in all habitats. While in the field, droppings were broken apart and examined macroscopically by the senior author for chitinous or calcareous fragments. Fresh droppings were rinsed to remove the still soft, more finely divided plant material. Fecal pellets were inspected on all feeding sites and throughout the entire summer and winter periods. Special emphasis was placed on this examination during the more critical time of late winter when plant availablity was lowest. It was estimated that over 500 droppings were examined. From this sample, one pellet contained a 0.125 in. fragment of the bright orange enamel from the outer surface of the nutria's incisors. No other animal remains were present in any droppings.

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BREEDING SEASON OF WHITE-TAILED DEER IN LOUISIANA

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INTRODUCTION

In order to efficiently manage deer herds within any given area, it is necessary for biologists to have a thorough knowledge of reproduction within each deer herd to be managed. Detailed investigations are required to obtain this type of information. A recently completed basic survey of reproduction in the white-tailed deer in Louisiana involved

such an investigation. Beginning in 1958, data concerning reproduction in the major deer herds were collected and analyzed in an effort to gain some understanding of the characteristics of reproduction within these herds. This report summarizes the results of this long term study.

Preliminary information for this study was a contribution from Federal Aid in Wildlife Restoration Project W-29R. Additional information was provided by personnel of the Louisiana Cooperative Wildlife Research Unit.

DESCRIPTION OF STUDY AREAS

Collections of reproductive tracts used in this study were made at seven (7) localities. These areas are listed and described as follows:

Avery Island

Avery Island is located in the southwest portion of Iberia Parish approximately ten (10) air miles southwest of New Iberia, Louisiana. This unusual island was apparently formed by an upturned fault in the underlying salt bed. It rises to a height of 152 feet above sea level and is surrounded by coastal marsh. The island supports a rugged terrain with high hills, deep ravines, low valleys and some flat lands.

Much of the island is cleared and maintained in pasture or cultivated fields for the production of peppers. Live oak (*Quercus virginiana*), sweetgum (*Liquidambar styraciflua*), white oak (*Quercus alba*), water oak (*Quercus nigra*), willow oak (*Quercus phellos*), southern red oak (*Quercus falcata*), beech (*Fagus grandifolia*), magnolia (*Magnolia grandiflora*), pine (*Pinus* spp.) and black gum (*Nyssa sylvatica*) make up the dominant overstory in the higher areas. Cypress (*Taxodium distichum*), tupelo gum (*Nyssa acquatica*) and red maple (*Acer rubrum*) form the dominant overstory in the lower areas. The understory vegetation is primarily comprised of greenbrier (*Smilax* spp.), yaupon (*Ilex vomitoria*), wax myrtle (*Myrica cerifera*), French mulberry (*Callicarpa americana*), rattan (*Berchemia scandens*), dewberry (*Rubus* sp.), button bush (*Cephalanthus occidentalis*) and Eastern Baccharis (*Baccharis halimifolia*).

The deer herd on Avery Island has seen very little management effort. Due to the fact that the land involved is completely isolated and privately controlled, the deer herd has been carried at a very high level for quite some time. No long-term management program has ever been initiated. Hunting has been very limited. It is believed that the Avery Island deer herd has exceeded the natural limits of the range.

Delta National Wildlife Refuge

Delta National Wildlife Refuge is located 75 miles southeast of New Orleans in Plaquemines Parish, Louisiana. This area is maintained and operated by the Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service, and is accessible only by water or air. Comprised of approximately 48,799 acres of deltaic marshes, the refuge is surrounded entirely by water. It is bounded on the west by the Mississippi River, on the east by Breton Sound, on the north by Baptiste Collette and on the south by Pass-a-Loutre. The deltaic marshes of the area are comprised of shallow ponds, passes, bayous and canals. Large masses of floating vegetation of a semi-solid nature are quite common. These "floats," as they are called, are often quite large and vary from several inches to several feet thick.

The fertile nature of the delta marsh encourages a luxuriant plant growth. Plants occur in three states of succession: pass banks, floats and aquatic vegetation on ponds. On the pass banks black willow (*Salix nigra*), marsh elder (*Iva frutescens*), rattlebox (*Daubentonia longifolia*), dog-tooth grass (*Panicum repens*) and deer pea (*Vigna repens*) are found. On the "floats" scattered rattlebox, broomsedge (*Andropogon* sp.) and roseau cane (*Phragmites communis*) are the dominant plants. There are also many large floats of alligator weed (*Alternanthera philoxeroides*). Aquatic vegetation of the ponds includes coon-

tail (*Ceratophyllum demersum*), water milfoil (*Myriophyllum* sp.) pondweed (*Potamogeton* sp.) delta duck potato (*Sagittaria platyphylla*), duck weed (*Lemna* sp.) and alligator weed. Alligator weed is probably the most common plant over most of the area.

The Delta Refuge deer herd has existed for many years. Strict protection has no doubt been responsible for the high population that is normally present. Herd size is influenced by hurricanes, high water and, to some extent, illegal hunting. In recent years, an annual removal of approximately one-third of the herd for restocking purposes has helped to bring the herd under management. Deer removed for this purpose are captured in the early spring with the aid of air boats.

Evangeline Game Management Area

Evangeline Game Management Area is located in south-central Rapides Parish near Woodworth, Louisiana. Moderately rolling hills broken by numerous creeks and branches occur throughout the area.

The primary timber type of the area is mixed pine-hardwood. Longleaf pine and scrub hardwood occur in the hills; shortleaf-loblolly pine and hardwoods occur in the stream bottoms. Overstory of the longleaf pine hardwood type consists of longleaf pine (*Pinus palustris*), southern red oak, post oak (*Quercus stellata*), hickory (*Carya* spp.) and blackjack oak (*Quercus marilandica*). Understory is composed of wax myrtle, dogwood (*Cornus* spp.), huckleberry (*Vaccinium* spp.), deciduous holly (*Ilex decidua*), yaupon, hawthorn (*Cratageus* spp.) fringetree (*Chionanthus virginica*), red bay (*Persea borbonia*), white bay (*Magnolia virginiana*), blackberry (*Rubus* sp.), poison oak (*Rhus quercifolia*) and poison ivy (*Rhus radicans*).

Overstory of the shortleaf and loblolly pine-hardwood type is composed of shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), magnolia, southern red oak, post oak, white oak, hickory, beech and water oak. Understory species are hawthorn, deciduous holly, huckleberry, greenbrier, dogwood, red maple, azalea (*Rhododendron canescens*), wax myrtle and seedlings of the overstory species.

This deer herd should be considered to be under proper management. Either-sex hunting has been allowed six out of eight years since 1958. The herd appears to be within the carrying capacity of the range.

Jackson-Bienville Game Management Area

Jackson-Bienville Game Management Area is located in eastern Bienville and western Jackson Parishes, approximately 12 air miles southwest of Ruston, Louisiana. The terrain can be described as gently rolling hills interlaced with creeks and small bottoms.

The primary timber type of the Jackson-Bienville Game Management Area is mixed pine-hardwood with small amounts of hardwoods occurring in the stream bottoms. Major overstory species for the pine-hardwood type are loblolly pine, shortleaf pine, white oak, post oak, southern red oak, blackjack oak, hickory, sweetgum and blackgum. Overstory species in the hardwood bottoms are beech, water oak, willow oak, Nuttall's oak (*Quercus nuttallii*), hackberry (*Celtis laevigata*) and cypress. Understory for the area is comprised of greenbrier, rattan, French mulberry, wax myrtle, honeysuckle (*Lonicera japonica*), yellow jessamine (*Gelsemium sempervirens*), dewberry, blackberry, hawthorne, sweetleaf, (*Symplocos tinctoria*) and hardwood seedlings.

Since 1958 this herd has been hunted. Either-sex hunting has been allowed annually each year except 1958. It is believed that this herd has been managed well.

Red Dirt Game Management Area

Red Dirt Game Management Area is located in the southern portion of Natchitoches Parish, Louisiana. This area is located in the rugged Kistachie Hills and is comprised of steep to gently rolling hills with numerous creeks, branches, ravines and stream beds. Large outcrops of standstone and claystone are fairly common over most of the area.

The timber type is predominantly longleaf pine, with mixed pine-hardwood in the bottoms. In the upland longleaf type the overstory consists of yaupon, hawthorn, deciduous holly, blackgum, wax myrtle and winter huckleberry (*Vaccinium arboreum*). In the stream bottoms the overstory is composed of pine, white oak, willow oak, water oak, blackgum, sweetgum, beech and hickory. Understory consists of large-leaf gallberry (*Ilex coriacea*), white bay, red bay, greenbrier, sweetleaf, fringe tree, winter huckleberry, snowbell (*Styrax americana*), viburnums (*Viburnum* spp.) and seedlings of the overstory species.

Deer have been removed from this herd both by hunting and trapping for restocking purposes. Hunting seasons were started in 1955 and have been held annually each year except 1962. This herd should be considered to be under proper management.

Tensas Parish

Tensas Parish is located in northeast Louisiana in the Mississippi River alluvial floodplain. The Mississippi River serves as the eastern boundary, while the western boundary is formed by the Tensas River. The land is flat to gently undulating with low ridges and flat sloughs.

Bottomland hardwood forests occur throughout the entire parish. Major overstory species are overcup oak (*Quercus lyrata*), bitter pecan (*Carya aquatica*), green ash (*Fraxinus pennsylvanica*), sweet pecan (*Carya illinoiensis*), water oak, willow oak, Nuttall's oak, tupelo gum, cedar elm (*Ulmus crassifolia*), sweet gum, cypress, hackberry, black willow (*Salix nigra*), red maple, honeylocust (*Gleditsia triancanthos*) and persimmon (*Diospyros virginiana*).

Major understory species are trumpet creeper (*Campsis radicans*), pepper vine (*Ampelopsis arborea*), virginia creeper (*Parthenocissus quinquefolia*), greenbrier, grape (*Vitis* spp.), crossvine (*Bignonia carpreolata*), honeysuckle, rattan, dewberry, blackberry, deciduous holly, poison ivy, hawthorn, French mulberry, roughleaf dogwood (*Cornus drummondii*), buttonbush, palmetto (*Sabal minor*), switchcane (*Arundinaria tecta*), swamp privet (*Forestiera acuminata*) and planer tree (*Planera aquatica*).

This has been a problem deer herd for many years. Evidently, agricultural crops have been responsible for sustaining these high populations. Although several attempts have been made to bring this herd under management this goal has been achieved only in certain small areas. This herd, as a whole, should still be considered as being beyond the natural limits of its range.

West Bay Game Management Area

West Bay Game Management Area is located in north central Allen Parish near Elizabeth, Louisiana. Level to nearly level or slightly undulating flatwoods occur over most of the area.

West Bay Game Management Area is composed of pure pine stands, mixed pine hardwood areas and some almost pure hardwood stands. Large pine plantations for pulpwood make up the pure pine sections. The mixed pine hardwood stands are scattered throughout the area. In the center of the area is an 18,000 acre block of almost pure hardwoods.

Major overstory species are loblolly pine, longleaf pine, slash pine (*Pinus caribaea*), willow oak, water oak, red oak, white oak, blackgum, sweetgum, elm (*Ulmus* sp.), magnolia and beech. Understory is comprised of yaupon, yellow jessamine, arrowwood (*Viburnum dentatum*), greenbrier, rattan, dewberry, blackberry, largeleaf gallberry, fringe tree, red maple, azalea, French mulberry, sweetleaf, sassafras (*Sassafras albidum*), hawthorn, Eastern Baccharis, red bay, white bay, virginia willow (*Itea virginica*), huckleberry and wax myrtle.

Several attempts to initiate a management program in this area have met with severe opposition from local people. The deer population is very high and the area is judged to be overpopulated. This condition has prevailed for several years.

METHODS

Data used in this study were obtained by measuring fetuses taken from complete reproductive tracts. Reproductive tracts were obtained from two sources: (1) from does killed by hunters on game management areas, and (2) from does killed specifically for the purposes of this study. Those deer collected specifically for the purpose of this study were taken at a time when gestation and fetal development were assumed to be far enough advanced as to provide fetuses developed well enough for easy handling and measuring. The deer involved in these special collections were collected by two methods. In marsh habitat, deer were captured with the aid of air boats. Deer thus captured were then taken to a field laboratory where they were sacrificed and their reproductive tracts removed. Deer collected from upland areas of the state were taken with high powered rifles equipped with telescope sights. Practically all of the deer from the upland areas were collected at night with the aid of a light. Usually, those deer collected at night were shot from a vehicle with the aid of a twelve volt, hand-held spotlight. Occasionally, hunters on foot using conventional six volt headlights were used. Neck shots were made whenever possible to prevent crippling loss and massive tissue destruction. Caution was exercised to limit the collection to animals that would be most useful to this study. Even then, some bucks with shed antlers or fawns were inadvertently collected. All animals collected were utilized as completely as possible. Stomach samples were collected as well as ectoparasites, physical measurements, and in some cases blood and tissue samples. These additional samples were taken for use in related studies being conducted at the time of the collections.

Entire reproductive tracts were removed from collected deer. When small fetuses were present the entire tract was tagged, injected with and preserved in 10% formalin. Large fetuses were removed from the reproductive tract, tagged, injected with 10% formalin and preserved in 10% formalin. It was found that thorough injection of the abdominal and cranial cavities was necessary to prevent spoilage of the fetus.

All fetuses were measured and aged using techniques described by Armstrong (1950). Vernier calipers and a measuring board graduated in millimeters were used for taking measurements. Measurements taken were in the following manner:

> *Crown-Rump (C-R).* This measurement was taken on young fetuses up to 64 millimeters in which the mesencephalon protrudes as a hump. It was taken from the mesencephalon to the posterior end of the rump using vernier caliper.
> *Forehead-Rump (F-R).* This measurement was taken on larger fetuses and made from the points of the coronal and sagittal sutures of the skull, to the tuberosity of the ischium. These measurements were taken with a metric measuring board constructed for this study.

Using the metric measurements obtained in the previously described manner, the approximate age in days was determined by interpolation of the age brackets of the key produced by Armstrong (1950). No body weights were used in aging the fetuses. External characters were used primarily to confirm approximate ages determined by measurements.

To more readily define the approximate age in days, the age brackets from the key produced by Armstrong (1950) were broken down into smaller increments. Rather than plot measurements on a growth curve and drop a perpendicular to the abcissa, as done by previous investigators (Armstrong, 1950) (Cheatum and Morton, 1942) to arrive at an approximate age, each age bracket was broken down and the average growth (AG) in millimeters per day was computed. This was done by dividing the total number of days in the bracket into the total number of millimeters growth in the bracket.

Cheatum and Morton (1942) stated that results of their work indicated a lapse of 2-3 weeks occurs between impregnation and the descent and establishment of the embryo. The smallest embryo found

by them was 8 mm., and it was found 28 days after impregnation. On this basis a scale was made to encompass those embryos in the sample which were less than 17 mm., and, therefore, not covered by the Armstrong (1950) key which only applied to those 17 mm. and larger.

To arrive at an approximate age, each fetus was assigned to a bracket on the basis of C-R and F-R length in millimeters. In cases of multiple fetuses the average length was used. After arriving at an age bracket, the following procedure was used: the smallest length (SL) in the bracket was substracted from the length of the specimen (FL). The remainder, representing the progression of growth into the bracket, was divided by the average growth per day computed for the bracket to obtain an approximate number of days of progression into the bracket. This number of days was added to the lowest number of days in the bracket (SD) to arrive at the approximate age in days.

$$\text{Age in days} = \frac{\text{FL} - \text{SL}}{\text{AG}} + \text{SD}$$

Upon arriving at an approximate age for a fetus or pair of fetuses, this age in days was back-dated on a Julian Date Calendar from the date of collection to arrive at the approximate date of conception (Table 1).

RESULTS

A total of 206 fetuses from 139 does were used in this study. The following is a summary of the results from each area.

Avery Island

A total of 54 fetuses from 39 adult does were examined. Breeding extremes ranged from September 26 through December 9, with 69.2% of the sample breeding from October 1 through October 31. Of this group 38.5% bred from October 1-15 and 30.7% bred from October 16-31.

Delta Refuge

Thirty fetuses from 20 does were examined. Breeding extremes ranged from November 15 through January 18 with 80% of the sample breeding from December 1 through December 31. Of the sample, 35% bred from December 1 through December 15 and 45% bred from December 16 through December 31. Twelve of the 20 does bred between December 14 and December 29, representing 60% of the sample.

Evangeline Game Management Area

The sample consisted of 12 embryos and fetuses from eight does examined. Breeding dates ranged from October 18 through October 31 with 100% breeding in this period. All of the sample was collected during the managed hunts.

Jackson - Bienville Game Management Area

A total of nine fetuses from six does were examined. Breeding extremes occurred from December 2-January 26 with 66.7% of the sample breeding from December 1-December 15.

Red Dirt Game Management Area

The sample from this area consisted of 23 fetuses from 12 does. Breeding extremes ranged from October 22-January 25 with 50% of the sample breeding from November 1-November 15.

Tensas Parish

A total of 41 fetuses from 28 does were examined. Breeding extremes ranged from December 10 through February 26 with 42.8% of the sample breeding from January 1 through January 15.

West Bay Game Management Area

Thirty-seven fetuses from 26 does were examined from this area. Breeding extremes ranged from September 27 through December 9 with 61.5% of the sample breeding from October 16-October 31.

TABLE I

Collection Area	Number of Deer Collected	No. of Fetuses	Calculated Dates of Breeding Extremes	Calculated Dates of Peak Breeding Activity	Percent of Sample Showing Breeding During Peak Period
Avery Island	39	54	Sept. 26-Dec. 9	Oct. 1-Oct. 31	69.2%
Delta Refuge	20	30	Nov. 15-Jan. 18	Dec. 14-Dec. 29	60 %
Evangeline GMA	8	12	Oct. 18-Oct. 31	Oct. 18-Oct. 31	100 %
Jackson-Bienville GMA	6	9	Dec. 2-Jan. 26	Dec. 1-Dec. 15	66.7%
Red Dirt GMA	12	23	Oct. 22-Jan. 25	Nov. 1-Nov. 15	50 %
Tensas Parish	28	41	Dec. 10-Feb. 26	Jan. 1-Jan. 15	42.8%
West Bay GMA	26	37	Sept. 27-Dec. 9	Oct. 16-Oct. 31	61.5%

DISCUSSION

Comparison of the results in Table I indicates that definite differences in time of breeding do exist between some of the herds studied.

Also, these data show results contrary to previous reports that white-tailed deer in southern latitudes breed later than those in northern latitudes. Some of the herds in this state breed earlier than herds in such northern states as New York (Cheatum and Morton 1946).

On a local basis, little difference can be found to substantiate such radical differences in breeding dates. Photoperiod does not seem to be a major factor, for only 12-15 minutes difference in day length occurs between northern and southern extremes. Furthermore, some of the southerly herds in the state breed earlier than the northern herds in the state. Ecological factors offer no substantial reason either.

The only correlation which can be found in the breeding pattern of any of these herds is between the later breeding herds of Delta Refuge, and Tensas Parish. The common factor among these herds is the annual flooding of the Mississippi River which normally occurs in the spring. While flooding does not still occur in Tensas Parish, it did when the herd was started. At Delta Refuge flooding occurs annually. Flooding does not occur at Jackson-Bienville, but because of the deer restocking program this herd is directly descended from the Tensas Parish herd, and could carry this late breeding factor as an inherent characteristic. Possibly all these deer have evolved a race which breed later in the year which in turn would bring about a later fawn drop and thus affect fawn survival.

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DELINEATION OF THE PERIOD OF RUT AND BREEDING SEASON OF A WHITE-TAILED DEER POPULATION [1]

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INTRODUCTION

The white-tailed deer (*Odocoileus virginianus*) is undoubtedly one of the most important game species throughout its range. It is of particular importance in the Southeast where deer are the only large game mammals which provide numerous, huntable populations. The astounding reproductive potential of these large herbivores is well-known among wildlife biologists. One of the best documented examples of this aspect of deer biology is that of the George Preserve deer herd in which six

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