nitrate should be applied about two months later (Stribling 1994a).

When identifying areas to be fertilized, look for patches that receive adequate amounts of sunlight and areas large enough to handle the additional browsing the fertilizer will attract. Deer feed heavily on these fertilized areas and sometimes use them almost to the point of ignoring the unfertilized patches. It is best to fertilize several patches throughout the property to reduce the chances of overbrowsing any one area.

Other plants that should respond favorably to fertilization are mast producing trees, vines, and shrubs. It is reasonable to believe fertilizing oaks, persimmon trees, grape vines, and other mast producers prior to flowering each year should increase the number of flowers produced. If more flowers are produced, there is a potential for more fruit production later in the year. At the very least, an annual application of fertilizer should make these plants more vigorous and healthy, which should improve fruit production in future years.

WILDLIFE OPENINGS

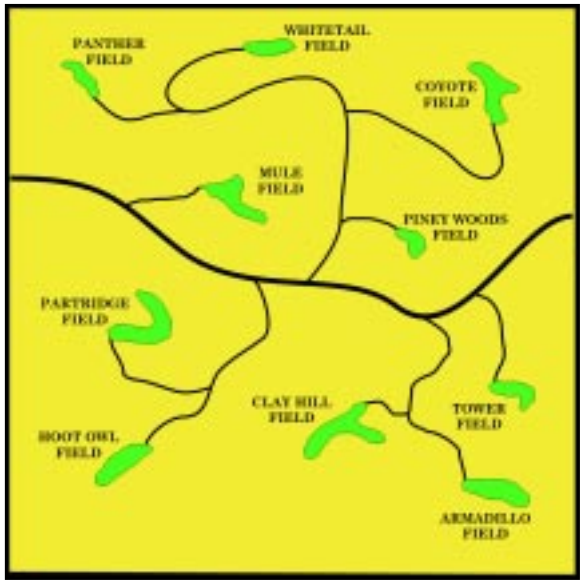
Of all the management practices available for improving white-tailed deer habitat, none is more popular in Alabama than planting agricultural crops in wildlife openings or food plots. Millions of dollars are spent on growing agricultural crops solely for the purpose of feeding deer. Most of these crops are planted to increase harvest and viewing opportunities. Others are planted in an effort to improve the quality of food available to the local deer herd. Regardless of the purpose of the plantings, always remember no single crop is the "silver bullet" to solve all deer management problems. If done properly, planted wildlife openings can be an integral part of an overall deer management plan and can potentially improve the quality of habitat on the property being managed.

The most popular habitat improvement tool used by Alabama deer hunters is planted wildlife openings.

Location and Size

The first things to decide before planting is where to plant and how much to plant. On many properties, the options are limited. Small

log-loading decks, turn-arounds on dead end roads, or utility company rights-of-way may be the only options. In cases where space is limited, it is best to plant all possible areas in the fall. These small openings usually will not provide much food for the deer, but they greatly improve the chances of reaching established harvest quotas.



Ideally, wildlife openings are irregularly shaped and evenly distributed across a property.

If the number and location of openings are not limiting, then plantings should be well dispersed over the entire property. Planted openings should be located away from public roads and property lines. This will lessen the chances of poaching in these areas. It also will reduce the number of confrontations with neighbors who like to hunt on the property line. Openings also should be irregularly shaped where practical. These irregularly shaped openings have more edge than a square or circular opening of the same size. Since deer tend to feed close to the edge of a field, the irregularly shaped openings should get more use (Griffin and Jacobson 1994).

A typical winter in Alabama is very wet. For this reason, openings planted with cool-season crops need to be located in well-drained

areas. Very few of the crops commonly planted in the fall for deer can survive several days of flooding. Flooding also makes these openings useless for hunting. Upland sites usually are great locations for fall and winter plantings.

On the other hand, summers can be very dry in Alabama. Openings planted during the spring and summer should be located on sites that will retain some soil moisture, even during the dry times. Upland sites should be avoided during this time because they are generally the driest areas during the summer.

Another factor that will determine the size and number of wildlife openings is the purpose of the plantings. Openings planted solely to attract deer during hunting season do not have to be numerous or big. Under the right situation, a one-half acre opening placed in the right location works great. If the purpose of the plantings is to provide a supplemental food source for the deer, then larger, more numerous openings usually are better. To get the most out of the plantings, at least two to three percent of the total acreage should be planted with high-quality crops. For example, a 2,000-acre property should have a minimum of 40 acres of planted wildlife openings. Even one percent or less of an area planted in high-quality crops improves deer diets and enhances reproduction, growth, antler development (Johnson et al. 1987, Vanderhoof and Jacobson 1989), and harvest (Kammermeyer and Moser 1990).

As a rule, most wildlife openings planted during the cool-season should be one to three acres. Crops typically planted during the cooler months can handle a substantial amount of grazing pressure. A

two-acre plot planted with these crops can produce a great deal of forage during the fall and winter months.

Most warm-season crops cannot handle as much grazing pressure as the cool-season plants. For this reason, wildlife openings planted with warm season crops need to be larger than most cool-season fields. To produce adequate amounts of food, warm-season openings should be at least five acres. Smaller openings can be planted, but the length of time they are productive generally is not very long.

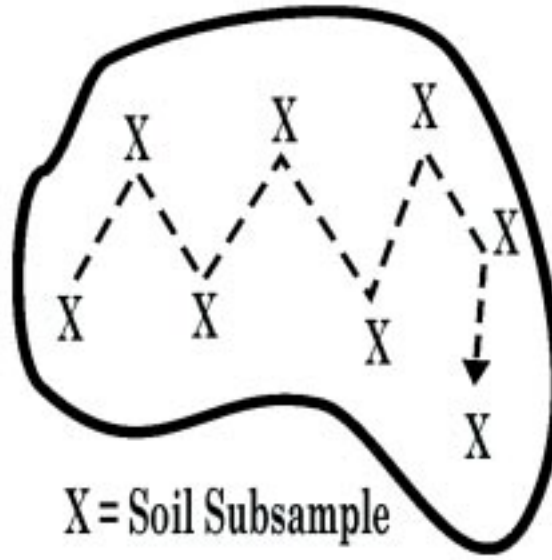
As with anything, the final determining factor on quantities to be planted is available time and money. If time and/or money are not limiting, plant as much as practical with the most productive plants available. If time and/or money are limiting, decide which openings will produce best and plant these with highly productive, highly nutritious crops. The benefits may not be as substantial as when time and money are not limiting, but even a few small openings are better than none at all.

Soil Testing

Once the locations of the wildlife openings are established, soil samples should be taken from each area to be planted and sent to a soil testing lab for analysis. A soil test will determine how much lime and fertilizer should be applied for a specific crop. Soil tests should be conducted at least every two years. Tremendous amounts of nutrients are removed from the soil each year by the growing plants and by leaching due to rain.

Taking soil samples is a fairly easy task. The only materials needed are a shovel or soil probe, a clean bucket, and boxes to ship the

samples. These boxes are usually available at no cost from the county extension office or most feed and seed stores. A sample should be taken from the top six inches of soil in each opening to be planted. This is the region where the roots of the crops will be growing. The sample should be free of grass and other vegetation. This added material will throw off the test results. The sample should be taken with the shovel or soil probe. On small openings (one-half acre), it is okay to take the sample from one spot in the field. On larger openings (one acre or larger), taking only one sample may not be adequate. Soil types and fertility can vary from one end of the field to the other. Taking only one sample can often give inaccurate test results.



The diagram above shows how soil samples should be taken from larger fields. The subsamples (X) are mixed together and one sample is taken from the combined subsamples. This sample is submitted to the soil testing lab.

To make sure the lime and fertilizer recommendations are accurate for the larger fields, several subsamples should be taken from many locations in the field. These subsamples should be mixed together in a clean bucket and one sample from the entire field should then be taken from these mixed subsamples. On fields three acres or larger,

two or three samples may be needed to get an accurate report from the soil testing lab.

The soil sample should then be placed in a box to be shipped to the testing lab. The box should be labeled with the name of the field and the crop to be planted. If more than one field is tested and their locations or names are not written on the boxes, it will be impossible to match test results with the source field. Different crops have different pH and nutrient requirements. Make sure the crops to be planted are indicated on the box so the lab can make the correct recommendations

Most soil testing labs charge a small fee (<$10) for their services, but some of the larger feed and seed stores provide free soil tests to their customers. Regardless of the cost, taking soil samples and getting soil tests for each field are two of the most cost efficient things that can be done prior to planting. Knowing exactly how much lime and fertilizer to apply will maximize the productivity of each field, which saves money in the long run.

Lime and Fertilizer

Once the soil test results are received, it may be necessary to get some assistance with interpreting the recommendations. Most test results will give recommendations as tons of lime per acre and pounds of nitrogen (N), phosphorous (P), and potassium (K) per acre. Other secondary nutrients required by the crop to be planted also will be indicated on the test results and will be expressed in pounds per acre. For many people, the confusion comes from the recommendations and the way fertilizers are labeled. Commercial fertilizers are labeled to indicate the percentage of nitrogen, phosphorous, and potassium in each

bag of fertilizer, while soil test results give recommendations as pounds per acre. For example, if a soil test recommends 20 pounds of nitrogen, 60 pounds of phosphorous, and 60 pounds of potassium, an application of 500 lbs. of 4-12-12 fertilizer per acre is needed to provide the recommended amounts of N, P, and K. Assistance with test result

Soil Acidity	Nitrogen Wasted	Phosphate Wasted	Potash Wasted
Extremely Acid 4.5 pH	70%	77%	67%
Very Strong Acid 5.0 pH	47%	66%	48%
Strongly Acid 5.5 pH	23%	52%	23%
Medium Acid 6.0 pH	11%	48%	0%
Neutral 7.0 pH	0%	0%	0%

This table shows how much fertilizer is wasted at different pH levels. Very little fertilizer is utilized in extremely acid soils, but as soil acidity decreases, efficiency goes up.

interpretation can be found at farmers' co-ops and most seed and fertilizer dealers.

To get the most production from a crop, it is very important the lime and fertilizer recommendations be followed exactly. Skimping on lime and fertilizer will result in wasted money and crops that do not produce to their potential. Of the two, the most benefit will be gained from adding the recommended amount of lime and raising the soil pH

to the recommended level. Having the soil pH in the optimum 6.5 to 7.0 range enables plants to utilize a much larger percentage of the available soil nutrients than when the soil pH is more acidic or basic. To allow lime adequate time to correct the soil pH, it should be applied well in advance of planting. Applying the lime three to six months in advance will give it time to affect the soil's chemistry. Since the amount of lime needed usually amounts to several tons per field, it is best to have the lime applied with a spreader truck or with a spreader buggy pulled behind a tractor. Distributing lime with a normal seed/fertilizer spreader on a farm tractor may be necessary on some fields, but this method can be very labor intensive. The lime can be applied to either plowed or unplowed fields, but plowing it in will enable it to work faster.

Fertilizer can be applied at the time of planting. Fertilizer can easily be applied with a spin-type seed/fertilizer spreader or a spreader buggy. Using the smaller spin-type spreader allows better control of fertilizer distribution than the buggy and generally works best on average-sized wildlife openings.

Fertilizer should be plowed into the soil before the seed is applied. Some components of fertilizer, for example phosphorous, are not mobile in the soil. They need to be distributed in the root region of the soil (the top 4 to 6 inches) to improve utilization by the plants. Leaving the fertilizer on the soil surface will place most of these immobile components out of the reach of the plant roots. Plowing too deep also will put much of the fertilizer out of the plant's reach.

Applying the Seed

Seed should be applied to a well-prepared seedbed to help ensure the seed have good soil contact and are covered to a uniform depth. Using a culti-packer or drag on a plowed field prior to applying seed helps create a smooth, firm seedbed. Seed can be applied with a handheld spreader, large capacity seed/fertilizer spin spreader, or a grain drill. It is important to distribute the seed uniformly across the field. If a handheld spreader or larger spin spreader is used, it will be necessary to cover the seed. Seed can be covered using a drag, a culti-packer, or by lightly discing. It is important not to cover the seed too deep. Covering seed too deep will keep most of the plants from ever emerging from the soil. Larger seed, such as wheat or soybeans, should be covered no more than 1/2 to 1 inch. Smaller seed, such as clovers, should be covered no more than 1/4 to 1/2 inch.

What to Plant

The growing interest in deer management and the increased awareness of the nutritional requirements of deer has given rise to a tremendous assortment of crop seed and seed mixes developed solely for white-tailed deer. Just as the decision of size and number of openings depends on the purpose of the plantings, the decision of what species to plant also depends on the purpose of the plantings. If the main purpose is to attract deer for harvest, planting small grains, such as wheat, oats, or rye, will work fine. These crops grow well during hunting season and are readily eaten by white-tailed deer. Unfortunately, their productivity and palatability decline rapidly in late winter and early spring, which is a time when naturally occurring foods are scarce.

High protein foods are essential for large antlers, large bodies, and healthy fawns. Photos by Jeff Shaw.

If crops are planted to improve the nutrition level of the local deer herd, then crops with a high protein level and a long growing period should be used. These plants also should be the most nutritious and palatable at the times when deer need them most. In Alabama, the two most stressful periods for white-tailed deer are late winter/early spring and late summer/early fall. Food levels are at their lowest point during these times.

Deer also need highly nutritious food during late spring and summer. Does are pregnant and raising fawns, and bucks are growing antlers at this time. To maximize fawn and antler production, these deer need highly nutritious, high-protein foods. Supplementing the native foods with agricultural plantings during these times can help deer reach their potential.

The wide array of available seed varieties can make it difficult to decide the best thing to plant for white-tailed deer. New varieties appear on the market each year, making the decision even more diffi-

cult. Many of these new crops show promise as deer forages. They are highly nutritious and highly palatable, and many can grow on a wide variety of sites. Unfortunately, many of these new crops are expensive, which is a major drawback for most hunting clubs and landowners. Still others do not produce as advertised. Luckily, there are several crops used by wildlife managers for years that are consistent producers of high quality forage.

It is best to plant a combination of seeds in wildlife openings. This applies to both warm-season and cool-season crops. Planting a combination helps minimize the chances of total crop failure due to drought, poor seed, pests, diseases, or any of a number of other problems (Koerth and Kroll 1994). Ideally, the various plants in the combination will mature at different rates and extend the period of productivity for most wildlife openings (Koerth and Kroll 1994). Using combinations also can reduce grazing pressure on certain crops until they become established.

For cool-season wildlife openings, the most frequently planted combinations include various small grains and clovers. Other crops such as vetch, Austrian winter pea, and broadleaf crops in the Brassica family (rape, kale, turnips, etc.) also can be used. These combinations are planted in the fall and most will remain productive until late spring/early summer. An assortment of crops gives the deer manager many options for planting cool-season openings. One of the best combinations for an annual cool-season wildlife opening in Alabama includes wheat (one bushel per acre), oats (one bushel per acre), crimson clover (eight pounds per acre), and arrowleaf clover (four pounds per acre). This seed combination works in a wide variety of soil types. If planted

Using clovers, such as crimson (top left), arrowleaf (top right), red (bottom left), and ladino (bottom right), in combination with other cool-season crops can extend the productivity of winter food plots well into the following spring and summer.

in late-September or early-October, this mixture will remain productive and palatable from November through June. Red clover (five pounds per acre) can be substituted for arrowleaf clover on more fertile sites. Using red clover can extend the productivity of a fall food plot well into late summer (August) in years with adequate rainfall.

A popular perennial clover mix that can be planted in the fall includes ladino clover (six pounds per acre), red clover (ten pounds per

acre), and wheat (one bushel per acre). This combination provides high quality forage all the way though the summer months. If properly planted and maintained, ladino clover is a nutritious food source during most of the year and can persist indefinitely. Planting dates and seeding rates for other commonly planted cool-season forages are found in **APPENDIX 9, pages 157-164**.

Many of the commonly grown warm-season crops can be more difficult to grow than most of the commonly grown cool-season crops. This primarily is due to problems with competition from weeds and grasses, as well as insect pests. Another potential problem with warm-season crops is most cannot handle heavy grazing pressure as well as the clovers and small grains commonly planted in the fall. This requires planting larger fields to prevent overgrazing of the crops. The positive attributes of most warm-season crops (e.g., soybeans, lablab, cowpeas, alyce clover, American jointvetch, etc.) are their palatability and high protein content. Consequently, these crops make excellent supplemental food sources for the all important summer months, when both fawns and antlers are rapidly developing.

Most warm-season crops, such as lablab, are very nutritious, but cannot handle heavy grazing pressure in the early stages of development.

Corn often is planted as a warm-season crop, but other crops

are usually better suited for use in deer food plots. Corn is a high-energy food source that can increase body weights of deer. The drawbacks of corn are the expense and difficulty in growing, and a protein level below the level (16 to 18 percent) deer need to achieve optimum antler, skeletal, and muscular development (Kroll 1994). Most use of corn does not occur until after the corn has dried (fall and winter). Better crop choices for warm-season plantings include high-protein legumes, such as soybeans, cowpeas, alyce clover, lablab, and American jointvetch. One of the best combinations to plant during the spring and summer months includes cowpeas (40 to 60 pounds per acre) and alyce clover (10 to 15 pounds per acre; Griffin and Jacobson 1994). Both of these crops are high in protein and make excellent deer forages. These two crops can be planted as a mixture or in separate strips and should be planted in late-spring or early-summer (Griffin and Jacobson 1994). Grain sorghum (5 pounds per acre) also can be planted with these two crops (Kammermeyer and Thackston 1995). Sorghum helps support the cowpea vines and alyce clover stems and keeps deer from overgrazing the cowpeas and alyce clover early in the growing season. Planting dates and seeding rates for other warm-season forages can be found in **APPENDIX 10, pages 165-170**.

Exclosures

Many hunting clubs and landowners have started using wire exclosures or utilization cages in their wildlife openings. These exclosures generally measure about three feet in diameter and four feet in height. They can easily be constructed from a piece of 2" x 4" net wire 10 feet in length. These cages prevent deer and other animals from

using small portions of the openings. By noting the differences in plant height and species composition inside and outside of the cages, hunters can gauge how heavily their crops are being utilized, how much forage is being produced, and which crops are being eaten most heavily. The differences inside and outside of the cages usually are obvious. By using this information, it is possible to fine-tune the crop mixtures that perform best in a particular area. This also allows the utilization and production of new seed varieties to be field tested in one or two openings before being applied on a much larger scale.

A wire exclosure is a valuable tool for monitoring food plot production and utilization.

SUPPLEMENTAL FEEDING

Supplemental feeding of shelled corn, whole soybeans, or some other type of pelleted feed has gained popularity in recent years. These feeds are placed in troughs or spin feeders and are made available to deer outside of the open hunting season. This feed is intended to make up for the shortcomings of the natural browse and agricultural plantings. Deer can be conditioned to feed from these feeders and this additional

food can help deer survive stressful times. If done properly, this practice can be an important part of a deer management program.

Anyone initiating a feeding program on his or her property should do so with caution. To be effective, feed should be available throughout the year in quantities sufficient to increase the carrying capacity of the habitat (Kammermeyer and Thackston 1995). Providing this much feed will be extremely expen-

Much of the food provided in troughs or other types of feeders is eaten by non-target wildlife, such as raccoons. This photo shows 25+ raccoons in a trough filled with soybeans and corn intended for deer. Photo courtesy of Jamie Banks.

sive on most sites, with no guarantees of positive results. A study conducted by Auburn University on two sites in Alabama produced mixed results from supplemental feeding of free-ranging white-tailed deer with soybeans. Kearley and Causey (2001) found does on one site showed measurable weight gains and does on the second area showed measur-

able weight loss at the conclusion of the study. They also found no measurable improvements in antler size from the beginning to the end of the project.

A risk associated with feeding is the potential spread of diseases and/or parasites. Troughs, or even spin feeders, bring many deer in close contact with each other. In these situations, diseases or parasites can be easily transmitted from sick deer to healthy deer. If supplemental feeding is utilized, hunters need to be aware in Alabama it is illegal to hunt deer with the aid of bait. To avoid any problems, feeding should be suspended during hunting season.

Just as planting agricultural crops will not make up for poor herd and habitat management, supplemental feeding is not a cure all for poor management. Proper herd management, as well as management of the natural habitats, should take priority over supplemental feeding. This practice should only be viewed as a management tool to be used in conjunction with other, more important, deer management practices.

MINERAL SUPPLEMENTS

Like all animals, white-tailed deer require a certain amount of a wide array of minerals in their daily diet. In most situations deer are able to get their required doses of these minerals in their normal daily diet (Griffin and Jacobson 1994). Regardless, many deer hunters and managers provide mineral supplements, in block or granular form, to deer on their property. Many do so to try to improve antler size on bucks using their property. Yet, no research shows a positive effect of

Mineral and salt licks are used considerably during spring, summer, and early fall by deer of all ages and sexes, yet no research has shown any measurable improvements in the physical condition of free-ranging deer given mineral supplements.

mineral supplements on antler size of wild, free-ranging white-tailed deer. This makes the use of mineral supplements suspect as an aid to improve deer quality on most areas.

Some things need to be kept in mind if a supplement is used. Mineral supplements should contain less than 35 percent salt to be most effective (Kroll 1994, Griffin and Jacobson 1994). However, most commercial mineral supplements contain 50 percent or more salt by volume (Kroll 1994). Of all the minerals possibly lacking in a deer's diet, the two that appear to be the most important for antler and skeletal development are calcium and phosphorous. To be effective, supplements should contain the right ratio of these two minerals. For whitetails, the proper ratio is two parts calcium for one part phosphorous (Griffin and Jacobson 1994). All supplements should be clearly labeled with a tag showing the percentages of each of the minerals they contain. It is important to read this tag to make sure the supplement contains the right amounts of each of these minerals, as well as other

trace minerals. Another consideration is the form in which the supplement is provided. Deer seem to more readily consume a granular supplement than a block form (Griffin and Jacobson 1994).

As with supplemental feeding, hunters may experience problems hunting near mineral licks. In Alabama, the only legal supplement that can be used during deer hunting season is pure, white salt (NaCl). Mineral licks containing anything other than salt are illegal to hunt near according to Alabama law.

SUMMARY

Many options are available to deer managers interested in improving deer habitat on properties they manage. Habitat is only one part, albeit an extremely important part, of a deer management plan. Each habitat management practice can be beneficial in the right situation, but to be most effective, the techniques should be implemented in conjunction with a sound deer harvest program. Consultation with a professional wildlife biologist is recommended before initiating any intensive habitat management program.

LITERATURE CITED

Baker, R. H. 1984. Origin, Classification, and Distribution. Pages 1-18 *in* L. K. Halls, ed. White-tailed Deer: Ecology and Management. The Wildlife Management Institute, Washington, D.C.

Ball, D. M., C. S. Hoveland, and G. D. Lacefield. 2002. Southern Forages, Third Edition. The Potash and Phosphate Institute and the Foundation for Agronomic Research, Norcross, Georgia. 322 pages.

Brown, R. D. 1985. Water Requirements of White-tailed Deer. Pages 19-26 *in* R. D. Brown, ed. Livestock and Wildlife Management During Drought. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas.

Brown, R. D. 1997. Nutrition and Reproduction of White-tailed Deer. Proceedings of the Second Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 2, Pages 105-113.

Carroll, D. J. and M. K. Causey. 1995. Effects of Early Weaning on Survival and Growth of Captive White-tailed Deer. Annual Meeting of the Southeast Deer Study Group. Volume 18, Pages 31-32.

Caughley, G. 1977. Analysis of Vertebrate Populations. John Wiley and Sons, Inc. New York. 234 pages.

Causey, M. K. 1991. Nutrition Enhances Growth and Antler Development of Alabama White-tailed Deer. Highlights of Agricultural Research. Alabama Agricultural Experiment Station. Volume 38(1), Page 9.

Causey, M. K. 1993. The Effects of Mineral Supplementation on Growth and Antler Development of Alabama White-tailed Deer. Alabama Game and Fish Report. P-R Project W-44, VIII, Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Davidson, W. R. and V. F. Nettles. 1997. Field Manual of Wildlife Diseases in the Southeastern United States, Second Edition. Southeastern Cooperative Disease Study, Athens, Georgia. 417 pages.

Davis, J. R. 1979. The White-tailed Deer in Alabama. Special Report

Number 8. P-R Project W-35, Alabama Department of Conservation and Natural Resources, Montgomery, Alabama. 60 pages.

Demarais, S. 1998. Managing for Antler Production: Understanding the Age – Nutrition – Genetic Interaction. Proceedings of the Role of Genetics in White-tailed Deer Management Symposium, Texas A&M University, College Station, Texas. Volume 1, Pages 33-36.

DeMarais, S. and B. Strickland. 1999. Buck Movements and Mortality: Limitations in Deer Management Programs. Proceedings of the Fourth Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 4, Pages 9-18.

Downing, R. L. and B. S. McGinnes. 1976. Movement Patterns of White-tailed Deer in a Virginia Enclosure. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners. Volume 29, Pages 454-459.

Downing, R. L., and D. C. Guynn, Jr. 1985. A Generalized Sustained Yield Table for White-tailed Deer. Pages 95-104 *in* S. L. Beasom and S. F. Robertson, eds. Game Harvest Management. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas.

Gee, K. L., J. H. Holman, M. K. Causey, A. N. Rossi, and J. B. Armstrong. 2002. Aging White-tailed Deer by Tooth Replacement and Wear: A Critical Evaluation of a Time-honored Technique. Wildlife Society Bulletin. Volume 30, Pages 387-393.

Gray, W. N., S. S. Ditchkoff, M. K. Causey, and C. W. Cook. 2002. The Yearling Disadvantage in Alabama Deer: Effect of Birth Date on Development. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners. Volume 56 (In Press).

Griffin, B. and H. Jacobson. 1994. Food Plantings for Deer in Mississippi. Mississippi Department of Wildlife, Fisheries, and Parks, Jackson, Mississippi. 16 pages.

Hamlin, K. L., D. F. Pac, C. A. Sime, R. M. DeSimone, and G. L. Dusek. 2000. Evaluating the Accuracy of Ages Obtained by Two Methods for Montana Ungulates. Journal of Wildlife Management. Volume 64, Pages

441-449.

Harmel, D. E. 1982. Effect of Genetics on Antler Quality and Body Size in White-tailed Deer. Pages 339-348 *in* R. D. Brown, ed. Antler Development in Cervidae. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas.

Harmel, D. E., W. E. Armstrong, E. R. Fuchs, E. L. Young, and K. D. McGinty. 1998. The Kerr Area Penned Deer Research Facility. Proceedings of the Role of Genetics in White-tailed Deer Management Symposium, Texas A&M University, College Station, Texas. Volume 1, Pages 40-45.

Hamilton, J., W. M. Knox, and D. C. Guynn, Jr. 1995. How Quality Deer Management Works. Pages 7-18 *in* K. V. Miller and R. L. Marchinton eds. Quality Whitetails: The Why and How of Quality Deer Management. Stackpole Books, Mechanicsburg, Pennsylvania.

Hickie, P. 1937. Four Deer Produce 160 in Six Seasons. Michigan Conservation. Volume 7, Pages 6-7, 11.

Hirth, D. H. 1973. Social Behavior of White-tailed Deer in Relation to Habitat. Wildlife Monographs. Volume 53, Pages 1-55.

Holzenbein, S. and R. L. Marchinton. 1992. Emigration and Mortality in Orphaned Male White-tailed Deer. Journal of Wildlife Management. Volume 56, Pages 147-153.

Jacobs, G. H., J. F. Deegan II, J. Nietz, B. P. Murphy, K. V. Miller, and R. L. Marchinton. 1994. Electrophysiological Measurements of Spectral Mechanisms in the Retinas of Two Cervids: White-tailed Deer (*Odocoileus virginianus*) and Fallow Deer (*Dama dama*). Journal of Comparative Physiology. Volume A, Pages 551-557.

Jacobson, H. A. 1996. Feeding Periodicity of White-tailed Deer in Mississippi. Annual Meeting of the Southeast Deer Study Group. Volume 19, Page 19.

Jacobson, H. A. 1997. Genetics and Antlers. Proceedings of the Second Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation,

Tuscaloosa, Alabama. Volume 2, Pages 16-20.

Jacobson, H. A. 1998. Culling as a Management Practice for White-tailed Deer: The Dark Side. Proceedings of the Role of Genetics in White-tailed Deer Management Symposium, Texas A&M University, College Station, Texas. Volume 1, Pages 80-82.

Jacobson, H. A. and R. J. Reiner. 1989. Estimating Age of White-tailed Deer: Tooth Wear Versus Cementum Annuli. Proceedings of the Annual Conference of Southeastern Fish and Wildlife Agencies. Volume 43, Pages 286-291.

Jacobson, H. A. and S. D. Lukefahr. 1998. Genetics Research on Captive White-tailed Deer at Mississippi State University. Proceedings of the Role of Genetics in White-tailed Deer Management Symposium, Texas A&M University, College Station, Texas. Volume 1, Pages 46-55.

Johnson, M. K., B. W. Delaney, S. P. Lynch, J. A. Zeno, S. R. Schultz, T. W. Kegan, and B. D. Nelson. 1987. Effects of Cool-Season Agronomic Forages on White-tailed Deer. Wildlife Society Bulletin. Volume 15, Pages 330-339.

Kammermeyer, K. E. and R. L. Marchinton. 1976. Notes on Dispersal of White-tailed Deer. Journal of Mammalogy. Volume 57, Pages 776-778.

Kammermeyer, K. E. and E. B. Moser. 1990. The Effects of Food Plots, Roads, and Other Variables on Deer Harvest in Northeastern Georgia. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners. Volume 44, Pages 364-373.

Kammermeyer, K. E. and R. Thackston. 1995. Habitat Management and Supplemental Feeding. Pages 129-154 *in* K. V. Miller and R. L. Marchinton, eds. Quality Whitetails: The Why and How of Quality Deer Management. Stackpole Books, Mechanicsburg, Pennsylvania.

Kearley, M. A. and M. K. Causey. 2001. Supplemental Feeding of Free-Ranging White-tailed Deer With Soybeans. P-R Project W-44, Study 26. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. 66 pages.

Koerth, B. H. and J. C. Kroll. 1994. The Southern Food Plot Manual. Institute for White-tailed Deer Management and Research, Nacogdoches, Texas. 132 pages.

Kroll, J. C. 1994. A Practical Guide to Producing and Harvesting White-tailed Deer. Stephen F. Austin Sate University Press, Nacogdoches, Texas. 590 pages.

McDonald, J. S. and K. V. Miller. 1993. A History of White-tailed Deer Restocking in the United States 1878 to 1992. Research Publication 93-1. The Quality Deer Management Association, Watkinsville, Georgia. 109 pages.

Miller, K. V. 1997. What Do We Know About Deer Scent Communication? Proceedings of the Second Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 2, Pages 36-42.

Miller, K. V., K. E. Kammermeyer, R. L. Marchinton, and E. B. Moser. 1987. Population and Habitat Influences on Antler Rubbing in White-tailed Deer. Journal of Wildlife Management. Volume 51, Pages 62-66.

Miller, K. V., R. L. Marchinton, and J. J. Ozoga. 1995. Deer Sociobiology. Pages 118-128 *in* K. V. Miller and R. L. Marchinton, eds., Quality Whitetails – The Why and How of Quality Deer Management. Stackpole Books, Mechanicsburg, Pennsylvania.

Miller, K. V., R. L. Marchinton, and T. Atkeson. 1997. How Do Deer Talk? Proceedings of the Second Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 2, Pages 85-89.

Mitchell, C. J. and W. P. Smith. 1991. Reliability of Techniques for Determining Age in Southern White-tailed Deer. Journal of the Tennessee Academy of Science. Volume 66, Pages 117-120.

Ott, J. R., J. T. Baccus, S. W. Roberts, D. E. Harmel, E. Fuchs, W. E. Armstrong. 1998. The Comparative Performance of Spike- and Fork-antlered Yearling White-tailed Deer: The Basis for Selection. Proceed-

ings of the Role of Genetics in White-tailed Deer Management Symposium, Texas A&M University, College Station, Texas. Volume 1, Pages 22-32.

Ozoga, J. J., and L. J. Verme. 1985. Comparative Breeding Behavior and Performance of Yearling vs. Prime Age White-tailed Bucks. Journal of Wildlife Management. Volume 49, Pages 364-372.

Ryel, L. A., L. D. Fay, and R .C. Van Etten. 1961. Validity of Age Determination in Michigan Deer. Michigan Academy of Science, Arts and Letters. Volume 46, Pages 289-316.

Sauer, P. R. 1971 Tooth Sectioning vs. Tooth Wear for Assigning Age to White-tailed Deer. Transactions of the Northeast Fish and Wildlife Conference. Volume 28, Pages 9-20.

Severinghaus, C. W. 1949. Tooth Replacement and Wear as Criteria of Age in White-tailed Deer. Journal of Wildlife Management. Volume 13, Pages 195-216.

Shultz, S. R. and M. K. Johnson. 1992. Effects of Supplemental Mineral Licks on White-tailed Deer. Wildlife Society Bulletin. Volume 20, Pages 303-308.

Soil Conservation Service. 1984. Mississippi Planting Guide. Jackson, Mississippi. 40 pages.

Stewart, D. 1999. Wildlife Food Planting Guide for the Southeast. Publication 2111. Mississippi State University Extension Service, Mississippi State University, Mississippi. 29 pages.

Stribling, H. L. 1991. Cool-season Food Plots for Deer. Circular ANR-592. Alabama Cooperative Extension Service, Auburn University, Alabama. 2 pages.

Stribling, H. L. 1994a. Fertilizing Honeysuckle for Deer. Circular ANR-887. Alabama Cooperative Extension Service, Auburn University, Alabama. 2 pages.

Stribling, H. L. 1994b. Wildlife Planting and Practices. Circular ANR-

485. Alabama Cooperative Extension Service, Auburn University, Alabama. 8 pages.

Van Deelan, T. R., K. M. Hollis, C. Anchor, and D. R. Etter. 2000. Sex Affects Age Determination and Wear of Molariform Teeth in White-tailed Deer. Journal of Wildlife Management. Volume 64, Pages 1076-1083.

Vanderhoof, R. E. and H. A. Jacobson. 1989. Effects of Agronomic Plantings on White-tailed Deer Antler Characteristics. Annual Meeting of the Southeast Deer Study Group. Volume 12, Page 20.

Wood, D. E. and W. N. Gray. 2002. A Five Year Case Study of Quality Deer Management in Russell County, Alabama. Annual Meeting of the Southeast Deer Study Group. Volume 25, Page 19.

Woods, G. R. 1997. Mount Holly – An Example of Sound Deer Management. Proceedings of the Second Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 2, Pages 78-84.

Woods, G. R. 1999a. Introduction to Deer Management. Proceedings of the Fourth Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 4, Pages 1-8.

Woods, G. R. 1999b. Designing a Deer Management Plan. Proceedings of the Fourth Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 4, Pages 116-124.

Woods, G. R. 1999c. A Practical Guide to Food Plots for White-tailed Deer. Proceedings of the Fourth Annual White-tailed Deer Shortcourse, Gulf States Paper Corporation, Tuscaloosa, Alabama. Volume 4, Pages 24-56.

Yarrow, G. K. and D. T. Yarrow. 1999. Managing Wildlife. Sweetwater Press, Birmingham, Alabama. 588 pages.

APPENDICES

Appendix 1: AVERAGE BODY WEIGHT, ANTLER SIZE, AND LACTATION RATES OF DEER IN THE DIFFERENT SOIL REGIONS OF ALABAMA

	Lower Coastal Plain	Upper Coastal Plain	Black Belt Prairies	Major Flood Plains and Terraces
0.5 Year Old Bucks				
Avg. Weight	53	58	56	55
1.5 Year Old Bucks				
Avg. Weight	97	106	101	101
Avg. Points	2.7	3.1	2.7	2.9
Avg. Basal Circumference	1.9	2.1	2.0	2.1
Avg. Main Beam Length	5.3	6.7	5.2	6.3
Avg. Inside Spread	5.7	5.9	6.0	6.1
2.5 Year Old Bucks				
Avg. Weight	127	137	139	137
Avg. Points	5.7	6.2	6.3	6.4
Avg. Basal Circumference	2.9	3.2	3.3	3.3
Avg. Main Beam Length	12.4	13.9	14.0	14.0
Avg. Inside Spread	10.3	11.0	11.3	11.1
3.5+ Year Old Bucks				
Avg. Weight	150	158	162	159
Avg. Points	7.0	7.6	7.4	7.5
Avg. Basal Circumference	3.7	3.9	3.9	3.9
Avg. Main Beam Length	15.9	17.3	17.1	17.3
Avg. Inside Spread	12.9	13.5	13.8	13.7
0.5 Year Old Does				
Avg. Weight	53	56	54	54
1.5 Year Old Does				
Avg. Weight	84	89	88	86
% Lactating	18	17	16	15
2.5 Year Old Does				
Avg. Weight	93	100	99	98
% Lactating	55	56	54	54
3.5+ Year Old Does				
Avg. Weight	99	105	105	104
% Lactating	64	62	64	61

Appendix 1: AVERAGE BODY WEIGHT, ANTLER SIZE, AND LACTATION RATES OF DEER IN THE DIFFERENT SOIL REGIONS OF ALABAMA (continued)

	Piedmont Plateau	Appalachian Plateau	Limestone Valleys and Uplands
0.5 Year Old Bucks			
Avg. Weight	55	56	60
1.5 Year Old Bucks			
Avg. Weight	102	108	116
Avg. Points	3.1	3.2	3.8
Avg. Basal Circumference	2.1	2.2	2.4
Avg. Main Beam Length	6.7	7.5	8.1
Avg. Inside Spread	6.2	6.4	6.7
2.5 Year Old Bucks			
Avg. Weight	131	137	149
Avg. Points	6.2	6.2	6.6
Avg. Basal Circumference	3.1	3.1	3.5
Avg. Main Beam Length	13.5	14.0	14.7
Avg. Inside Spread	10.9	11.4	12.0
3.5+ Year Old Bucks			
Avg. Weight	155	162	167
Avg. Points	7.5	7.7	7.8
Avg. Basal Circumference	3.9	3.9	4.0
Avg. Main Beam Length	16.9	18.0	18.0
Avg. Inside Spread	13.6	14.1	14.7
0.5 Year Old Does			
Avg. Weight	52	52	55
1.5 Year Old Does			
Avg. Weight	85	88	91
% Lactating	14	15	16
2.5 Year Old Does			
Avg. Weight	94	98	103
% Lactating	52	58	56
3.5+ Year Old Does			
Avg. Weight	101	104	106
% Lactating	63	64	66

Appendix 2: DEER HARVEST AND HUNTER NUMBERS IN ALABAMA FROM 1986-87 THROUGH 2001-02

	ESTIMATED NUMBER OF HUNTERS			ESTIMATED HARVEST		
Season	Gun	Archery	Gun and Archery Combined*	Gun	Archery	Gun and Archery Combined*
1986-87	213,471	37,426	215,764	288,487	17,653	300,115
1987-88	219,280	42,023	221,285	309,517	15,683	322,977
1988-89	191,862	44,259	195,032	257,734	18,854	275,032
1989-90	182,080	40,232	186,211	225,077	20,798	242,033
1990-91	193,600	53,200	200,700	263,100	31,300	294,400
1991-92	199,700	58,900	205,200	269,500	25,500	295,000
1992-93	203,300	62,500	211,100	261,500	31,600	293,100
1993-94	204,000	66,300	210,600	305,300	45,200	350,500
1994-95	203,700	58,900	211,200	290,600	40,400	331,000
1995-96	223,700	70,900	229,600	353,000	45,100	398,100
1996-97	217,400	61,100	220,900	334,200	32,600	366,800
1997-98	212,400	64,300	217,300	367,900	55,500	423,400
1998-99	204,800	59,100	210,600	349,000	41,300	390,300
1999-2000	215,300	69,600	221,700	368,500	47,200	415,700
2000-01	213,200	65,700	218,400	435,100	43,600	478,700
2001-02	210,900	55,400	213,400	376,200	34,500	410,700

***Estimates for gun and archery hunters do not sum to the combined estimate because each include hunters participating in both seasons.**

Appendix 3: AGING DEER USING TOOTH REPLACEMENT AND WEAR

For over 5 decades, wildlife biologists have used a technique for aging deer based on tooth wear and replacement. This technique was developed based on jawbones from 26 known-age deer (Severinghaus, 1949). Over the years, some biologists have raised questions about the accuracy of this technique. In fact, all biologists who have evaluated this technique using known-age jawbones were unable to consistently assign accurate ages to deer beyond 2-1/2 years old (Ryel et al. 1961; Sauer, 1971; Jacobson and Reiner, 1989; Mitchell and Smith, 1991; Hamlin et al. 2000; Gee et al. 2002). Additionally, another study noted that buck and doe teeth wear at different rates—this pattern of wear is common among other cervids (Van Deelan et al. 2000).

It is logical to suggest that all deer do not display similar tooth wear rates. Some deer's teeth wear faster than do those of other deer. Soil composition and the type and amount of foods eaten can influence tooth wear. Some deer tend to chew more on one side of their mouth. This aspect of feeding behavior also can influence tooth wear and subsequent attempts to accurately age deer.

There is great reluctance among many in the deer management community to question, let alone abandon, the Severinghaus aging technique. However, the fact remains that this technique cannot reliably assign precise ages to deer older than 2-1/2 years of age. These shortcomings notwithstanding, the tooth wear and replacement aging method remains a valuable tool for discerning between fawns, yearlings, and adult deer. For most deer managers, this technique can be used in conjunction with other physical characteristics in their efforts to ex-

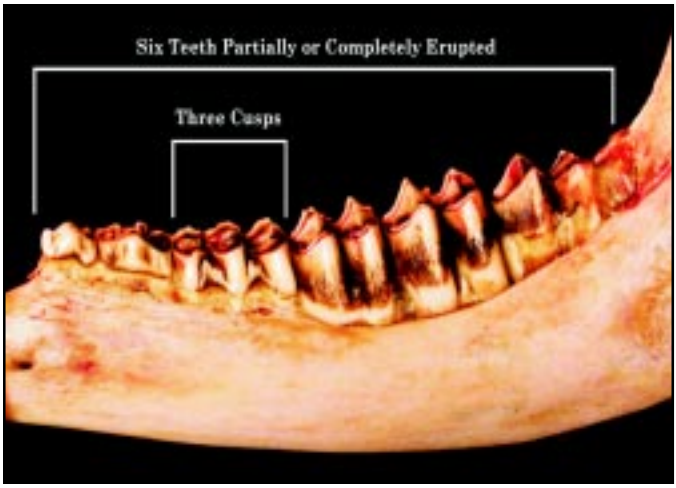
Appendix 3: AGING DEER USING TOOTH REPLACEMENT AND WEAR (continued)

clude from harvest those bucks that are less mature and effectively identify those that are more mature.

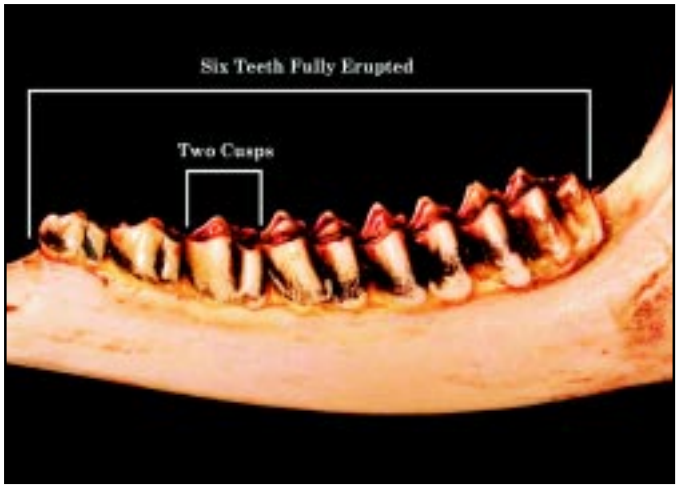
In the following series of photographs, jawbones from fawns, yearlings, and 2-1/2 year old and older deer are easily distinguished. In addition to fawn and yearling jawbones, adult deer jawbones with light, moderate, and heavy wear are shown. Those with heavy to excessive wear are most likely older adults and those with light to moderate wear are most likely younger adults.

FAWN: Jawbone obviously smaller than that of yearlings or adults; five or fewer teeth erupted and third tooth has three cusps.

Appendix 3: AGING DEER USING TOOTH REPLACEMENT AND WEAR (continued)

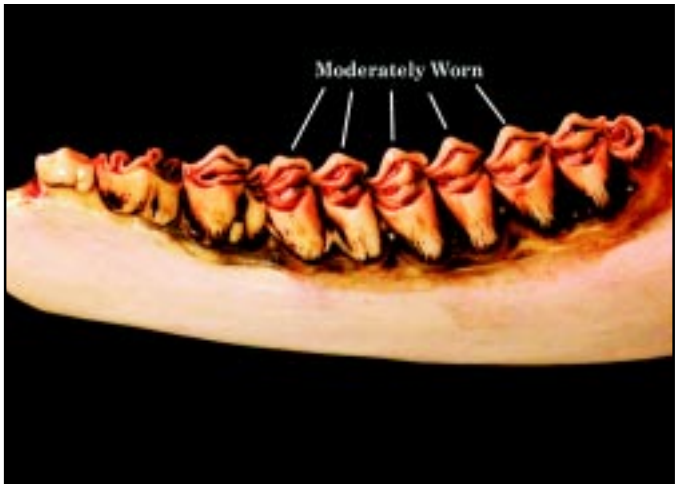


YEARLING (above): Jawbone obviously larger than that of fawns; six teeth erupted with the third tooth having three cusps. Deer is not a fawn, but is not more than 20 months old.

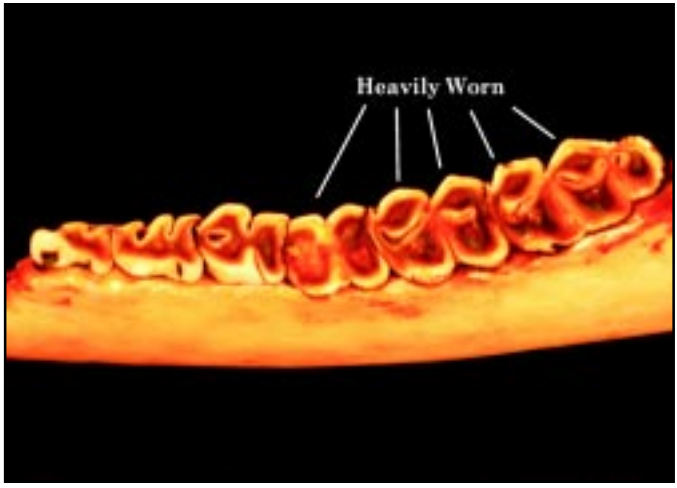


ADULT: Jawbone has six teeth fully erupted with third tooth having only two cusps. Deer is two or more years of age.

Appendix 3: AGING DEER USING TOOTH REPLACEMENT AND WEAR (continued)



YOUNGER ADULT (above): Jawbone has six fully erupted teeth with the third tooth having only two cusps. Jawbone shows light to moderate wear on some or all teeth; may indicate a younger or middle aged adult.



OLDER ADULT: Jawbone has six fully erupted teeth with the third tooth having only two cusps. Jawbone shows heavy to excessive wear on all teeth; may indicate a much older adult.

*Appendix 4: SELECTIVE ANTLERLESS DEER HARVEST**

The best rule of thumb when trying to avoid the harvest of buck fawns is to wait until other deer are present to provide a size comparison. The first deer to arrive at most feeding sites is often a buck fawn.

By paying close attention to head size and shape, separating adult does (left) from fawns is much easier. Adult does have larger, longer faces than fawns.

Appendix 4: SELECTIVE ANTLERLESS DEER HARVEST (continued)*

Head shape is also helpful when trying to distinguish doe fawns (left) from buck fawns. Note the flatter head and developing pedicles on the buck fawn.

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Appendix 5: GUIDELINES FOR AGING LIVE MALE WHITE-TAILED DEER IN ALABAMA

Although antler characteristics are commonly used, hunters can look for certain body size and shape characteristics to more accurately assess age in older bucks.

1-1/2 year old buck

- Resembles doe with antlers
- Does not have swollen neck or muscular characteristics
- Body is thin and lanky and legs look long
- Often enters feeding areas earlier and tend to travel with doe family groups

2-1/2 year old buck

- Typically has a much larger build than a doe
- Still visibly underdeveloped or not "filled-out"
- Limited amount of neck swelling during the rut
- Waist is still thin

Appendix 5: GUIDELINES FOR AGING LIVE MALE WHITE-TAILED DEER IN ALABAMA (continued)

3-1/2 year old buck

- Still a distinct junction between the neck and shoulders
- Thickly muscled neck during the rut
- Chest appears deeper than hindquarters, giving the appearance of a well-conditioned race horse

4-1/2 year old buck

- Have attained almost all of the adult body mass
- Fully muscled neck blends with shoulders
- Waistline is as deep as the chest

Appendix 5: GUIDELINES FOR AGING LIVE MALE WHITE-TAILED DEER IN ALABAMA (continued)

5-1/2+ year old buck

- Fully mature bucks have a very distinct look
- Front half of the body (neck, shoulders, and chest) blends together
- Legs appear shorter than legs of younger bucks because of thicker chest
- Swayed back and sagging belly
- Battle scars (torn ears, scratches, puncture wounds, etc.) are common

Photo credits: 1-1/2 photo by Jeff Shaw; 2-1/2 photo courtesy of Harry Jacobson; 3-1/2, 4-1/2, and 5-1/2+ photos courtesy of Dave Edwards

Type Hunting	Buck Harvest	Doe Harvest
Archery		
Firearms		
Subtotal		
Total		

CLUB NAME: _____

HUNTING SEASON: _____

DEER NUMBER	JAWBONE MARKED	AGE	HARVEST DATE		SEX	WEIGHT		MILK PRESENT	# POINTS	ANTLER MEASUREMENTS				INSIDE SPREAD	COMMENTS/ HUNTER NAME
										CIRCUMFERENCE (inches)		LENGTH (inches)			
			Month	Day	BUCK/ DOE	LIVE	DRESSED	Y/N		LEFT	RIGHT	LEFT	RIGHT	(inches)	
1	✓	3 1/2	11	25	B	176			8	3 3/4	4 1/8	18 1/2	19	15 5/8	F. BROWN
2	✓	2 1/2	12	1	D		91	Y							J. SMITH
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															

DEER SIGHTINGS AND OBSERVATIONS

Date	**Hours Hunted**	**Does**	**Fawns**	**Bucks** (Spiked/Forked)	**Age/Sex Unknown**	**Remarks** (hunter name, weather, stand hunted, etc.)
11/25	5:45 am - 10:00 am	3	2	2 / 3	4	J. Jones - mid 40's, NW wind - Creek Stand
				/		
				/		
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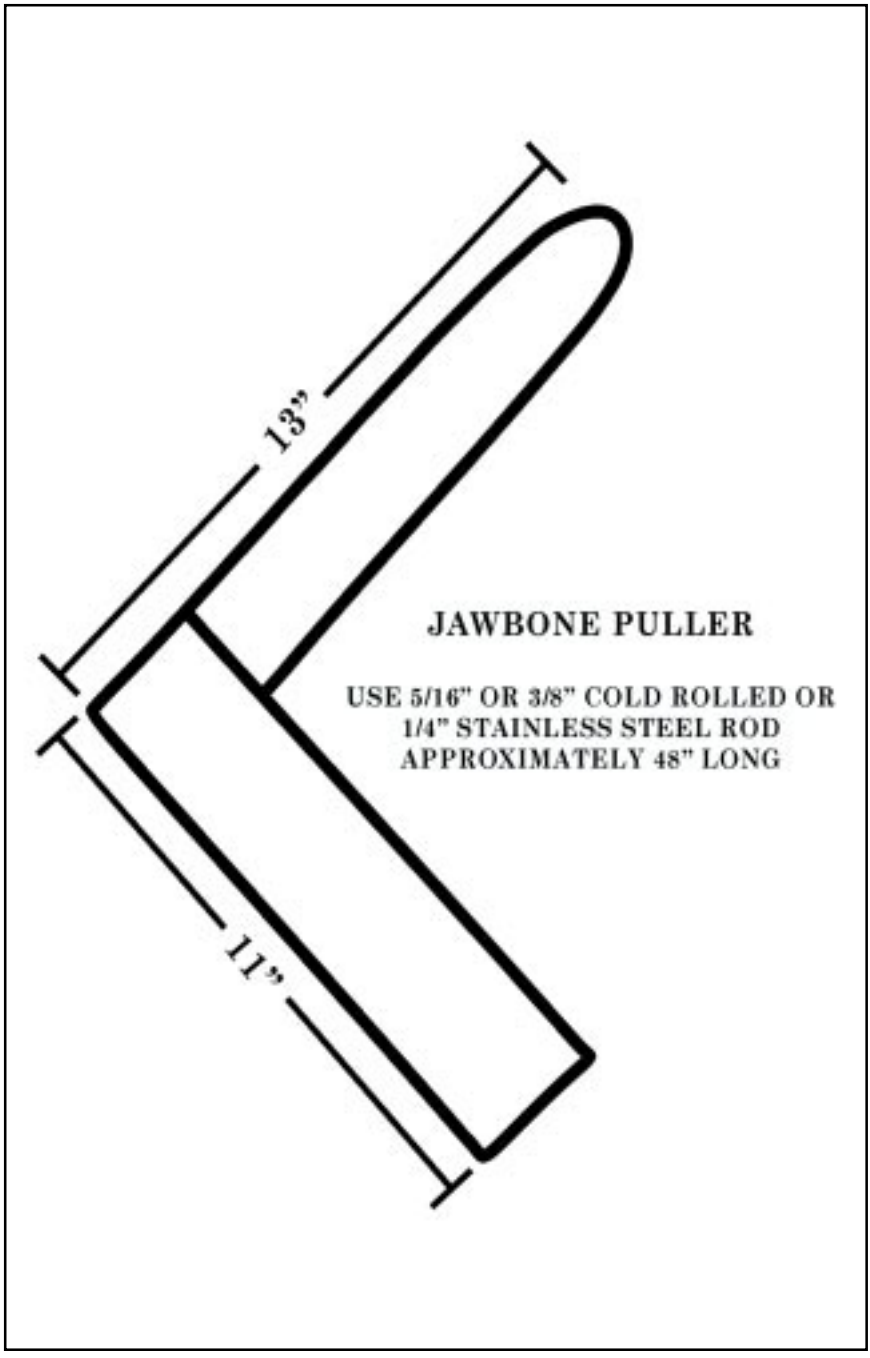
				/		

Appendix 8: TEMPLATE FOR JAWBONE PULLER



Appendix 9: COOL-SEASON PLANTING GUIDE

ALFALFA

Planting Date: September 1 - October 15

Seeding Rate[a]: 18-20 pounds per acre (broadcasted), 14-16 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Alfalfa produces high-quality, highly preferred forage for deer from mid-spring until mid-fall. Alfalfa requires a well-prepared, firm seedbed and usually requires quite a bit of maintenance (insect and weed control). It should always be planted alone. Common varieties include Apollo, Vanguard, and Florida 77.

ARROWLEAF CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 8-15 pounds per acre (broadcasted), 8-10 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: This clover does well in a wide variety of soils, but does best on fertile, well-drained sites. Arrowleaf clover provides good forage production from late winter (February) until early summer (June). It does well when planted with small grains such as wheat or oats. Varieties include Yuchi, Meechee, Amclo, and Chief.

AUSTRIAN WINTER PEA

Planting Date: September 1 - November 1

Seeding Rate[a]: 40-60 pounds per acre (broadcasted), 30-40 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Austrian winter peas provide excellent fall, winter, and early spring deer forage. They can be easily overgrazed. Winter peas do well in well-drained sites, but can tolerate soils that may be too wet for most clovers and small grains. They do well when planted in combination with small grains (wheat, oats, rye).

BALL CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 4-5 pounds per acre (broadcasted), 3-4 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Ball clover is not productive over as long a period as most other clovers. Peak production only lasts for a short time during early spring (late March to April). This clover is adapted to a wide variety of soils and can grow on sites not suited for other clovers.

BERSEEM CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 18-20 pounds per acre (broadcasted), 12-16 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Berseem clover is not very tolerant of freezing conditions. This clover is tolerant of alkaline soils and is more tolerant of wet soils than most annual crops. Berseem clover is well-suited for non-acid Black Belt soils and high rainfall areas near the coast. Cold hardy varieties produce hard seed and will often reseed the following fall.

CRIMSON CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 20-30 pounds per acre (broadcasted), 15-20 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Crimson clover is an excellent forage producer during the winter and early spring. It can grow in a variety of sites and tolerates acid soils better than many other clovers. It does best on well-drained soils. Crimson clover initiates growth earlier in the fall than other clovers and also seeds out sooner than most other clovers. This makes it an excellent plant to include in combinations of small grains and clovers having peak forage productivity in late spring and early summer. Varieties include AU Robin, AU Sunrise, Chief, Dixie, and Tibbee.

CHICORY

Planting Date: August 15 - November 1

Seeding Rate[a]: 5-6 pounds per acre (broadcasted), 5-6 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: This perennial herb is a member of the lettuce family. Chicory is currently found in several deer plot seed mixtures. Although planted in the fall, chicory does not begin rapid growth until spring and will continue producing until late summer. This plant can last for up to three years.

LADINO OR WHITE CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 4-6 pounds per acre (broadcasted), 3-4 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Ladino or white clover is a highly preferred and nutritious deer forage. It is initially slow growing in the fall, but will produce abundant forage from late winter until early- to mid-summer. Ladino is somewhat tolerant of wetter soils and dry weather, but does not do well on droughty soils. Once established, ladino clover stands can persist for several years on good sites if weed and grass competition is controlled. Control can be accomplished using mowing or treatment with herbicides. Ladino clover does well when planted with small grains (wheat, oats, rye). The two most commonly planted varieties are Osceola (best for sandy soils) and Regal (fairly drought tolerant).

OATS

Planting Date: September 1 - November 1

Seeding Rate[a]: 80-100 pounds per acre (broadcasted), 60-80 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Oats are one of the most popular plantings for cool-season deer plots in the Southeast. Oats do well on most well-drained sites, but are not tolerant of poorly drained or sandy soils. Most varieties of oats are not as cold hardy as wheat or rye. Oats do well in combinations with other small grains and clovers.

RAPE

Planting Date: August 15 - November 1

Seeding Rate[a]: 10-12 pounds per acre (broadcasted), 8-10 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Rape is a warm-season, high protein perennial that closely resembles turnips. Rape can be planted as a warm-season crop or early cool-season crop. It can produce a large amount of forage due to its broadleaf growth form. Rape does well on damp sites. The variety most commonly planted for deer is Dwarf Essex. Many other varieties can be found in several deer plot seed mixtures.

RED CLOVER

Planting Date: September 1 - November 15

Seeding Rate[a]: 12-15 pounds per acre (broadcasted), 6-8 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Red clover is an excellent deer forage with a very long growing season. This clover remains productive throughout most of the spring and summer, and in cooler regions, can last until early October. In areas where it is well adapted, red clover may be the most productive of all the clover species. This clover does best when planted on fertile, well-drained sites. Red clover is moderately drought resistant. It does best when planted alone, but can be planted with small grains (wheat, oats, rye). Commonly planted varieties include Redland II & III, Kenland, and Cherokee.

RYE

Planting Date: September 1 - November 1

Seeding Rate[a]: 80-115 pounds per acre (broadcasted), 45-75 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Rye is a commonly used component of many cool-season food plots. It is best suited to well-drained soils, including sandy sites, and is not as tolerant of wet sites as wheat. Of the cereal grains, rye is the most drought tolerant. Rye also is more cold hardy than oats. It does well when planted in combination with other small grains and clovers.

RYEGRASS

Planting Date: September 1 - November 1

Seeding Rate[a]: 40-60 pounds per acre (broadcasted), 30-40 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Ryegrass is moderately preferred by deer and will not receive much use in areas where more palatable food is available. It will grow on most sites and poorly prepared seedbeds. Ryegrass will reseed and plots can be maintained by disking and fertilizing in the fall. Additional seed may need to be applied to get thick stands. Ryegrass can be planted with a variety of other plants, including small grains and clovers, but will usually form dense stands that can adversely affect the other crops, especially clovers. There are many better choices for fall food plots.

SUBTERRANEAN CLOVER

Planting Date: September 1 - November 1

Seeding Rate[a]: 10-20 pounds per acre (broadcasted), 8-10 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Like nearly all clovers, subterranean clover is a nutritious forage that is readily consumed by deer. This species of clover reaches peak productivity in late winter and early spring, and reaches maturity before the summer stress period. Subterranean clover does best in open areas, but it is more tolerant of shade than most clovers. This clover is a good choice for seeding logging roads and under thinned timber stands. It is best suited for well-drained sites. Subterranean clover can be planted with other clovers and small grains. Varieties include Mt. Barker, Meterora, Woogenellup, Nangech, and Tallarook.

TRITICALE

Planting Date: September 1 - November 1

Seeding Rate[a]: 90-120 pounds per acre (broadcasted), 50-80 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Triticale is a hybrid between rye and wheat. Some possible advantages triticale has over wheat or rye are that it often does better in colder climates and on less fertile areas. This grain can be used in combinations much the same as wheat, oats, or rye.

VETCH (BIGFLOWER, COMMON, HAIRY)

Planting Date: September 1 - November 1

Seeding Rate[a]: 25-40 pounds per acre (broadcasted), 15-25 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Vetch is most productive from late winter (February) until late spring (May). Vetch does best in well-drained, medium textured soils. It is not extremely tolerant of heavy grazing, especially when plants are less than 6 inches tall. Vetch can be planted with small grains and clovers. Reseeding can be encouraged by disking in February every third year. Bigflower vetch is usually more preferred by deer than either hairy or common vetch.

WHEAT

Planting Date: September 1 - November 1

Seeding Rate[a]: 90-120 pounds per acre (broadcasted), 50-80 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Of the small grains, wheat is probably the most commonly planted for cool-season deer plots. Wheat does well in a variety of sites, including fairly wet soils, and is readily consumed by deer. Like rye, it also is more cold hardy than oats. Wheat begins growth early in the fall so it is an excellent choice for including in mixtures with later growing clovers, such as arrowleaf, crimson, red, and ladino.

Information taken from Ball et al. 2002, Griffin and Jacobson 1994, Kammermeyer and Thackston 1995, Koerth and Kroll 1994, SCS 1984, Stewart 1999, Stribling 1991, Stribling 1994b, and Woods 1999c.

[a]All seeding rates are for planting a single plant species. If planting in combination with other species, reduce seeding rates by 1/2 to 2/3, depending on the number of species used in the combinations.

Appendix 10: WARM-SEASON PLANTING GUIDE

AESCHYNOMENE (JOINTVETCH)

Planting Date: March 1 - June 30

Seeding Rate[a]: 10-15 pounds per acre (broadcasted), 8-10 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Aeschynomene or jointvetch provides excellent, high-protein forage for deer during the summer months. It can be slow to establish due to grass and weed competition. Jointvetch grows best in moist, light textured soils and is not suited for dry sites or sandy soils. It does best when planted with companion plants such as grain sorghum, alyce clover, or cowpeas.

ALYCE CLOVER

Planting Date: March 15 - June 30

Seeding Rate[a]: 15-20 pounds per acre (broadcasted), 15-17 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Alyce clover provides high-quality forage from late spring until first frost. It does not grow well on moist sites and is quite tolerant of dry conditions once established. Alyce clover is not very tolerant of weed competition. It does best when planted with other crops, such as Aeschynomene, cowpeas, or grain sorghum.

BUCKWHEAT

Planting Date: May 1 - June 1

Seeding Rate[a]: 50-70 pounds per acre (broadcasted), 30-40 pounds per acre (drilled)

Planting Depth: 1/4 to 1-inch

Comments: Buckwheat grows well in a variety of soil types and can be planted in areas with only minimal soil preparation. Buckwheat is highly palatable to deer, but cannot handle heavy browsing. For this reason, it can be quite difficult to establish in areas with high deer numbers.

CORN

Planting Date: March 15 - May 1

Seeding Rate[a]: 12-15 pounds per acre (broadcasted), 10-12 pounds per acre (drilled)

Planting Depth: 1-inch

Comments: Corn is highly preferred by deer, both during development and after the corn has dried. Corn is a high-carbohydrate food that enables deer to put on large amounts of fat during the fall. Corn is low in protein when compared to many other crops planted for deer. Although planted in the spring, most of the crop will not be utilized until fall and winter. Like alfalfa, it can be expensive and require a lot of maintenance to produce a good crop. Corn is best suited to well-drained, upland sites.

COWPEAS

Planting Date: May 1 - July 15

Seeding Rate[a]: 40-90[b] pounds per acre (broadcasted), 15-30[b] pounds per acre (drilled)

Planting Depth: 1-inch

Comments: Cowpeas are highly nutritious (high-protein), highly productive, and highly preferred by deer. They cannot handle heavy browsing, so larger fields should be planted to maximize production. Cowpeas grow on a variety of sites, but do best when planted on well-drained fertile sites. They can be planted with companion plants, such as grain sorghum, Aeschynomene, or alyce clover. Numerous varieties of cowpeas are available, including both bush and climbing/trailing varieties. Varieties commonly planted for deer include combine, iron clay, Catjang, Tory, and Wilcox.

GRAIN SORGHUM

Planting Date: April 15 - June 30

Seeding Rate[a]: 15-20 pounds per acre (broadcasted), 8-12 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Grain sorghum is a warm-season grain that will grow in a wide variety of soils. Although deer will often consume the plant during early growth and the seed heads once they mature, sorghum is most valuable as a support crop for more nutritious deer forages, such as Aeschynomene, alyce clover, and cowpeas. In addition, grain sorghum produces an abundance of seeds that are readily consumed by doves, quail, and turkey.

HAIRY INDIGO

Planting Date: May 1 - June 30

Seeding Rate[a]: 20-30 pounds per acre (broadcasted), 10-20 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Hairy indigo provides abundant growth in late summer and early fall, but may not be heavily grazed if more preferred foods are available. This legume has a deep taproot which gives it excellent drought tolerance. This characteristic makes hairy indigo a good insurance plant for planting with higher preference species, such as cowpeas, lablab, or soybeans.

LABLAB

Planting Date: April 15 - June 30

Seeding Rate[a]: 20 pounds per acre (broadcasted), 10-12 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Lablab is a highly nutritious (high-protein), highly preferred deer forage. It grows well on sandy, well-drained upland sites. Lablab is very drought resistant and can grow in areas that may be too dry for other warm-season legumes. It does not tolerate wet conditions. Weed competition can be a problem during early stages of growth. Once established, lablab is tolerant of moderate to heavy grazing pressure. Lablab can be planted with other drought resistant legumes, as well as corn and sorghum.

RAPE

Planting Date: April 15 - June 15

Seeding Rate[a]: 10-12 pounds per acre (broadcasted), 8-10 pounds per acre (drilled)

Planting Depth: 1/4 to 1/2-inch

Comments: Rape can be planted as a warm-season crop or early cool-season crop. It is a high-protein perennial that closely resembles turnips. Rape can produce a large amount of forage due to its broadleaf growth form. Rape does well on damp sites. The variety most commonly planted for deer is Dwarf Essex. Many other varieties are found in several deer plot seed mixtures.

SOYBEANS

Planting Date: April 15 - June 30

Seeding Rate[a]: 50-70 pounds per acre (broadcasted), 30-50 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Soybeans are one of the most highly preferred and nutritious of all the crops that can be planted for deer. Unfortunately, soybeans cannot handle heavy browsing pressure and will not last long when planted in small fields or in areas with high deer densities. Other browse tolerant legumes are probably better suited for warm-season deer plots. If sufficient acreage can be planted, soybeans can produce high quality forage throughout most of the summer. They grow best in well-drained soils and are only slightly drought tolerant. Can be planted with companion plants such as cowpeas, grain sorghum, or corn. Hundreds of varieties of soybeans are available for planting, but a slow maturing or forage variety is recommended for deer food plots.

VELVETBEAN

Planting Date: April 15 - June 15

Seeding Rate[a]: 40-60 pounds per acre (broadcasted), 30-35 pounds per acre (drilled)

Planting Depth: 1/2 to 1-inch

Comments: Velvetbean is a viney, annual legume that can grow up to 40 feet in length. This legume is tolerant of acid soils and low fertility. Velvetbean is not highly preferred by deer. It is often planted as a companion plant to corn, which provides support for the long, trailing vines. The hairy seed pods can irritate human skin.

Information taken from Ball et al. 2002, Griffin and Jacobson 1994, Kammermeyer and Thackston 1995, Koerth and Kroll 1994, SCS 1984, Stewart 1999, Stribling 1991, Stribling 1994b, and Woods 1999c.

[a]***All seeding rates are for planting a single plant species. If planting in combination with other species, reduce seeding rates by 1/2 to 2/3, depending on the number of species used in the combinations.***

[b]***Seeding rate varies depending on variety.***

Appendix 11: CONTACT INFORMATION FOR DIVISION OF WILDLIFE AND FRESHWATER FISHERIES, WILDLIFE SECTION OFFICES

DISTRICT I
(Colbert, Cullman, Fayette, Franklin, Lamar, Lauderdale, Lawrence, Limestone, Madison, Marion, Morgan, Walker, and Winston Counties)

21438 Harris Station Road
Tanner, AL 35671-9716
(256) 353-2634

DISTRICT II
(Blount, Calhoun, Cherokee, Clay, Cleburne, DeKalb, Etowah, Jackson, Marshall, Randolph, St. Clair, and Talladega Counties)

4101 Alabama Highway 21 North
Jacksonville, AL 36265
(256) 435-5422

DISTRICT III
(Bibb, Chilton, Dallas, Greene, Hale, Jefferson, Marengo, Perry, Pickens, Shelby, Sumter, and Tuscaloosa Counties)

NORTHPORT OFFICE
P.O. Box 305
Northport, AL 35476
(205) 339-5716

DEMOPOLIS OFFICE
P.O. Box 993
Demopolis, AL 36732
(334) 289-8030

Appendix 11: CONTACT INFORMATION FOR DIVISION OF WILDLIFE AND FRESHWATER FISHERIES, WILDLIFE SECTION OFFICES (continued)

DISTRICT IV
(Autauga, Bullock, Chambers, Coosa, Elmore, Lee, Lowndes, Macon, Montgomery, Russell, and Tallapoosa Counties)

64 North Union Street
Montgomery, AL 36130
(334) 242-3469

DISTRICT V
(Baldwin, Choctaw, Clarke, Conecuh, Escambia, Mobile, Monroe, Washington, and Wilcox Counties)

SPANISH FORT OFFICE
P.O. Box 247
Daphne, AL 36526
(251) 626-5153

JACKSON OFFICE
P.O. Box 933
Jackson, AL 36545
(251) 246-2165

DISTRICT VI
(Barbour, Butler, Coffee, Covington, Crenshaw, Dale, Geneva, Henry, Houston, and Pike Counties)

ENTERPRISE OFFICE
P.O. Box 310292
Enterprise, AL 36331
(334) 347-9467

ANDALUSIA OFFICE
1100 South 3-Notch Street
Andalusia, AL 36420
(334) 222-5415

Appendix 12: SUGGESTED READING AND ADDITIONAL RESOURCES

BOOKS

Quality Whitetails - The Why and How of Quality Deer Management (1995) Karl V Miller and R. Larry Marchinton, editors. Stackpole Books, 332 pages

White-tailed Deer - Ecology and Management (1984) Lowell K. Halls, editor. Stackpole Books, 870 pages.

Producing Quality Whitetails - Revised Edition (1998) by Al Brothers and Murphy E. Ray, Jr. (Charly McTee, editor). Texas Wildlife Association, 226 pages.

The Southern Food Plot Manual (1994) by Ben H. Koerth and James C. Kroll. Institute for White-tailed Deer Management and Research, 132 pages.

A Practical Guide to Producing and Harvesting White-tailed Deer (1994) by James C. Kroll. 491 pages.

The Deer of North America (1989) by Leonard Lee Rue III. Outdoor Life Books, 544 pages.

Forest Plants of the Southeast (1999) by James H. Miller and Karl V. Miller. Southern Weed Science Society, 454 pages.

Managing Wildlife - Managing Wildlife on Private Lands in Alabama and the Southeast (1999) Greg K. Yarrow and Deborah T. Yarrow, editors. Sweetwater Press, 588 pages.

Wildlife of Southern Forests - Habitat and Management (2001) James G. Dickson, editor. Hancock House Publishers, 480 pages.

Southern Forages - Third Edition (2002) by Donald M. Ball, Carl S. Hoveland, and Garry D. Lacefield. Potash & Phosphate Institute and the Foundation for Agronomic Research, 322 pages.

Appendix 12: SUGGESTED READING AND ADDITIONAL RESOURCES (continued)

ORGANIZATIONS

Alabama Division of Wildlife and Freshwater Fisheries,
Wildlife Section
64 N. Union Street
Montgomery, Alabama 36130-1457
(334) 242-3469

Auburn University, School of Forestry and Wildlife Sciences
108 M. White Smith Hall
Auburn University, AL 36849-5418
(334) 844-9248

Quality Deer Management Association
P.O. Box 227
Watkinsville, Georgia 30677
1-800-209-3337

ABOUT THE AUTHORS

Chris Cook received a B.S. (1990) and a M.S. (1993) in Wildlife Science from Auburn University. He began work with the Alabama Division of Wildlife and Freshwater Fisheries in 1993 as an area biologist in Walker County. In 1995, Chris transferred to Demopolis to begin work as a technical assistance biologist. He currently provides technical assistance on wildlife management to cooperators enrolled in the Deer Management Assistance Program, as well as other landowners and hunting clubs throughout Alabama. Chris also serves as the Deer Studies Project Leader for the Division of Wildlife and Freshwater Fisheries. Chris lives in Demopolis with his wife, Aprille.

Bill Gray received a B.S. in Wildlife Science from Auburn University in 1990. He began his career with the Alabama Division of Wildlife and Freshwater Fisheries in 1991 as an area biologist in northwest Alabama. Since 1994, he has worked as a deer management biologist in east central and southeast Alabama. His primary duties include working with the Deer Management Assistance Program, providing technical assistance to landowners and deer enthusiasts, and conducting various deer research projects. Bill lives in Ashford with his wife, Aimee, and son, Forrest.