MISSOURI

WHITETAILS

A management guide for landowners and deer enthusiasts

Missouri Department of Conservation
The white-tailed deer can be different things for different Missourians. For wildlife enthusiasts, it is natural beauty and grace; for motorists, a collision threat; for farmers, a potential crop damager; for recreational hunters, a worthy adversary. But for all Missourians, the whitetail is an important part of the natural resource heritage under our stewardship.

INTRODUCTION

The white-tailed deer is one of Missouri’s most valuable wildlife resources. Each year hunters spend over three million hunter-days in the field pursuing the whitetail, contributing millions of dollars to the economy in the process. Public viewing of deer attracts thousands of visitors to our state’s public lands annually. A recent survey of urban and rural Missouri citizens revealed that of all animals outside a zoo, people most prefer to see the white-tailed deer. It also is a favorite with children. The whitetail was selected as our state mammal by vote of school-age children.

On the down side, deer cause thousands of vehicle accidents on our roadways annually and feed on agricultural and household plantings throughout the state. It is not surprising that the Missouri public has strong feelings toward whitetails, mostly positive, but some negative. As a steward of this important wildlife resource, the Missouri Department of Conservation is sensitive to these attitudes.

The Department’s goal is to maintain deer numbers at levels that serve the best interest of the Missouri public. This requires knowledge of whitetail biology. Equally important, however, is commitment and cooperation from Missouri citizens who serve both as the advisory board that guides our management and the tool with which we regulate deer numbers. The landowner is the key to this process because most deer management in Missouri takes place on private properties.

This handbook is designed to help managers and landowners set and achieve deer management goals on individual land holdings. Diverse, often complex factors, affect deer, and every piece of land is unique. Therefore, our goal is not to provide a deer management cookbook that will work in every situation. Rather, we hope to provide a framework of information that enables landowners to make educated decisions about management of their lands. Information presented is from a variety of sources. However, whenever possible, we used information gathered from deer research projects conducted in Missouri.
Historical Review

The history of white-tailed deer in Missouri shows positive and negative influences humans can have on wildlife. During presettlement times, the whitetail was abundant in Missouri, especially in the more fertile and diverse habitats of northern Missouri. The influx of European settlers to Missouri during the last half of the nineteenth century coincided with a rapid decline in the deer population (Figure 1). Unrestricted market hunting and habitat destruction, such as cutting, burning, farming and grazing forest lands, contributed most to this decline.

Token laws restricting the killing of deer were passed in the late 1800s and early 1900s, but they went largely unenforced. In 1925, the state’s deer herd was estimated to be only around 400. In response to these findings, the Missouri State Legislature declared deer season closed and made the first substantial effort to enforce its regulation. At the same time, deer brought to Missouri from Michigan were released onto five refuges in the Ozarks. In 1931, deer season reopened but resulted in a small harvest, which indicated a low population that was stable or declining.

Only when the first Conservation Commission formed in 1937 did significant efforts to restore the whitetail begin to succeed. The Commission closed deer hunting season from 1938 to 1943. During this closure, additional deer were stocked from Wisconsin, Michigan, Minnesota and from existing refuges within the state. Enforcement of the Wildlife Code of Missouri by professionally trained conservation agents helped deter poaching.

By 1944, the statewide deer population soared to 15,000, and Missouri held its first deer season since the recovery effort had begun. Between 1944 and 1951, hunting was restricted to bucks only to allow deer populations to grow. In 1951, limited doe harvests were initiated.

The story since then is clear: Early management promoted continued population growth which, in turn, was accompanied by people's growing interest in deer hunting. Recent management efforts have attempted to define optimal population levels and design hunting regulations to achieve them. The success of the deer program is a tribute to Missourians' support of their natural resources and to the adaptability of the white-tailed deer to human-altered habitats.
white-tailed deer are ungulates, or hoofed mammals, belonging to the family \textit{Cervidae}. Characteristics distinguishing this group from other hoofed mammals are forked antlers, a four-part stomach and the absence of a gall bladder. The whitetail is the only remaining native ungulate still thriving in Missouri. Ancestors of our modern deer actually had five toes. Through evolution the first toe disappeared, the second and fifth toes became dew claws, and the third and fourth toes enlarged to form hooves. As a result, deer actually walk on their toes or, more precisely, on their toenails. Like our fingernails and toenails, hooves are composed of keratin. As whitetails grow older, their hooves become wider. Experienced trackers can tell yearling deer from adults based on this characteristic.

A whitetail’s coat and color tend to change throughout the year. During the summer months, deer are reddish-brown, and their coats are rather thin—less than a quarter-inch thick. By August or September they shed their summer pelage, or coat, and replace it with a thick, brown-grey winter coat sometimes more than 1-inch thick. The winter pelage is made up of both a short underfur and outside guard hairs. This dense layer of hair may weigh up to 2.8 pounds. The molt/shed cycle begins again in April when deer start to grow their summer coats. This almost continual shedding and regrowth requires substantial amounts of protein and energy.

Occasionally, deer have either all white, very dark brown or piebald coats. White deer are usually albinos. This genetic trait is sometimes prevalent in one area, but it is not common anywhere. Deer that have patches of both white and brown hair are called piebald deer. These animals may have a patchwork as extensive as that of a pinto horse, or it may be less pronounced. Dark brown or black, albino and piebald deer are legal game in Missouri.

Whitetails have four sets of external glands that are used primarily for communication (Figure 2). Gland secretions can describe a deer’s social status, breeding condition and health. The most recognized glands are the tarsal and metatarsal glands, located on a deer’s hind leg. The tarsal gland, located on the leg’s inner surface, serves to identify individuals. The metatarsal gland, found lower on the leg and on the outside, may help in regulating the animal’s body temperature. Interdigital glands, located between the hooves, probably leave scent trails for other deer to follow. Preorbital glands function as tear glands and may relay sex and social hierarchy when rubbed on branches.

\textbf{Antlers and Antler Growth}

Whitetails are probably best known and sought after for their antlers. Sometimes incorrectly referred to as horns, deer antlers are cast and regrown annually. Horns, on the other hand, grow continually much like hooves. Another difference between horns and antlers is that horns, like hooves, are composed of keratin, whereas antlers are composed of bone. The actual composition of antlers depends upon their stage of growth. Growing antlers are 80 percent protein and 20 percent ash. Hardened antlers are roughly 63 percent ash, 22 percent calcium, 11 percent phosphorus and 4 percent organic matter. Antlers are most dense on young deer and tend to become more porous as the animals grow older.
The phrase, “the head grows according to the pasture,” is probably more accurate when stated, “the body grows according to the pasture.” Antler growth requires a substantial amount of protein and minerals, yet body growth always takes precedence. This is true especially for young deer because they are still putting energy into body growth.

Measuring specific nutritional and mineral effects on wild deer antler growth is difficult because of the animals’ large home range and varied diet. A number of studies on penned deer have found relationships between nutrition and antler growth in young deer. Whitetail fawns fed a ration containing less than 9.5 percent protein developed smaller racks, weighed less and cast their antlers earlier than fawns fed 16 percent protein rations.

Although spring nutrition is important for body and antler growth, whitetails possess adaptations that enable them to prosper in areas with mineral deficiencies. For example, deer deposit minerals in their skeletons throughout the year. Then, during antler growth, they mobilize these minerals to the growing antlers. A second adaptation is their ability to change absorption rates of minerals in their stomach. When using large amounts of minerals for antler growth, deer siphon more minerals from their diet. Deer rely on plants for these minerals, and they select plants offering the highest mineral concentrations.

Protein and minerals play an important role in deer growth and antler development. Yet under normal weather conditions in decent habitat, deer are able grow to their potential without supplementation. A recent study that took place in an area with markedly poor soils found no significant difference between body weight or antler size in two populations of wild deer. One group had unlimited access to mineral blocks, and the other did not. In another study, deer with access to food plots were not heavier nor did they have larger antlers than deer without access to food plots.

The large number of big deer and racks that come from north Missouri, however, suggests the abundance of agricultural plantings seems to influence deer body size and antler growth. Nutrition is important, but other factors, such as genetics and age, probably play a role in the antler growth of deer in Missouri. Most studies that examine the effects of genetics on antler growth are studies of penned deer. Whether these findings may be extrapolated to wild populations remains in question. One theory suggests
that spike bucks—bucks, usually yearlings, with non-branched antlers—are genetically inferior. Another has found that many of these spike bucks are late-born fawns whose antler development is retarded but will eventually catch up with other bucks.

No doubt if we take 100 bucks and feed them the same rations until they reach 4 1/2 years of age, antler development will vary among these deer. Much of this variance probably is caused by genetics. Genes and nutrition aside, however, a 3- to 7-year-old deer in Missouri will have a “braggin’ sized” rack because Missouri has good deer habitat. Most deer never reach their potential because they are harvested the first year they grow antlers.

The Four Stomachs

Whitetails, like most herbivores, are ruminants. This means they have a four-part stomach (Figure 3) and, like cattle, regurgitate food from their first stomach to “chew the cud,” which aids the digestive process. As ruminants, deer can use many foods indigestible to humans and other nonruminants. A deer’s stomach contains microbes that break down cellulose—the fibrous parts of plants—and ferment carbohydrates, thus providing energy and nutrients. This process is especially important for animals living on low-quality forage.

Rumen: This largest stomach compartment lies on top of the intestines. It functions both as a storage and fermentation chamber. Food is mixed with bacteria and protozoa, which aid the digestive process. When a deer feeds, it quickly fills its rumen. Later, it regurgitates the food and chews it more thoroughly. Rechewing helps digestion and allows microbes to break down cellulose and other plant fibers into easily digested materials.

Reticulum: This compartment lies forward of the rumen. It forces water into the rumen, suspending food particles and floating them to the reticulum where the digeston continues. Similar processes occur in the rumen and reticulum, but most material in the reticulum consists of smaller particles. Food also passes to the esophagus for rechewing.

Omasum: For the most part, the function of the omasum is to absorb water and minerals produced through digestion and to move food to the last stomach compartment, the abomasum.

Abomasum: This compartment most closely resembles the stomach of nonruminants. It secretes enzymes that further digest the products created by microbial action and the microbes themselves. Further digestion takes place in the small intestine.
Table 1. Average Dressed Carcass Weights (lbs)

<table>
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<th>FEMALE PAWNS</th>
<th>YEARLINGS</th>
<th>ADULTS</th>
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**Deer Weights and Growth Patterns**

Generally deer from northern climates have larger body sizes and weigh more than their southern counterparts. This principle, called Bergman’s Rule, holds true for most mammals and is most pronounced at the extreme northern and southern reaches of an animal’s range. Animals with larger body sizes have a proportionally smaller body surface to keep warm during cold weather. Smaller body sizes are more efficient at cooling during hot weather.

Deer weights also may vary by region within a state (Table 1). In Missouri, deer are heavier and sport better racks in the northern half of the state. Latitude may play a role, but the range quality likely plays a greater role. Superior soils and abundant agriculture in northern Missouri offer better nutrition. The largest recorded deer taken in Missouri weighed 407 (live weight) pounds and was killed in 1979 in Davies County.

Deer lose weight during winter and then undergo a phase of rapid growth during spring. Bucks often lose weight during the breeding season, but regain it during spring. Females with fawns begin to lose weight in January and do not regain it until late summer when fawns are weaned. Some studies suggest deer undergo stress periods and lose weight during hot dry periods.

**Activity Patterns and Home Range**

Most deer activity takes place around dusk and dawn with brief periods of activity during midday. These patterns vary with the time of year and the weather. Recent studies suggest that deer are most active at low humidities and show increased movement during overcast periods. High winds decrease deer movements, and approaching storms increase them. During winter, deer move later in the morning and increase activity during warm spells.

Deer activity varies by season with peaks during spring and fall. The least active months are January, February and June through August. During fall, deer are active during breeding periods and while feeding to prepare for winter. Spring brings abundant food resources, and deer have increased metabolic demands due to pregnancy and growing antlers. Females are more active than males from January to July, and males are more active from September to October. Buck fawns are more active than doe fawns. Road kill data collected by the Missouri Department of Conservation and the Missouri Highway and Transportation Department show kill rates are highest during fall with smaller peaks during spring (Figure 4).

The size and shape of a deer’s home range vary with habitat quality, deer density, sex, time of year and the deer’s age. Deer that live in the best habitats can satisfy all their daily requirements in a smaller area; deer that live in less diverse habitats must travel to find suitable food and cover. Most home ranges tend to be elongated, and researchers theorize that this shape maximizes available resources. Deer living in diverse habitats with lots of edge and an even distribution of food and cover tend to have more circular home ranges. Adult bucks have larger overall home ranges than does and young bucks. As a general rule, deer have the smallest home ranges during summer and the largest during fall.
Deer are susceptible to a variety of diseases and parasites. Nevertheless, disease does not typically account for a large percentage of deaths. During a deer study in northern Missouri, radio transmitters were placed on more than 200 deer. Less than 4 percent died from disease.

This chapter covers only a few of the more common parasites and unusual conditions that people, especially hunters, might observe in deer. Few situations actually render deer unsuitable for the table. Only rare exceptions occur, but if you have questions about the deer you harvested, contact your local conservation agent or Conservation Department office.

Normal organs and structures occasionally are misinterpreted as abnormal. Lymph nodes, which are found throughout the body, are sometimes taken to be multiple tumors or abscesses. The nodes, which are part of the body’s system used to fight off disease, are located under the skin, between muscle groups and in the body cavity. They are beige to light brown and range from 1/4 to 1 inch in diameter. Lymph nodes may become enlarged and darkened when the deer is fighting an infection.

Hemorrhagic Disease

Hemorrhagic disease is a general term for epizootic hemorrhagic disease and bluetongue virus. Both diseases are closely related, have similar clinical signs and are spread by a small, biting midge fly. White-tailed, mule and black-tailed deer all are susceptible. Cattle and goats are not affected or show only mild signs of being sick. Sheep are susceptible only to bluetongue virus.

Hemorrhagic disease outbreaks tend to occur from August to September and may go unnoticed because carcasses quickly decompose and are scavenged. Some infected deer may not show obvious symptoms, while others may die in one to three days. Typical symptoms include fever, excessive salivation, swollen neck, tongue or eyelids, sloughed or interrupted growth of hooves, reduced activity and/or emaciation. Because sick deer are feversish, they are often found near water. Not all deer die from the disease, but losses of up to 50 percent have been documented. Researchers speculate that 20 percent of the deer herd was lost in some areas of Missouri during past outbreaks.

The most common evidence that deer have survived the disease is sloughing, or cast and regrowth of the hooves. Their hooves are rough and may regrow much like a finger nail regrows after falling off. The deer are generally in good shape, and the hoof problem is simply a residual effect of the disease. In some cases, the deer have sores on their tongues, dental pads or insides of their cheeks. Their health may vary from excellent to poor depending on the degree to which the sores affect feeding.

Humans do not get hemorrhagic disease, so handling and consumption of meat from deer that have recovered from the disease pose no health hazard. Any animal in a poor, diseased condition, regardless of the cause, may be unfit for consumption. If you find a dead deer and the cause of death is not apparent, report it to your local conservation agent.

Lyme Disease

Deer often are implicated in the spread of Lyme disease. One of the tick species that harbors and spreads the disease is called the "deer tick" in some regions. However, there has never been a documented case of a human contracting Lyme disease through the handling or consumption of venison. The disease actually is caused by bacteria and is spread through certain species of ticks. Deer, other wildlife and domestic animals often are hosts for the ticks that carry Lyme disease and may expand its range.

Deer can become infected with Lyme disease, but they do not carry large numbers of the bacteria. The disease isn't passed from one deer to another or to...
humans. Deer may have large numbers of ticks and other parasites, and certain deer handling precautions will minimize your exposure to them.

1. Hang a deer carcass for a day or two to let many of the ticks drop off. Refrigeration may discourage ticks from dropping.

2. Wear latex gloves while dressing and processing deer. Wearing gloves is strictly precautionary because there are no documented cases of people acquiring diseases or parasites from dressing deer.

3. Treat clothing with permethrin or a similar tick spray to prevent most ticks from biting. Take a shower after being in the woods, and check your body closely.

4. Cook meat thoroughly. Although there is no evidence to suggest that deer diseases or parasites can be transmitted through venison, thoroughly cooking meat will ensure this.

**Chronic Wasting Disease**

Chronic wasting disease, first detected in deer in Colorado in 1967, belongs to a group of diseases known as transmissible spongiform encephalopathies. It occurs in both wild and captive deer and elk. Deer with CWD show changes in natural behavior and can exhibit extreme weight loss, excessive salivation, stumbling and tremors. CWD is always thought to be fatal to the infected animal, but it can take months or years before the symptoms of infection appear. CWD can only be confirmed by laboratory examination of brain or lymph tissue.

CWD has been found in deer and elk from a number of midwestern and western states. Deer managers are most concerned about the potential impacts CWD could have on deer populations and deer management. The Conservation Department has tested thousands of Missouri deer, and no CWD-infected deer have thus far been found.

There is no evidence that CWD affects humans. Hunters are encouraged to take some common-sense measures, such as wearing rubber gloves while field dressing and processing deer, and not eating deer brain, spinal cord, spleen or lymph nodes.

**Nasal Bot Flies**

Nasal bot flies (*Cephenemyia spp.*) are common parasites that infest the nasal passages of deer. They most often are found by taxidermists while preparing heads for mounting, although hunters occasionally notice them.

Adult female flies deposit small larvae in the nostrils of the deer. The larvae enter the nasal passages and pass through several stages of development and growth. They are liberated when the deer sneezes. They then form a pupa and emerge as an adult fly.

Although quite large (up to 1 1/2 inches) and unpleasant looking in the final stages of development, nasal bots cause little harm to the deer and do not infect humans. They also do not affect meat quality.

**Cutaneous Fibromas**

These wartlike growths can cover large portions of the body, but usually are small, single to multiple, and range from a fraction of an inch to several inches in diameter. They are caused by a virus that often infects the deer through a wound. Fibromas are more com-
mon in bucks because they are more likely to incur wounds while fighting other bucks and rubbing antlers.

Although sometimes grotesque in appearance, fibromas generally do no harm to deer. The virus that causes them to grow in whitetails does not infect other wild animals, domestic animals or humans. Fibromas are confined to the skin and, therefore, are removed when the deer is processed for consumption. They do not affect the quality of the meat.

**Abdominal Worms**

These slender, white parasites (*Setaria yehi*) range from 5 to 10 inches in length. They usually are located in the abdominal cavity, so hunters are most likely to find them as they dress their deer. In some cases, 75 percent of deer may have the parasite, but usually the infection rate is lower. Younger deer are more likely to harbor the parasite than older deer.

The life cycle of this parasite is not completely understood. It is thought that mosquitoes serve as intermediate hosts and transmit larval stages of the parasites to deer, the final hosts for the adult worms. Like most parasites, *Seteria* seldom harm the host deer and are of no significance to other animals or humans. Consumption of meat from a deer infected with *Seteria* is safe.

**Tapeworms**

Several tape worms can infect whitetails, but one of the most visible is the juvenile stage of the canine tapeworm (*Taenia hydatigena*). This stage, called the bladderworm, appears as a white oval in the liver or on membranes within the deer's abdominal cavity.

Deer become infected by consuming plants contaminated with eggs. The eggs hatch and burrow through the deer's gut wall, enter blood vessels and emerge within the liver. They move to the surface of the liver and enter the body cavity. A coyote or dog can become infected by eating tissues from the abdomen of an infected deer. Deer infected with bladderworms experience minimal ill effects. In addition, bladderworms do not infect humans and do not affect venison quality.

Another species of tapeworm (*Echinococcus granulosus*), confined mostly to the northern United States and Canada, can be harmful to humans. However, humans become infected by ingesting eggs originating from a dog or coyote, not from consuming deer meat. Cysts in deer caused by this tapeworm are harmless to humans but indicate the parasite is present in the region and infection by other means may be possible.

**Traumatic Injuries**

Deer that have suffered injuries due to accidents occasionally are taken by hunters. Injuries may be due to hunter-inflicted wounds or to run-ins with automobiles or fences. Many of these injuries heal without complication, but occasionally they cause infections characterized by dead tissue and pus in and around the wound.

Small, localized infections pose no problems, but large infections that appear to have spread may affect the general health of the deer and render it unfit for consumption. Common sense and good judgement must be used to determine if the animal's injury makes it unsuitable for the table.
Above, a pregnant doe feeds on a lush stand of red and ladino clover. Top right, this buck tests the air for does during the rut. Lower right, deer tend to bed close to feeding sites and seek foods high in fat and carbohydrates during the cold winter months. Right, white-tailed fawns begin eating vegetation at about two weeks.
Spring is the time of plenty for deer. New succulent plants send out tender shoots every day. Food is abundant even in areas that do not normally provide deer with nutritious food. At this time of year, the woods become a huge salad bar, and deer are able to sample different flowers and plants as they choose. Among the spring favorites in Missouri are wild lettuce, grape vines, trumpet vine, cinquefoil, sweet clover, violets and spring beauty. Most plants offer peak nutrition during spring, and whitetails respond with growth spurts and weight gain. Males channel energy to their antlers and regain the weight lost during last year’s breeding activities. Females transfer energy to unborn fawns, which now undergo rapid growth.

Almost all Missouri does 1 1/2 years old or older breed and produce fawns each year. In addition, 30 to 40 percent of fawns that are less than 1/2 years old breed and produce offspring by the time they are 1 year old. The number of fawns that are born and survive annually is dependant upon a number of factors including the age and nutrition of the mother, deer density in the area and winter stress. Birthrates vary from region to region as these factors change.

In Missouri, the pregnancy rate of whitetails was measured by examining the number of fetuses in road-killed does. These data were grouped by natural regions because habitat and nutrition are similar (Figure 5). Pregnancy rates for deer 2 1/2 years old and older and yearling does were nearly equal, but rates for younger deer were markedly lower (Table 2). Adults had more offspring per doe than yearlings, who had more than the youngest group. In Missouri, most adult and yearling does have twins each year. The folk tale that old does tend to be barren is a myth. Researchers documented fetuses in does over 15 years of age. In fact, some researchers suggest that older does are more successful mothers because they are experienced and have the best territories.

Peak fawning takes place in late May and June and begins when pregnant does isolate themselves and drive other deer from their fawning areas. Adult deer use the same areas each year. The establishment of fawning territories is thought to limit social stress and
help distribute populations evenly. Territories also
may prevent newborn fawns from imprinting on deer
other than their mothers.

Does may give birth while standing but often are
bedded during delivery. The actual birthing process
lasts 30 to 150 minutes with twins born 15 to 30 min-
utes apart. After giving birth, the doe consumes pla-
cental membranes and afterbirth—probably to reduce
scent and recycle nutrients. Mothers also consume
their fawn’s fecal materials for the first two to three
weeks. Fawns, which weigh from four to eight pounds
at birth in Missouri, can stand as soon as 30 minutes
after being born and usually begin nursing at this
time. During these first hours and days, fawns
imprint on their mothers or, in some cases, on
another deer or animal.

The first weeks of life for newborn fawns are pre-
carious. Young fawns are vulnerable to a variety of
predators, diseases, parasites and human-caused mor-
tality. In Missouri, the major natural predators are
cyotes, dogs and bobcats. To reduce exposure to
predators, fawns spend most of their time bedded and
hidden in heavy cover, such as hay fields, grown pas-
tures and old fields. Studies using radio transmitters
suggest fawns are active less than one-fifth of a 24-
hour day.

Both the doe and its offspring spend most of their
time in a 10- to 20-acre area these first weeks. Does
visit their fawns two to four times a day to nurse and
groom them. Fawns move to a new bed site after each
feeding and grooming session, but siblings generally
do not bed together. During this time, does some-
times physically defend their offspring from preda-
tors. It is also during this period that people find
what they believe are “abandoned” fawns. In most
cases, its mother is close by. Bedded fawns should be
left alone.

Following its first month, the fawn increases nurs-
ing and activity periods. After four to six weeks, a doe
may visit her fawn as often as five or six times per
day. Fawns begin eating vegetation and ruminating at
two weeks, although they cannot digest plant nutri-
ten until five weeks. Fawns become more social, are
more likely to be seen with their siblings or mother
and increase their activity to levels similar to adult
does. After 10 weeks, fawns eat grasses and forbs and
are functional ruminants.

Young does typically establish fawning territories
next to their mother’s, but sometimes they disperse
and establish in a new area. Missouri deer studies
suggest does travel widely during spring then, before
giving birth, reduce their movements dramatically.

It is much more common for 1-year-old bucks to
disperse. In a northern Missouri study that used radio
transmitters, 77 percent of buck fawns roamed more
than 8 miles. Dispersal by young bucks and does is
especially pronounced in areas with high deer densi-
ties. Dispersing deer tend to have higher mortality rates, but this phenomenon is part of deer biology. It helps expand populations and limits inbreeding.

During summer, does and bucks are segregated, sedentary and spend most of their active time eating. Does and fawns travel and feed together throughout the summer. Sometimes fawns from the previous year travel with this year’s doe/fawn groups. Does with fawns may spend 70 percent of their time eating to meet their high nutritional requirements. They often seek shrubby, thick cover because it offers better hiding and higher quality forage.

Bucks often congregate in bachelor groups composed of neighboring bucks. Males typically use open habitats, such as mature hardwoods, fields and poorly stocked forests. Thus, they often are found in different habitats than family groups of does and fawns. Some deer researchers suggest males prefer open areas so that they can keep track of their position in the social hierarchy and to keep from damaging their antlers while feeding. Others theorize that the males’ nutritional requirements are lower per pound of body weight or that their large rumens allow them to consume more food and gather sufficient nutrition from poorer ranges.

Activity levels in deer are proportional to their nutritional needs. Larger bucks are reported to be more active than smaller bucks during summer. Females are more active than males. Nonetheless, both sexes tend to have smaller home ranges during summer and use wooded cover during daytime periods and open areas at night.

**Fall and Winter**

Fall is a frenzied time of year for whitetails. Does and fawns continue to travel in groups, but now fawns are totally weaned and does feed aggressively to recover from the stresses associated with raising them. During fall, deer eat items rich in starch and carbohydrates: in oak-hickory forests, this means acorns and soft mast, such as persimmons. Deer also graze on cool season grasses and legumes, which are undergoing a resurgence of growth with cooler fall temperatures and rain.

Yearling bucks that have not dispersed the previous spring do so in fall and winter. According to studies, this group represents less than 20 percent of yearling bucks in Missouri. Adult and yearling buck bachelor groups break up, and bucks begin to shed their antler
velvet and rub trees. An increased production of 
testosterone, triggered by decreasing day length, 
brings on the changes in buck behavior and the hard-
ening of antlers. Rutting behavior and activity varies 
with the age and experience of the bucks and the sex 
and age ratios of the local deer herd.

Sparring matches are common prior to the break 
up of bachelor groups, especially among younger ani-
mals. Yearling (1 1/2-year-old) and 2 1/2-year-old 
bucks spar to size each other up without injuring 
themselves. Older bucks with previously established 
dominance tend not to participate in much pre-rut 
sparring.

Through sparring and visual posturing, fraternal 
groups of whitetails establish a social hierarchy. This 
limits energy expenditures on unnecessary fighting. 
Bucks establish a dominance ranking that tends to 
hold year round, but a dominant animal may tem-
porarily lose rank if it casts its antlers sooner than the 
others. Occasionally, two evenly matched individuals 
meet, and the resulting battle for dominance is quite 
serious. Adult bucks can injure or kill one another. 
Sometimes antlers become locked, and both animals 
perish.

About the time bucks decrease their sparring activ-
ities, they increase their antler rubbing. Most rubs are 
thought to be signposts made by bucks to advertise 
their presence. Rubs provide visual cues and scents 
that inform other deer about the rub maker. 
Although no one knows for sure, these rubs probably 
relay information about social status. The number of 
rubs a deer makes seems to vary among individuals, 
but studies of penned deer have shown that adults 
rub more often than yearlings.

The pattern and frequency of buck sign in an area 
often reflect the age structure and sex ratios of the 
resident deer herd. Areas with mature adult bucks 
have more buck sign, and these areas show signs of 
rubbing and scraping activities earlier than areas with 
predominantly yearling bucks.

Scrapes also are signposts made by bucks. They 
probably are used to attract or keep track of breeding 
females and to advertise the presence of the maker. 
When making a scrape, a deer paws the ground and 
urinates on the disturbed soil. Most scrapes are made 
near deer travel routes under low tree branches that 
typically are nibbled on and marked with a scent 
gland from the deer's forehead. Adult bucks make 
about twice as many scrapes as yearlings. Although 
not common, buck fawns and does have been 
observed freshening scrapes.

Testosterone levels increase as the rut progresses, 
and bucks become driven to find estrous does—those 
that are ready to breed. The period just prior to peak 
breeding probably offers bow hunters the best hunt-
ing of the season because bucks constantly move and 
search for does in heat. Rutting bucks spend more 
time searching for and tending to does than eating 
during breeding season and sometimes lose consid-
erable weight. Bucks typically visit the various doe fam-
ily units in their home range checking for estrous 
does.

Prior to breeding, does also increase activity levels, 
thus increasing the likelihood of finding a buck and 
being bred. Does allow a buck to breed only during 
the 24-hour-period when they are in peak estrous. 
Does that are not bred cycle again about 28 days later 
and may be bred in subsequent cycles. In Missouri, 
most adult does are bred the second and third weeks 
of November. Doe fawns are bred about a month later 
because they cycle later than adults. Some hunters 
and biologists have voiced concerns that not all does 
are bred in populations with heavily exploited bucks. 
This may not be the case for yearling and adult does 
in Missouri. During a Conservation Department 
reproductive study, more than 90 percent of exam-
ined does were pregnant.

During the whitetail's courtship, bucks trail and 
chase does to test their receptivity to breeding. Does 
aid this process by urinating frequently, which allows 
trailing bucks to determine their stage of estrous by 
smelling and tasting the urine. When a buck finds a 
receptive doe, he remains close by, and the two mate 
several times. Using radio telemetry during deer stud-
ies in north Missouri, researchers determined that 
mating pairs spent more than 12 hours together in 
some cases.

The breeding behavior of yearling bucks seems to
Occasionally during the breeding season, two evenly matched bucks battle for dominance. These serious confrontations are quite different from the gentle sparring typical of younger bucks before the breeding season.

be more haphazard and frantic. Yearlings probably don’t do much of the breeding if there are an appreciable number of adult bucks in the area. Nevertheless, yearlings are capable of breeding and may do most of the breeding in heavily exploited populations.

As breeding activities wind down, testosterone production decreases in males, and they, in turn, begin to shed their antlers. Some studies suggest that antler shedding also is tied to nutrition because deer living on better ranges tend to carry antlers longer than those on poorer ranges. Young deer typically shed antlers earlier than adults. The older deer, who are actively breeding, shed their antlers after there are no longer does coming into estrous.

During the rut, bucks are struck by vehicles more frequently than at other times of the year and are more vulnerable to hunting. In areas with large predators, such as wolves or mountain lions, rutting bucks are preyed on because they are less wary and perhaps weakened by intensive breeding activities. The rut leaves most bucks in poor physical condition. Besides weight losses of up to 20 percent, bucks also may suffer from battle scars and exhaustion. They often enter winter in poorer condition than the rest of the herd.

Winter can be a very difficult time of year for deer, especially in the north. Cold weather and reduced food availability force deer to change their habits in order to conserve energy and survive. Although Missouri winters are not severe, our whitetails display some of the same behaviors as their northern counterparts. These northern deer spend the winter in a sheltered area, sometimes referred to as a deer yard, then return to their summer range the following spring. A number of radio-tagged deer in Missouri made movements of up to 10 miles each winter then moved back to their summer ranges each spring.

Extended family members often reunite during winter. Most family units winter in the same areas each year, but deer concentrate in new areas if food is abundant. Typically, bucks and does are still segregated. Does and their offspring from several generations often form large groups while males reunite with members of their bachelor group or travel alone.

Deer reduce activity during the winter months. Studies have documented activity changes of up to 50 percent. One study found deer were active 68 percent of the time in October but only 37 percent of the
time in February. Their metabolic rate slows down as their activity rate declines, and they require less energy to live. In Missouri, researchers noticed this reduced metabolic rate while tranquilizing deer to draw blood or affix ear tags. Deer trapped during the winter months required less tranquilizer than those captured during fall and spring months because the higher metabolism burned up the drug faster.

During the winter months, deer readily eat foods that are rich in carbohydrates, such as acorns and waste grain. Deer also browse on young trees and shrubs—staple foods for deer in areas lacking agricultural crops and a supplement for all deer during the winter months.

The degree to which deer browse certain shrub and tree species sometimes is used as an indicator of deer population levels and winter severity. Some species of sumac and dogwood, for example, are readily consumed by deer. Red cedar and hickory are considered starvation foods and are only eaten when populations are high.

Browse surveys that reveal high use of starvation foods generally are interpreted to mean deer populations are surpassing the carrying capacity of the habitat. Deer weight, growth and nutrition are linked closely to available foods. Population reduction and, in some cases, habitat management are prescribed to alleviate overpopulation problems.

**Diet**

Because whitetails are ruminants, they are able to use a wide variety of foods. Their four-part compound stomach enables them to break down woody browse and herbage, but they cannot digest low quality forage, such as grass and woody browse, as efficiently as cattle and goats.

Deer are selective feeders and seek out preferred plant species. They seem to possess an ability to select those plants that offer the most nutrition during that particular time of year, such as when the plants are flowering, producing fruit or undergoing rapid growth.

Deer have been documented eating more than 600 different types of plants. Deer in the Ozark region of Missouri live in chiefly wooded areas and rely on natural forage, such as grape vines, green brier, Virginia creeper, oak leaves, pussy toes, clovers and prickly lettuce. During spring and summer, deer eat perennial plants more than annuals.

Studies in agricultural areas of Missouri, Iowa and Ohio indicate cultivated crops comprised 41 percent, 56 percent and 48 percent respectively of deer diet by volume. Most researchers found wild browse, fruits and seeds also are major food items. Deer prefer corn, soybeans and hay from the variety of agricultural crops. Listed below are the agricultural crops used by deer:

**Soybeans:** Green leaves are eaten from germination to yellowing. Beans are eaten throughout winter if left unharvested.

**Corn:** Silk is eaten in June and July. Dented corn is used from September through winter.

**Milo:** Milo is eaten from dough stage (70 days) through spring.

**Wheat:** Wheat is used from germination in September until snow covered or several hard freezes and then again in spring.

**Alfalfa and Clover:** Alfalfa and clover are used after germination until hard frost.

**Sunflowers:** Sunflowers are eaten from germination to maturation.

Oak mast and leaves, corralberry and various forbs are important wild browse food for deer in agricultural areas. These differences in plant use and regional food habit studies are likely a reflection of plant availability. Agricultural crops may be preferred when they are available, but deer still rely on early successional plants and oak mast. Ask your local conservation agent for details on which species to plant or encourage to attract deer to your land.
The effect of food plots, agricultural plantings, forest management and management of natural vegetation on deer in Missouri is open to speculation. Because deer populations in our state are under the land’s carrying capacity—the number of deer the habitat can support—deer are not limited by food scarcity. Missouri’s mild winters, naturally diverse habitats and good mixture of crop ground and woody cover provide deer ideal conditions.

However, the larger body sizes, better antler growth and higher reproductive rates of north Missouri deer, where soils are fertile and intensive agriculture predominates, suggest an abundant, high-quality food source may be important for producing these desirable characteristics in deer. In addition, studies of penned deer have found positive correlations between soil fertility (mostly calcium and phosphorus levels) and increased antler growth, productivity and body weights. It seems apparent that well-nourished deer are more likely to reach their biological potentials for reproduction, body size and antler growth.

But will one or two quarter-acre food plots surrounded by 1,000 acres of the poorest woods in Missouri make a difference? Probably not. But 25 well-placed one- to two-acre plots could benefit deer under these conditions, especially if coupled with proper forest management.

Besides the potential benefits for deer, land management gives deer enthusiasts a better understanding of deer habits. Proper management makes property more attractive to deer, which increases the time they spend on that piece of land. A patch of lush clover or wheat is a dynamite spot to harvest a deer early in the archery season. Later in the season, grain such as milo, and heavy cover such as a 6-year-old clearcut, attract deer because they offer both high energy carbohydrates and cover. During spring, grown-up pastures provide concealment for newborn fawns and an abundance of nutritious forbs. Bucks seem to prefer openings and open woods during summer when they are growing antlers and visually sorting out their dominance hierarchy. Certain songbirds, quail, rabbits and other edge species attracted to food plots also may benefit from deer habitat management.

Step One: Evaluate Your Land

Once you’ve decided to do some habitat management, the first step is to determine what habitat qualities are lacking on your land. Unless you own 1,000 acres or more or live on an island, also consider your neighbors’ properties. Remember, deer are mobile and seldom spend an entire lifetime or even a season in one small area. A deer study in north Missouri showed many radio-collared deer roamed areas greater than 1,000 acres during a given season, and many made seasonal movements of more than eight miles.

When evaluating your land for deficiencies in deer habitat, keep in mind that deer are an edge species. This means they prefer areas where two or more cover-types come together. If you own mostly woods, does your ground have an adequate number of openings? Do the woodlands contain a variety of trees and shrubs in various growth stages? Is there thick brush for hardcore cover? How far is the nearest agricultural planting?

Perhaps you own mostly open or agricultural ground. If this is the case, consider whether there are adequate woodlands providing cover and hard mast production, such as acorns. Tree and shrub plantings also might be an option. The appendix contains a
Step Two: Select the Right Management Practices for Your Land

Manipulating habitat to better suit the needs of deer can be accomplished through forest management, planted food plots and management of natural vegetation. There are myriad opinions about which practices attract and benefit deer. We have outlined those that are applicable to Missouri and that do not require a great deal of special equipment.

Timber Management

Forest management for deer generally consists of setting back plant succession to create brush and low browse for food and cover. Landowners often are reluctant to cut trees, but it is important to remember that trees do grow back. If you treat them like a crop, both you and your resident whitetails will benefit from a managed timber harvest.

Deer in large wooded tracts rely on shrubs and young trees for cover and food during all months of the year. Leaves are an important food source in spring and summer; twigs provide browse during winter.

A timber harvest generates income, creates small openings and sets back succession. Of course, harvest intensity depends upon the condition of the stand, but a heavy cut will create better and longer-lasting deer habitat. For guidance and technical assistance with timber management, contact your local Conservation Department forester.

Cutting Firewood

If you or your woodlands aren’t ready for full-scale timber management, making a firewood patch cut is another option. Simply select an area accessible by truck or tractor and cut next year’s supply of firewood; one-quarter to one-half acre cuts are adequate. You will obtain the best results if you cut all the trees. Piling the tops provides cover for other wildlife as well. Mowing with a brush cutter slows regrowth and allows other beneficial plants and shrubs to gain a foothold.

Plan next year’s cut in a nearby area and, in a few years, you will have a patchwork of trees and shrubs in various stages of growth. Cutting firewood along
<table>
<thead>
<tr>
<th>SPECIES</th>
<th>VARIETY</th>
<th>PLANTING DATE</th>
<th>BROADCAST LBS PER ACRE</th>
<th>GROWTH HABIT</th>
<th>DROUGHT TOLERANCE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Victoria Creeper</td>
<td>Spring, early fall</td>
<td>20–30</td>
<td>Perennial</td>
<td>Very Good</td>
<td>Most productive legume, hard to establish, alfalfa weevil a problem</td>
</tr>
<tr>
<td>Clover</td>
<td>Kenslow Red Redland</td>
<td>Winter–April</td>
<td>12–15</td>
<td>Biennial</td>
<td>Fair</td>
<td>Best choice for hay production, mow after second flowering</td>
</tr>
<tr>
<td></td>
<td>Regal Ladino</td>
<td>Spring, fall</td>
<td>2–4</td>
<td>Perennial</td>
<td>Good</td>
<td>Best source of protein, susceptible to dry, hot weather</td>
</tr>
<tr>
<td></td>
<td>White Dutch</td>
<td>Aug–Oct</td>
<td>3–6</td>
<td>Perennial</td>
<td>Poor</td>
<td>Tolerates shade, but not drought</td>
</tr>
<tr>
<td>Wheat</td>
<td>Stacy Clark Caldwell Bin-Run</td>
<td>Sept–Nov</td>
<td>30–60</td>
<td>Annual</td>
<td>Fair to Poor</td>
<td>Also attractive to turkeys</td>
</tr>
<tr>
<td>Rye</td>
<td></td>
<td>Sept–Oct</td>
<td>112–168</td>
<td>Annual</td>
<td>Fair</td>
<td></td>
</tr>
<tr>
<td>Milo</td>
<td>Savannah 5</td>
<td>May–June</td>
<td>10–15</td>
<td>Annual</td>
<td>Good</td>
<td></td>
</tr>
</tbody>
</table>

Field and woods borders also increases edge.

As a guide, about 30 percent of your woodlands should be in shrub and brush or old field stages. Old fields are simply grown up pastures. Hay or crop fields can be maintained in this stage by mowing with a brush cutter every three to seven years. Leaving the rest in mature hardwoods provides ample mast during fall and early winter.

**Planting Food Plots**

Food plots are a popular way to attract deer to selected areas for viewing or harvest. Green browse food plots, such as clover, alfalfa and wheat, provide deer and other wildlife with protein-rich vegetation during the critical growth period of early spring. Grain plots offer energy for maintenance during the cold winter months.

Food plots should be established near cover and away from roads to reduce the potential for deer/vehicle collisions and poaching. Again, a patchwork of one- to two-acre plots is better than one large one. Table 3 lists prescriptions for various green browse and grain plots.

Generally, double- or triple-discing provides adequate seedbed preparation. A soil test will dictate liming and fertilization rates required for your site. For a soil test, bring a pint of soil gathered from your seedbed to your county extension agent. The analysis typically costs less than $10 and is critical to any successful food plot.

To plant a green browse plot, fertilize and prepare the seedbed in mid-August to early September and broadcast with wheat at one bushel per acre. Disc lightly to cover seed wheat. Feed wheat is less expensive and also works well. The wheat will die the following summer, but it holds soil and is an attractive food source for deer during fall and winter.

In late February or early March, broadcast a mixture of 3 pounds red clover, 3 pounds ladino and 2 pounds white Dutch per acre. Korean lespedeza can be substituted for white Dutch clover on dry sites. These plots need to be mowed once during June and possibly in September to reduce weed competition and keep the fields green longer into the fall when they will be attractive to deer. Also, 100 pounds of phosphorus and 100 pounds potash per acre, top dressed every other fall, will prolong the life of the stand.

Although there are other alternatives to green browse plots (Table 4), clover is the crop of choice for achieving planting success rates, ease of maintenance, longevity and attractiveness. Recent clover studies indicate deer prefer Regal Ladino, which is available at most grain elevators.

However, protein levels of all ladino clovers average more than 24 percent throughout the year. Red
Table 4. Growth Patterns for Selected Green Browse Species

<table>
<thead>
<tr>
<th>FORAGE TYPE</th>
<th>MARCH</th>
<th>APRIL</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUG.</th>
<th>SEPT.</th>
<th>OCT.</th>
<th>NOV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Red Clover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trefoil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alsike Clover</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladino &amp; White Clover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lespedeza</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Closers and native vegetation peak at around 15 percent. Deer require 13 to 16 percent protein for optimal growth and 7 percent for maintenance. Ideally, green browse plots and other maintained openings should account for 7 to 15 percent of your deer management acres.

Milo is the grain of choice for food plots in Missouri because it is drought tolerant, requires a shorter growing season, needs less fertilizer and is palatable to a wide range of animal species. Corn is an alternative, but it should be sown with a planter and cultivated or sprayed to control weeds. Another drawback with corn is that it often doesn’t do well on rough or dry ground.

Grain plots should be at least one acre, but two to three acres are reasonable if you have lots of deer or wish to supply food through late winter. Field preparation is the same as described for green browse plots except that clover is not seeded. During May, disc the wheat under, lime and fertilize appropriately for milo, then broadcast milo at 15 pounds per acre and disc lightly.

Milo is a good source of carbohydrates and remains available to deer even after a snowfall. If grass hasn’t invaded the milo, wheat can be broadcast in the stand during early September at a rate of 1/2 bushel per acre. Disc, replant and fertilize next spring as previously outlined. About 7 to 15 percent of your ground should be sown in grain for optimal deer habitat.

**Burning and Discing**

Burning or discing to create wild foods for deer has been called the poor man’s food plot. Nevertheless, they can be effective methods to improve deer browse availability. Both management practices set back succession and are useful in areas where planted food plots may not be practical. To manage wild foods for deer browse, simply disc open ground to encourage weed growth. Forbs and fertilized plots typically are preferred over grasses. One bag of 13-13-13 per quarter-acre should be adequate to encourage a lush stand of annual forbs. When forbs are mature, another discing will allow a new crop of wild browse to grow. With good rainfall, you may be able to disc two to three times a year.

Timing and location selection for burning is a bit more complicated and can be dangerous. Before burning, contact a Conservation Department biologist to assist you with the site selection and burn plan.

* * * * * * *

Managing habitat and planting food plots for deer is rewarding. Seeing deer tracks and browse signs in a food plot or managed area is a measure of success. Buck rubs and bedding sites in your firewood cuts indicate you’ve created some preferred habitat. Taking an interest in deer habitat allows you to learn more about deer—and that makes you a better naturalist, hunter or deer enthusiast.
A question often asked by landowners is, “Can I effectively manage deer on my property?” The hunting season framework affords the opportunity for landowners to achieve desirable harvests on any property. Yet landowners’ ability to control deer numbers on their property depends upon the land’s size, shape and quality of habitat. Habitat quality and hunting pressure on surrounding properties also are important factors to consider.

The amount of land owned by one person decides how much of a role outside factors may play. As described earlier, deer move over large areas. As a result, the ability to manage deer increases proportionally with amount of acres owned. For example, landowners with 10 acres will have less control over deer on their property than landowners with 1,000 acres.

The amount of hunting or other activity on adjacent properties also is an influencing factor. Light or no hunting pressure on surrounding land may make it easier for a person to produce large bucks or increase deer densities. On the other hand, people trying to reduce deer numbers on their property may find it difficult if hunter access is limited on surrounding properties.

The physical shape of the property may affect how often deer move onto adjacent land. A long linear shape, as opposed to a more compact shape, may have more individual deer on the area, but these animals may spend less time there. When surrounded by heavily hunted ground, deer that live on a linear holding would spend more time off the property and, therefore, would be exposed to greater hunting pressure.

Quality of deer habitat and primary sources of food control how much time is spent on an area because deer shift movement patterns according to food distribution. In a year with a good acorn crop, deer may select oak-hickory forests for foraging in the fall instead of agricultural fields. On the other hand, deer may favor agricultural fields at other times of the year and also in years of poor acorn production.

In Missouri, most adult does have twin fawns; triplets are less common. Although the mortality rate for fawns can be 40 to 50 percent, deer have a 95 percent survival rate without hunting once they reach six months of age.

**Population Principles**

Whether a deer population increases, decreases or remains stable depends upon the balance between reproduction and mortality. Deer reproductive rates in Missouri are high, typical of those throughout much of the lower Midwest. Studies in several parts of Missouri determined deer mortality by monitoring free-ranging deer fitted with radio transmitters. These studies show that fawn mortality during the first six months of life may exceed 40 percent. Predation and farming activities are the primary causes of mortality in fawns less than two months of age.

Without hunting, the annual mortality of six-month-old and older deer is usually less than 5 percent. An exception to this occurs during hemorrhagic disease outbreaks, which take place periodically in Missouri and kill up to 20 percent of the deer in some areas.

Hunting is the leading cause of deer mortality in most of Missouri. Each year hunters take 40 to 70 percent of the antlered bucks and up to 25 percent of the does. It is apparent, therefore, that hunting is the primary factor governing deer abundance. A population model represents how we might expect deer numbers to respond to hunting given the reproductive and mortality rates experienced by animals within the population. The model provides a means of predicting the growth or decline of a population.
There are many examples of deer populations in various parts of the United States that have grown out of control when hunting was curtailed. Such cases are rare in Missouri but have occurred in localized situations. Knob Noster State Park in west central Missouri provides an example of what can happen when a deer population is not managed.

Deer disappeared from the area around Knob Noster in the early 1900s. Between 1945 and 1947, the Missouri Department of Conservation reintroduced about 50 deer into Knob Noster State Park. The population grew rapidly, and by 1953 most plants showed signs of heavy browsing. A severe winter in 1959-60 caused the only documented case of winter starvation of Missouri deer. Seventeen deer were found dead or starving in Knob Noster; and it is likely there were more. If the habitat had not been browsed severely by too many deer, the deer probably would have survived.

The Missouri State Parks Board, in cooperation with the Missouri Department of Conservation, responded to the situation by conducting a three-day archery hunt in 1960. A total of 1,054 hunters harvested 136 deer. Since this first hunt, periods of hunting have alternated with non-hunting periods. Increasing deer populations and severe browsing characterized nonhunting periods. In recent years, modern firearms hunts have controlled the Knob Noster deer population successfully, and habitat quality has improved.

As illustrated above, uncontrolled populations ultimately exceed the land’s carrying capacity. Fortunately, agriculture in much of the Midwest provides an almost unlimited supply of food for deer. Deer in Missouri, especially in the northern agriculture areas, exist at levels well below the land’s carrying capacity. These populations could reach much higher densities if deer were not hunted (Figure 6). Severe crop damage and unacceptable numbers of deer/vehicle accidents would take place long before the land’s carrying capacity was reached.

The need to control deer numbers in Missouri, therefore, is not related to the land’s carrying capacity but to a typically lower cultural carrying capacity—the maximum number of deer that the public will
accept before the negative aspects of high deer numbers, such as damage to crops and deer/vehicle accidents, become intolerable.

The Conservation Department’s statewide deer management program attempts to maintain deer populations at levels high enough to provide adequate opportunity for hunters and people who enjoy watching deer. Conversely, numbers must be low enough to minimize crop destruction and deer/vehicle accidents. Of course, people do not always agree about how many deer are too many or not enough.

The Conservation Department monitors the attitudes of the two groups most affected by deer abundance: farmers and hunters. Periodic mail surveys serve as the basis for setting deer population goals, along with information supplied by Conservation Department field staff.

Legal hunting most efficiently keeps deer at or below the cultural carrying capacity. Doe harvests have the greatest effect on the population so control of their harvest is necessary to avoid overharvest and to ensure an adequate harvest. Although deer management units were used historically to regulate doe harvests, in 2004 a county deer management system was implemented. Deer management by county provides for a simpler but finer level of deer management. Until 1997, hunters seeking any-deer and bonus permits had to apply for them, and recipients
were chosen by random drawing. Since 1997, any-deer and bonus permits have been sold over the counter through an automated point-of-sale system.

Information gathered from population models, public opinion, conservation agent reports, harvest data and deer/vehicle accident summaries are used to set doe harvest goals. Conservation Department wildlife managers know the average harvest success rates on any-deer and firearms antlerless permits and the percentage of does in the harvest because this information is gathered annually. Therefore, they can determine county levels that will attain the desired doe harvests. Landowners with deer damage problems can recruit hunters with any-deer and antlerless permits to achieve a sufficient doe harvest and control the local deer population size.

As deer populations have increased, permit availability and method of distribution have changed to provide abundant harvest opportunity and the convenience of over-the-counter deer permit sales while carefully controlling deer harvests to meet population objectives. Nevertheless, 93 percent of the land in Missouri is privately owned, and hunting access varies among properties. The variability in hunting pressure produces harvests that are high on some properties and low on others. Although the overall county harvest may be appropriate, there are often spots where hunters have taken too few or too many deer. Fortunately, landowners can control harvests and populations, especially if cooperative agreements are arranged between neighbors.

**Managing Deer: What are the Goals?**

Landowners have diverse attitudes toward deer on their property. Some would just as soon have no deer vying for the crops they produce. Others would like to have a deer behind every tree. Most landowners are somewhere inbetween. Harvest preferences also vary. Some landowners who hunt just want the opportunity to harvest a deer; others want only that trophy buck.
The guidelines indicate the number of deer to be taken per square mile under various outside harvest pressures.

* Deer populations were too low to create harvest guidelines.
Whether it be population or harvest goals, there are steps that can be taken to increase chances of achieving them. Sometimes a goal may be achieved simply by adjusting harvests. Other times it may require considerable effort, including regulating harvest and cooperating with adjacent landowners.

One difficult question facing most landowners is just how many deer should be taken from a property during hunting seasons. As described above, the answer depends upon many characteristics of the property and those surrounding it. A careful assessment of these conditions is necessary before making even a rough estimate of how many deer to take each year. Even then, this figure will require regular evaluation and correction.

On the previous page, Figure 8 provides some harvest guidelines based on population modeling. The data used to generate these graphs are based on a square mile segment of habitat. Average densities, mortality and reproductive parameters for different regions of the state were used for input. Deer hunting pressure on adjacent properties was entered as light (little or no pressure; bucks are the only deer taken), moderate (heavily hunted the first weekend of the firearms season; little hunting after that; both bucks and does taken but mostly bucks), or heavy (hunting pressure heavy throughout the firearms season; both bucks and does harvested at high rates).

The initial deer densities are based on regional averages. These, of course, vary locally and are greatly influenced by historical hunting pressure on and off the area. Therefore, actual starting values on your area may be different from those used in these calculations. The recommended harvests indicate the number of deer that can be removed and still maintain a stable population. If higher or lower deer densities are desired, harvests should be adjusted.

Although the recommended harvest figures can be used as a guide to deer management on your lands, monitoring deer populations is important. Annual population estimates are essential to decide if goals are being achieved. It is likely that adjustments in annual harvests will have to be made. This requires continual monitoring to re-evaluate harvest strategies. In the end, landowners need to design a harvest schedule that works best for them.

**Specialized Deer Management**

Considerable interest in managing land for mature bucks has developed in recent years. Two tenets dominate popular and management-oriented literature: quality and trophy management. The concept of quality deer management began in the southern United States. Its primary objective is to manage deer populations and habitat to ensure a quality hunting experience. Although deer in older age classes is one goal, other factors are considered.

Trophy management is more restrictive. Its primary emphasis is producing a buck with the largest possible rack. This requires intense management and strict control over harvests. It is not practical in most situations in Missouri. Most trophy management is
hunted. The key to management for larger bucks is simply to allow males in younger age classes to survive to older age classes.

Managers can accomplish this by not shooting young bucks during the hunting seasons. This may seem too simplistic, but deer survival is high when they are not hunted. Chances are good that a buck will survive if not taken during the hunting season and, in so doing, will grow bigger antlers the following year.

Modeling hypothetical populations in which buck harvest is varied illustrates this the best. Sex and age ratios differ considerably depending upon the percentage of bucks harvested. A model with 10 percent antlered buck harvest indicates that 50 percent of the antlered bucks are between 2 1/2 and 4 1/2 years old, and 24 percent are 4 1/2 years old and older.

In contrast, populations where bucks are highly exploited, only 27 percent of the antlered bucks are between 2 1/2 and 4 1/2 years old and 1 percent are 4 1/2 years old and older. Antlered bucks would make up 35 percent of the total population in the low buck-exploited population compared with 16 percent in the high buck-exploited population (Figure 9).

When regulating buck harvest, the same factors that affect populations on a property apply except that bucks are more active and have larger home ranges. This is especially true during the breeding season, which coincides with the firearms season. As a result, the minimum acreage required to effectively manage quality bucks is higher. Unless ownership is at least 1,000 acres, effective management of bucks in older age classes will require the cooperation of surrounding landowners.

Landowners desiring this type of management should contact neighbors with similar goals and develop a plan that protects 1 1/2- and 2 1/2-year-old bucks during the deer hunting seasons. The relative experience of deer hunters involved dictates minimum antler size requirements. If most deer hunters are experienced hunters, a minimum antler spread, such as length beyond the ears, may be established.

Another way to restrict harvest to bucks with a minimum number of points. However, the number of
Yearling bucks should be protected if your goal is to produce adult animals with large racks. Because mortality is low when they are not hunted, young bucks are likely to survive if not taken during the hunting season and will grow larger antlers the following year.

points and deer age do not always correlate. Hunters may take yearlings with many points that should be protected. In contrast, hunters may pass up some older, larger deer with well-developed antlers but too few points to qualify for harvest.

Controversy currently exists over whether spike bucks should be culled. In Missouri though, most bucks that reach 4 1/2 years of age will be trophies to most hunters. Given most hunter expectations and the inability to control harvests and dispersals on small land holdings in Missouri, the best strategy is to pass up these young bucks during the hunting seasons. The result usually will be the production of a quality animal several years down the road.

Record Keeping

Assessing the success of a deer management program on a property is an important part of every management effort. This can be as simple as keeping track of the number of deer observed and taken during the deer hunting seasons each year to more scientific efforts, such as aerial census of deer. Most landowners prefer the former, but those whose primary goal for their land is deer management may choose a more careful evaluation method.

Simple records carefully collected over a period of years can tell a lot about the status of the deer population. Most often landowners take these records during the deer hunting seasons when they spend the most time in the woods. Diaries of hunting trips (see Appendix) not only can be rewarding historical accounts of hunts and observations but also can provide useful information about the deer population. Population indices, such as the number of deer sighted by sex and age per hour, may be determined from this type of information.

Deer sightings per hour are used by some state conservation agencies as a population measurement on public lands. Many biologists believe deer sighting indices are better able to track population changes than track or spotlight counts. Population indices become more meaningful over time and are not intended to produce complete counts; they show general trends in sex and age ratios and population changes. The key is to record this information consistently from year to year.

Annual records of harvested deer, their sex, age, weight, antler beam circumference and date taken also may be useful (see Appendix). Records may provide information on the herd structure and condition that can be used to gauge the success of a management effort.

Census, or an actual count of deer, is much more expensive than those methods listed above and will not be a practical option for most landowners. An aerial census with a helicopter over snow-covered ground currently is the most accurate way to count deer. Unfortunately, necessary conditions, such as adequate snowcover, do not consistently occur in Missouri.

Infrared scanners, which detect body heat and do not require snow cover, have shown some promise for counting deer. Other methods include fecal pellet group counts, spotlight surveys and track surveys.

These methods are of questionable accuracy if actual deer population estimates are required. They may be of more value as an index to population trends than for counting deer.
The future of white-tailed deer in Missouri will be influenced by available habitat and food, but perhaps more important, by the attitudes of Missouri's landowners and citizens. Whitetail populations were high prior to settlement by immigrants. During the 1920s, populations were at all time lows. Today we have as many or more deer than during presettlement times.

The recovery of white-tailed deer in Missouri can be credited, in part, to grassroots movements that helped create a strong, less politically influenced Conservation Department, which tries to maintain deer numbers at levels that serve the best interest of the Missouri public.

Deer today are pursued by more than 400,000 firearm and archery deer hunters each fall. Many other deer enthusiasts shoot their trophy deer with cameras or simply enjoy viewing whitetails in their natural habitat.

Maintaining deer numbers to serve the pursuits of all deer enthusiasts, but not adversely impact agriculture or cause excessive automobile accidents, requires active public participation. Public opinion from surveys is necessary to determine appropriate deer densities for given areas. Annual hunting seasons provide recreation for deer hunters but are equally important to maintain deer densities at or near management goals.

The key to maintaining healthy deer populations compatible with human activities is to set reasonable population goals. Deer numbers must be maintained at levels that do not damage habitats or unnecessarily impact surrounding agricultural areas. These same principles used to manage the state's deer herd should be considered by individual deer managers.

We hope that throughout this publication we have provided information and management philosophy that will enable landowners of 40 or 4,000 acres to make educated decisions when managing deer populations.
White-tailed Deer Habitat Appraisal

This appraisal is intended as a general guide for landowners and deer enthusiasts who wish to assess the quality of deer habitat on a particular tract of land. Whitetails are extremely adaptable and can live and thrive in a variety of habitats. However, you can use this appraisal to help you recognize potential deficiencies on your lands or, perhaps, help you create a deer paradise.

DIRECTIONS

1. Assess overall food value.

Consider the surrounding 1,000 acres as a management unit when completing the food value appraisal to the right.

a. Circle the values next to the food availability descriptions that best describe your tract of land on the worksheet to the right.

b. Add the six food availability scores together to find the total food availability score.

c. Divide the total food availability score by six to obtain the overall food value for the land.

<table>
<thead>
<tr>
<th>Total food availability</th>
<th>= OVERALL FOOD VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

An overall food value greater than six should provide deer with adequate nutrition, provided there are no obvious deficiencies in one particular category.

Remember, whitetails use a wide range of woody, herbaceous and agricultural crops—more than 272 different foods in Missouri. Food is seldom a limiting factor, but certain plant species are preferred by deer.

Criteria with the lowest scores should be considered first when formulating a deer management plan for your area.

2. Estimate cover and habitat value.

Consider the surrounding 1,000 acres as a management unit when completing the cover and habitat appraisal to the right.

a. Circle the values next to the cover and habitat descriptions that best describe your tract of land on the worksheet to the right.

b. Add the five scores together to find the total cover and habitat score.

c. Divide the total score by five to obtain the cover and habitat value.

<table>
<thead>
<tr>
<th>Total cover &amp; habitat score</th>
<th>= COVER &amp; HABITAT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Any score of six or better indicates good deer habitat. Higher scores usually are the result of intensive management.

Remember, whitetails use many habitats. However, some cover types are selected during certain periods. In addition, deer have smaller home ranges in areas with optimal cover and may spend more time on ground with excellent habitat.

Cover and habitat criteria with the lowest scores should be considered when any habitat improvement program is implemented.
## Habitat Appraisal Worksheet

### Criteria for Food

*Circle the correct value*

- **Agricultural crops available to deer**
  - 10 10-30% in agricultural crops
  - 8 30-50% in agricultural crops
  - 6 Less than 10% or greater than 60% in agricultural crops
  - 4 No agricultural crops

- **Availability of winter crop residue**
  - 10 No fall tillage, residue undisturbed or seeded to winter wheat
  - 4 Chisel plowing once in fall
  - 2 Crop residue grazed or bailed
  - 0 Fall plowing or discing with no cover crop

- **Pasture, hay fields or green browse composition**
  - 10 Alfalfa, clover and other legumes dominate fields
  - 6 Alfalfa, clover and other legumes comprise at least 1/3 field
  - 4 Field is primarily grass

- **Pasture, hay field or green browse management**
  - 10 Annual haying in June, fertilization in September
  - 6 Moderate grazing pressure or haying pressure
  - 2 Heavy grazing or haying pressure

- **Availability of winter browse**
  - 10 30-50% brush and old field cover types with a variety of tree, shrub and herbaceous species
  - 6 10-30% of area in brush and old field cover types, edge feathering common
  - 4 Less than 10% of area in brush and old fields, edge feathering present
  - 2 Less than 10% of area in brush and old fields, no edge feathering

- **Availability of fall mast**
  - 10 Oaks are dominant tree species with both red and white oak groups
  - 6 Oaks are dominant tree species with either red or white oak group forming more than 75% of trees
  - 4 Oaks are present but form less than 10% of trees

### Criteria for Cover and Habitat

*Circle the correct value*

- **Extent of winter escape cover**
  - 10 30% of area consists of brush, old fields or cedar thickets
  - 6 20% of area consists of brush, old fields or cedar thickets
  - 2 10% of area consists of brush, old fields or cedar thickets

- **Extent of fawning habitat**
  - 10 Brushy areas and old fields scattered throughout area
  - 6 Brushy areas and old fields present in large blocks
  - 4 Brushy areas and old fields not present

- **Edge configuration and extent of border**
  - 10 Irregular border and edge feathering greater than 50%
  - 8 Straight border and edge feathering 25-50%
  - 4 Irregular border no edge feathering
  - 2 Straight border no edge feathering

- **Crop field of food plot size**
  - 10 Average field size between 1 and 5 acres
  - 8 Average field size between 5 and 10 acres
  - 6 Average field size between 10 and 20 acres
  - 4 Average field size greater than 20 acres

- **Number of habitat type changes**

  Use an aerial photo or walk transects to determine how often the habitat type changes. Take one transect on a line that runs north to south and another that runs east to west at the widest points and count the number of habitat changes.

  - 10 Habitat type changes more than 10 times
  - 6 Habitat type changes more than 5 times
  - 2 Habitat type changes more than 2 times
Dental-Age Characters of White-tailed Deer

(Cheek side of lower molar tooth row)

**2 1/2 to 4 months**
- CRESTS OF FIRST PERMANENT MOLAR VISIBLE
- TEMPORARY PINCERS

**4 to 7 months**
- FIRST PERMANENT MOLAR FULLY ERUPTED OR NEARLY SO
- PINCERS EITHER TEMPORARY OR PERMANENT

**6 to 9 months**
- CRESTS OF SECOND PERMANENT MOLAR VISIBLE
- PERMANENT PINCERS

**17 months**
- TEMPERATURE PREMOLARS WORN
- THREE CUSPS

**18 months**
- TEMPORARY PREMOLARS BEING REPLACED BY PERMANENT PREMOLARS
- THIRD PERMANENT PREMOLAR HAS TWO CUSPS

**19 months**
- PERMANENT PREMOLARS ALL IN PLACE BUT RELATIVELY UNSTAINED
- THIRD PREMOLAR NOT FULLY ERUPTED
- LAST CUSP OF THIRD MOLAR NOT FULLY ERUPTED AND UNWORN