Acorn production began again in 1962 with a bumper crop following in 1963. Ovarian activity was reported by hunters in 1962 and was present in the ovaries examined at the checking station in the fall of 1963.

A sudden increase in the plane of nutrition for domestic hogs is called flushing. When the technique of flushing is applied prior to the breeding season, there is a stimulation of the endocrine and reproductive system, which results in an increase in the number of eggs at breeding time and in litter size (Ensminger, 1961). Acorns, when first available, probably cause a similar response in wild hogs. Conception dates for the fall breeding period occur soon after the mast begins falling to the ground.

During the fall months of 1960-1961 pen raised wild sows, fed a balanced commercial ration, were bred in October and farrowed in February.

Surveys which detect periodic fluctuations of the acorn crop might provide a basis for predicting fluctuations in hog productivity and for setting hunting regulations.

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Effect of Site Preparation on Wildlife and Vegetation in the Sandhills of Central Florida

By

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INTRODUCTION

A project designed to evaluate the effect of mechanical land clearing and planting slash pine (*Pinus elliottii*) on the ecology of animals and plants in a Longleaf Pine (*Pinus palustris*)—Turkey Oak (*Quercus laevis*) Association of central Florida was initiated in 1959. This was a cooperative venture between the Florida Forest Service, the Florida Game and Fresh Water Fish Commission, and the University of Florida Agricultural Experiment Station. Primary attention has been directed toward white-tailed deer (*Dama virginianus*), since this is the chief game species involved, but mourning doves (*Zenaidura macroura*), bobwhite quail (*Colinus virginianus*), and fox squirrels (*Sciurus niger*) have also been considered. Rodent populations have been analyzed in detail. Plant studies have been concerned with changes in the vegetation

caused by site preparation and an examination of following successional changes.

The 47,000-acre Citrus Tract of the Withlacoochee State Forest, situated approximately 70 miles north of Tampa in Citrus and Hernando Counties, was selected as a study area. Topography is generally rolling on the Citrus Tract, with elevations ranging from about 50 to over 200 feet above sea level. Tillis Hill, the highest point on the Tract, has an elevation of 226 feet. Soils of the Lakeland series are characteristic of this terrain. Vegetation consists principally of longleaf pine and turkey oak, but also considerable amounts of blue-jack oak (*Quercus incana*) and live oak (*Q. virginiana*). Understory vegetation is composed largely of wiregrasses (*Aristida stricta* and *Sporobolus junceus*) in addition to various shrubs and herbs. Laessle (1942) describes this vegetative complex in considerable detail. According to Laessle (1958) this Association extends from southern portions of De Soto and Highlands Counties, north of Lake Okeechobee, northward along the Coastal Plain to southcentral North Carolina and westward to central Alabama and eastern Louisiana.

Site preparation is accomplished by first dragging a heavy chain

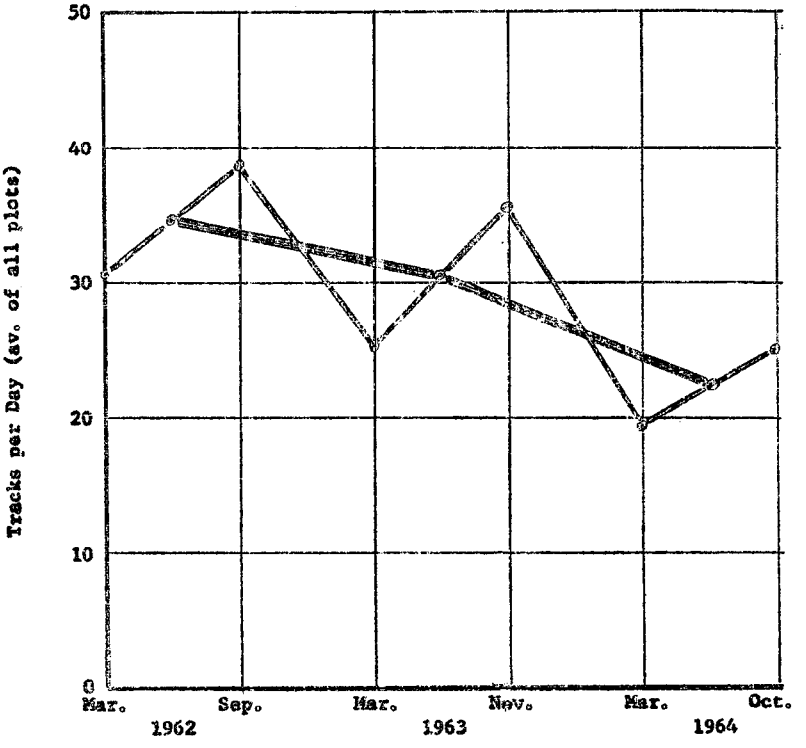

Fig. 3.--Average relative deer use of all study plots (based upon track counts) during spring and fall periods, 1962 through 1964, Withlacoochee State Forest. The heavy line represents yearly averages.

across the area between two Caterpillar D-7 tractors spaced about 100 feet apart. This pulls down most of the turkey oaks, but live oaks are usually left standing. After a period of a month or six weeks the down trees are pushed into piles and burned. The cleared ground is next chopped with a Marden M-7 double tandem chopper weighing 8 tons, which greatly reduces any remaining surface plant cover. Pines are usually planted in January or February, two months or more after clearing is completed.

Grateful acknowledgment of assistance is made to Dr. A. E. Brandt, statistician, and the late Mr. Erdman West, botanist, University of Florida Agricultural Experiment Station; to Mr. W. F. Cowan, Forest Manager, and Mr. R. A. Bonninghausen, Chief of Forest Management, Florida Forest Service; and to Game Biologists, S. B. Fickett and A. G. Spratt, Florida Game and Fresh Water Fish Commission.

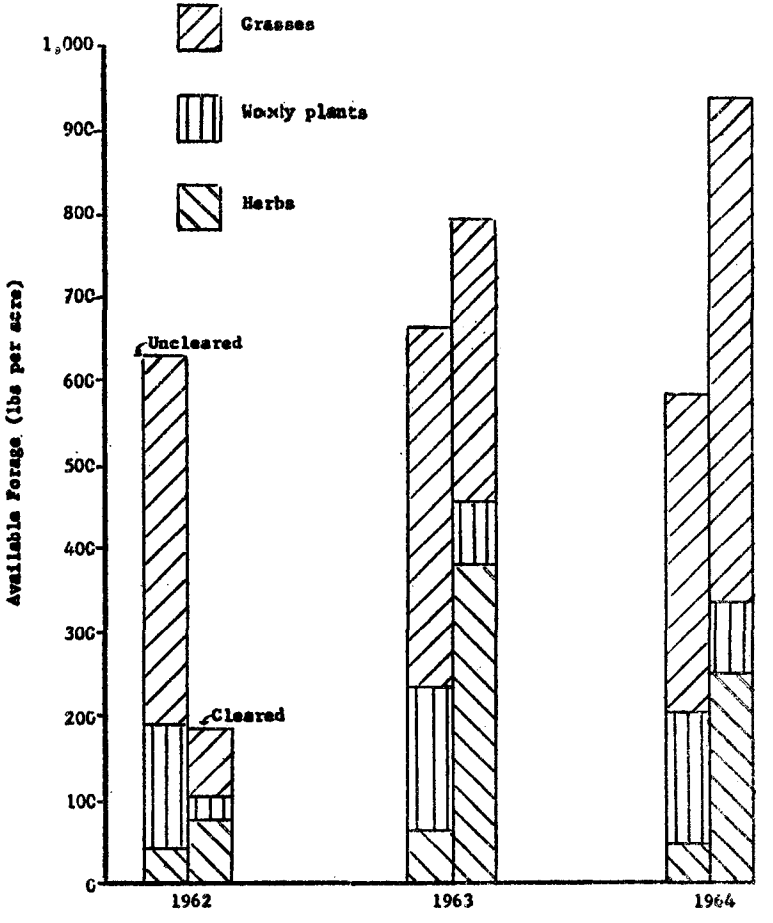

Fig. 4. -- Air dry forage available during June on uncleared and cleared areas, 1962 through 1964, Withlacoochee State Forest.

TECHNIQUES OF STUDY

Data for this project were obtained from three replications of four plots, each plot comprising one square mile (640 acres). One plot of each replication was completely cleared of all existing vegetation and planted to slash pine, the second one was three-fourths cleared and planted, one-half of the third plot was treated, and the fourth plot of

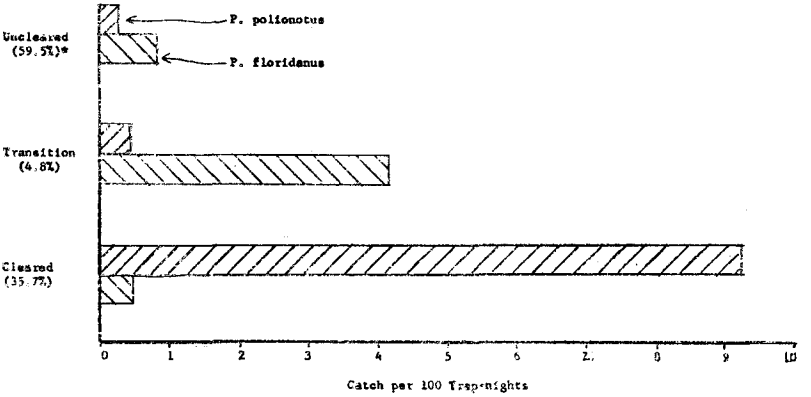

Fig. 5. -- Rodent catch on uncleared, transitional, and cleared areas based on 4536 trap-nights, 1961 to 1964, Withlacoochee State Forest.

*Percentage of total trapping effort.

each block was left in its natural condition as a control. Of the total 12 square miles involved in this experiment only nine were affected by the clearing and planting operations for a total of 4,320 acres, or slightly over 9 percent of the 47,000 acre Tract. Uncleared portions of the second and third plots consist of strips of natural plant cover 10 chains (660 feet) in width. Accordingly, the 75 percent cleared plot has one 10-chain uncleared strip remaining in each one-half mile of width, and the 50 percent cleared plot has alternating 10-chain wide cleared and uncleared strips. Clearing operations began during the spring of 1960, but this experiment will not be completely established until this coming winter season, when pine planting will be completed in the last portions of the third series of plots.

Rodents were sampled with Sherman live traps on twelve 20-acre sampling units. Six of these were in uncleared areas and the remaining six were in areas cleared and planted to pine. Three of the latter group were trapped before they were site prepared to obtain more complete information on changes in rodent populations. Twelve traps were randomly placed within each 20-acre sampling unit, and each trapping period consisted of three consecutive nights. A mixture of oatmeal and sunflower seeds was used as bait. All rodents captured were sexed and aged, toe-clipped for future references, and released.

Vegetation analyses were made with the forage-weight method proposed by Campbell and Cassady (1955). This method estimates the amount (in pounds per acre) of air dry forage available by species to a height of 4½ feet. It was originally applied to cattle range lands, but has been used in deer range analyses by Harlow (1959) and others.

Exclosures measuring 82 feet on a side were established during the early spring of 1961 in an area planted the preceding January to study the effects of deer and cattle on the planted pines as well as on the successional development of the vegetation. Three series of exclosures were located, each series consisting of one plot fenced to a height of 8

feet to exclude deer and cattle, a second plot fenced only with three strands of barbed wire so as to exclude cattle but not deer, and a third plot an unfenced control. All planted pines were examined carefully for evidences of browsing. Ground vegetation within the exclosures was analyzed by the loop method proposed by Parker (1950) and explained more recently by Parker and Harris (1959). This system was modified by using a 50-foot cable in place of a steel tape. Plant occurrences were recorded in a notebook in such a manner that the data could be punched directly on to IBM cards, thus greatly facilitating their analysis.

Additional vegetation studies involved the caging of individual deer browse plants so as to observe their growth in the absence of browsing or grazing. Counts of acorns on selected turkey oaks were initiated in the fall of 1962. Sample trees were chosen by means of the point-centered quarter mehod of Cottam and Curtis (1956). Each tree was examined carefully with a pair of 7 x 50 binoculars to determine the number of acorns on the tree. Acorns that had previously fallen to the ground were also counted by carefully examining the ground beneath each tree.

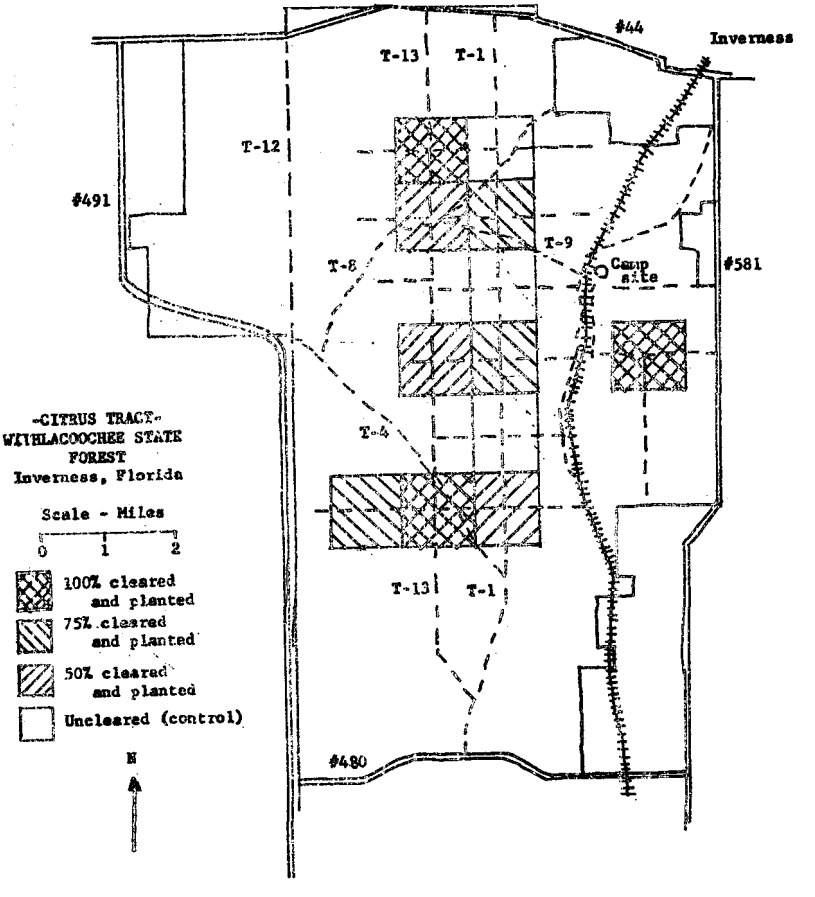

Fig. 1 -- Distribution of plots to study effect of site preparation for pine planting on wild animals.

RESULTS AND DISCUSSION

Effect of site preparation on deer—The following discussion is based upon track counts obtained only from Blocks I and II, since these are the only two groups of plots that have been completely established to date. It is apparent that the attractiveness of the different plots for deer was markedly influenced by the extent to which they had been site prepared, see (Figure 2 and Table I). Accordingly, when areas as large as a mile square were completely cleared and planted to pines they became relatively unattractive to deer, averaging only 18.2 deer tracks per day compared to 26.6 tracks in the naturally vegetated control plots during the period from March 1962 through October 1964. Partially cleared (i.e. 75% and 50% cleared) plots, received about twice as much use (38.4 and 33.6 deer tracks per day, respectively) as the cleared plots, or approximately 40% more than occurred in uncleared areas. Complete clearing of tracts as large as a mile square is, therefore, detrimental to white-tailed deer, at least during the early successional period. Leaving from 25 to 50% of the native vegetation on the plots makes them more attracive to these animals than uncleared areas.

Data in Table I indicate a significant interaction between season of the year and the comparison between totally cleared plots and all of the others. This was caused by the fact that deer made more frequent use of cleared areas during spring but showed a preference for uncleared areas (including the uncleared strips of partially cleared plots) during the fall. The nearly significant interaction between season and the comparison between partially cleared and uncleared plots was due

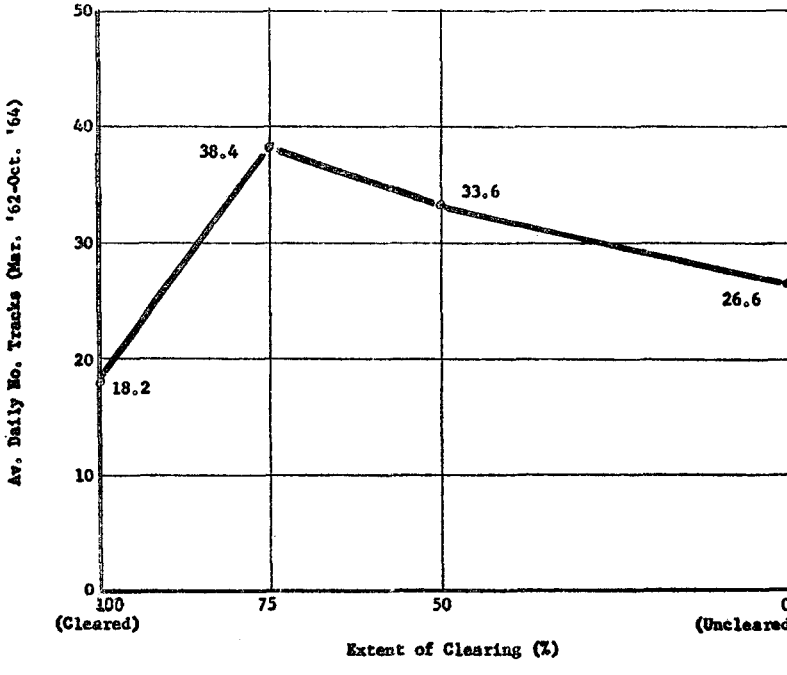

Fig. 2. -- Deer use as related to extent of clearing and pine planting on mile-square plots, March 1962 through October 1964, Withlacoochee State Forest.

to the relatively greater preference shown by deer for partially cleared areas in spring than in the fall. Subsequent data will also verify these points.

Deer were evidently more abundant (i.e. tracks were more numerous) in the fall months than during the spring, but this simply reflects reproduction on the part of the animals. A general decrease in deer, however, is evident when spring and fall counts are averaged by years (Figure 3. These data revealed a highly significant linear decline in the use of the different plots by these animals during the period 1962 through 1964. Although the possibility exists that this reduction in number of tracks could have been due to reduced mobility on the part of the deer, it more likely indicates an actual decrease in the number of deer. Such a decrease is on the order of 12% from 1962 (34.7 tracks per day) to 1963 (30.6 tracks per day) and 27% from 1963 to 1964 (22.3 tracks per day). Observations of actual deer have also indicated that a decrease in the population has occurred, but

Table I—Analysis of Variance for Deer Track Data (Block I and II only) from March 1962 through October 1964, Withlacocchee State Forest.

Source	d.f.	MS	F ratio
Blocks	1	213.3633	1.40°
Season	1	810.1633	5.32*
Years (lin.)	1	1227.6012	8.07*
" (quad.)	1	49.3067	.....
Total clearing vs. others (P_1)	1	1943.3403	12.78**
Partial clearing vs. uncleared (P_2)	1	720.7339	4.74*
75% vs. 50% cleared (P_3)	1	140.1667	.....
Season x years (lin.)	1	17.7012	.....
" x years (quad.)	1	34.0817	.....
" x P_1	1	691.6900	4.55*
" x P_2	1	486.7200	3.20°
" x P_3	1	11.4817	.....
Years (lin.) x P_1	1	329.3004	2.16°
" x P_2	1	0.3502	.....
" x P_3	1	43.2306	.....
Error	32	152.1184	
Total	47		

these data are inadequate to permit a quantitive estimate of the amount.

Reasons for the decline noted above are not immediately apparent, but there is no indication that it should be due to the clearing and planting operations. A very probable reason is an excessive illegal kill of deer which was known to have occurred, particularly immediately following the 1963-64 hunting season and during the spring of 1964. This was due to a misunderstanding on the part of the local people, but it assumed rather drastic proportions and apparently removed many animals before it was eventually brought under control.

Declining numbers of deer may also simply have been an adjustment to the expected carrying capacity of the Citrus Tract. The population was estimated as high as one deer per 19.2 acres (5.2 per 100 acres) in April 1963 as the result of three separate drives covering a total of 4800 acres. This is an extremely dense population compared to other portions of the Southeast, according to Goodrum and Reid (1958). For example, exclosure studies showed maximum densities of 27 acres per deer in Alabama, 30 acres per animal in Louisiana, and as low as 18 acres per deer in a prime area in Mississippi. Harlow (1959)

estimated that the Florida sandhill vegetation type could support a maximum of one deer per 22 acres. Presumably this applied to optimum conditions which prevail during the fall period rather than to less favorable conditions such as would be anticipated in the spring.

A very probable reason for the attractiveness of the partially cleared plots to deer is the presence of both cleared and uncleared areas, which are used at different times of the year, in close proximity to each other. For example, during the spring months track counts showed that deer occurred over two and one-half times more commonly in the cleared areas (4.32 tracks per 10 chains) than in the uncleared strips (1.62 tracks per 10-chain-wide strip). (See Table II.) In the early summer deer were more evenly distributed with respect to the cleared and uncleared areas (4.34 and 3.85 tracks, respectively), but in the fall deer utilized the uncleared strips (5.20 tracks) over four times as frequently as the cleared portions (1.38 tracks per 10 chains). Except for the difference in summer use, which was not statistically significant, the other differences noted were significant at the 1% level of probability.

Table II.—Seasonal Use by Deer of Uncleared and Cleared Areas, Withlacoochee State Forest.

Season	*Deer Tracks Per Day* Uncleared	Cleared
Spring (March '63, April '64)	1.62*	4.32
Early summer (June '63, June '64)	3.85	4.34
Fall (October '63)	5.20	1.38

* Number of tracks per 10 chains.

These data help explain why partially cleared plots are attractive to deer. During the spring they frequent the cleared strips, doubtless feeding on the new growth of their preferred browse plants. During the summer months deer evidently search more widely for suitable food materials. In the fall they confine themselves to the uncleared strips because of the acorns that occur in such locations. Acorns are well known as preferred deer foods (Pearson, 1943; Goodrum, 1959; Reid and Goodrum, 1957; Harlow, 1961; and Duvendeck, 1962). The close proximity of spring and fall feeding areas caused by site preparation activities on the partially cleared plots evidently makes ideal deer habitat.

Effect of site preparation on the vegetation—One of the chief reasons for site preparation by mechanical means is to destroy the existing vegetation and thus reduce competition for the planted slash pines. Forage-weight studies have revealed how striking these changes in the plant cover are following clearing and planting operations, both in amount of plant cover and in the kinds of predominant plant species. These changes will be described only briefly at this time, but they will be reported in greater detail at a later date.

Uncleared areas changed only slightly in the amount of grasses, herbs and woody plants during the period from June, 1962 through June, 1964 (Figure 4). The amount of grassy forage decreased from 432 to 380 pounds per acre. Woody available forage was fairly constant between 160 and 170 pounds per acre, and herbaceous forage increased from 44 pounds per acre in 1962 to 64 pounds in 1963 and decreased to 47 pounds per acre in 1964. These vegetative changes can be related to the fact that the last controlled burning was done in the winter of 1960-61, just before site preparation operations were initiated. Dead litter, which accumulates as a result of fire exclusion, suppresses the amount of forage available.

Mechanical site preparation followed by pine planting initiated

marked vegetative changes on the cleared areas. The first year after clearing and planting (1962) there were only approximately 185 pounds of available forage per acre compared to 630 pounds on uncleared areas. Grassy and herbaceous forage each occurred at the rate of 80 pounds per acre, whereas woody browse comprised only 25 pounds per acre. In 1963 the total available forage increased to approximately 800 pounds per acre, exceeding that present on the uncleared sample areas by 150 pounds per acre. Grasses and herbs both increased between four and five fold, 342 and 382 pounds per acre, respectively. Woody browse trebled to 74 pounds per acre. During June 1964, the third year since clearing and planting, total available forage increased to 940 pounds per acre, almost 50 per cent more than the amount on naturally vegetated areas. Two-thirds of the forage available was composed of grasses and one-fourth was herbaceous forage.

Differential effects of deer and cattle on successional changes in the plant cover have been revealed by vegetation analysis within the three series of exclosures. Wiregrass *(Aristida stricta)*, for example, was significantly more abundant on the unfenced control plots than on either of the fenced plots. Other grasses, which are grazed to a greater or lesser extent by cattle, were more abundant on the fenced plots. Exclosure studies have also indicated at least two plants, *Berlandiera humilis* and *Chrysopsis* sp., that are apparently preferred deer browse species. Both of these plants were much more common on the plots fenced to exclude both deer and cattle than on the control plots or those fenced against cattle and not deer. It is interesting to note that Harlow (1961) also recognizes these two plants as important sources of deer browse based upon food habits analyses.

Deer were responsible for over twice as much of the recent browsing damage to the planted pines as were cattle, but this depended upon the season of the year. Deer and cattle together accounted the fact that 51 per cent of the pines showed evidence of recent browsing damage, but deer alone were responsible for 35 per cent of the damaged seedlings. Browse damage was much more prevalent in spring than in late summer. After the second growing season damage decreased until it was hardly noticeable. Heavily damaged seedlings, severely hedged because of the browsing, eventually recovered and resumed an apparently normal appearance, having been set back at least a year in their height growth.

Effect of site preparation on rodents.—Mechanical clearing of existing longleaf pine-turkey oak vegetation caused drastic changes in the distribution and numbers of rodents. On naturally vegetated areas two species of rodents occur, the Florida mouse *(Peromyscus floridanus)* and old field mouse *(Peromyscus polionotus)* (Figure 5). Florida mice are slightly more abundant, but they seem to occur as widely dispersed colonies. For example, one 20-acre uncleared sampling area has not yielded a single rodent of either species in over three years of trapping. Another similar area has yielded only one old field mouse during this same period.

Ideal conditions for old field mice seem to be established with the destruction of the original vegetation. These rodents invade the cleared areas in the summer as early as one month after site preparation. By the following spring they are present in large numbers and continue to occupy clearings almost exclusively. Florida mice also occur in the open cleared areas but less commonly than in areas that are uncleared.

SUMMARY AND CONCLUSIONS

1. Deer populations have generally declined on the Citrus Tract of the Withlacoochee State Forest since September, 1962, two years after this study was initiated. Reasons for this decline are presently unknown, but they are not thought to be due to site preparation activities.

2. Removal of from one-half to three-fourths of the native plant cover from plots one mile square results in increased use by deer. Complete destruction of the vegetation on plots of this size caused a pronounced reduction in deer use.
3. Marked vegetation changes following site preparation result in substantially more available forage beginning with the second growing season after pines are planted on the cleared areas.
4. Deer cause over twice as much browsing damage to seedling pines as cattle. This damage becomes negligible two years after planting the pines.
5. Old field mice become extremely common on the cleared areas the first spring following pine planting. Florida mice are essentially restricted to uncleared areas, but they are nowhere abundant.

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