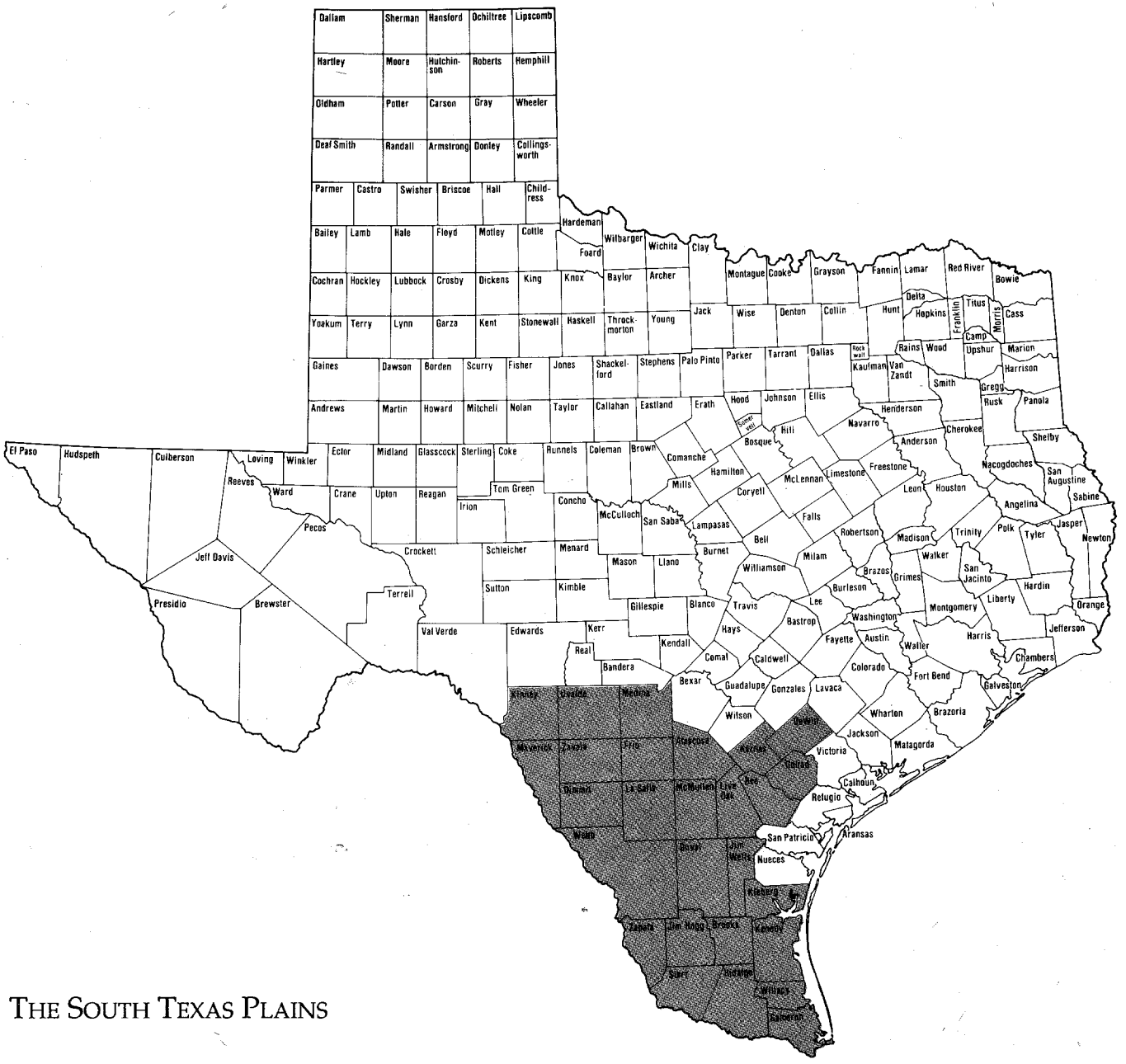
Deer Management in the South Texas Plains



THE SOUTH TEXAS PLAINS

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DEER MANAGEMENT IN THE SOUTH TEXAS PLAINS

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INTRODUCTION

The South Texas Plains has long been noted for its thriving cattle industry and abundant populations of wildlife. This 20 million acre area, lying south of San Antonio and extending to the lower Rio Grande Valley, contains some of the State's best habitat for white-tailed deer. The soils and vegetative complex in the region are a valuable resource that, when managed properly, can sustain excellent deer populations.

The purpose of this publication is to assist interested land-managers in recognizing the potential of their resource and applying sound deer management practices. Basic deer biology, population management and habitat management are discussed. Habitat management is emphasized as the most important aspect of deer herd management.

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Geographic Location:

The South Texas Plains has an area of approximately 20-million acres encompassing all or part of 29 counties. It is a wedge-shaped section located in the extreme southern and southwestern parts of Texas, terminating in the most southerly projection of the state at the mouth of the Rio Grande river. This plain is bordered on the north by the Balcones Escarpment of the Edwards Plateau. On the east its border is marked by an irregular transition zone where the plain merges with the East Texas timber country, Blackland Prairies and Coastal Prairies.

Topography:

The South Texas Plains is a broad undulating to rolling plain with a general slope to the southeast. The area is drained primarily by the Rio Grande and the Nueces rivers and their tributaries. Stream valleys are relatively broad and shallow, often cut by intersecting channels. In the southern part there are few streams, and large sections are poorly drained.

Description of Region

Elevations range from sea level to nearly 1,000 feet at the north border. Most of the region lies at elevations between 200 and 700-feet above sea level.

The climate is mild, even sub-tropical in the extreme southern part. Average annual temperatures range from 69 to 74 degrees Fahrenheit. Winters are generally mild, with occasional short periods of freezing temperatures. The average annual rainfall is about 30-inches in the eastern part, gradually decreasing westward to approximately 20-inches. However, in most areas extended drought conditions occur frequently. This rainfall variability is an important factor influencing habitat and deer management in South Texas.

Vegetative Composition

Native vegetation consists of a moderate to dense growth of small trees, shrubs, weeds, short grasses, and coarse bunch grasses common to sub-humid and semi-arid regions of the southwestern United States and northern Mexico. The predominant woody plant is mesquite, which occurs over most of the region in widely scattered to very thick growth. Various thorny shrubs of many species grow abundantly in all sections. Prickly pear is present throughout the region, and in places is very abundant. The stream bottoms are characterized by a heavy growth of mesquite, live oak, hackberry, elm, pecan, and other trees. Weeds and forbs are present in great variety, and grow profusely when soil moisture is adequate.

Important Deer Foods:

Much research has been done on the food habits and nutritional requirements of the white-tailed deer. The native rangelands of South Texas provide excellent habitat for meeting the dietary needs of a deer population. Deer require a diet of approximately 16 percent protein plus various minerals and energy to be well-nourished. They are selective foragers, preferring to feed on a wide variety of plants rather than a few specific ones. The leaves, twigs and fruit of woody brush species, along with weeds and forbs, make up the bulk of their diet. Small amounts of grass may be taken seasonally.

Deer food plants can be classified generally as shrubs, forbs and grasses. The shrubs or woody plants eaten by deer are called browse. Cactus may be included in this category, of which prickly pear is an important food plant. Browse or brush makes up the bulk of deer diets on most South Texas deer range, especially during dry times. It is present in abundance and variety throughout South Texas, and deer utilize the leaves, twigs and fruit in their diet. Many of the brush species are evergreen, which persist during drought conditions, and are very palatable. Several are legumes and most are rated consistently high in protein and mineral content on a year round basis. In a normal brush habitat a percentage of the brush will be in a nutritious stage at any season of the year. Also, fruit crops of the various species ripen at different seasons. This diversity insures that a source of good to high quality food is provided on a year-round basis.

Browse plants must meet several requirements to be beneficial to a deer herd. They must be palatable, or easily digested by the animal. They should also be nutritious, or high in protein, energy or mineral content. Finally they must occur in abundance. A plant can be high in all categories, but occur in such small amounts that they are of little benefit. Deer must choose those plants that meet their nutritional needs throughout the year. There will be some seasons, even entire years, when drought conditions prevail. Browse species become more important then, due to their ability to withstand drought. An example of this would be the legume species which often produce large bean crops in drought years. Prickly pear, which is low in protein but very high in carbohydrates (energy) and Vitamin A, makes up a large percentage of deer diets, especially during dry periods. Some important deer browse plants and their nutritional values are shown in Table 1.

Forbs are the broad-leaf plants, both annual and perennial, commonly referred to as weeds. Annual forbs are seasonal plants that are abundant in wet years, but may be absent during droughts. Most winter and spring weeds are in this category and can provide high quality, very palatable forage from February to April. Annual forbs are normally short-lived and are gone when hot temperatures arrive. Perennial forbs are present in some growth stage year-round. Their abundance is also dependent on rainfall and they may make up a large part of deer diets. Some of the higher quality species may be scarce or lacking on most ranges, as over-grazing by livestock and excessive deer numbers will quickly take its toll on these favored plants. Proper range management is necessary to insure their abundance. Some of the important forbs in South Texas are listed in Table 1.

Important Cover Plants:

The same plants that provide the primary food source for South Texas deer are also the most important for furnishing cover and protection. Woody shrubs, such as mesquite, blackbrush, whitebrush, guajillo, granjeno, and brazil provide both escape cover and shade from the harsh elements. Mesquite is probably

the most important species. It is the most abundant overstory plant in the South Texas Plains, and there is evidence it plays a key role in the establishment and maintenance of a variety of other brush species, as well as forbs and grasses. Mature mesquite trees, which generally grow on deeper soils, (as opposed to switch mesquite or running mesquite), maintain a spacing that allows an interspersion of other brush clumps, along with a variety of weeds and forbs. Other shrubs that are adapted to shallow, gravelly soils provide a source of cover in these areas. Shallow ridges covered with blackbrush, guajillo and cenizo provide important deer habitat. If these plants are removed, these sites will produce little of value for deer. River bottoms and drainages with large trees such as mesquite, hackberry, live oak, elm, and pecan are also important cover areas for deer. When all of these areas are managed in a mosaic pattern to optimize the production of food and cover, excellent deer habitat is the result.

Table 1. Percent crude protein of some important South Texas deer food plants, by season. (Lynch, 1977; Varner & Blankenship, 1985)

Forage Species		Spring	Summer	Fall	Winter	Average
Shrubs						
Guajillo	*Acacia berlandieri*	27.7	21.4	22.2	21.4	23.2
Catclaw Acacia	*Acacia greggii*	23.3	18.5	17.9	25.4	21.0
Blackbrush	*Acacia rigidula*	18.2	17.4	19.8	16.5	18.0
Twisted Acacia	*Acacia tortuosa*	16.9	19.6	21.6	16.7	18.7
Coma	*Bumelia celastrina*	17.7	15.9	15.1	15.6	16.1
Granjeno	*Celtis pallida*	28.3	23.5	24.5	19.0	23.8
Brazil	*Condalia obovata*	23.8	14.3	17.1	17.5	18.2
Lotebush	*Condalia obtusifolia*	18.0	16.7	16.3	11.7	15.7
Vine Ephedra	*Ephedra antisyphilitica*	16.4	14.5	17.8	14.6	15.8
Kidneywood	*Eysenhardtia texana*	24.4	20.4	17.1	17.0	19.7
Guayacan	*Porlieria agustifolia*	26.1	22.6	18.8	17.4	21.2
Desert Yaupon	*Schaefferia cuneifolia*	18.1	14.3	14.4	10.7	14.4
Lime Prickly Ash	*Zanthoxylum fagara*	21.0	15.9	18.5	16.9	18.1
	Average	21.5	18.1	18.5	16.9	18.8
Forbs						
Western Ragweed	*Ambrosia psilostachya*	21.6	18.5	19.8	21.1	21.2
Plains Dozedaisy	*Aphanostephus ramossissimus*	11.1	9.2	10.8	19.2	12.6
Erect Day flower	*Commelina erecta*	20.0	17.0	16.0	–	17.7
Crown Coreopsis	*Coreopsis nuecensis*	10.3	9.9	–	23.8	14.7
Indian Blanket	*Gaillardia pulchella*	12.0	10.7	12.9	22.5	14.5
Hermannia	*Hermannia texana*	21.6	15.8	16.6	–	18.0
False Ragweed	*Parthenium hysterophorus*	17.7	13.8	16.6	20.6	17.4
Groundcherry	*Physalis viscosa*	19.8	17.1	19.9	21.0	19.5
	Average	16.8	14.0	16.1	21.4	17.1
Pricklypear						
Opuntia lindheimeri		13.3	5.6	10.3	5.4	8.6

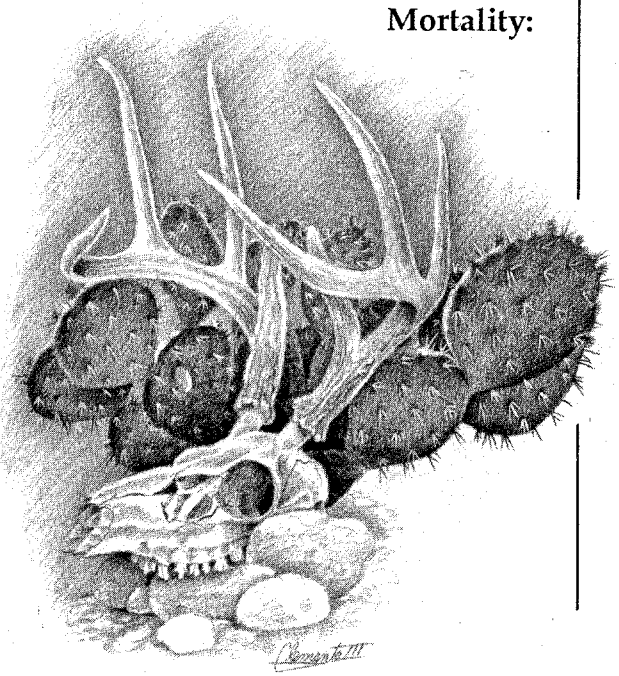
Basic Deer Biology

Breeding and Productivity:

Breeding activity in the South Texas Plains begins in the fall (November) and continues on into late winter (February). The peak of the rut, in normal years, will occur in late December and early January, with sporadic activity for several weeks before and after the peak. The gestation period is approximately 200 days with most fawns being born in July and August.

Adult does, on a good nutritional level, will normally produce twin fawns. Yearling does (1.5 years old when bred) usually have single fawns. It is possible for fawns, under optimum conditions, to breed their first fall when 6-7 months old. The annual reproductive potential for a deer herd on good nutrition is slightly less than 2 (1.5-1.8) fawns per doe. However, fawn survival rates rarely approach this potential in the wild. Good deer range in the hill country has produced 100 percent annual fawn crops, or 100 fawns per 100 does. This level of survival is rare in South Texas. Due to many factors that influence a deer population, such as quality of habitat, overpopulation of deer and livestock, predation and weather, fawn survival rates for South Texas in the fall of the year normally average less than 50 fawns per 100 does. On extremely abused ranges, and in drought years, it is not uncommon for fall survival to be only 1 fawn raised per 10 does. Thus, it becomes apparent that the key to maintaining a productive and healthy deer population lies in optimizing their reproductive and survival potential. A key principle to remember is that deer survival and productivity in the South Texas Plains are controlled by the least favorable circumstances of their environment.

Mortality:



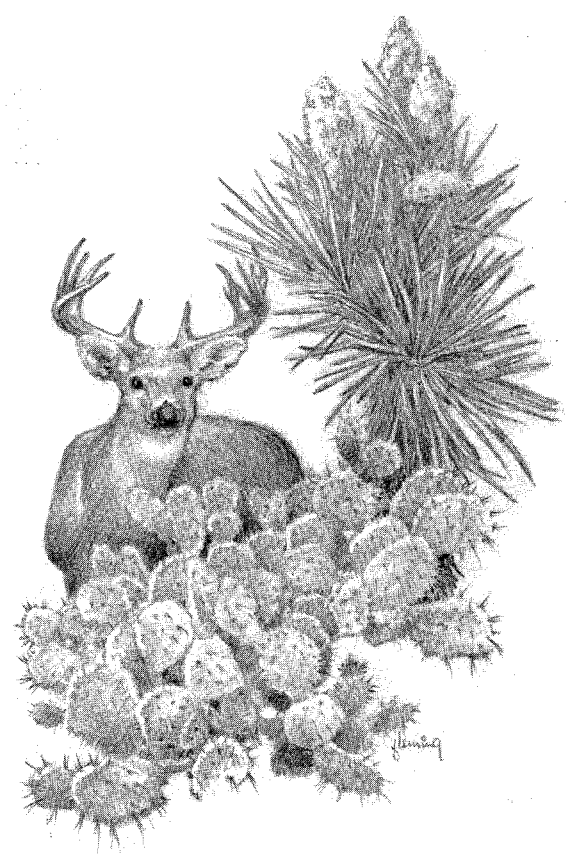
The reproductive potential of white-tailed deer, as with most animals, is influenced by nutrition. Animals must be maintained on a proper nutritional level on a year-round basis or reproductive rates will decline. While a decline in reproductive potential will limit a deer population, the most critical time occurs immediately after fawns are born. Mortality from various sources then enter the picture. The mortality rate is higher among fawns than any other age group. Studies have shown that predation, primarily by coyotes, accounts for a high percentage of this mortality in South Texas. It should also be noted that predation is more severe on poor habitat and over-grazed ranges, than on properly managed ranges. When sufficient food and cover are available for deer, especially ground cover of weeds and grasses, losses to predation are reduced. Without question, proper habitat management along with range and water conservation is the foundation on which to establish a healthy deer herd.

Habitat Requirements:

Habitat management is the key to deer management. The success or failure of most deer management programs can usually be attributed to habitat improvement or abuse. Providing quality habitat is an essential part of any successful deer management program.

Every animal has the basic needs of food, cover and water in order to exist. Some animals live well, others barely exist and still others live briefly and die, depending on the degree in which these needs are provided. Much research has been done on the food habits and nutritional requirements of the white-tailed deer. We know what must be provided by the habitat for deer to exist. For example, deer require a diet of approximately 16 percent protein and a balanced ratio of calcium and phosphorus to be well-nourished

Habitat Management



and achieve optimum growth potential. However, deer can subsist on a lower quality diet. We know they prefer weeds, forbs and the leaves and fruit of woody browse species. There is very little grass in their diet. Their food supply should be distributed evenly throughout their range, as deer do not migrate enmass to seek food. They will travel considerable distance to seek preferred foods, such as an oat patch in winter. However, when you see deer congregating in bunches or traveling long distances to feed, it is an indication their need for quality food is not being met.

We also know deer are selective foragers, preferring to feed on a wide variety of plants rather than a few specific ones. For these reasons, the mixed brush habitat found in much of South Texas is excellent deer range. Habitat improvement recommendations should emphasize the need for an even distribution of a food supply and the production of a wide variety of choice. Thus, solid stands of brush may be broken up by cleared strips or a mosaic of brush, interspersed with clearings. This provides a better variety of weeds, forbs and

brush species, while retaining adequate cover for hiding and protection from the elements. A monoculture, such as large fields of bufflegrass, does not meet the basic needs of deer.

The primary reason South Texas has historically produced excellent deer populations is the variety and quality of deer food and cover plants that make up the habitat. Research has shown that South Texas vegetation comes nearer providing adequate levels of protein during all seasons of the year than any other region of the state. Spring and winter weeds and forbs are usually present, but the most important food and cover source is the variety of brush species that occur. Many of these plants are nutritious legumes and some are semi-evergreen, persisting into the winter. Fruit crops of the various species ripen at different seasons, thus a source of good to high quality food is provided on a year-round basis, which is the key to producing quality animals.

There are many factors that influence habitat, such as soil type, periodic drought, severe freezes and other acts of nature that man cannot control. However, other important factors are primarily controlled by the land-manager's decisions; factors such as brush management, livestock grazing systems and stocking rates, supplemental feeding and water distribution. Decisions and management techniques concerning these factors can literally make or break a deer management program.

Brush Management:

Brush control or "management" may be a positive or may be a negative influence on deer in South Texas. Any amount of brush control on a ranch will have some impact on the deer population. Whether it is considered habitat improvement or destruction, depends on how it influences deer food and cover. Important factors to consider in any brush management plan are: (1) Method of brush control used; (2) Pattern of brush removal; (3) Amount of brush removed; and finally (4) Your objective or goal.

Various methods of brush management are available to the land manager, who must determine the most practical and economical method suited to his objective. Factors such as density and variety of brush species, soil types, and contour of the land should be considered in any brush control program. Mechanical clearing by rootplowing, chaining, roller-chopping or discing, will remove brush overstory, set back plant succession, and stimulate forb and grass production. However, some brush management methods are more beneficial to deer than others. Rootplowing, followed by raking and seeding to introduced grasses, is least desirable when wildlife is a consideration. This method results in a monoculture of vegetation. There is less variety and quality of deer food produced, even though deer may use such clearings for a year or two due to the initial flush of forbs. Chemical spraying produces similar results, and is not well suited for wildlife needs. When planning brush control with both deer and cattle in mind, mechanical clearing with a heavy disc or roller-chopper is recommended. These methods disturb the soil, promote a variety of forb and grass production, and remove the brush canopy. However, most brush species will quickly resprout from their roots and produce a variety of quality food.

Fire, nature's brush control method, is gaining popularity as a management technique in South Texas. Controlled burning is economical to implement and results in a mosaic type pattern that is attractive to wildlife. Nutrient values and palatability of most plants increase following a fire. Adequate vegetative ground cover is necessary for burning operations, and lack of proper fuel can limit its use in many situations. Selecting the proper time of year and optimum climatic conditions are important considerations when conducting a controlled burn. It is always wise to seek experienced help if burning is selected as a brush-control tool.

The method of brush control selected is probably the most important decision in any brush management program. It will influence decisions on patterns and amount of brush removal, in addition to immediately reducing deer food and cover. The variety and quantity of future plant communities will also vary according to the control method selected.

Patterns of brush clearing can be designed in many shapes and sizes. Important factors to consider include the control method selected, habitat types, topography of the land, and the amount of edge that will be created between brushy areas and openings. The landowner's

objectives will determine the pattern and size of clearings. Large blocks of cleared land tend to optimize cattle production, while smaller, irregular shaped openings provide better deer habitat.

The most common pattern of brush control is strip clearing, with cleared strips alternating with strips of brush. This pattern is generally the most acceptable from the standpoint of economics and mutual benefits for deer and cattle. Strip clearings can be in either a parallel or zigzag pattern (Fig. 1). Other patterns can be checkerboard, block, mosaic, golf-course or contour systems (Fig. 2).

Optimum clearings for deer tend to be irregular in shape, often following the contour of the land. Travel ways connecting ridges, draws and creek bottoms should be left in brush and interspersed with cleared areas. Such patterns usually produce the highest edge effect possible and generate excellent brush, forb and grass production. Any pattern selected should be designed to leave cover well distributed and optimize the variety and quantity of food produced. Total clearing of an area, or clearing of large blocks, is not desirable for white-tailed deer (Fig. 3).

The amount of brush removed is a major consideration. Deer will move into open areas to feed, but require cover nearby for protection from the weather and for security. Clearings can be too wide for optimum utilization by deer, so their size and distribution should be designed to allow free movement of deer from cover to cover.

How large is too large? This depends on several things and will vary with the type of brushy cover present, thickness and distribution of cover, topography, and method of bush control used. No set rule can be applied to all ranch operations. Generally, removal of up to 25-30 percent brush, in proper patterns, can be accomplished and still provide optimum habitat for wildlife.

When using strip clearing, cleared strips of 100-500 feet in width are acceptable, alternated with equal strips of brush. Brush should be left undisturbed along water courses or other terrain features that serve as wildlife travelways. Belts or blocks of brush should be left every 200-300 yards in excessively long strips. Contour or mosaic patterns should follow a similar scheme. Do not make openings too wide, so deer will move freely from cover to cover. Islands of brush can be left in larger openings to provide escape cover.

A higher percentage of brush can be removed when using roller-chopping or

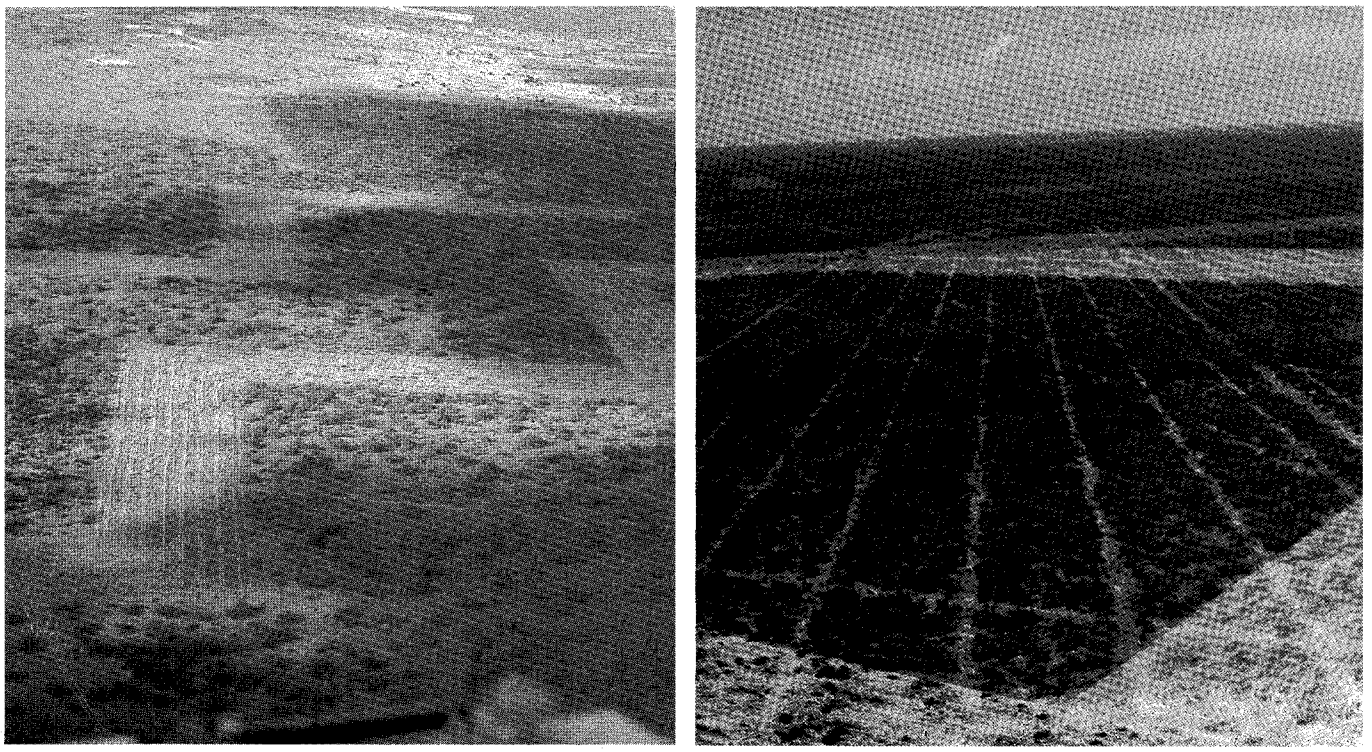


Figure 1. **Variations in strip clearings, showing parallel and zig-zag patterns. Zig-zag pattern creates more edge effect than parallel strips.**

discing. These methods produce a shorter-term reduction of vegetation than does root-plowing. They also maintain a greater variety of existing plants. In heavy brush, these methods stimulate regrowth of established native plants, and increase their nutritive value. However, care should be taken not to remove excessive amounts of brush in any area. Additional brush can always be removed at a later date if desired, but replacing destroyed habitat requires many years.

Management of treated areas following brush control is very important. Soil disturbance and opening up areas to sunlight will produce a flush of nutritious new growth. These areas become very susceptible to overgrazing by livestock, and care should be taken to prevent this. Range conditions and food supplies for wildlife and livestock can be improved by brush management, but only through sound range management practices. Brush control without proper follow-up management can be more detrimental to the land and animals than no brush control at all.

Livestock Management:

Since the objective of most landowners is to achieve maximum sustained income from their property, providing adequate amounts of quality food for both deer and cattle is a primary concern. Cattle, by their grazing nature, have the ability to cause severe range deterioration, if not controlled. Therefore, a controlled grazing system and proper stocking rates are very important components of a ranch management program.

Continuous grazing, or unrestricted livestock access to any part of a pasture or ranch throughout the year, is least compatible with wildlife. The most palatable range plants invariably suffer under this system. Preferred plants are often eliminated entirely and range conditions generally deteriorate. More desirable would be a rotation grazing system whereby pastures are rested periodically during the year. This allows for improved seed production, establishment of seedlings, and restoration of plant vigor. Periodic rest from grazing pressure promotes range improvement and benefits both livestock and deer. A variety of rotation grazing systems have been applied successfully on South Texas ranches.

The number of animal units, or stocking rate, a given acreage will support is dependent on many variables. It is impossible to apply a uniform stocking rate for either cattle or deer to South Texas. However, on most South Texas ranches, it would be acceptable to stock cattle at

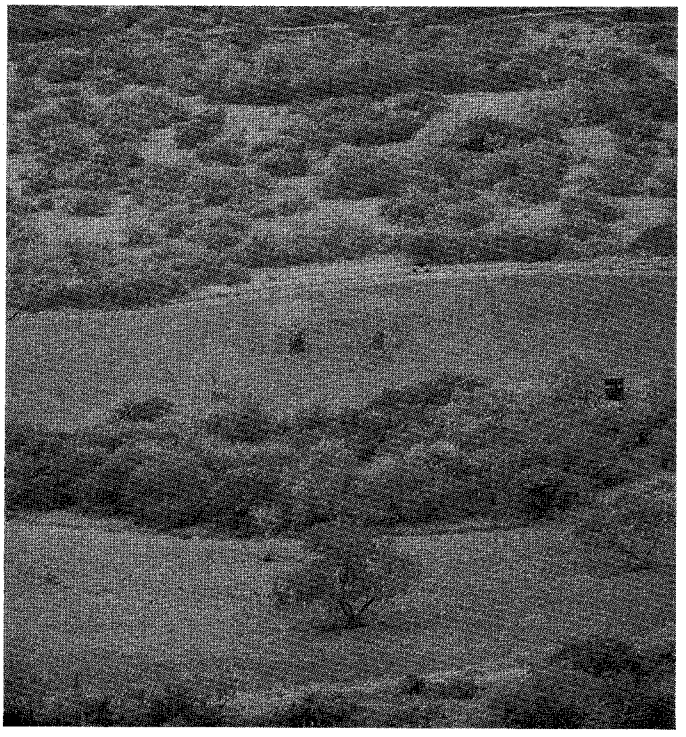


Figure 2. **Contour or mosaic pattern of clearing. This pattern allows for selective brush removal and produces the highest amount of edge effect.**

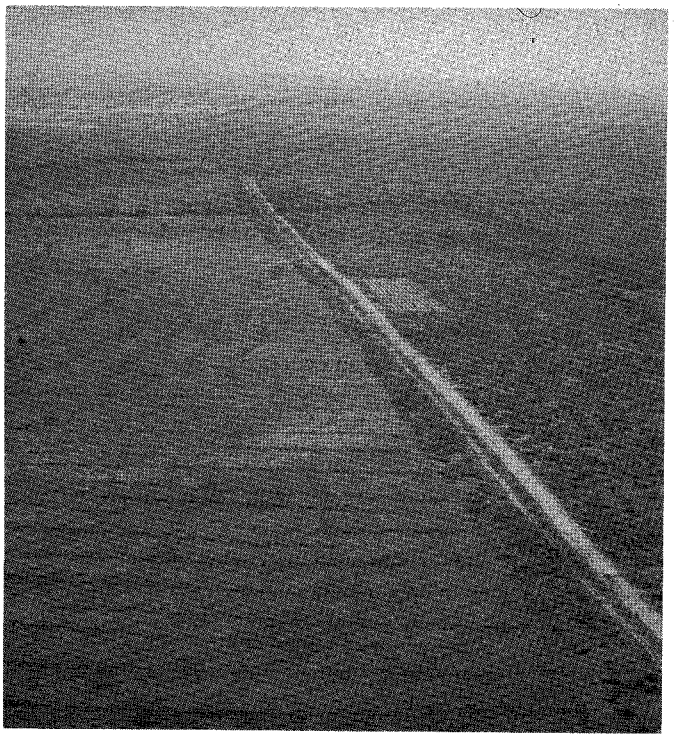


Figure 3. **Clearing pattern showing excessive brush removal. Clearing large tracts of brush severely reduces wildlife food and cover.**

the rate of one animal unit for each 25-30 acres. This rate is acceptable during most years when applied in a rotational grazing system. Depending on habitat quality, ranches will vary in the number of animals that can be supported. Managers must be able to recognize signs of forage over-utilization and adjust animal numbers accordingly.

South Texas is noted for erratic rainfall and periodic droughts. Range conditions constantly change and optimum stocking rates vary with these changes. Stocking rates of deer and cattle should be flexible so they can be adjusted to stay in balance with forage production. The key to providing quality habitat is maintaining this balance between animal density and forage production.

The range manager should also have a knowledge of preferred food plants for both deer and livestock. By providing an adequate supply of quality forage during all seasons, maximum benefits can be derived from both resources.

Supplemental Feed:

Providing a non-native food source for deer is generally done for two reasons; to supplement the diet of deer with a quality food source, thereby improving animal condition, and to aid the manager in a harvest program. Feed may be provided by strictly artificial means, such as pre-mix pellets or grain fed in troughs or automatic feeders, or by a more natural method of food plots planted with nutritious forage. Neither method will compensate for poor range management practices, nor should they be used to maintain excessive numbers of animals. Supplemental feeding may be beneficial under certain conditions, but the control of animal numbers to provide a dependable source of native food is the basis for establishing a sound management program.

Supplemental feeding is very popular in South Texas. Many tons of "deer pellets" and shelled corn are distributed from automatic feeders and troughs each year. Generally, the economics of such a feeding program and the benefits to the deer population are poor. In some isolated cases, under closely controlled conditions, gains in growth rate of deer body size and antlers have been noted. But, to offer a feed-mix free choice to a free-ranging population of deer and expect a measurable return in increased body and antler size, is not usually realistic.

Shelled corn is probably the most popular supplemental feed, as deer are readily attracted to it. It has the disadvantage of being low in protein (8 percent), but is high in carbohydrates and is a good source of energy. It is an excellent choice to attract deer for harvest, but will not meet nutritional requirements for optimum development.

If improving animal quality is the goal, then a well-balanced ration should be used (Table 2). Research has shown that penned deer fare well on three to five pounds of 16 percent protein pellets per day per animal. Optimum body and antler growth is obtained when this protein level is combined with 0.64 percent calcium and 0.56 percent phosphorus in their diet. Deer pellets, cubes or blocks containing adequate amounts of protein and minerals can be obtained commercially. This type of feed can be fed free-choice, either in open troughs or by automatic feeders. Draw-backs to this type feeding program are numerous. It can be expensive when dealing with large acreages and populations. Other non-target animals will invariably utilize the feed, and it is virtually

Table 2. Deer ration used by Texas Parks and Wildlife Department in research studies on the Kerr Wildlife Management Area. Ration is in the form of a 3/16 inch cube pellet and contains 16 percent crude protein; no urea is used.

20	percent peanut hulls
20	percent corn meal
05	percent dehydrated alfalfa meal
22	percent ground milo
15	percent cottonseed meal
10	percent soybean meal (44 percent)
05	percent masonex
02.5*	percent mineral mix
00.5	percent vitamin/trace mineral premix
40	grams aeromycin per ton

* mineral mix should contain adequate calcium and phosphorus to supply the ration with 0.64 percent calcium and 0.56 percent phosphorus.

impossible to exclude them. Measurable results, as to actual benefits to the deer population, are difficult to obtain especially when dealing with non-confined deer populations.

Food plots are beneficial to deer populations under certain conditions. When planted to nutritious forage, they supplement the diet of deer during critical times of the year. Plots should be designed to provide forage during late summer and again in late winter, the most critical stress periods for deer. Rainfall, or lack of it, is usually a limiting factor in food plot production.

Food plots must meet certain criteria to be effective. They must be of adequate size to provide enough forage for animals that may use them, and be distributed evenly throughout the range of the deer population. They should be fenced to exclude cattle. Plots should be approximately 5-20 acres in size. One plot may service 100-500 acres of land area, depending on deer density, ranch size, habitat types, and plot size.

Winter food plots are probably the most important from a deer management standpoint. Besides providing a source of food, they can be used to selectively harvest animals in the herd. Several winter plantings are available to managers in South Texas. Oats and wheat are most commonly used and have proven very effective. Legumes, such as clover, vetch, peas, and beans are other choices, but their establishment may be more difficult and expensive.

Summer food plots provide a highly nutritious food source in late summer. The best choices include legumes, such as peas, peanuts, quar, mung bean, and soybean. Again, establishment can be a problem, limited by rainfall in the area. Grain sorghums may also be used, especially where bird species are desired, and sorghum almum, red-top cane, millet and sunflowers have been successful.

Food plots can be expensive and deer foods can be produced more economically on well-managed native range. However, they may be beneficial when re-establishing poor and over- grazed ranges, and as an aid in a harvest program. A planting table for some South Texas game foods is shown in Table 3.

Table 3. Planting table for South-central Texas. (Game Food Bulletin; Douglass W. King, Co., San Antonio, Texas.)

Crop	Growth Habit[a]	# seed/lb.	Planting Dates	Depth	Pounds/acre Broadcast	Rows
Native Sunflower	RA	300,000	Dec-Mar	1/4 to 1/2"	15	5
Sesame	A	164,000	Mar-Apr	1/2"		4-6
W.G.F. Sorghum	A	30,000	mid Aug, Mar-Jul	1 to 2"	20	5
Big German Millet	A	218,000	Mar-Aug	1 to 1-1/2"	20-25	5
Browntop Millet	RA	145,000	Mar-Sept	1 to 1-1/2"	20-25	5
"Comanche" Partridge Pea	RA	65,000	Mar-May 15	1/4 to 3/4"	10 pls	4 pls
Japanese Millet	P	143,000	Mar-Jun	1 to 1-1/2"	20-25	5
"Sabine" Illinois Bundleflower	P	64,000	Mar-May 15	1/2 to 3/4"	10-15 pls	3-5 pls
"Aztec" Maximilian Bundleflower	P	320,000	Mar-May 15	1/4 to 1/2"	1-2	–
Sorghum Almum	A	90,000	Mar-Sept	1 to 2"	10-15	3-6
Egyptian Wheat	A	25,000	Mar-May	1 to 2"	15-20	5-10
Quail Haven Soybean	RA	10,000	Apr-May	1 to 1-1/2"	25	8
Kleingrass	P	1,500,000	Feb-May	1/2"	2-4	1-2 pls
Four-Winged Saltbrush	P	65,000	May-Mar 15	1/2 to 1"	–	4-6 (60"-row)

[a] A = Annual
RA = Reseeding annual
P = Perennial

Water Management:

Historically, South Texas was severely lacking in permanent surface water. Major river drainages are limited to the north and south extremities, with vast areas in between deficient in water supplies. Due to intensified cattle ranching, pastures became smaller and watering places, consisting of earthen reservoirs and water wells, multiplied. Today, surface water is distributed throughout the region. Wildlife, especially deer populations, have benefitted from this increased water availability.

Availability of surface water is an important consideration in providing quality habitat for white-tailed deer. Although deer do obtain some water through certain plants in their diet, well distributed sources of permanent water on a ranch will allow animals to more completely utilize existing habitat. Lack of water can be a limiting factor on deer densities and distribution. Construction of dirt tanks and/or wells with storage tanks should be considered if additional water is needed. Deer prefer to use ground surface water located near adequate cover. Allowing concrete troughs to overflow into adjacent earthen ponds provides watering places that are more readily used by all wildlife.

Development of specialized wildlife waterers have recently become popular in optimizing water distribution on some South Texas ranches (Fig. 4). A network of underground water lines, usually plastic pipe, can distribute water over an area from a central supply. Either gravity-flow or pressure pumps are used to furnish water to multiple watering stations. Waterers may be 1-6 feet in diameter, spaced 400-600 yards apart, and regulated by a drip or float system. Such systems may be designed to provide an adequate water source, distributed throughout the habitat where all animals may benefit from it.

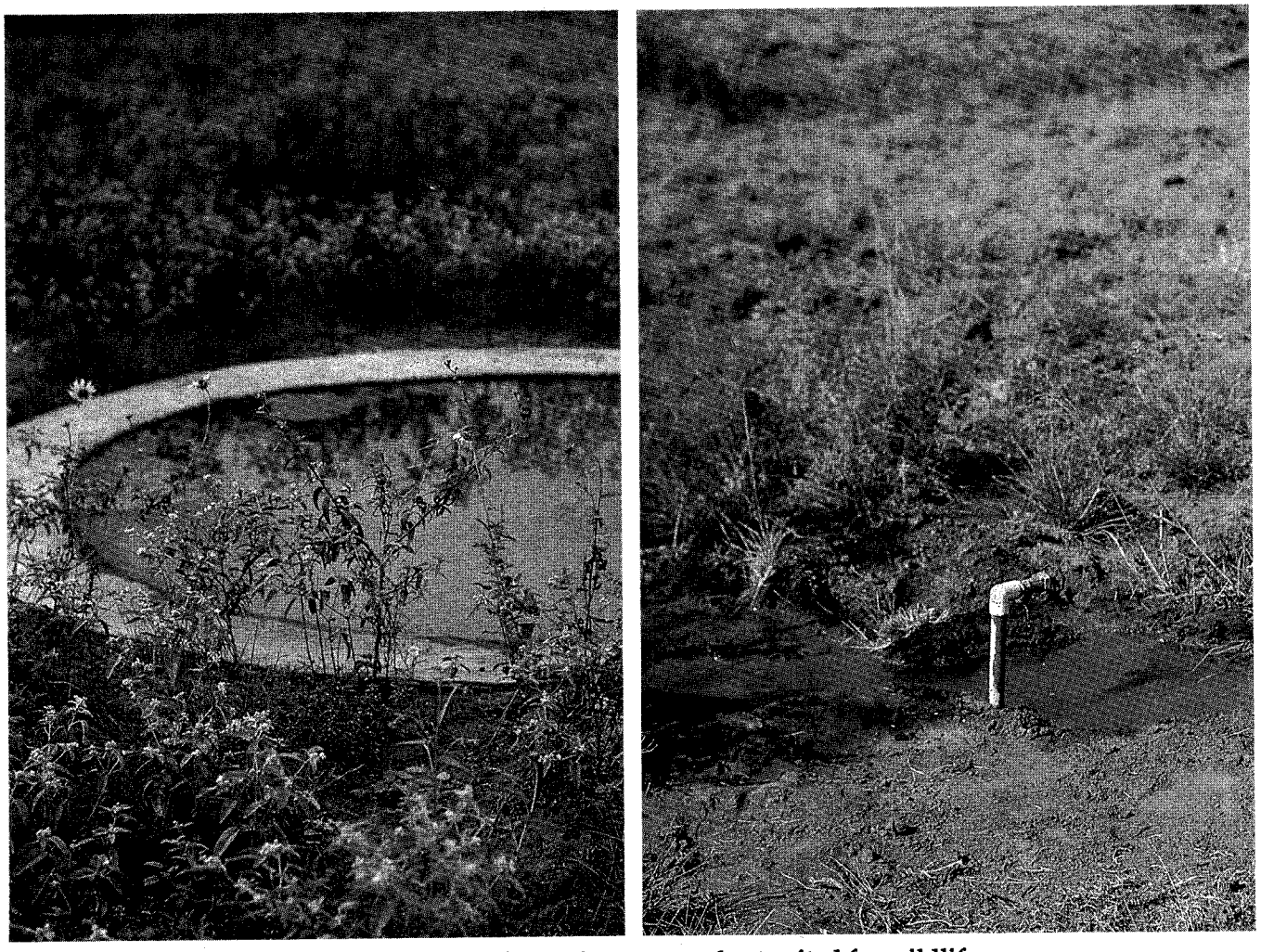


Figure 4. **Examples of watering systems best suited for wildlife use. Adequate water distribution is important to wildlife production.**

Deer Herd Management

Basic Management Principles:

A deer management program can basically be divided into two major segments; habitat management and population management. The foundation of any program must be sound habitat management. Too often, managers emphasize population management, giving little thought to habitat quality. Although improvement may be made in a deer herd on poor range, much greater success comes when working with animals living under good habitat conditions. Population management is important on either good or poor ranges, but the land manager has many more options available to him when selecting goals and techniques to apply to a herd in quality habitat.

Once it is understood that a well-founded program involves a combination of factors, it is important to establish goals or objectives and develop a plan to reach them. The land manager is constantly faced with decisions that affect both the animals and the range they utilize. Development of a management plan, along with regular adjustments, is needed to aid in wise decision making. Goals of a plan usually reflect the aesthetic and economic desires of the land manager. They should also be realistic and tailored to fit the land unit.

The most sound, long-term, goal for any management program is to produce healthy animals living in quality habitat. A management plan may have several other objectives that reflect the desires of the land manager, but the central goal should be the production of a healthy animal. This means that animals of both sexes and all age classes will exhibit a higher level of quality, as opposed to poor animals living on poor range. A quality animal can be a fawn, yearling buck or middle-aged doe, as well as a mature buck. Herd improvement, under this goal, can be measured in increased body size, by age class for fawns, does and bucks. Antler measurements of bucks, again by age class, will also show improvement. Fawn survival rates and herd production will increase. Over-all herd quality will increase as the health of individual animals improve.

This concept of quality management should not be confused with a "managing for trophy bucks" or a "quantity vs. quality" question. The manager may elect, as an objective, to optimize the production of older-age, "trophy" bucks in his plan, or he may decide it is more economical in his situation to manage for quantity and maximize annual harvest rates. His desire in deer herd management may fall somewhere in between these two goals. Whatever his objectives, the production of healthy, quality animals living in quality habitat is the foundation to build on.

Management Techniques:

Once a plan with objectives has been formulated, the manager can begin to "manage" his deer herd. Emphasis should be placed on population analysis, developing a harvest strategy, and establishing a system of record-keeping. This will involve a certain amount of data collecting, which is needed to determine the status of the herd and measure progress toward reaching goals. Continued analysis of pertinent data paints a picture of the ever-changing, or dynamic state of a deer population, and aids in making management decisions.

Data Collecting:

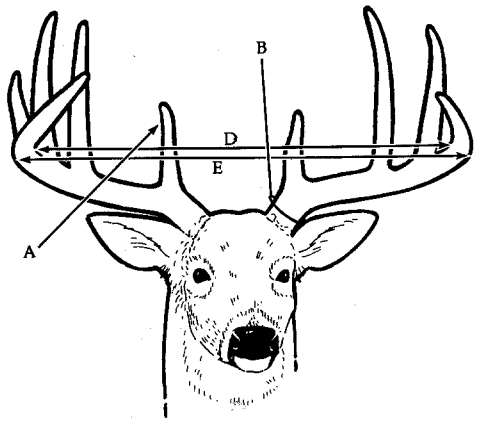
Accuracy in population analysis requires collection of the following representative data:

A. Population Data
   1. Deer Density (Deer/Acre)
   2. Buck:Doe Ratio
   3. Fawn Survival/Mortality
   4. Age Structure

B. Harvest Data By Age Class
   1. Number Harvested
   2. Weights
   3. Antler Measurements
   4. Body Condition
   5. Lactation Rates

Examples of data record sheets are shown in Table 4a through 4e.

Table 4a. Example of record sheet for collecting deer population data.



Date:_____

Hunter:_____

Pasture and/or blind number:_____

Buck:_____ Doe:_____

Age:_____ Weight:_____

ANTLER MEASUREMENTS:

A. Number of points longer than 1 inch:_____

B. Basal circumference: Left_____ Right_____

C. Length of main beam: Left_____ Right_____

D. Inside main beam spread:_____

E. Greatest outside spread:_____

COMMENTS:_____

Deer Census:

Collection of population data usually involves some type of deer census. Basically, this is a technique designed to "count" the number of deer in an area. Several different census methods have been developed through the years, with varying degrees of success. Some that have been used in Texas are Hahn walking census, driving census, spotlight counts, deer track counts, deer pellet group counts, aerial fixed-wing census, and aerial helicopter census. Some of these methods are specialized for different regions, and all have their limitations. None of these methods will yield data that is 100 percent accurate. In working with animals as mobile and secretive as white-tailed deer, a manager should understand the inherent limitations of any census method. Thus, data collected from a deer census is an "estimate" of herd composition, and should be treated as such.

Deer surveys most commonly used in South Texas have been spotlight counts and helicopter counts. In recent years, personnel with the Texas Parks and Wildlife Department and Texas A&I University have conducted extensive research with both census methods. Their common goal was to improve the effectiveness of these tools for deer management.

Research has shown the aerial helicopter census provides the best census data for South Texas. Although this method is not totally accurate, research findings point out several positive attributes when compared to other methods. Repetitious counts made in various habitat types in the region showed the helicopter census counted between 25 percent and 75 percent of the deer actually present. It is thus difficult to establish an absolute density figure for any given area or deer population. However, it was determined that helicopter counts tend to under-estimate actual densities, allowing a manager to establish minimum density estimates. Density estimates are also improved with multiple counts, meaning several counts are better than one, although this is not usually feasible in most management situations.

The helicopter census is more consistent than other deer census methods in South Texas. It also provides better buck:doe ratio data and fawn survival estimates, because it allows the observer to see a large number of animals in a short period of time. This method does have limited effectiveness in areas with a canopy of large trees, such as in river bottoms and dense stands of hardwood timber. The spotlight census has been used with some degree of success in these areas where helicopter counts are ineffective, but has limited application in most of the region. When considering the alternatives available to gathering herd composition date, the helicopter census method remains the best choice for the South Texas area.

Table 4b. Example of record sheet for collecting deer population data.

DATE _____ LICENSE # _____ DAYS SPENT HUNTING _____

NAME _____

ADDRESS _____ CITY _____ STATE _____ ZIP _____

DEER: BUCK _____ DOE _____ # POINTS _____(1"+) LENGTH OF BEAM: R _____ L _____

BASAL CIRCUMFERENCE _____ AGE _____

WEIGHT _____(dressed) BODY CONDITION _____ SPREAD _____(inside)

RIFLE _____ CALIBER _____ NUMBER SHOTS _____

KILLED OR WOUNDED _____

LOCATION _____

TIME OF DAY KILLED _____

QUAIL _____ DOVES _____ WATERFOWL _____ JAVELINA _____ WEIGHT _____

COMMENTS: _____

Harvest Data:

In addition to deer census data, other valuable information can be collected from the animals themselves. This process should be part of a harvest program. The age of each animal harvested should be determined. This is best done by a visual inspection of the lower jawbone, using the tooth wear and replacement method of aging (Fig. 5). Body weights, antler measurements, body condition and lactation rates should be recorded by age class (Table 4a - 4e). Photos of harvested animals, with pertinent data for each one is also recommended (Fig. 6).

Record Keeping:

It is important to develop a consistent system of record keeping for collected data. Also, data should be comparable from year to year to be meaningful. It should be kept in a concise and orderly form that can be easily summarized. When properly done, such data can then be used to monitor the progress of a management program.

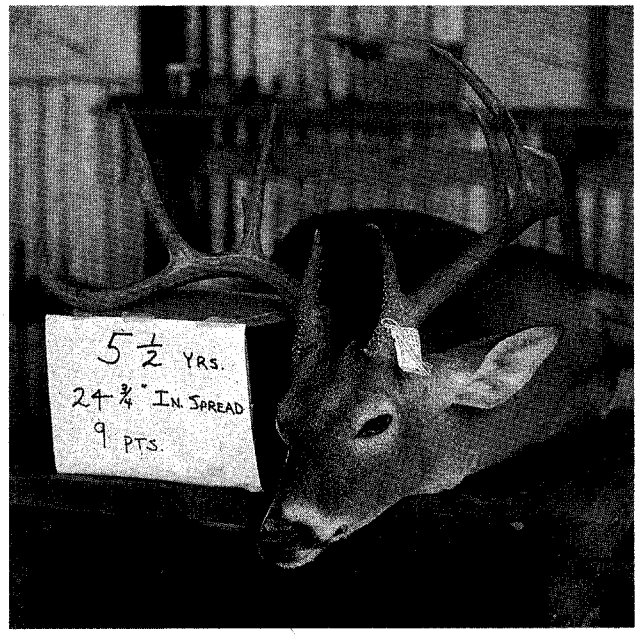


Figure 6. **Photo record of harvested deer. Data included with photo can be a valuable aid in record keeping.**

Table 4c. Example of record sheet for collecting deer population data.

WHITE-TAILED DEER

Hunting Season_____ Ranch Name _____

_____ Sex: Antlered Buck

City County

Sample Number	Date of Kill		Hunter	Pasture	Age	Dressed Weight (lbs.)	Antler Development			
	Mo.	Day					Total Points	Spread	Antler Base	Beam Length

Figure 7. **Antlers of 3.5 year old bucks from study pens on the Kerr WMA. The 5 antlers above are from bucks which were fork-antlered at 1.5 years of age. The 5 lower antlers are from bucks which were spikes at 1.5 years.**

Harvest Strategy:

Once population and harvest data has been collected and analyzed, the manager is better prepared to make some decisions about his deer management program. He now has some knowledge about the density, buck:doe ratio, productivity, weights and body condition of the animals, antler size and age structure of the population. By comparing the present status of the population to his desired goals, the manager can then devise a harvest strategy to reach his objectives.

The buck:doe ratio must be addressed in the management of any deer population. It can be altered by man's influence and may vary between areas. Depending on the intensity and direction of management techniques, primarily hunting pressure, ratios may vary from 1 buck per 5-10 does to less than 1 buck per 1 doe. The "proper" buck:doe ratio will depend on a manager's objective for his deer herd. In general, harvest rates should be aimed at achieving and maintaining a sex ratio

Table 4d. Example of record sheet for collecting deer population data.

SUMMARY

WHITE-TAILED DEER AGE, WEIGHT, AND ANTLER DATA
Year _____

Ranch _____

Age Class	Sample Size	Total Weights	Average Weight (lbs)	Total Antler Spread	Average Antler Spread	Total Antler Base Meas.	Average Antler Base	Total Main Beam Length	Average Main Beam Length	Total Points	Average Points
1½											
2½											
3½											
4½											
5½											
6½											
7½											
8½											
Comb.											

NOTE: Double check all calculations:
Retain a copy of this data sheet in project files, along with a copy of the field data sheets.

of approximately 1 buck for each 1 to 2 does. This will provide optimum numbers of bucks, while maintaining an adequate number of does for herd replacement.

Herd composition or the percentage of bucks, does and fawns by age class, is another important facet of population dynamics. Again, the desired objective becomes the primary consideration. If the manager is content with harvesting primarily young bucks in the 1.5 year and the 2.5 year age classes, theoretically he could remove 100 percent of the bucks in a population each year. Buck harvest for each succeeding year would then be dependent on the previous year's fawn crop. On the other hand, if a manager desires more mature bucks with larger antlers, he must allow some young bucks to grow older and, thereby, increase the percentage of animals in older age classes.

If the sustained harvest of older age bucks is an objective, then 30-40 percent of the buck population should be in the 4.5+ age group. The remainder of the population should be distributed evenly among 1.5, 2.5, and 3.5 year old animals. An annual sustained harvest of older age bucks would then be possible, once these proportions are accomplished. Annual harvests of approximately 20 percent of both bucks and does can be expected with proper herd management.

Any discussion on the proper harvest of bucks and does must address the role of spike bucks. Harvesting spikes has become a popular management tool on many hunting leases in South Texas. Like any management tool, it must be used properly to be effective. If used improperly it can also be detrimental to a management program.

There have been volumes of publicity in recent years concerning spikes. There is still controversy and misconceptions about this animal. Is the statement, "Once a spike, always a spike," true? Should you harvest only the "older spikes"? Are spikes really inferior? Should they be harvested or protected? Answers to these questions have been found through research on the Kerr Wildlife Management Area and from state-wide deer harvest data collected by Texas Parks and Wildlife Department biologists.

Table 4e. Example of record sheet for collecting deer population data.

White-tailed Deer Population and Harvest Supplement for Management Plans

Ranch _____ Owner or Manager _____ County _____

POPULATION TREND DATA

Year	Acres Per Deer	Does Per Buck	Fawns Per Doe	Bucks Observed % Spikes	Bucks Observed % 8 points +	Estimated Population Bucks	Does	Fawns	Total Deer

HARVEST TREND DATA

Year	Number Hunters	Average No. Days Hunted	Antlered Bucks Harvested Spike & 3 points	Forked Antlered	Total Antlered Bucks	Antlerless Deer Harvest Adult Does	Doe Fawns	Buck Fawns	Total Antlerless

Most spikes are 1.5 year old deer. A very small percent of bucks will have only 2 points when they reach 2 years or older. Even fewer will be spikes all their lives.

Research has shown that body weights and antler size is influenced by the quality of an animal's diet. These characteristics are also influenced to some degree by genetics. Yearlings that are spikes have smaller body weights and antler size than do fork-antlered yearlings. This comparison remains true in later years. Even though spikes will produce more antler points as they grow older, body weights and antler size tend to remain smaller (Fig. 7). For whatever the reason, nutrition and/or genetic related spikes do exhibit inferior characteristics and should not be a protected segment of a deer population.

In some management programs the removal of spikes should be part of a plan to selectively cull bucks from the herd. However, many land managers and sportsmen have the misconception that eliminating spikes will automatically result in a quality deer herd. This is not true. These people are over- emphasizing a single management tool. Spikes are a symptom of a problem. Removal of the symptom does not eliminate the cause of the problem.

A quality deer herd is produced by controlling doe numbers and providing animals with quality habitat and proper nutrition, not by just killing spikes. Harvesting spikes is important, but it should be kept in proper perspective by the land manager. On a scale of important "things to do" in a management program, the harvest of spikes would be included, but it is not the most important issue. Also, the practice of selectively "culling" inferior bucks, other than spikes, has been misapplied by many hunters and ranch operators. An intensive culling program may have a place in an advanced stage of a management program, but most ranges in South Texas are far from this level. Their immediate needs are to improve habitat and range conditions, reduce deer densities, increase fawn survival and improve buck:doe ratios.

An increase in fawn survival and herd productivity should be a goal in any management plan. It is a biological rule of thumb that as deer numbers are reduced, fawn survival increases. This applies especially on over-populated ranges, where a reduction in numbers will result in increased deer quality and improved range conditions, followed by higher fawn survival rates. This is an important concept when planning harvest strategy to compensate for over-population and distorted buck:doe ratios.

The comparative status of individual animals in a herd is important to consider when establishing goals and monitoring the progress of a management plan. What are the maximums of bucks and does in an area pertaining to body weights and antler size? What should a fawn, yearling or adult animal weigh? Based on numerous records, an adult South Texas doe should weigh 75-100 pounds dressed weight. Adult bucks should weigh 135-200 pounds dressed weight. Average weights that fall below these minimum levels can be improved upon. Fawn production in South Texas averages 40 percent. This can be increased to twice that level, or higher, on well-managed ranges. Establishing such records for a deer population and maintaining them through time will allow the manager to evaluate the status of his herd and measure the progress of his management program.

The success or failure of any deer management program is dependent to a large degree on the amount of control the manager has over the situation. He may make the right decisions and select the proper techniques, but fail to apply them. For instance, he may attempt to increase or reduce the harvest pressure on either bucks or does, but hunting pressure on neighboring land may result in the opposite effect. He may need to reduce livestock grazing pressure in order to improve range conditions, but does not control the grazing lease. Management plans and goals must be realistic in view of such limitations. It is important to gain as much control as possible over factors that have an impact on a management program. The amount of this control will ultimately determine the degree of success in reaching management goals.

Landowners interested in planning wildlife and habitat management programs can obtain assistance from the Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas, 78744.

Figure 5. **Criteria for aging deer by the tooth replacement and wear method. Reprinted by permission of the Texas Agricultural Extension Service, College Station, Texas. Bulletin Number B-1453, Charles W. Ramsey and Milo J. Shult, authors.**

The Age of a Deer

Charles W. Ramsey and Milo J. Shult
Extension Wildlife Specialists
The Texas A&M University System

Tooth eruption and wear in deer are closely related to the age of the animal. Deer shed and replace milk teeth with permanent teeth at consistent ages. They replace all incisiform milk teeth (front teeth) by 7 months and milk premolars by 19 months. Thus, beyond the fawn stage, a deer's age, unlike the age of sheep, goats, and cattle, cannot be determined by examining front teeth replacement.

As a deer grows older, certain portions of its permanent teeth, particularly crests of its jaw teeth, wear and expose increasing amounts of dark dentine. Biologists observed this phenomenon and, working with deer of known ages, developed criteria for characterizing age classes based on tooth replacement and wear. They identified most age classes on the basis of the relative amount of exposed dentine on the lingual crests (next to the tongue) of molar teeth. However, the criteria for age classes differ between species.

Texas biologists and technicians tested the technique with white-tailed deer of known ages from the Edwards Plateau and Post Oak Savannah. In testing, they found a small percentage of known-age animals that did not fit their corresponding age-class criteria, but these were only 1 year off. They discovered that the greatest source of error was misinterpreting age-class criteria which caused them to assign 1 extra year to the age of mature animals (4+ years-of-age).

To calculate a deer's age accurately, the scientists learned that they had to use all criteria for an age class because accident, deformity or individual variation can cause wear on any single tooth. They found that using multiple characteristics tended to be self-correcting. Because this technique generally has been accurate in determining the age of white-tailed deer, it also has been adapted for use with mule deer and elk.

Key Words

Terms used when determining a deer's age by tooth replacement and wear.

Premolars: the rather narrow jaw teeth in front of the molars adapted to cutting food — tooth 1, 2, and 3.

Molars: the large jaw teeth adapted for grinding food — tooth 4, 5 and 6.

Milk teeth: temporary teeth in young animals which are shed by 2 years of age.

Permanent teeth: teeth which replace milk teeth and remain throughout an animal's life.

Gum line: point to which flesh of the gum covers a tooth. Food stains are deposited above the gum.

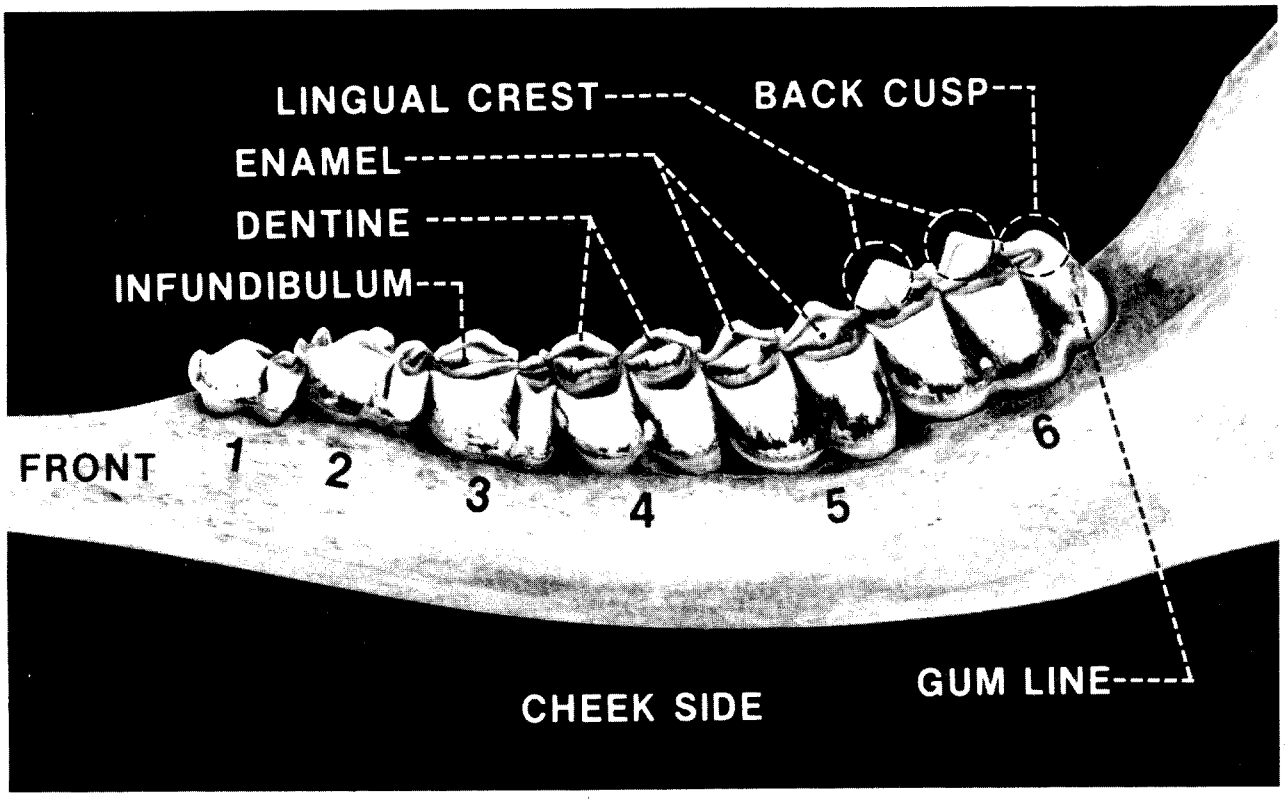
Lingual crests: tooth ridges running from front to back adjacent to the tongue.

Cusps: the points or projections on the surface of a tooth.

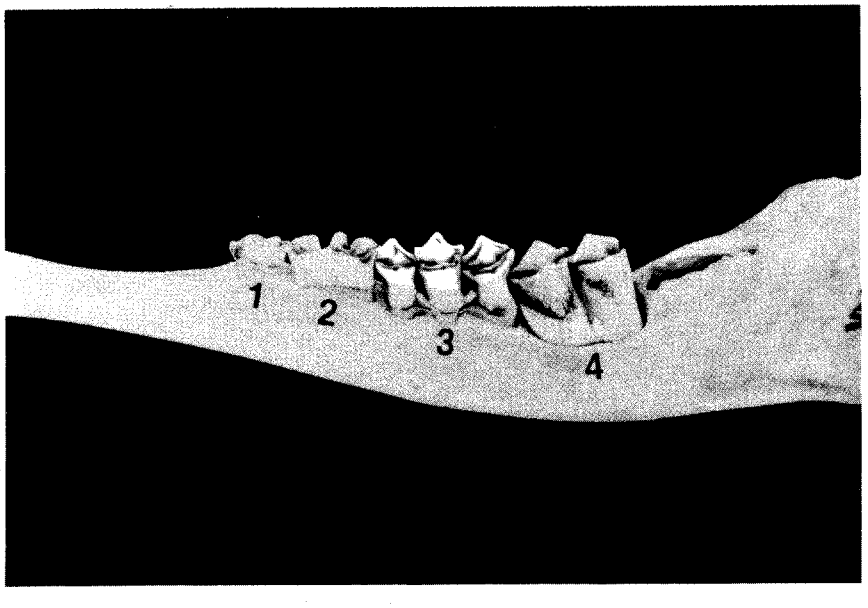
Infundibulum: the funnel-shaped depression in the central crown of tooth between crests. Exterior surfaces will be stained dark.

Enamel: the hard, white outer coat of a tooth.

Dentine: the softer inner core of a tooth, much darker in color than the enamel.



The major tooth parts used in determining a deer's age are shown in this three-quarters top view of a deer's jaw.

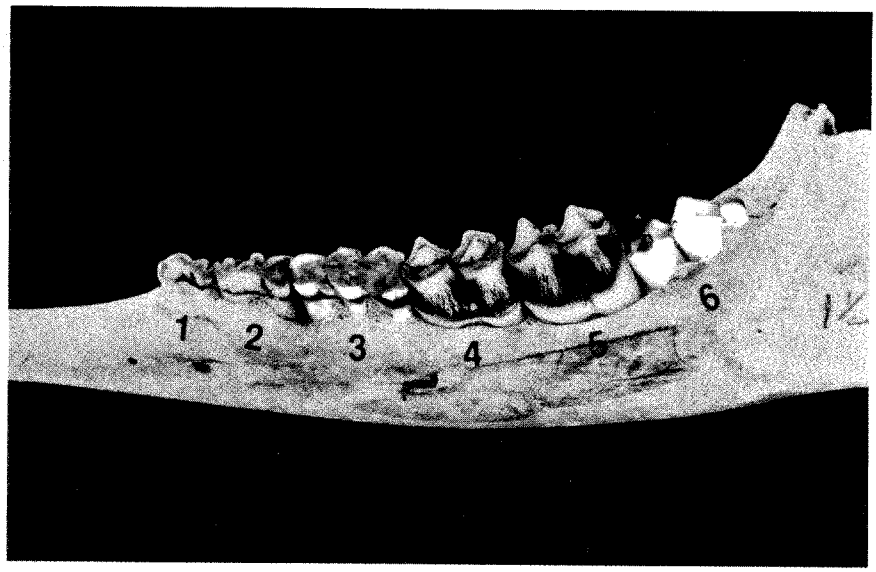


½ year

Less than six teeth are present in the jaw (usually four teeth for ages 5 and 6 months and five teeth for 7 months). Tooth 1, 2, and 3 are temporary (milk) teeth. Tooth 3 has three cusps. Tooth 4 is the first permanent tooth to erupt.

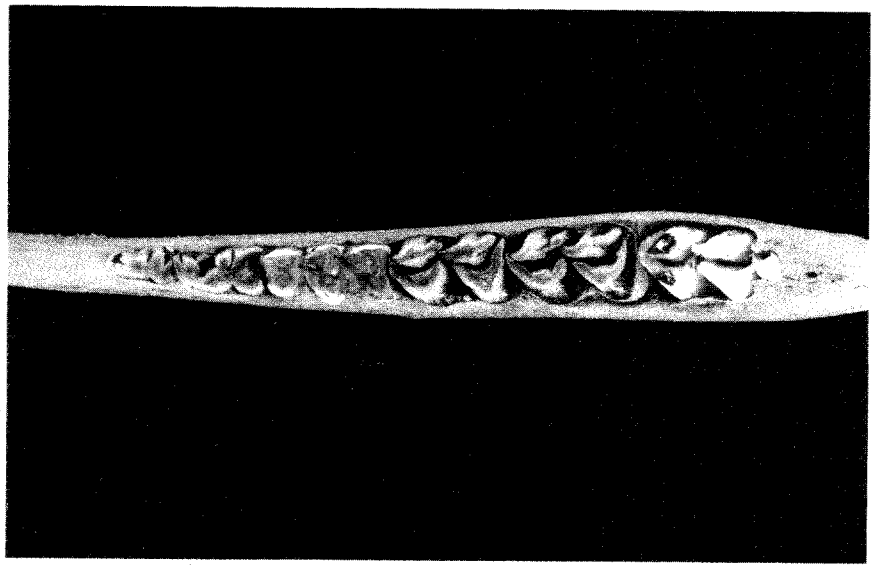
1½ years

Six teeth are present in the jaw. Tooth 6 — not fully erupted through the gum (gum line high on back cusp).

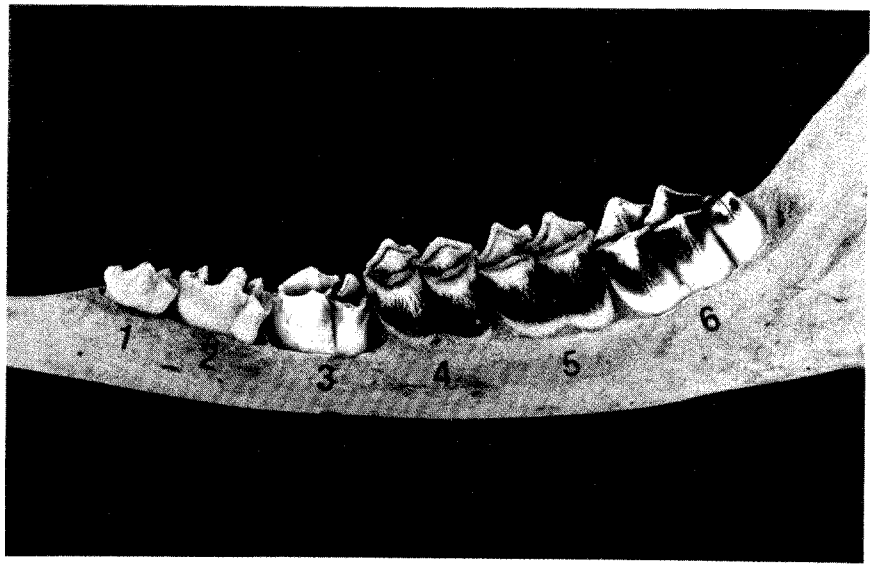


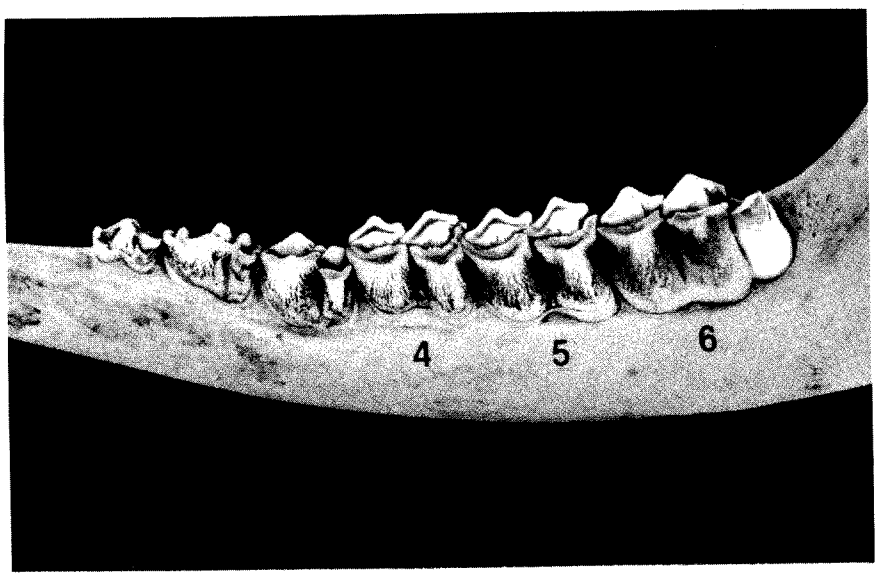
Caution — there may be either of two conditions for the premolars:

- Tooth 3 — a milk tooth with three cusps may be heavily worn (less than 1 year, 6 months of age). This is the most common condition.



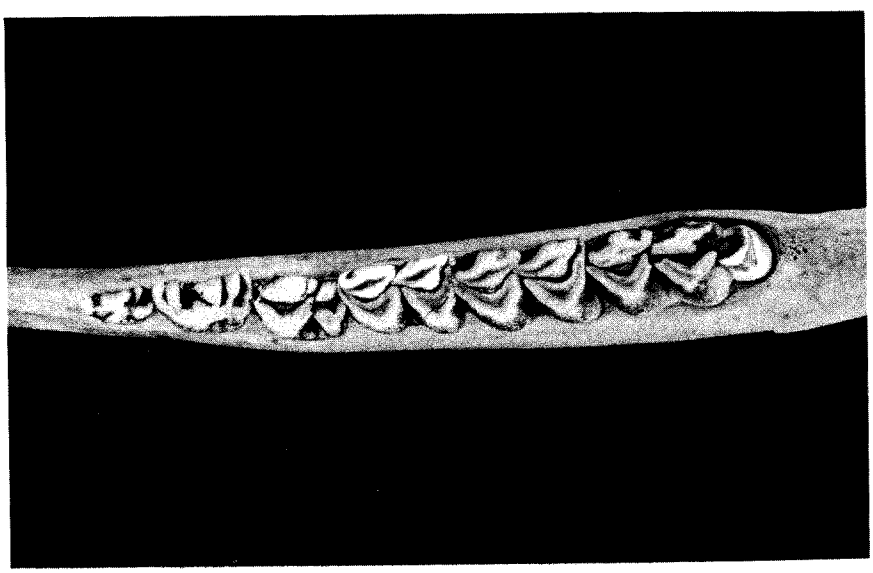
- Tooth 3 — a permanent tooth with two cusps may have replaced its milk tooth. This two-part tooth is white or much less stained than adjacent tooth 4 (1 year, 6 months of age or older).



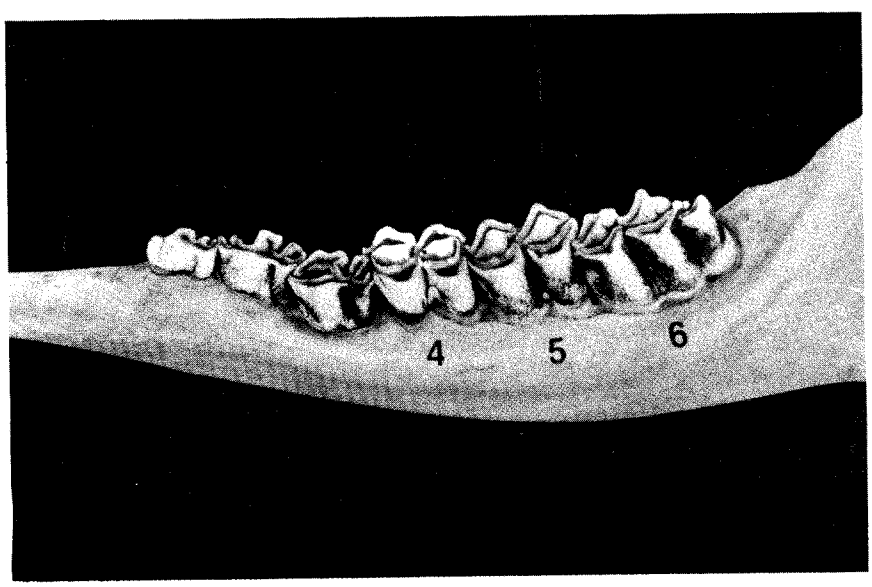


2½ years

Lingual crests on all molars are sharp. Tooth 6 — gum line is high on back cusp.



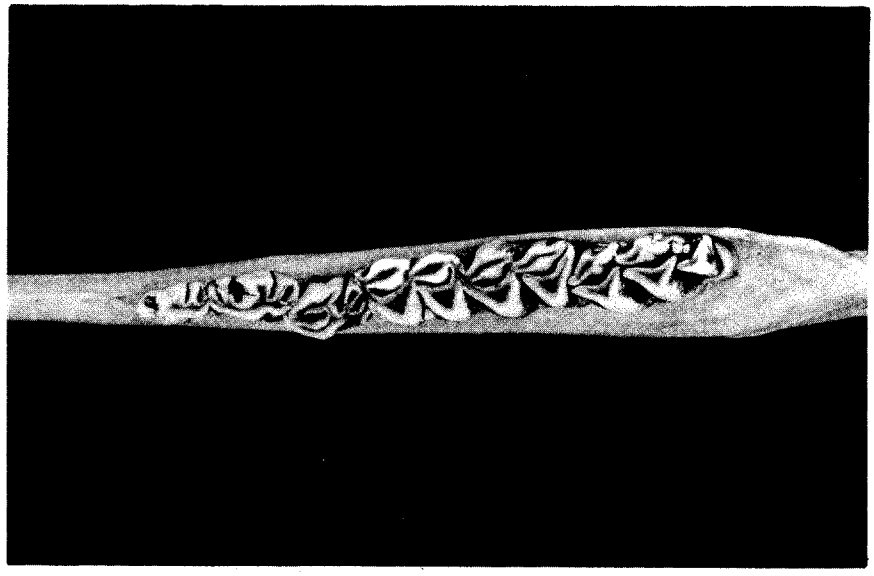
Tooth 4 — lingual crest has enamel well above narrow dentine of crest. Tooth 6 — wear on back cusp is very slight (dentine, if showing, in narrow line).



3½ years

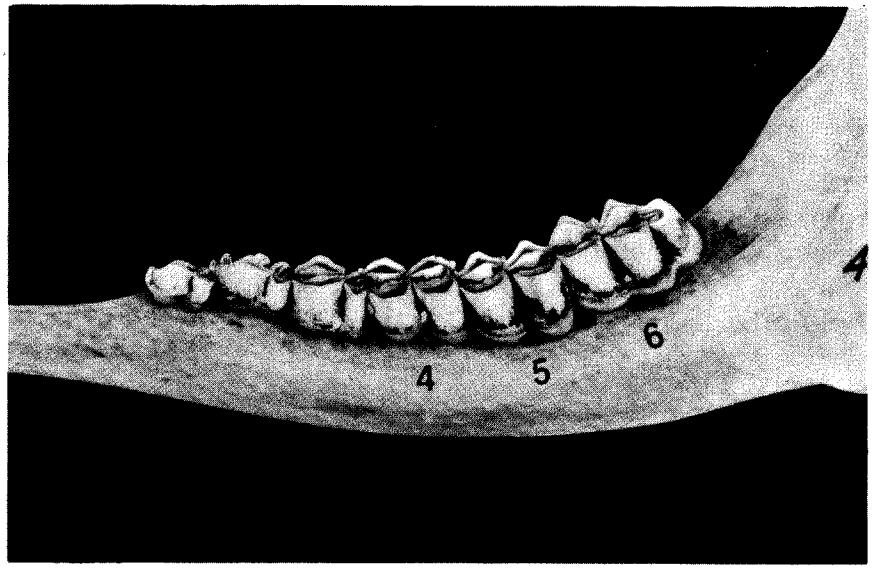
Tooth 4 — lingual crests are blunt. Tooth 6 — back cusp is worn to a definite concavity.

Tooth 4 — dark dentine line in lingual crests is wider than the enamel bordering it, but not in tooth 5 or tooth 6.
Tooth 6 — back cusp is worn concave.

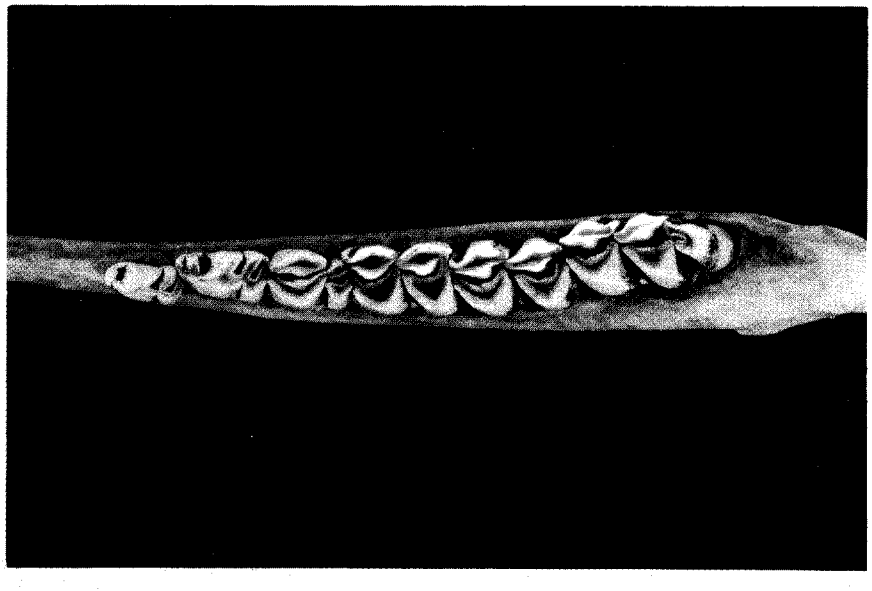


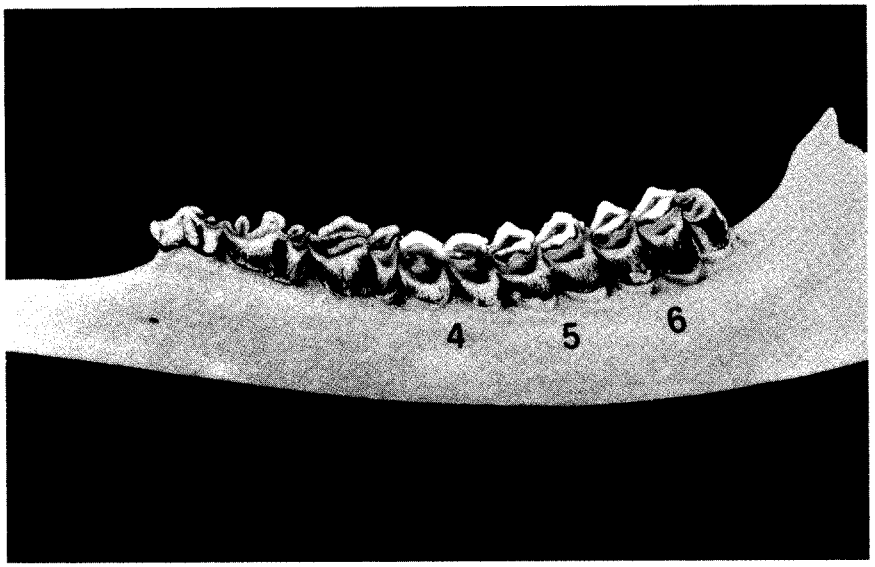
4½ years

Tooth 4 — lingual crests are almost worn away.
Tooth 5 — lingual crests are blunt.
Tooth 6 — back cusp is worn so badly that the outward surface slopes downward.



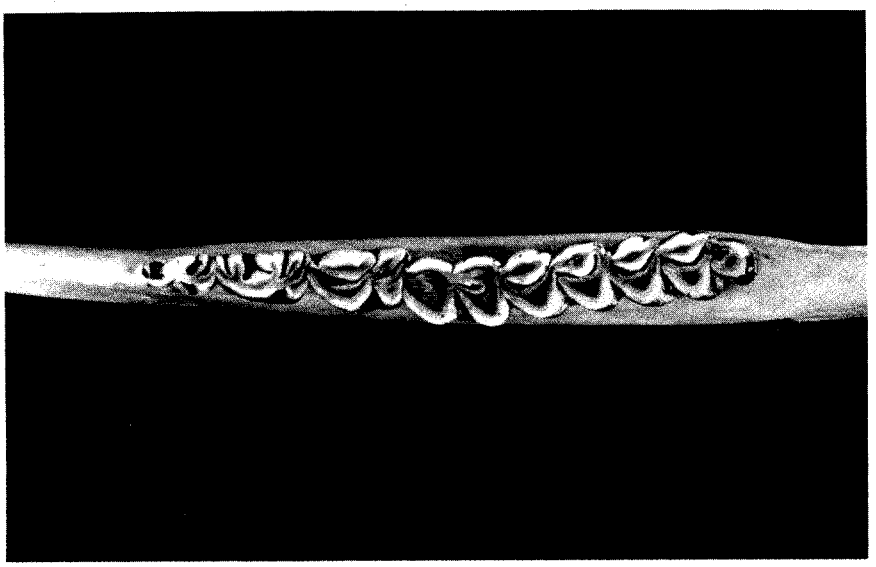
Tooth 4 — dark dentine line in lingual crest is almost twice as wide as the enamel bordering it.
Tooth 5 — dentine in lingual crest is wider than enamel.
Tooth 6 — dentine in lingual crest is about as wide as enamel.



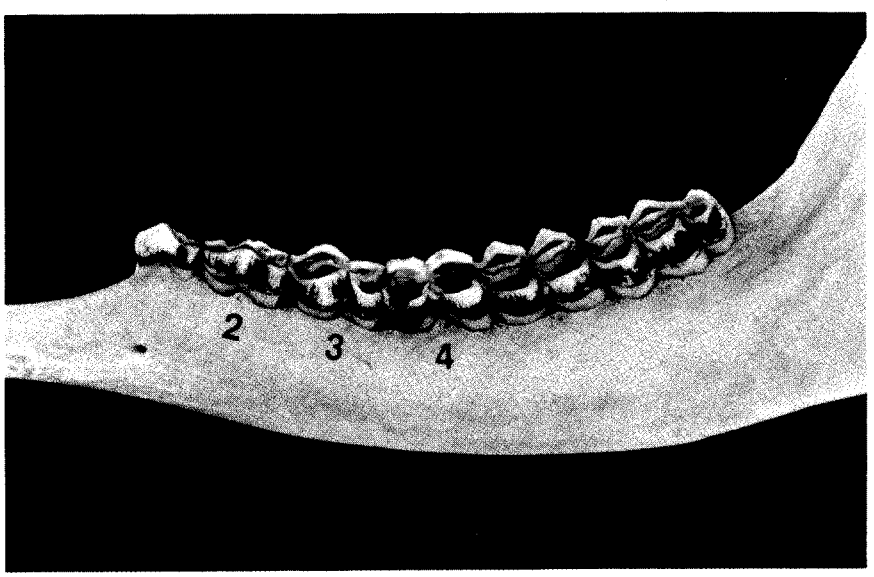


5½ years

Tooth 4 and tooth 5 — lingual crests are worn away to rounded ridges. Tooth 6 — lingual crests are blunt.



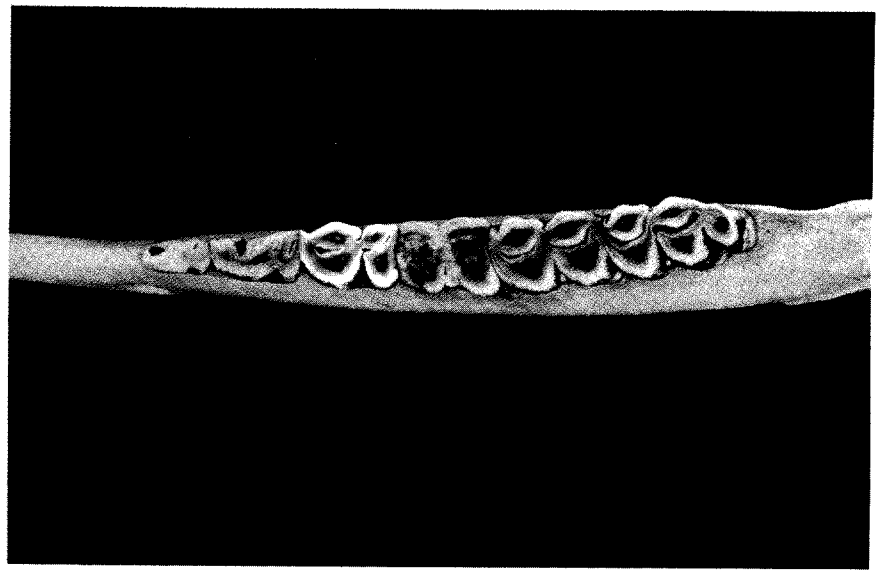
Tooth 4, tooth 5 and tooth 6 — dark dentine line is wider than the enamel bordering it.



6½ years

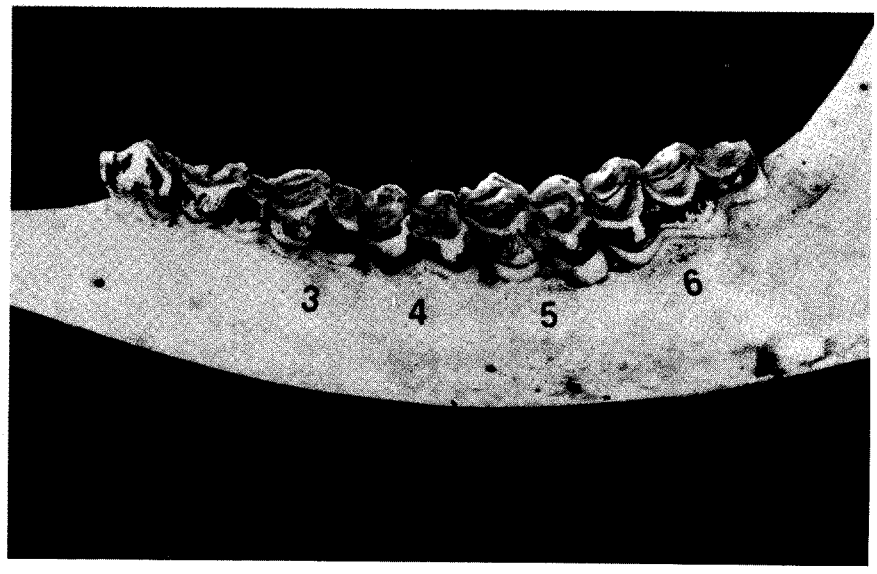
Tooth 4 — crown is worn smooth. Tooth 2 and tooth 3 — crown is heavily worn. This is first time for heavy wear on permanent premolars.

Tooth 3 — infundibulum is a small triangular hole. **Caution** — Heavily worn two-cusped, permanent tooth 3 should not be confused with similar conditions on three-cusped, temporary tooth 3 in 1½-year-old deer.

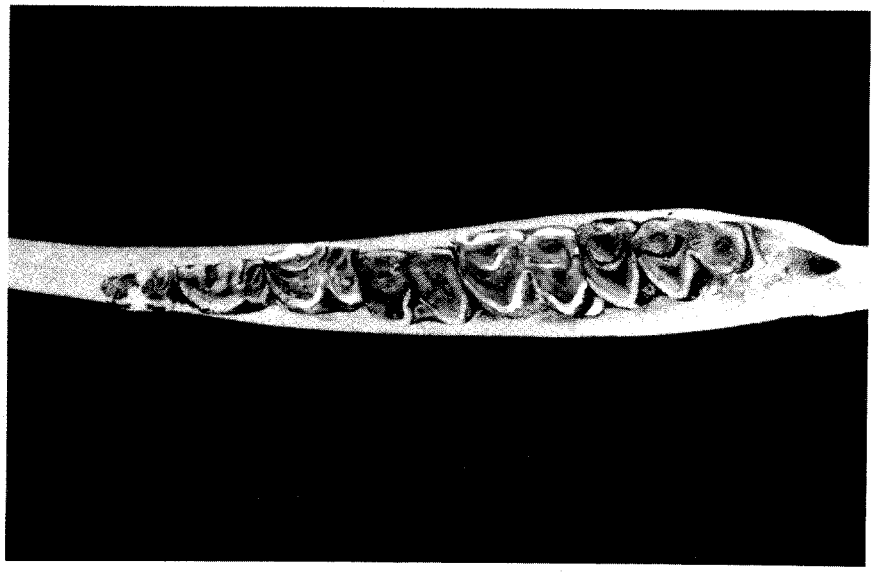


7½ years

Tooth 4 — crown is worn smooth. Tooth 5 — crown is is almost worn smooth. Tooth 6 — lingual crests are gone.



Tooth 3 and tooth 5 — infundibulum is almost gone. Tooth 6 — infundibulum is a narrow, crescent-shaped line with some depth.



The age of a deer is of interest to both the landowner and the hunter. This interest is more than simple curiosity because many indicators of deer quality and welfare are related to age.

On nearly all deer ranges in Texas, food supply is the most critical element in the habitat. When deer numbers are not in balance with available food, inadequate nutrition causes poor body conditions, reduced reproductive efficiency and undesirable antler characteristics, but the severity of the impact is greatest on growing animals.

Body growth needs take priority over antler growth or reproduction in all age deer. This means that food shortages affect antler size in males and fawn production and lactation in females before body weights decrease significantly.

The massiveness of antlers rather than the number of points generally increases with age but is strongly influenced by nutrition. A well-fed yearling could be an eight-point buck, but a poorly fed 7-year-old could be a four-point. Large antlers at an early age reflect good food condiitons.

Fawns have the highest nutritional needs and are more sensitive to nutritional deficiencies than any other age class. Body weight as a measure of growth of fawns generally reflects food availability because fawn weight is influenced by both the doe's lactation and fawn's feeding. However, too few are harvested to be an adequate sample for most ranches.

Of the deer harvested each year, yearlings are the most important indicators of herd nutrition and welfare. Adequate numbers are usually harvested and since they are rapidly growing animals, inadequacies are magnified in this age class.

In yearlings, the percentage or relative number of spikes taken is an indicator of nutritional conditions if harvesting spikes is not a major hunting objective. A large percentage of spikes indicates a food shortage from year to year although it might be a short term effect of drought conditions. Repetitive high spike numbers indicate long term habitat deficiencies or severe animal to animal competition.

A disproportionate number of yearling males compared to mature bucks (4 years and older) taken during the hunting season indicates a deer herd with heavy buck harvest. For example, records compiled by the Texas Parks and Wildlife Department combining years 1975 to 1981 indicated that the heaviest hunting pressure was the Post Oak Savannah (59 percent yearlings to 5 percent mature bucks) and in the Cross Timbers and Prairies (53 percent yearlings to 7 percent mature). A more moderate pressure was indicated by the 44 percent to 12 percent in the Pineywoods, with the lightest pressure in the Edwards Plateau (21 percent to 23 percent) and South Texas Plains (19 percent yearlings to 35 percent mature bucks).

Similar proportions of yearlings to mature does would have similar implications. Most commonly the harvest records show a high proportion of old-age does, indicating light hunting pressure.

Deer managers should keep accurate records on all deer harvested with their ages to determine the nutritional effects of practices such as brush control, livestock management and levels of deer harvest. Without such records management cannot be evaluated accurately.

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