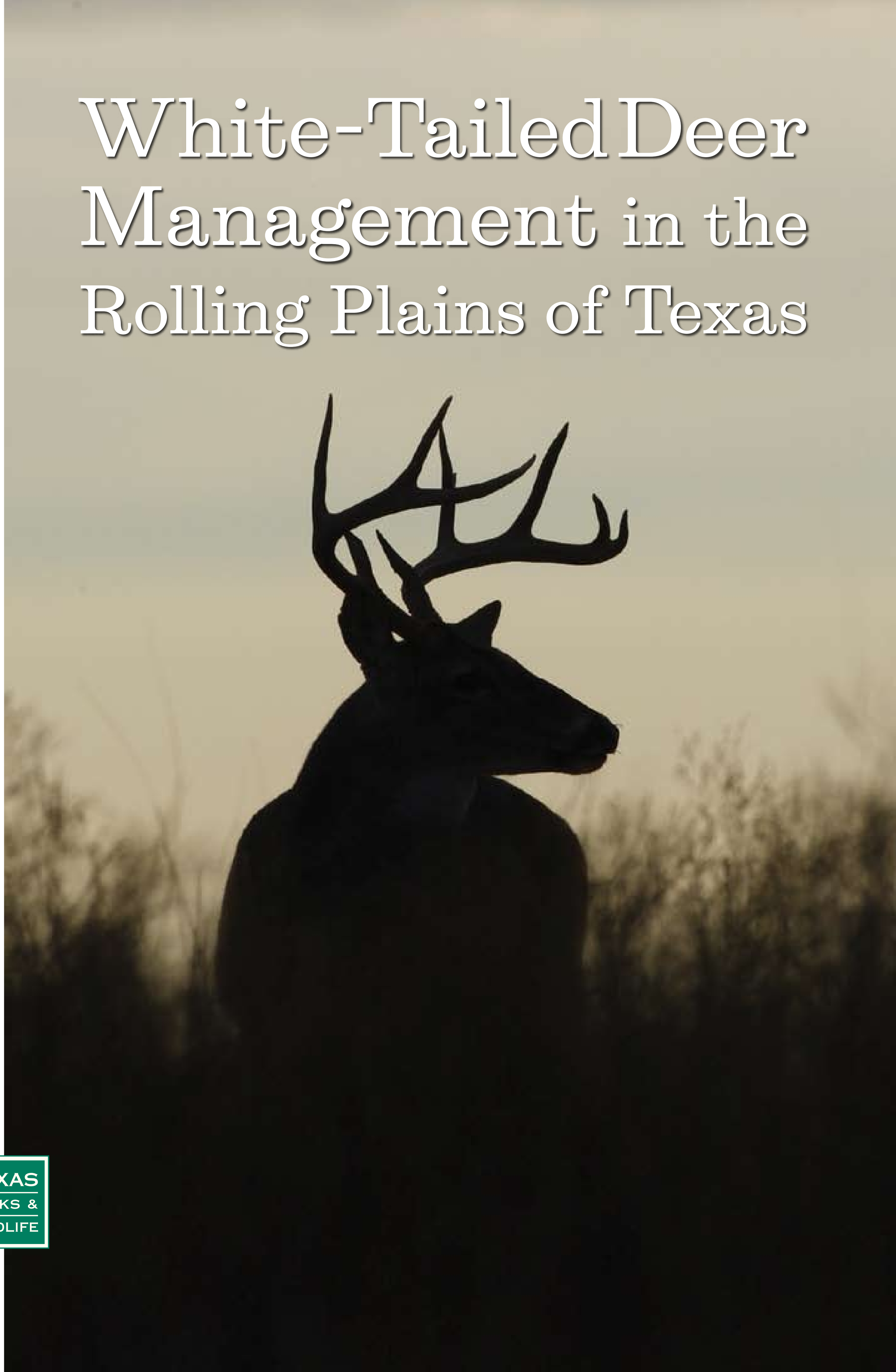
White-Tailed Deer Management in the Rolling Plains of Texas



TEXAS PARKS & WILDLIFE

White-Tailed Deer Management in the Rolling Plains of Texas

by

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Cover photo courtesy of Russell A. Graves.

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INTRODUCTION

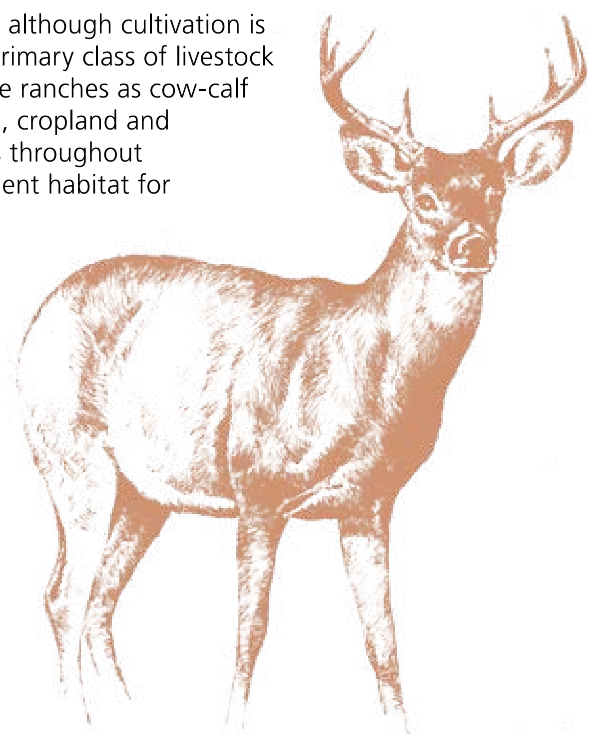
Texas is renowned for its abundant wildlife, especially white-tailed deer. They have gained prominence throughout the Rolling Plains due to increasing numbers and an increasing appreciation for their aesthetic, recreational and economic value. The Rolling Plains produces some of the largest deer in the state, especially the northern extremes (TPWD 1980–2005). This publication is intended to inform interested landowners, managers, sportsmen and the general public about the biology and management of white-tailed deer in the Rolling Plains of Texas.

ROLLING PLAINS REGION

The Rolling Plains ecological region encompasses approximately 24 million acres and is part of the Southern Great Plains region of the central United States (Figure 1). The Rolling Plains region is located in the northern portion of Texas and stretches eastward from the Llano Estacado Escarpment into Oklahoma and westward along the Canadian River drainage. The region includes portions of Montague, Clay, Archer, Young, Stevens, Callahan, Coleman and Brown counties on the eastern extreme, and portions of McCulloch, Concho and Tom Green counties on the southern extreme (Griffith et al. 2004).

The topography is generally rolling except in localized areas where stream channel erosion has produced prominent escarpments and canyons. Elevations range from 800 to 3,000 feet. Soils range from coarse sands adjacent to streams to tight or compact clays underlain by caliche and sandstone. The original vegetation on the loamy soils included little bluestem, big bluestem, silver bluestem, Texas wintergrass, yellow Indiangrass, switchgrass, sideoats grama, blue grama, wildrye, tobosagrass and buffalograss. The sandy soils support tall bunchgrasses, while sand shinnery oak, sand sagebrush and mesquite are the dominant woody plants. Redberry juniper typically dominates the shallow-soil sites, especially along the western portion of the region. Other important woody species occurring throughout the region are netleaf hackberry, Eastern cottonwood, aromatic sumac, littleleaf sumac, four-winged saltbush, woollybucket bumelia, western soapberry, lotebush, and vine ephedra. Annual precipitation ranges from 18 inches in the west to 29 inches in the southeastern portion. Although annual and seasonal rainfall is highly variable, May and September normally are the high rainfall months (Griffith et al. 2004). Variability of rainfall is an important factor influencing deer habitat and populations in the Rolling Plains.

About two-thirds of the area is rangeland, although cultivation is important (wheat, cotton, peanuts). The primary class of livestock is cattle, most of which are grazed on large ranches as cow-calf operations. The interspersion of rangeland, cropland and Conservation Reserve Program (CRP) lands throughout most of the region provides good to excellent habitat for white-tailed deer and other wildlife.



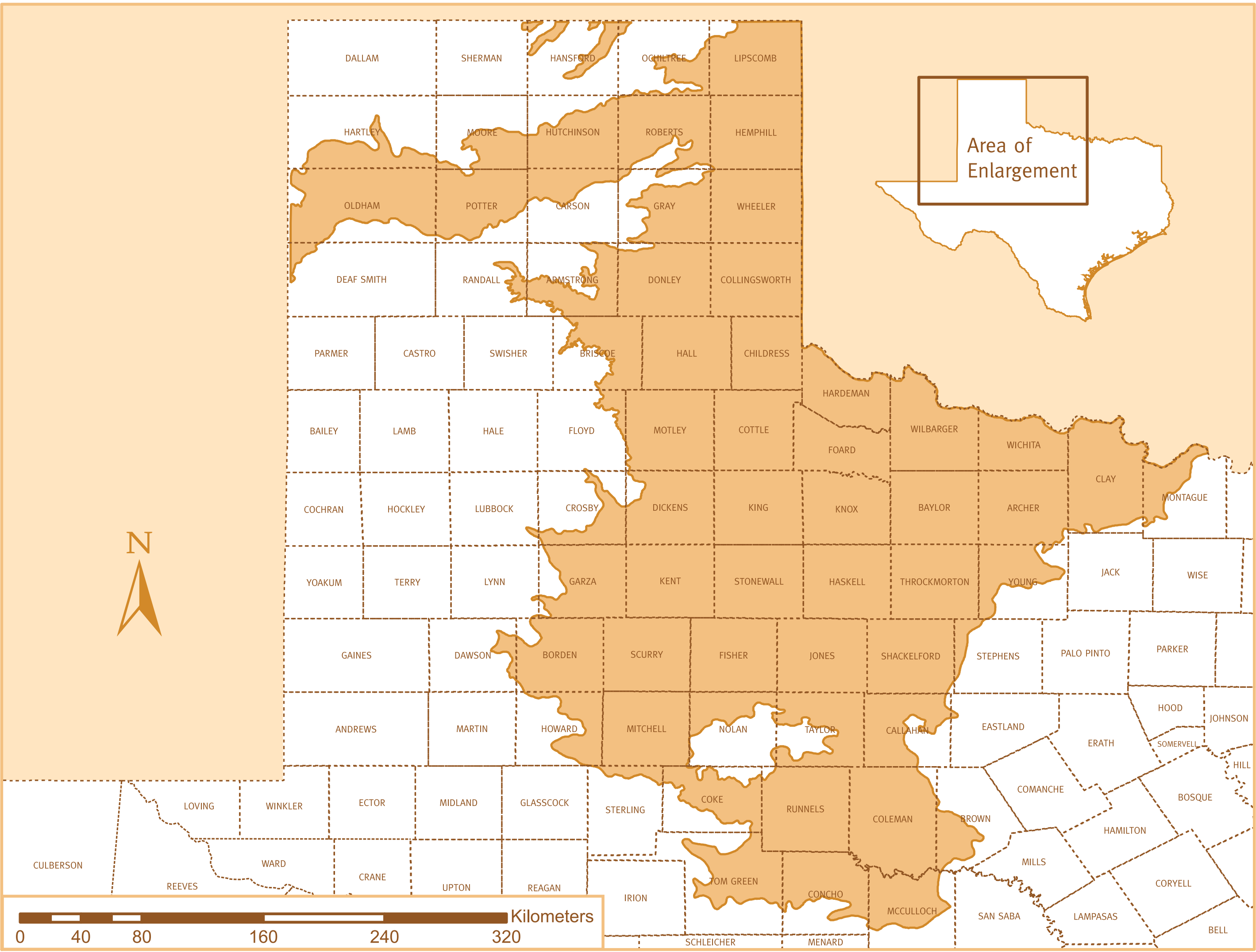


Figure 1.
The Rolling Plains Ecological Region of Texas.

HISTORY, POPULATION STATUS AND DISTRIBUTION

Historically, the Rolling Plains consisted of vast grasslands dissected by the Canadian River in the north and headwaters of the Pease, Red, Brazos, Wichita and Colorado rivers in the central and southern areas. Woody cover preferred by white-tailed deer was limited to sparse stands of mesquite in some grassland areas, redberry juniper scattered along the slopes of Palo Duro Canyon and the Llano Estacado escarpment, and various drainages containing cottonwood, hackberry and soapberry.

Early records of white-tailed deer in the region suggest their distribution was very limited. Bailey (1905) listed only three records for the region in a biological survey of Texas. One record described three white-tailed deer collected from Beaver Creek in Sherman County in 1885. He also indicated that a few white-tailed deer were present in 1903 in brushy areas around Canadian, Hemphill County, and in 1904 near Mobeetie, Wheeler County.

Activities associated with human settlement of the region such as suppression of wildfires and heavy livestock grazing promoted encroachment of native woody species such as redberry juniper, mesquite and shinnery oak. Additional woody cover has developed in recent decades with the invasion of saltcedar along many riparian areas.

Increasing amounts of woody cover gradually improved white-tailed deer habitat in the Rolling Plains. Approximately 3,170 white-tailed deer were transplanted (released) on numerous sites within the Rolling Plains by the Texas Game, Fish and Oyster Commission and later by the Texas Parks and Wildlife Department between 1939 and 1991 (M. Lockwood, TPWD, personal communication). The majority of deer released in the Rolling Plains were transported from sites in South Texas and the Edwards Plateau. Today, white-tailed deer are found in all Rolling Plains counties and have expanded into portions of the High Plains (Figure 2).

Created in 1895 by the legislature, the Texas Fish and Oyster Commission regulated fishing until 1907 when the Game Department was added. It was not until 1963 with the merging of the State Parks Board that the commission was renamed the Texas Parks and Wildlife Department.

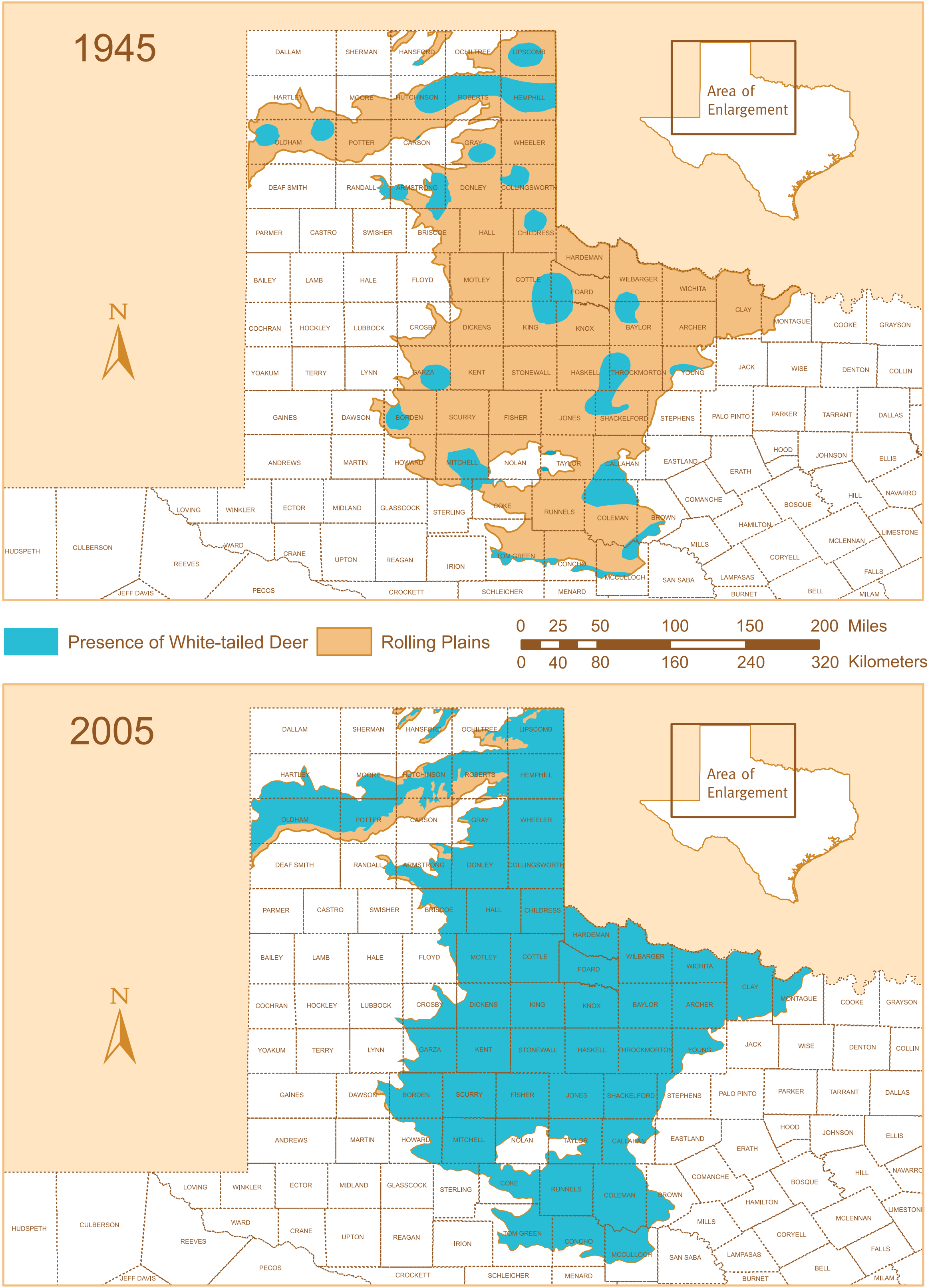


Figure 2.
White-tailed deer distributions in 1945 (Texas Game, Fish and Oyster Commission 1945) and 2005 (Texas Parks and Wildlife Department 2005).

BASIC DEER BIOLOGY

Morphology

Body size of white-tailed deer varies by region in Texas, and some of the largest deer occur in the northern Rolling Plains. Field-dressed weights of mature bucks average more than 150 pounds (Table 1), with live weights occasionally exceeding 230 pounds (TPWD 1980–2005). Field-dressed weights of adult does average 83 pounds in the northern Rolling Plains and 74 pounds in the southern Rolling Plains (n=262, 3.5 to 6.5 years old).

Antler Development

Antlers grow from pedicels on the frontal bone of the skull and harden into true bones. Antler growth in white-tailed deer begins in early spring and is influenced by a decrease in production of the hormone testosterone. As the antler grows, it is covered with hairy skin called velvet that contains nerves and blood vessels that provide nourishment for the growing antler. Velvet is shed in late summer when testosterone levels increase, leaving the hardened antler. After the breeding season, the supply of testosterone decreases again, a separation layer forms between the antler and the pedicel, and the antler is shed.

Antler development in white-tailed deer results from the collective contribution of nutrition, genetics and age (Ullrey 1982, Demarais 1998). White-tailed deer require a diet containing 13 to 16 percent crude protein (including adequate levels of carbohydrates, fats, minerals and vitamins) in order to express their genetic potential for antler development. Many species of forbs and a few woody plants in the Rolling Plains meet or exceed this level of protein. Some grain crops such as winter wheat can also supply this level of protein. Studies conducted with captive white-tailed deer have demonstrated that body size and antler characteristics in yearling deer are influenced by both genetics and nutrition (Harmel et al. 1989, Armstrong 2002). Another important factor determining antler characteristics in white-tailed deer is age. During the early years of life, most of the nutrients ingested are used for supporting body growth. In adult bucks, the majority of nutrients ingested through forage intake contribute to body maintenance and antler growth. Antler measurements and number of points by age class in the Rolling Plains indicate that antler size increases through age 6.5, although there is little difference between antler characteristics at 5.5 and 6.5 years of age. Antler characteristics, with the possible exception of "inside spread," typically decline by 7.5 years of age. Table 2 illustrates typical antler characteristics for mature bucks in the Rolling Plains (TPWD 1980–2005).

Data collected over the past 25 years in the Rolling Plains suggests that the incidence of "spike" bucks (unbranched antler on each side) in the yearling age class is partially influenced by nutrition. Rainfall patterns fluctuate dramatically among years and appear to have a noticeable effect on deer nutrition and antler development. Depending on rainfall conditions in spring and early summer, the percent of spikes in the yearling age class may range from 5 percent to 50 percent annually (TPWD 1980–2005). The long-term average percent of spikes in the yearling age class is 12.1 percent in the northern Rolling Plains and 26.6 percent in the southern Rolling Plains (n=957). The difference in spike incidence between northern and southern areas further demonstrates the inverse relationship between spike occurrence and nutrition.

Table 1.
Average field-dressed weights of bucks by age class in the northern and southern Rolling Plains (based upon weights of 1,031 deer collected during 1980–2005).

Field-Dressed Weights (lbs.) by Age Class							
Years of Age	1.5	2.5	3.5	4.5	5.5	6.5	7.5
Northern Rolling Plains	95	117	132	146	150	152	144
Southern Rolling Plains	77	95	107	118	121	123	116

Table 2.
Antler characteristics of 6.5-year-old bucks harvested in the northern and southern Rolling Plains, 1980–2005 (n=100).

	Total Points	Inside Spread (in.)	Basal Circumference (in.)	Main Beam Length (in.)
Northern Rolling Plains	9.4	17.2	4.7	21.4
Southern Rolling Plains	8.9	16.6	4.2	20.0

Nutrition

The nutritional requirements of deer vary annually and seasonally, depending on factors such as sex, age, physiological state and environmental conditions. Deer typically will consume about 4 percent of their body weight per day in forage (dry weight basis), although average intake declines during the winter months. A 100-pound deer will consume approximately 4 pounds of forage (dry weight) per day or 1,460 pounds during the year. White-tailed deer are very adaptable, and if preferred foods are reduced or depleted, they will attempt to obtain nutritional requirements from alternate forage sources. Basic nutrients required by all deer for body growth and maintenance include protein, macro-minerals, trace minerals, vitamins and fats/carbohydrates for energy.

Protein

Growing fawns require 14–20 percent protein, with buck fawns requiring slightly more than doe fawns (Ullrey et al. 1967). Growing antlers consist almost entirely of protein (collagen) and typically consist of 35–45 percent protein once they harden or "mineralize." While antlers are growing, bucks require a diet of 13–16 percent protein for optimum development, along with other required nutrients. Only 6–10 percent protein is required for maintenance of adult deer. Lactation places the greatest demand for protein on adult does. A doe nursing twin fawns requires 16–18 percent protein in the diet (Brown 1996).

Minerals

Calcium and phosphorus are the primary minerals necessary for bone and antler growth, milk production, blood clotting, muscle contraction and general metabolism. Hardened deer antlers are about 22 percent calcium and 11 percent phosphorus. Many studies have been conducted on mineral requirements for antler growth, but results have been highly variable and often conflicting. Reported requirements for calcium have ranged from 0.40–0.64 percent, while optimum phosphorus levels ranged from 0.12–0.30 percent (McEwen et al. 1957, Ullrey 1982, Jacobson 1984, Grasman and Hellgren 1993). One reason for the inconsistency is the confounding effects of genetics in antler development studies. Another

Deer rumens are relatively small with quick passage rates, obligating them to a low-fiber, high-quality diet of forbs, tender grass shoots and fresh browse.

reason for the variability is that bucks can store minerals in their skeletons and transfer them to the antlers during mineralization. After the antlers harden, minerals lost from the bones are replaced from the diet. Other macro-minerals (needed in large amounts and measured in "percent of intake") important in antler development and other bodily functions include sodium, potassium, magnesium, chlorine and sulfur.

Trace minerals, which are measured in parts per million (ppm), are just as critical but needed in only very small quantities. Several trace minerals have been documented as constituents of white-tailed deer antlers: iron (55 ppm), manganese (6.6 ppm), zinc (116 ppm) and copper (48 ppm) (Varner 2002). Other micro-minerals important to bodily processes in deer are iodine, cobalt, fluorine, molybdenum and selenium. Just as important as obtaining required amounts of minerals and vitamins is obtaining the proper balance (ratios) of these nutrients. Deer are highly selective foragers and seldom have difficulty obtaining the proper combination of minerals/vitamins in quality habitats that support a diversity of grasses, forbs and woody plants.

Vitamins

Vitamins are classified as either fat soluble (A, D, K and E) or water soluble (C and B complex). Fat-soluble vitamins are stored in the fat and liver of a deer, but water-soluble vitamins are not stored and are needed on a daily basis. The specific requirement for vitamin D is not known. However, vitamin D is needed for calcium absorption and metabolism, and a study documented that vitamin D levels in the blood fluctuated with the antler growth cycle in bucks (Van der Eems et al. 1988). Vitamin A is seldom deficient because it is readily converted by deer from carotene found in green vegetation. Even when green vegetation is limited during the winter months, deficiencies generally do not occur because deer can store vitamin A for three to four months.

Energy

Although energy is an important nutritional requirement, it is really not a nutrient. It is a property of protein, fats and carbohydrates. Vegetative parts of plants (foliage) are typically low in fats but are the primary source of carbohydrates (sugar, starch, cellulose). The mast/fruits of plants (i.e. acorns, peanuts, corn) have high levels of fat, which have almost 2.5 times the energy content of carbohydrates or proteins (Brown 1996). Most ranchers think of energy in terms of total digestible nutrients (TDN) or digestible dry matter (DDM), which are essentially equivalent. Using this terminology, deer must consume forages that range from 50–68 percent TDN, depending on sex, age and physiological state. The greatest energy levels are required by growing fawns (64–68 percent TDN) and lactating does (60–65 percent TDN), while energy requirements for bucks during antler growth are slightly less (55–60 percent TDN). Adult deer on a maintenance diet only require 50–55 percent TDN (Varner 2002).

Food Habits

Knowledge of deer food habits is fundamental to making informed management decisions. Understanding which plants are most valuable to the local deer herd will allow managers to assess habitat quality, and to improve habitat and health of the deer herd. Food habits research on white-tailed deer in Texas and elsewhere has indicated that browse (leaves, buds, fruits and flowers of woody plants) generally constitutes the majority of the annual diet, while forbs are preferred when available. With few exceptions, grasses tend to be the least important forage class, although they increase in importance in areas where forbs are scarce and woody plant diversity is low (Chamrad and Box 1968, Gee et al. 1991). However, diet studies conducted in other regions do not represent the seasonal availability or preference for plants used by white-tailed deer in the Rolling Plains. Therefore, the results of studies conducted in other regions are useful on a general basis, at best.

Until recently, limited information was available to landowners and managers concerning the foraging habits and food preferences of white-tailed deer in the Rolling Plains. One study of white-tailed deer diets in the southern Rolling Plains was conducted in parts of Haskell, Throckmorton, and Shackelford counties (Quinton et al. 1979). Food habits of deer were assessed by fecal analysis in relation to different brush treatments on six sites. Browse species composed 72 percent of the annual diet, while forbs and grasses represented 24 percent and 2 percent, respectively (2 percent unknown items). Mistletoe and prickly pear cactus were the most important foods in the annual diet, accounting for 53 percent of items consumed.

More recently, Burke (2003) conducted a comprehensive study of the seasonal food habits of white-tailed deer. Over a two-year period, 317 deer were collected from eight sites in the following counties: Tom Green, Runnels, Shackelford, Wilbarger, Cottle, Wheeler and Hutchinson. Rumen samples were analyzed to identify the most frequent food items in the diet. This information, combined with site-specific vegetation surveys to indicate species availability, was used to identify the forage species preferred by deer. The results of the study indicate that precipitation was a very strong influence on food item availability and preference, with several sites experiencing drought conditions during a substantial portion of the two-year research period. Because forbs are less available during drought, deer typically increase use of browse foliage and mast (e.g., prickly pear fruit and mesquite beans). This pattern of forage use was observed during the first study year (1999–2000), especially in the southern Rolling Plains collection sites (Figure 3). Improved rainfall and range conditions apparently led to higher plant diversity and broader resource use by white-tailed deer in 2000–2001 (Figure 4). As in most other studies, browse was used more than any other forage class, but woody plant use declined substantially when forbs were abundant. Forbs only composed 18 percent of the diet during the first year when drought conditions existed on many sites, but more than doubled (38 percent) in the second year when rainfall increased on many sites. Grasses were an important component of the diet with consistent use during both years (19 percent).

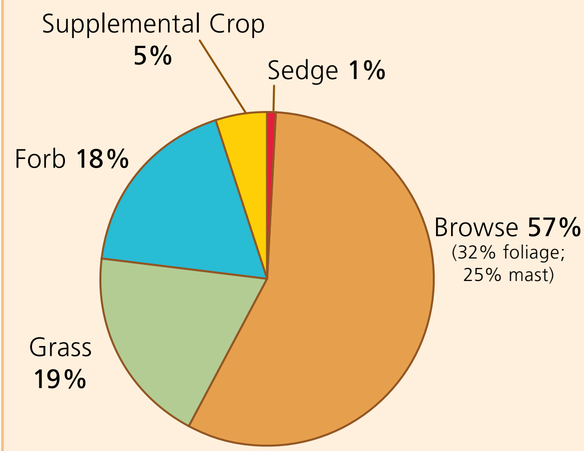


Figure 3.
Annual use of forage classes by white-tailed deer in the Rolling Plains Ecological Region in 1999–2000.

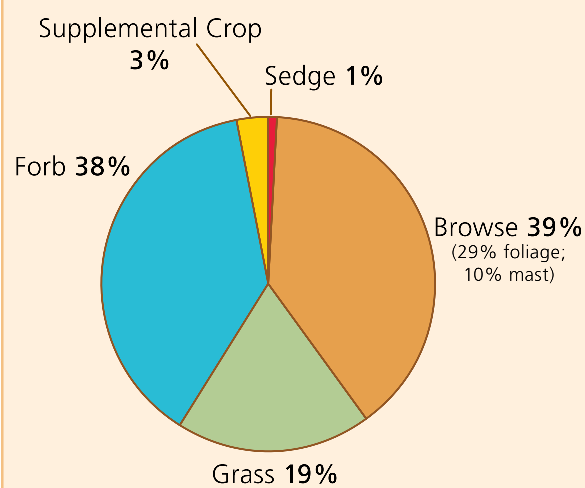


Figure 4.
Annual use of forage classes by white-tailed deer in the Rolling Plains Ecological Region in 2000–2001.

Use of major forage classes varied greatly among seasons (Figure 5). Browse (woody plants/cacti) use was considerable during each season but greatest during summer and fall. Forbs constituted the bulk of the diet in spring (50 percent), but substantial use also occurred during summer. This trend indicates that forbs are strongly preferred when available and actively growing. Grasses received little use during spring and summer but became increasingly important during fall (24 percent) and winter (41 percent), presumably as forb availability decreased and deciduous browse species defoliated. Although grasses are not "preferred" by deer as a forage class, cool-season annual and perennial grasses appear to be an important nutritional component of deer diets in the Rolling Plains when other forages decline in quantity and quality.

Burke's (2003) research identified 239 plant species occurring in the diets of Rolling Plains' white-tailed deer. Tables 3 and 5 show the forage items found most frequently in deer diets in the northern Rolling Plains (Matador WMA, Cottle, Hutchinson and Wheeler County sites) and southern Rolling Plains (San Angelo WMA, Runnels, Shackelford, Wilbarger County sites), respectively. The species occurring most frequently in the diet are obviously important to deer, but importance does not necessarily translate to preference. Some forage species are consumed primarily because they are abundant rather than because they are highly nutritious or preferred. Relative preference can be calculated for each forage species by measuring its availability at a collection site and then comparing availability to level of use. A summary of the preferred plant species (by forage class) is presented in Table 4 for the northern Rolling Plains and in Table 6 for the southern Rolling Plains. Recognizing preferred forage species can be especially helpful to managers desiring to promote or maintain valuable plant species when implementing management practices.

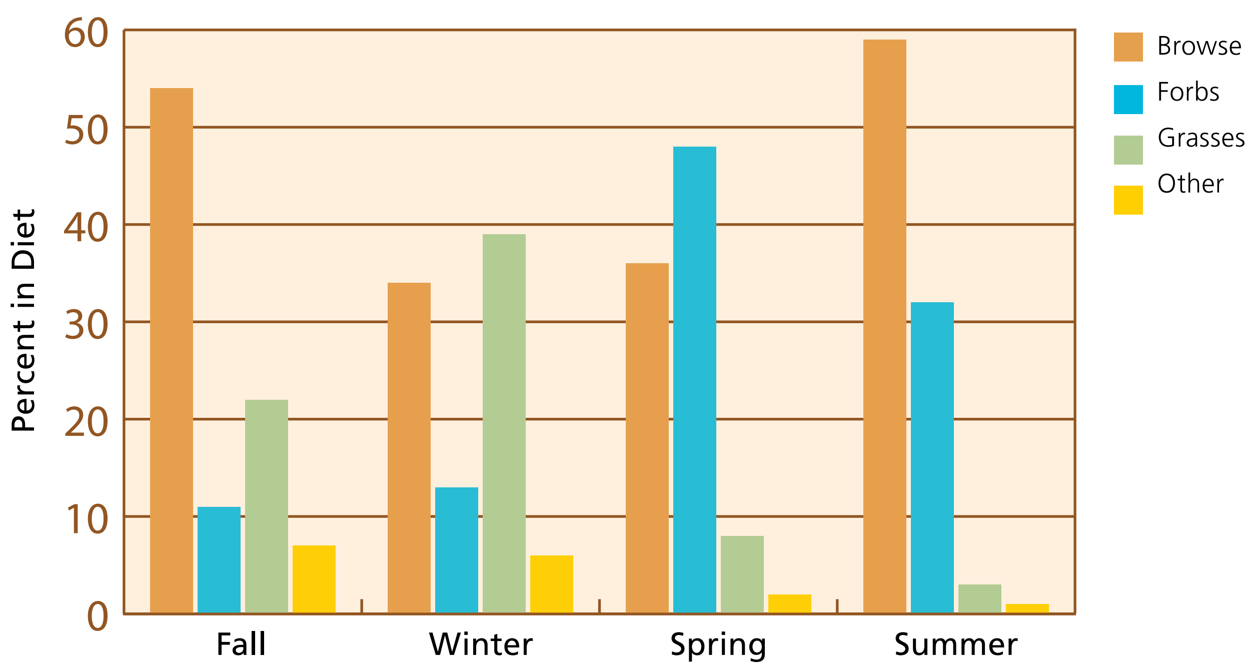


Figure 5.
Seasonal use of forage classes in the Rolling Plains Ecological Region (1999–2001).

Northern Rolling Plains

Table 3.
Ten most frequent food items in the diet of white-tailed deer in the northern Rolling Plains during 1999–2001.

Common Name	Scientific Name	Forage Class	Percent Frequency
Sand shin oak	*Quercus havardii*	Browse	11.6%
Japanese brome	*Bromus japonicus*	Grass	10.9%
Eastern cottonwood	*Populus deltoides*	Browse	7.3%
Dayflower	*Commelina erecta*	Forb	5.4%
Skunkbush	*Rhus aromatica*	Browse	4.8%
Mesquite	*Prosopis glandulosa*	Mast	2.9%
Sand shin oak	*Quercus havardii*	Mast	2.6%
Wheat	*Triticum aestivum*	Supplemental/Crop	2.2%
Texas wintergrass	*Stipa leucotricha*	Grass	1.8%
Western soapberry	*Sapindus saponaria*	Mast	1.8%

Table 4.
Preferred plants by forage class in the northern Rolling Plains.

Browse	Forbs	Grasses
Eastern cottonwood	Creeping spurge	Lovegrass spp.
Skunkbush	Dayflower	Japanese brome
Sand shin oak	Sleepy daisy	Texas wintergrass
Mesquite	Lazy daisy	
Osage orange	Mat euphorbia	
Western soapberry		
Sandhill plum		
Black willow		
Yucca		
Grape		
Netleaf hackberry		
Creek plum		
Black locust		

Table 5.
Ten most frequent food items in the diet of white-tailed deer in the southern Rolling Plains during 1999–2001.

Common Name	Scientific Name	Forage Class	Percent Frequency
Mesquite	*Prosopis glandulosa*	Mast	12.3%
Prickly pear cactus	*Opuntia spp.*	Mast	10.1%
Japanese brome	*Bromus japonicus*	Grass	7.3%
Lime prickly-ash	*Zanthoxylum hirsutum*	Browse	3.8%
Texas filaree (stork's bill)	*Erodium texanum*	Forb	3.8%
Mesquite	*Prosopis glandulosa*	Browse	3.2%
Littleleaf sumac	*Rhus microphylla*	Browse	2.9%
Corn	*Zea mays*	Supplemental/Crop	2.8%
Wild onion	*Allium drummondii*	Forb	2.1%
Texas wintergrass	*Stipa leucotricha*	Grass	1.9%

Table 6.
Preferred plants by forage class in the southern Rolling Plains.

Browse	Forbs	Grasses
Mistletoe	Creeping spurge	Rescuegrass
Skunkbush	Prickly lettuce	Thin paspalum
Lime prickly-ash	Dayflower	
Mesquite	Lizard-tail	
Prickly pear	Hairy tubetongue	
Littleleaf sumac	Wild onion	
Ephedra	Illinois bundleflower	
Redberry juniper	Spiderwort	
Lotebush	Ratany	
Netleaf hackberry		
Black willow		
Elbowbush		
Greenbriar		
Woollybucket bumelia		

Reproduction

White-tailed deer have high reproductive potential. The majority of does will breed at 1.5 years of age, although fawns (7 to 8 months old) in excellent body condition may conceive during their first winter (usually late in the breeding season). Although single fawns are typical during a doe's first fawning season, mature does generally have twins each summer. The period of peak breeding activity generally ranges from mid-November in the southern Rolling Plains to the first week of December in the northern Rolling Plains (Williams et al. 1995). Although fawns may be born over more than a two-month period, peak fawning dates usually occur during the first week of June in the southern Rolling Plains and during the third week of June for the northern Rolling Plains.

A three-year study conducted by the Texas Parks and Wildlife Department indicated that the conception rate for mature white-tailed does in the Rolling Plains is about 1.8 fawns per doe (Williams et al. 1995). This suggests a reproductive potential of almost 2 fawns per doe. However, some fawns are lost during or before birth because of accidents, disease or physiological problems. Therefore, the number of healthy fawns that are born in early summer is slightly less than the number conceived during the winter. Even fewer fawns survive until deer surveys are conducted in the fall. At that time, fawn survival estimates typically average only 40–45 percent in the northern Rolling Plains and about 50 percent in the southern Rolling Plains.

Mortality

Several factors contribute to mortality of white-tailed deer fawns, including disease, parasites, inclement weather and accidents. However, the most important mortality factor in the Rolling Plains is believed to be predation, especially during the first couple of weeks following birth. The most significant predator of white-tailed deer fawns in the Rolling Plains is the coyote. High coyote numbers can seriously limit deer production, especially in marginal habitats or on overgrazed rangelands with little herbaceous vegetation (grass and forbs) for fawning cover. In high-quality deer habitats with abundant herbaceous cover, predation is rarely a limiting factor.

Among adult white-tailed deer, the mortality rate for males typically exceeds that of females. Mortality differences are not only a function of hunter harvest but represent a combination of natural mortality factors. Unhunted deer herds have demonstrated sex ratios that range from 1.5 to 2.0 does per buck for the adult segment of the herd, although fawn sex ratios are approximately 1:1 (Hirth 1977). An unhunted herd in Washington approached 3 does per buck, as bucks experienced mortality rates twice that of does (Gavin et al. 1984). One reason for the mortality difference between sexes is the displacement of yearling bucks by the maternal doe, as well as by dominant bucks. Displaced yearling bucks encounter many disadvantages such as unfamiliar territory, inferior habitat conditions, accidents resulting from their increased movement, and increased encounters with predators and hunters. In contrast, yearling does become part of the maternal family unit, inheriting survival advantages of familiar territory and often superior habitat. Other factors affecting buck mortality involves reduced awareness, reduced forage intake, increased daily activity and long-distance movements associated with the breeding season or "rut." In contrast, does exhibit little change in movement patterns during the rut. The exhausted and often emaciated state of mature bucks following the rut increases their susceptibility to disease, parasites and predators. A severe winter can result in the mortality of bucks

Mortality sources include disease, parasites, predators and accidents. Impacts of mortality are minimized when a deer herd is on a high nutritional plane.

that are simply unable to recover nutritionally during this already stressful time of year (January–March). High-quality winter forage crops such as wheat may be more important in the northern Rolling Plains than in regions of Texas with more moderate climates.

Movements

A deer's annual home range is the area that it uses to fulfill food, cover, water and reproductive requirements. Several studies in south, central and east Texas reported home ranges of 300–900 acres for bucks and 200–600 acres for does (Michael 1965, Inglis et al. 1986, Green 1988, Webb 2005). Little research has been conducted on deer movements in the Rolling Plains, but available information suggests that deer in the central and northern Rolling Plains may travel greater distances than in other regions of Texas (DeArment 1961). Several studies indicate that deer movements and dispersal distance appear to be greater in landscapes fragmented by agriculture (Nixon et al. 1991, Rosenberry et al. 1999, Brinkman et al. 2005). Greater annual movements are not related to latitude but are likely associated with habitat quality and/or arrangement. Quality woody cover is less abundant in much of the Rolling Plains and is often arranged in widely scattered patches and drainages. Quality feeding areas such as crop fields may be located considerable distances from bedding areas. However, permanent vegetative cover afforded by Conservation Reserve Program (CRP) lands, with or without invasive woody species, is providing sufficient cover for deer in many areas. Cool-season crop fields or other winter foods may be located in the opposite direction from warm-season food sources. As a result, white-tailed deer in the Rolling Plains must generally travel greater distances to fulfill their requirements throughout the year. This situation is particularly obvious in the northern Rolling Plains, especially when compared to the abundance and quality of woody cover and the interspersion of food and cover that exists in the southern Rolling Plains.

Because deer travel over a large area, the ability of managers to accomplish deer management goals may be dictated by property size. Deer can move considerable distances daily, and they certainly move over a large area annually. Unless a property is at least 2,000 to 3,000 acres, neighboring ranches can strongly influence the structure of the local deer herd. The manager of a small property may experience greater success in attaining his goals if surrounding neighbors have similar goals and harvest practices. This is the idea behind development of wildlife management cooperatives. Landowners can accomplish a lot more by working together rather than acting individually. It doesn't have to be anything formal—just a group of people who agree about the way they want to manage the deer herd. When managing deer on small properties, development of landowner cooperatives may often be the only avenue for producing quality deer (see PWD booklet W7000-336, Wildlife Management Associations and Co-ops).

Woody travel corridors are critical for white-tailed deer in the Rolling Plains because long-distance movements are common between bedding areas and seasonal food sources.

HABITAT MANAGEMENT

Grazing Management

One of the most important factors influencing deer habitat in the Rolling Plains is livestock grazing. Not only is livestock grazing prevalent throughout the region, but it has a direct impact on the quantity and quality of food plants, fawning cover, and to some extent, on woody cover. Grazing can be beneficial or detrimental to deer habitat, depending on the kind of livestock, livestock numbers (intensity), grazing duration (time), grazing method, season of use and grazing distribution.

All of these factors are important management considerations, but the overriding influence on habitat quality is grazing intensity and duration. Regardless of livestock type or grazing method, too many animals of any kind (including deer) have the potential to overuse forage plants. Given enough time, range deterioration may occur, resulting in reduction of food and cover for deer and other wildlife. Overgrazing obviously has a direct impact on the health and survival of individual deer; but more importantly, it probably will result in a long-term reduction in carrying capacity of the range for livestock and deer. (Carrying capacity is the number of animals that a habitat can support without causing resource deterioration).

Cattle grazing is very compatible with deer management provided that stocking rates are moderate and flexible to match highly variable weather conditions in the Rolling Plains. Heavy stocking rates will result in competition for forbs and browse.

The kind of domestic animals that are grazed can greatly affect habitat characteristics, especially the availability of deer foods. Under light stocking rates, competition for forage between deer and livestock is minimal. Even under moderate stocking rates, there is very little competition between deer and cattle because the plants preferred by deer are seldom used by cattle. Cattle primarily eat grass (85–90 percent) and occasionally use forbs and browse. Deer prefer forbs and browse with fairly light use of grasses. Although grasses may represent up to 40 percent of a deer's diet in fall and winter, they represent only 5–20 percent of the diet on an annual basis. On range where quantity and quality of grasses decline due to overuse or drought, competition for forbs and browse will increase between cattle and deer.

Competition for food becomes more of a concern when sheep and/or goats are present. Sheep primarily eat forbs and grass and thus will often compete with deer for forbs. However, the greatest diet overlap occurs between deer and goats, which both prefer browse and forbs. Exotic ungulates (i.e., axis deer, fallow deer, aoudads, etc.) may also compete with deer because most exotic species prefer forbs and browse (Butts et al. 1982). Not only are they potential competitors for quality forage, but exotic ungulates, unlike deer, have the ability to shift their diet to grass when quality forages become less available. This foraging strategy can provide exotic species with a competitive advantage during prolonged drought or in overgrazed pastures.

When properly conducted, livestock grazing can improve habitat for deer and other wildlife species by promoting a diversity of plant species. Under very light grazing or deferment, pastures may be dominated by warm-season perennial bunchgrasses to the exclusion of important deer forages. Livestock grazing can be used to improve forb diversity through soil disturbance and by thinning dense grass stands. Homogeneous stands of grass provide few benefits to a deer herd; however, a diversity of perennial bunchgrasses is important as a component of quality fawning cover. A healthy and diverse bunchgrass community also provides numerous benefits to other wildlife species and promotes critical rainfall infiltration. Health and productivity of individual bunchgrass plants can be best maintained by periodic top removal through grazing and/or fire. For livestock production, most range management professionals have long recommended grazing only 50 percent of the annual forage production ("take half; leave half"). More recent research has indicated that grazing only 35 percent of the annual forage in semiarid regions will best maintain health of bunchgrasses and improve wildlife habitat (Holechek et al. 1999).

Grazing Systems

Grazing methods or "systems" can have a substantial impact on deer habitat. Grazing methods generally fall into one of two categories, continuous or rotational. Rotational grazing systems allow for greater control over grazing duration and intensity than continuous grazing systems do. Rotational grazing also can improve forage availability for deer and livestock by allowing grazed pastures to recover during rest periods, thus improving range condition.

Continuously grazed pastures receive no rest from grazing pressure, and plants preferred by livestock tend to be grazed repeatedly, often to the point of root-reserve depletion and plant mortality. Desirable perennial forbs are especially susceptible to loss from continuous grazing pressure. Only the less-preferred, unpalatable plants are not grazed, allowing them to increase proportionately over time in the total plant composition. Generally, these "increaser" and "invader" species are less productive than the more desirable "decreaser" species. Thus, over a period of several years, a continuously grazed pasture will tend to decline in range condition and in its ability to support livestock and provide food and cover for deer and other wildlife. At light stocking rates, the trend in grazing behavior is similar, but the impact on range condition will be less severe.

Rotational grazing systems result in several advantages for deer. First, there is an immediate benefit associated with the pasture or pastures being rested. The "regrowth" that occurs in rested pastures provides deer with an improved selection of food-plants and plant parts. Secondly, there is the long-term benefit of improved range condition that occurs with moderately stocked rotational systems, which is a direct result of periodic rest. Periodic rest promotes improved seed production, seedling establishment, and restoration of plant vigor. Good range condition translates to high plant diversity, quality cover (especially for fawns) and good nutrition. In other words, a productive range (or habitat) results in a greater carrying capacity and increased herd productivity. Finally, rotational grazing systems provide greater flexibility in management decisions. For example, land managers with an emphasis on deer management can rest a critical fawning pasture before and during the May–June fawning period. However, no method of rotational grazing can compensate for poor decision-making.

Rotational grazing systems also have their disadvantages. They generally require more management than continuous grazing, including increased labor for moving livestock. Livestock performance can suffer under certain rotational methods (i.e., high intensity–low frequency method) that allow forage to become mature and rank between grazing periods. Although it is one of the more management-intensive systems, short-duration grazing has shown acceptable livestock performance while improving range condition (Harmel 1981). One of the objectives of this method is to ensure livestock use of new growth during the growing season to maximize nutritional quality and prevent vegetation from becoming mature and rank. The rest period for each pasture typically will vary from 30 to 90 days, while the length of the grazing period is dependent on the number of available pastures. A less intensive method resulting in relatively good livestock performance is the "four-pasture, three-herd" (Merrill) system. Each pasture is grazed for one year followed by a four-month rest. Over a period of four years, each pasture is rested three times with each rest occurring during a different season to equally favor warm-season and cool-season plant species.

Prescribed Burning

When conducted under proper conditions, prescribed burning can be a valuable management tool for white-tailed deer as well as livestock. Historically, rangelands in the Rolling Plains evolved with periodic grazing (nomadic herds of bison and pronghorn) and periodic wildfire. These rangelands are still best managed using these two tools—grazing and fire.

In contrast to wildfires, prescribed range burning is conducted under a specific set of conditions that determine the subsequent vegetation response. These conditions include air temperature, relative humidity, wind speed, fuel load, soil moisture and season. For example, considering just one aspect that influences plant response (season of burn), a late winter burn tends to favor perennial, warm-season grasses, whereas an early winter burn will promote the production of forbs. The desired plant response and, ultimately, the type of prescribed burn to be applied, will depend on the land manager's range, livestock and wildlife management goals.

Total protection of rangelands from grazing and fire often will not result in the degree of restoration and improvement of range condition that may be expected. Because range plants in the Rolling Plains of Texas evolved under a pattern of grazing and fire, they are adapted to periodic top removal. Most plants subjected to periodic top removal through grazing or burning are more vigorous and productive than plants that are "protected." Removing old growth and litter build-up from bunchgrasses helps to increase production of new leaves, which is necessary for replenishing the roots with starches and carbohydrates through photosynthesis. Other benefits of fire include increased palatability of forages, a temporary (three to four months) increase in plant nutrients (fertilization effect), and suppression of undesirable woody plants (see Brush Management section).

Rangeland fires in early winter stimulate the production of cool-season annuals and perennial forbs, including a group of forbs called "legumes" (pea family). This includes plant species such as

Fire can benefit deer and other wildlife by stimulating forb production, promoting perennial bunchgrasses (fawning cover), and rejuvenating fire-adapted browse species.

Illinois bundleflower, partridge pea, rushpea, western indigo, sensitivebriar, wildbean, alfalfa and clovers. Most legumes are preferred by deer and typically contain high levels of crude protein and a variety of other key nutrients.

The most beneficial burning programs for wildlife incorporate a multi-year rotation so that 10–20 percent of the property is burned each year, rather than the entire property. This schedule will allow at least five to 10 years between burns for any given area and provide for a diverse pattern of food and cover at various stages of growth. Recently burned blocks can provide good brood habitat for upland birds and turkeys, as well as high-quality grazing for deer. During subsequent years, the same blocks will provide quality fawning grounds for deer, with the added bonus of nesting cover for upland birds. For grass monocultures, such as those often found in CRP, a multi-year burning rotation could help increase structural diversity.

Highly erodible areas should be protected from fire with a good fireguard. If prescribed burning is selected as a management tool, fuel load development will require grazing deferment in the area to be burned during at least a portion of the previous growing season. Additionally, it likely will be necessary to defer grazing immediately after the burn to promote plant growth and range recovery. If grazing is allowed, livestock will concentrate on and damage these areas as they attempt to take advantage of the increased palatability and nutrient content of the "fertilized" plants.

If prescribed burning is selected as a management tool, land managers should contact the Texas AgriLIFE Extension Service, Natural Resources Conservation Service, or Texas Parks and Wildlife Department for technical assistance in planning and conducting a prescribed fire. Landowners may also wish to join a prescribed burning association such as the Texas Panhandle Prescribed Burn Association at **http://www.ranches.org/tppba.htm**.

Brush Management

Woody plants (brush) provide escape cover, loafing cover, thermal protection and food (browse and mast) for white-tailed deer. However, there are instances when the brush density exceeds optimal habitat requirements for deer. Excessive brush density can hinder movement, reduce visibility of approaching danger (predators), reduce herbaceous forage and promote increased predator populations. Brush thickets can present similar management problems for livestock. In many instances, brush management is a viable option for improving livestock management and habitat quality for deer and other wildlife species. However, managers should avoid excessive removal of woody cover because inadequate cover can be just as detrimental as too much brush. Brush management planning should consider wildlife cover requirements, soil types, slope, aspect, soil loss/erosion factors and post-treatment management to extend benefits to habitat.

In many areas of the Rolling Plains, the amount and quality of cover influences deer densities and distribution. Although white-tailed deer may forage in areas with little cover, areas of dense brush are important for escape cover. Dense loafing/security cover is especially important for mature bucks (Steuter and Wright 1980, Pollock et al. 1994). Although white-tailed deer use a wide range of woody cover types and densities, they generally prefer a mosaic of woody brush and trees interspersed within open areas at an approximate 3-to-1 ratio of woody cover to openings. Prior to conducting brush management, careful planning is critical to ensure diversity and proper arrangement of woody plants for

Many areas of the Rolling Plains support a natural mosaic of woody cover and herbaceous openings. In areas dominated by shrubs, several methods (fire, mechanical, chemical) are available to create a desirable interspersion of habitat components.

deer food and cover needs. Retention of brush in critical areas along drainages, hillsides and steep areas will protect soil and provide important cover for deer. Likewise, removing brush on flat to gently sloping areas with deeper soils will yield the greatest herbaceous response for wildlife and livestock. Where large areas are cleared, retention of brush strips interspersed with openings in a mosaic pattern will accommodate the needs of wildlife and livestock. Clumps or strips of brush should be wide enough that an observer cannot see through them from one side to the other during the winter months when deciduous species are bare of leaves. Cover strips should be as continuous as possible to provide travel lanes.

Several brush management options are available to help accomplish deer management goals. Most of these options fall into three categories: mechanical, chemical and prescribed fire.

Mechanical

Tree grubbing, aeration and chaining are preferred mechanical methods of brush management in the Rolling Plains. These methods can be conducted in a selective manner, in that small areas or individual trees/brush can be targeted. They promote a variety of forbs and grasses through soil disturbance and decreased competition with brush for soil moisture and nutrients. Unlike herbicide treatments, where forbs are suppressed for a year

Certain mechanical techniques are highly selective and effective in reducing invasive species (mesquite and juniper), while leaving desirable woody species such as sumacs, hackberry, bumelia and plum.

Certain woody species become so dense that individual plan treatment (IPT) is not practical. However, broadcast chemical treatment can be applied in a mosaic that maximizes herbaceous response while maintaining an interspersion of habitat components.

or two, mechanical treatments produce an almost immediate forb response. Additionally, mechanical methods can be used to renovate severely compacted sites, leading to increased water infiltration and improved herbaceous cover.

Most brush species will quickly resprout unless their roots are removed (i.e., grubbing). Top-removal methods such as aeration and shredding will temporarily improve the palatability and nutritional quality of browse (regrowth) for deer and other browsing animals. Some of the more beneficial browse species in the Rolling Plains include littleleaf sumac, aromatic sumac, shinnery oak, bumelia and lotebush. Because most woody species are resprouters, top-removal methods are not effective in providing a long-term reduction in the brush canopy or density. However, prescribed fire can be used as a followup treatment to extend the benefits of mechanical treatments.

When managing honey mesquite, it is highly preferable to employ techniques that remove the entire plant. Top removal typically results in greater plant densities, improved vigor and an increase in thorns. Also, caution must be used when conducting mechanical techniques in areas with prickly pear. Research has shown that methods such as chaining, aeration, rootplowing and rootraking increase the density of prickly pear, especially in wet years (Dodd 1968). The spread of prickly pear can be minimized by conducting mechanical brush treatment during dry years; however, stacking and burning of pear may be desirable in heavily infested areas.

Chemical

Herbicides may be applied in pellet or liquid form by aircraft (helicopter or fixed-wing), backpack sprayer, or tractor spray-rig. Aerial methods allow large acreages of brush to be treated in a relatively short time, but ground-application methods are much more selective. Aerial treatments can be applied in strips, as total coverage, or in a variable rate pattern (VRP). The VRP involves aerially applying different rates of herbicide in strips at right angles to each other. This pattern creates numerous small blocks of vegetation ("checkerboard effect") treated with different herbicide rates, ranging from none to heavy and resulting in diversity of vegetative responses. This method has the greatest applicability in areas with dense stands of mixed brush, typically composed of sand shinnery oak, sand plum, sandsage and aromatic sumac on sandy sites.

Ground-application methods allow the manager to treat specific, undesirable species while not harming more desirable woody plants. A tractor with a boom-spray rig can be used to target low-growth brush in specific areas, such as the more responsive deep-soil lowlands, while avoiding less responsive uplands or erosive dune areas in sandy country.

Herbicide treatment is one of the best methods of opening dense stands of shinnery oak. Shinnery can seldom be root-killed by fire, and fire often invigorates a shinnery oak stand. Unlike mechanical methods, herbicide treatment does not disturb the unstable sandy soils. Tebuthiuron can provide suppression of shinnery (five to seven years) or permanent control, provided an adequate stand of grass is established.

Brush management in drainage (riparian) habitats should be carefully considered because these sites are important in providing food and cover for deer and other wildlife species. The structural features provide areas for midday loafing and bedding, and these moist, fertile sites are very important in producing quality forage. Often, the best option is to maintain the native woody vegetation in these drainages (at least 300 feet on each side of the creek or draw), especially in areas with erodible soils and/or steep slopes. Whenever possible, salt cedar (tamarisk), Russian olive, and Eastern red cedar should be eliminated from riparian habitats to prevent degradation from de-watering and loss of native plant diversity due to competition.

The primary disadvantage of herbicides, other than cost, is suppression of grasses and forbs in the treated area for up two years. Although temporary, this can have a significant, short-term effect on deer and other wildlife that heavily rely on forbs. To minimize detrimental effects of forb suppression, managers can stagger treatments among years and areas. A key consideration is the size and location of treatment areas (e.g., 500 acres versus 5,000 acres at opposite ends of the property). Unlike other brush management methods, herbicides leave the dead standing remains of woody plants even after they are killed. This may not be a problem for some managers, but one way to reduce the woody debris is to follow the herbicide treatment with a prescribed fire (two or three years later). Once brush is finally killed (may require two growing seasons), herbaceous vegetation normally responds with a flush of growth, which provides adequate fuel for a relatively hot burn that will reduce some of the woody debris. However, it may be necessary to lay down standing dead trees using mechanical methods prior to burning in order to accomplish complete debris removal.

Prescribed Fire

As previously discussed, cool-season fire is an excellent tool for enhancing wildlife habitat. In terms of brush management, it can be a very effective means for controlling seedlings of undesirable woody plants. Unfortunately, problematic species (mesquite, redberry juniper and shinnery oak) in the Rolling Plains are difficult to kill with cool-season fire, especially once they mature beyond the sapling stage. They generally resprout from the roots, sometimes at greater densities than before the fire (e.g., shinnery oak). However, periodic fire can be a useful tool in controlling the height and canopy cover of brush species, especially mesquite and juniper. With proper weather conditions and adequate fuel loads, prescribed burning can top-kill these woody plants. More importantly, woody plant densities can be managed over the long term by killing seedlings and saplings (before they become fire resistant). This will conserve soil moisture and nutrients so that grasses and forbs can increase. Careful control of invasive woody species will not only improve food and cover for deer and other wildlife, but can promote increased fine fuel loads for future prescribed burns (with proper grazing or rest).

Prescribed burning in the summer is seldom practiced in the Rolling Plains because of inconsistent rainfall in summer and fall, liability associated with escaped fire, and hazardous burning conditions associated with high temperatures and low humidity of summer. Extremely high temperatures generated by a summer fire can damage root systems of grasses, especially if they are already stressed from drought and/or overgrazing. However, native grasses are prolific seed producers and can respond rapidly due to tons of viable seeds stored in the soil ("seed bank") which readily germinate with rainfall following a disturbance such as fire. Additionally, high-intensity summer fires have demonstrated their effectiveness in stimulating the germination of valuable forbs and grasses (i.e., little bluestem and sideoats grama), while cool-season fires conducted in the same pasture have failed to do so (D. Ruthven, TPWD, personal communication). Drought conditions also cause woody species such as mesquite and redberry juniper to be more susceptible to mortality by fire (Wright and Bailey 1982); therefore, some control of these two species can be

Brush problems that have developed over decades may require chemical or mechanical pretreatment and rest from grazing before prescribed fire can be applied.

accomplished with warm-season (summer) fires. Some managers might question the ecological soundness of summer burns; however, in the context of probable herbaceous plant recovery occurring within two years versus woody regeneration in 10 to 15 years, warm-season fire can be a valuable habitat improvement technique.

Historical lightning-strike fires usually occurred during summer storms and burned expansive acreages, which is one of the primary reasons that dense stands of woody plants did not occur on the plains centuries ago (Wright and Bailey 1982). Summer burning can involve considerable expense and requires extensive planning, preparation, and careful execution by experienced personnel because of high heat, low humidity and fuel volatility (i.e., redberry juniper). Summer prescribed fires on steeply sloping lands with highly erodible soils should be avoided.

As previously stated, if prescribed burning is selected as a management tool, land managers should contact the Texas Cooperative Extension, Natural Resources Conservation Service or Texas Parks and Wildlife Department for technical assistance in planning and conducting a prescribed fire. Landowners may also wish to join a prescribed burning association such as the Texas Panhandle Prescribed Burn Association (http://www.ranches.org/tppba.htm).

Water Development

Water requirements for white-tailed deer vary with climatic conditions, physiological state, amount of activity, and moisture content of forage. Water intake by white-tailed deer averages 3–6 quarts of water per day (Brown 1985), depending on moisture content of forage, temperature and humidity. Because environmental and forage conditions vary greatly among seasons, water intake by deer will average 4–5 percent of their body weight in summer and 1–2 percent of their body weight in winter. Deer will reduce forage intake and lose weight even with a moderate restriction in water intake (Lautier et al. 1988). Pregnant white-tailed does will typically consume two to three times as much water as dry matter (Verme and Ullrey 1984). Of course, the amount of free water needed is less when there is a higher concentration of water in food. Where water availability may not be a concern in other areas of the state, it may limit distribution of deer in some areas of the Rolling Plains, especially during prolonged drought. Livestock and deer may disproportionately utilize native forage close to watering areas when distribution is limited. This may lead to a decline in habitat condition in those areas. In general, ranches that have livestock watering sites at one-mile intervals will have adequate water distribution for white-tailed deer. Some key considerations on provision of water are as follows:

Water facilities can be easily modified to provide access to all wildlife species. Special designs are available to prevent drinker damage by feral hogs.

White-tailed deer will use a variety of natural and man-made water sources. Although deer are adept at finding and using natural sources of water, there are times when permanent water is crucial to productivity of the deer herd, especially in drought-prone regions like the Rolling Plains.

Most livestock ranches, by providing water for livestock, provide ample water for most wildlife species. It is important to maintain water sources in operation (keep windmills pumping, keep earthen tanks filled, troughs filled, etc.) when livestock are temporarily removed from ranch or rotated out of pastures.

On large cattle ranches, the maximum distance between water locations often is two miles (allows livestock to be within a mile of water at all times). This distribution of water will result in areas with limited use by deer during drought, as daily movements relate to permanent water sources (no more than a half-mile from water). Although annual home ranges may be quite large, water availability during drought must be based upon critical-season home ranges, especially in arid regions. When possible, improving water distribution to one site per section (square mile) will improve habitat use and effective carrying capacity.

In remote areas without permanent water, an effective solution may be a water development system for wildlife called a "guzzler." Guzzlers are adaptations of cisterns used in many arid regions to catch and store rainfall. Numerous designs are available, and most catchments are designed to stay recharged with 8–10 inches of annual rainfall. However, they require periodic maintenance for prolonged life in the field.

Some troughs for cattle and/or horses can be inaccessible to deer and may require modification such as an earthen ramp (allows use by other wildlife species). Various designs for bird and small mammal access also exist (consult your local biologist or range management specialist). When installing new troughs, a trough height of 18–24 inches will allow weaned fawns and yearlings access to water. Maintaining water level near the rim of the trough or tank can also improve accessibility for young deer.

Small in-ground drinkers (concrete or aluminum) can be extremely beneficial in areas without a traditional livestock water facility (trough, earthen tank). High use has been documented at ground-level water sources by deer and other wildlife (quail, turkeys). Advantages include inexpensive installation compared to tanks and troughs, easy incorporation into existing water lines, and reduced evaporation due to an in-ground design. Heavy-duty steel with a protected float valve is necessary in areas with feral hogs.

Providing Supplemental Nutrition

Popular hunting culture suggests that white-tailed deer need supplementation; however, when sound habitat management practices are implemented (proper grazing, prescribed burning, brush management and provision of water), deer seldom require any type of supplement to native range. In certain situations, providing additional nutrition to deer on a seasonal basis may help to achieve desired management objectives (larger bodies, more deer), but the amount of space and cover remains the same; thus, space and cover per deer decreases (Brown and Cooper 2006). Numerous studies have shown that supplemental feeding of deer contributed to overpopulation; consequences include decline in their condition, as well as reduced quality of the area's vegetation (Brown and Cooper 2006).

A supplementation program will not substitute for proper range management. The objective of supplementation is to provide additional nutrients to the deer's natural diet during times when native forage is thought to be inadequate in quantity or quality (winter months). Two primary methods of supplementing deer are providing "feed" (grain or pelleted ration) and planting food plots.

"Baiting" deer to a particular area during the hunting season does not constitute a supplemental feeding program. The most commonly used deer "bait" is corn, which is an excellent energy supplement that may be beneficial in winter and late summer when carbohydrates decline in native forages. However, corn contains only 7–10 percent crude protein, which falls short of the 13–16 percent crude protein range considered optimum for proper muscle, bone and antler development in deer. Additionally, corn lacks some trace minerals that are essential for proper body and antler growth.

High-protein pellets are superior to corn as a choice for supplemental feed. A desirable pellet formula contains 16–20 percent crude protein along with proper amounts of minerals (calcium, phosphorus, manganese, magnesium, potassium, etc.), and Vitamins A, D and E. If an automatic feeder is used, a 3/16-inch pellet size should be used to avoid clogging the feeder (Perkins 1991). If high-protein pellets are provided, investment in free-choice feeders that are accessible by deer and resistant to non-target species (raccoons, quail, skunks, feral hogs) is recommended. One of the most important considerations for the landowner interested in supplemental feeding may be the cost. Feeding programs are very expensive, and generally the costs far exceed the financial returns that can be recovered through lease hunting.

A less costly alternative for providing additional year-round nutrition for a deer herd is food plots. Food plots have been used in conjunction with aggressive harvest programs in many areas of Texas to improve deer nutrition. Plantings of 5–10 acres located strategically near escape cover may help to provide quality forage during times of nutritional stress, such as winter and late summer. Winter wheat is an excellent choice for cool-season plantings because of its high protein content and digestibility during the early stage of growth. Grain sorghum and alfalfa can be a good combination for a warm-season food planting, especially for managers who are interested in enhancing quail and turkey habitat. Irrigated warm-season plantings may be beneficial in a drought situation.

Supplemental feeding has the potential to cause problems regarding disease transmission, herd distribution, nutritional deficiencies (incorrect supplement) and non-target species (Richardson 2006). However, the most prevalent problem associated with feeding operations is the overuse of native forages as a result of excessive deer numbers. Year-round, high-protein supplementation usually increases conception rates and fawn survival such that autumn fawn crops often exceed 80 percent. Recruitment far exceeds mortality to the extent that a deer herd often surpasses the carrying capacity of the habitat within four to five years after initiation of the feeding program. As a result, the highly preferred, most nutritious plant species decline in condition and abundance. Because overpopulation is the norm rather than the exception with year-round feeding programs, supplementation is largely ineffective in increasing average antler size of bucks.

In summary, the best way to provide deer and other wildlife species with adequate nutrition is through habitat enhancement and maintaining a balance between livestock/deer numbers and the available forage on native range.

DEER HERD MANAGEMENT

Deer herd management refers to the management of deer numbers, sex ratio and age structure. While deer genetics is also a factor in management, it is a controversial subject normally involving penned-deer studies that have been widely publicized and is not addressed in this publication.

There are several reasons why deer numbers and herd structure should be managed:

- White-tailed deer may increase beyond the natural carrying capacity of the habitat. When this occurs, nutrition declines and results in reduced body condition, weight, antler quality and reproduction. Because deer numbers may be reduced only once each year (during hunting season), it is important to keep the deer herd below carrying capacity.
- White-tailed deer numbers may be insufficient to meet a landowner's objectives, or a landowner may not be satisfied with the quality of bucks on his property. Management practices can be conducted to help increase deer numbers and/or improve buck quality.
- Proper herd structure can improve the productivity and health of the herd. For example, a proper sex ratio can result in earlier and shorter fawning periods, which can improve fawn survival (Guynn et al. 1988, Jacobson 1992).

One of the first steps in population management is to determine the status of a deer herd concerning deer numbers, sex ratios and fawn survival. This information can be obtained by conducting deer surveys.

Deer Surveys

Deer counts are referred to as "surveys" rather than "censuses" because surveys provide only an estimate of deer numbers. Estimates are valuable because they provide an indication of long-term trends in deer numbers. Each survey method has strengths and weaknesses, and some methods will suit a particular property better than others, depending on vegetation, topography, road system, landowner goals and finances. Helicopter and spotlight survey transects are two methods most applicable in the Rolling Plains.

Helicopter Surveys

Helicopter surveys are very practical for the Rolling Plains, especially in areas with limited road systems that prevent a thorough spotlight route. The major disadvantages are cost and the somewhat hazardous nature of the technique compared to other survey methods. Helicopter surveys involve two observers, each counting deer from opposite sides of the aircraft and within a fixed strip width (the pilot often serves as a second observer). The helicopter travels relatively slow (30–40 mph) at an altitude of 50–60 feet. The typical width of the observed strip is 200 yards (100 yards on either side of the aircraft) but may vary slightly, depending on topography and height and density of vegetation. Helicopter transects can be flown to count 100 percent of a ranch or any proportion of the property. Partial counts involve equally-spaced transects distributed across the ranch and allow results to be extrapolated to the entire acreage. The advantage of partial flights (used only for very large land tracts) is that they are less costly.

Managers sometimes get the wrong idea when a 100 percent count is mentioned. A 100 percent count refers to a complete flight of the property rather than a complete count of the deer. Research has shown that 35–85 percent of deer will be observed from a helicopter, and that the proportion observed tends to be inversely proportional to the density of woody cover (Synatzske 1984, DeYoung 1985, Bartmann et al. 1986, White et al. 1989). Many deer that are bedded or standing in dense, shaded thickets do not "flush" when a helicopter flies over or by them. Generally, fewer deer are observed during midday flights (when most deer are bedded) compared to early-morning or late-afternoon surveys. This problem can be minimized by restricting flying hours to approximately the first three hours and last two hours of daylight. Cool weather will improve the percentage of deer observed compared to warm-weather conditions and may extend optimum survey hours. Overcast days can also extend the survey time compared to days of bright sunshine; however, sightability of individual deer will decline because their antlers and coats will not reflect sunlight.

One advantage of the helicopter technique is that it may allow the observers to see a large proportion of deer that are present. Observation of mature bucks may be important for managers who are marketing trophy deer hunts. It also provides a good indication of sex ratio and, sometimes, fawn production. Helicopter surveys may underestimate fawn numbers because young fawns often lie down rather than run as the aircraft approaches (Synatzske 1984), especially if surveys are conducted too early (i.e., August). Some managers prefer conducting a post-harvest helicopter survey (January or February) to monitor annual recruitment into the herd and effects of harvest. With cooler temperatures during winter, optimum flight hours are normally extended and defoliation provides improved visibility for the observers. Distinguishing fawns from younger does can be difficult during winter, but fawn crops are generally not a concern at that time. Managers interested in obtaining accurate sex ratios should realize that a few bucks may begin to shed their antlers in February. Relative to overall deer numbers, winter counts tend to provide better estimates than early fall counts (increased deer movement, improved visibility).

Spotlight Surveys

Spotlight surveys are conducted at night from a pickup or jeep with at least three individuals: a driver and two observers. A fourth person may be used as a recorder or to help identify deer with binoculars. Once an appropriate route has been determined, the two observers count deer while the driver maintains a speed of 5 to 10 miles per hour, depending on the terrain and vegetation density. Visibility estimates (perpendicular distance to the direction of travel along the route that observers estimate they can see deer lying or standing) are taken from both sides of the vehicle every 1/10 of a mile. The average distance of visibility is multiplied by the length of the route to obtain the area observed. An estimated deer density can be derived (acres/deer or number of deer/1000 acres) using the number of deer recorded along the route. Because of the variability in deer movement from night to night, the survey should be conducted at least three times during September and October. By that time, antlers have hardened and are more conspicuous, and most fawns should be "at heel" with does.

Most properties in the Rolling Plains can be surveyed by spotlight or helicopter; however, it's important to be familiar with the limitations of the technique selected.

The spotlight survey technique sometimes receives criticism for producing erroneous or misleading results—such as too many or too few deer. Although deer numbers can vary greatly among various habitat types, a basic assumption of the method is that deer are randomly distributed within a given habitat type. If deer are concentrating at night around corn feeders or on a wheat field, these concentrations potentially can bias the results, unless special measures are taken to account for the concentrations. In areas where wheat is planted, conducting surveys prior to wheat emergence can be a key factor in obtaining a valid count. Erroneous deer densities are generally the result of an improperly established spotlight route. The location of a spotlight route is extremely important because the technique is designed to sample only a portion of the acreage. The information from the portion sampled is expanded to the entire ranch. A general rule is to establish a route that allows observation of at least 10 percent of the ranch during the survey. Therefore, it is important to locate the route through various habitat or vegetation types in proportion to their occurrence. This requires a good map showing the road system, with input from someone with knowledge of habitat distribution on the ranch. Topographic maps and aerial photographs can also be valuable in properly locating the spotlight route, along with use of GIS and computer mapping technology. It is important that the survey route be representive of the entire property and not located only in an area where deer are most likely to be observed, which would result in an inflated estimate of deer numbers.

When properly located and conducted, spotlight surveys can provide a reliable estimate of deer numbers. Spotlight surveys also can provide an indication of fawn survival and the buck to doe ratio (in areas with moderate to high deer numbers). With experience, observers will learn the limitations of their equipment (lights, binoculars) when attempting to accurately identify deer as bucks, does and fawns. For example, observers may agree to identify bucks, does, and fawns within 150 yards of the vehicle and simply record deer beyond that distance for the purpose of calculating deer density. The information for "identified" deer can be supplemented with daytime, incidental observations of deer recorded during routine activities on the ranch (a necessity in areas with low deer numbers). The accuracy of the estimated fawn crop and sex ratio will increase with the number of observations.

Supplemental Daytime Observations

Daytime observations should be recorded by sex and age (adult or fawn). Incidental daytime observations can be obtained while conducting normal farm or ranch activities. However, early-morning and late-evening counts are recommended for the specific purpose of collecting herd composition information. A minimum of 100 observations should be recorded during September and October, and replicate observations of the same deer should be avoided if possible. Simple math can be used to estimate herd composition (does per buck equal total number of does recorded divided by total number of antlered bucks recorded; fawns per doe equal fawns recorded divided by does recorded).

Harvest Records

As with deer surveys, valuable information for making management decisions also can be obtained from harvest records. Records from harvested deer can provide information about the nutritional status and age structure of the herd, proper or improper harvest rates, mortality rates, and if does are harvested, information about fawn survival. Hunting season offers the best opportunity for managers to collect hands-on information about the deer they manage.

Harvest records should include date of harvest, ranch, pasture, hunter name, deer age, field-dressed weight, antler measurements (basal circumference, beam length, inside spread, number of points), apparent body condition and lactation (milk) in does. Some managers also maintain visual records by taking a photograph of each harvested deer. The percent of does lactating can provide an indication of fawn survival. Weights, antler measurements, and general body condition are indicators of nutrition. Body condition of deer can be categorized as "good" (fat across the back and base of tail; fat on kidney and in body cavity), "fair" (little or no excess fat, bones not showing), or "poor" (ribs, backbone, and pelvic girdle prominent under skin). Field-dressed weights and antler measurements are not meaningful without determining the respective age of each harvested deer. Age-specific information is necessary to determine whether body weights and antler growth are acceptable or below standard for each age class.

Although age class is important for determining if the herd is receiving adequate nutrition, it also can be valuable in estimating the age distribution of deer on the ranch. Harvest will not necessarily reflect the exact age distribution in the population because the type of deer harvested is directly related to the management objectives of the ranch, harvest strategies and hunter decisions. However, when the majority of bucks harvested are 3.5 years old and less, it suggests that the buck segment is being heavily harvested. Likewise, if the majority of white-tailed does harvested on a ranch are four to seven years old, this indicates that they are under a very light harvest and probably experiencing a low rate of natural mortality.

Deer ages are determined by examination of tooth wear and replacement on the lower jaw. The procedure is not difficult; however, time and practice are required to become proficient with use of this technique. In addition, a deer aging guide with photos and a reference set of jaw bones collected locally may be helpful. Equipment that may be useful for collecting harvest information are weigh scales, measuring tape, jaw-spreader/remover, flashlight, wash bottle, clipboard and data sheets. For hunters or managers wishing to obtain an aging guide, see *A Guide to Age Determination of White-tailed Deer* (TPWD booklet W7000-755, July 2003) at **http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0755.pdf**. Managers unfamiliar with the aging technique are encouraged to remove the lower jaw for aging by an experienced biologist at a later date.

Harvest Management

The first step in any deer management program is identifying a realistic, specific set of deer management goals for the property. The goals may include a desired deer density, a specific quality-class of bucks with details about antler and body size, and/or more subjective interests concerning the quality of the recreational experience. Landowner goals should serve as a constant guide for every decision regarding harvest strategies and habitat management activities. Collection and analysis of survey data and harvest records will help the manager determine overall status and condition of the deer herd. Baseline information (deer numbers, age structure, sex ratio, nutrition and productivity) allows a manager to make informed decisions and develop a harvest strategy that will help accomplish deer management goals. More importantly, harvest and survey data can be used to annually evaluate progress toward deer management goals and to adjust harvest strategies and other management practices.

Harvest Intensity

When considering deer management goals and potential harvest strategies, managers should be aware that the number of deer to be harvested depends on carrying capacity of the habitat, as well as fawn production, fawn survival, adult deer mortality and the buck:doe ratio. The number of fawns surviving to September–October surveys is

Deer ages are determined by examination of tooth wear and replacement on the lower jaw.

Live weights or field-dressed weights are valuable indicators of nutrition, but the field-dressed weight is a more consistent index because the temporal variability of food and water intake is removed.

Small antler size in the harvest is seldom related to a genetic problem. Accurate harvest data (weights and antler measurements by age class) can quickly identify if there are problems associated with nutrition and/or buck age structure.

relatively low (40–45 percent) throughout much of the Rolling Plains, limiting the number of deer entering the adult population each year. In areas of the Rolling Plains where lower fawn recruitment exists, a more conservative harvest strategy may be required to maintain herd productivity. Moderate-density deer herds that exist throughout most of the region could be susceptible to overexploitation if landowners attempt to develop aggressive lease hunting enterprises on their property (day-hunting, weekend packages) involving a high number of hunters. In southern counties and along drainages in the northeastern portion of the region, deer densities tend to be greater with fawn crops often exceeding 50 percent. Deer herds in these areas may support a higher rate of harvest, depending on landowner goals.

Many hunters are interested in harvesting mature bucks with quality antlers, which requires managers to select a harvest strategy that allows many bucks to reach 5½ and 6½ years of age. Managing for mature bucks typically involves harvesting only of 15–20 percent of the buck segment annually. For much of the Rolling Plains, this translates to only one harvestable buck for every 1,500 to 3,000 acres, depending on the deer density and buck-to-doe ratio. This strategy allows a conservative harvest of does (5–15 percent) in low density areas but may require a moderate to liberal doe harvest (20–30 percent) in areas where deer numbers are approaching or have reached the habitat's carrying capacity. Producing quality antlers depends not only on bucks reaching maturity but also on quality habitat management. This requires balancing the forage supply with deer and livestock numbers.

Photo courtesy of Michael McInerney.

A conservative buck harvest promotes a balanced age structure represented by bucks in various age classes. An aggressive buck harvest can result in a reduced age structure with few mature bucks.

Sex Ratio

The buck-to-doe ratio of a deer herd is influenced by several factors, including the sex ratio of fawns at birth, natural mortality of males and females in all age classes, and hunting pressure on the buck and doe segments of the population. The percent of bucks in the fawn crop generally ranges from 40–60 percent. The factors that influence fawn gender are not known; however, research has indicated that a malnourished deer herd will produce proportionately more buck fawns, and a deer herd under good nutrition will produce more doe fawns (McCullough 1979, Verme 1985).

When considering factors that influence sex ratios, the manager has the most control over hunting pressure. Research has indicated that typical sex ratios in unhunted deer herds range from 1.5 to 2 does per buck (Hirth 1977, McCullough 1979). For most of our deer herds in Texas, this could be considered (although not without argument) the "natural" sex ratio. Hunting pressure on the buck segment of a herd can easily decrease this ratio to 3 or 4 does per buck, or worse. In contrast, extreme pressure on the doe segment has resulted in ratios that approached or exceeded 1 to 1 (in regions of high deer densities). However, a 1-to-1 sex ratio is not only impractical but undesirable for most herds in the Rolling Plains. There are several biological conditions that must be met before a manager can justify a harvest strategy designed to produce an "even" sex ratio. First, to counter the higher natural mortality rates experienced by bucks, the doe segment must be substantially reduced through harvest. Therefore, fawn production must be good to excellent (50 to 100 percent) to avoid excessive herd reduction. Secondly, natural mortality of bucks must be minimal in order for the buck segment of the herd to realize an increase in numbers while also sustaining hunting pressure. Additionally, after an "even" buck-to-doe ratio is obtained, a very conservative harvest of bucks is required to maintain the ratio. More appropriate buck-to-doe ratios for the Rolling Plains are approximately 1 to 2 in areas with relatively high deer numbers and approximately 1 to 3 in areas with fewer deer. This will provide an optimum number of bucks, while maintaining an adequate number of does for herd replacement.

SUMMARY

White-tailed deer are a key wildlife species in the Rolling Plains because of their aesthetic, recreational and economic value. A successful deer management program begins with establishment of well-defined goals. Annual surveys and harvest records assist the manager in making harvest recommendations. More importantly, they are critical tools for evaluating progress toward deer management goals. Buck harvest can be used to manage the age structure and quality of the buck segment, and doe harvest may be implemented to meet objectives regarding deer numbers and nutrition (i.e., increase, maintain, or decrease deer numbers). Nutrition and age structure are keys to producing quality bucks, and deer numbers can not be managed independently of livestock numbers. Genetic improvement may be a valid consideration, depending on the individual ranch and hunting operation. However, "culling" efforts should not be substituted for more important practices such as proper grazing management, brush management, prescribed burning, riparian management, controlling exotic plants and animals, controlling deer numbers, and providing native sources of food and water. Conservation of white-tailed deer in the Rolling Plains is a natural fit with land management that provides habitat for a large variety of other native species including grassland birds, wild turkeys and Texas horned lizards. Ultimately, management of healthy landscapes for deer helps conserve biological diversity in the Rolling Plains for all Texans to enjoy!

Free Technical Guidance for Managing Habitat and Wildlife

A complete range of comprehensive, non-binding and confidential technical guidance services are available to landowners wishing to manage wildlife and habitat. These services are free of charge and may be obtained by contacting Texas Parks and Wildlife Department in Austin at 512/389-4395 or toll-free at 1-800-792-1112, or by accessing the Department's Web site at **http://www.tpwd.state.tx.us** and navigating to "Find Your Local Biologist" on the site.

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