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SURVIVAL AND GROWTH OF OAKS PLANTED FOR WILDLIFE IN THE FLATWOODS

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ABSTRACT.-In the cutover pinelands of south Florida, hammocks of evergreen forests are oases of wildlife habitat, but they are too widely scattered to be effective. The artificial establishment of hammocks in the flatwoods has potential for enhancing forest wildlife. To determine minimum requirements for the establishment of native oaks in the flatwoods, a comparison was made between live oak (Quercus *virginiana* Mill.) and laurel oak (*Q. laurifolia* Michx.). Results indicate that live oak is superior to laurel oak, that bedding is necessary to establish oaks, and that protection from grazing for a few years is desirable for the best results.

Keywords: Hammocks, Quercus spp., habitat management, forest wildlife, bedding.

Flatwoods pinelands in Florida, withunderstories dominated by saw-palmetto (*Serenoa repens* (Bartr.) Small), common gallberry (*Ilex glabra* (L.) A. Gray), wiregrass (*Aristida* spp., *Sporobolus* spp.), and other species are often of little value as wildlife habitat. Soils are poorly drained and low in fertility. In south Florida, where extensive acreages of pinelands have been clearcut, wildlife habitat has been further reduced. Frequent burning and heavy year-long grazing maintain a condition of reduced cover and reduced winter foods (Harlow 1959).

The artificial establishment of hammock communities throughout the cutover pinelands has the potential for enhancing wildlife populations by providing a habitat diversity now lacking.

Site

Natural "hammocks" in south Florida flatwoods are evergreen hardwood forests-usually less than 1 hectare in size-dominated by cabbage palm (*Sabal palmetto* (Walt.) Lodd.), oaks (*Quercus* spp.), and bays (*Persea* spp., *Magnolia* spp.), but which also support a wide variety of plants-more than any other vegetation type in the State (Davis 1943).

Soil series are primarily the Immokalee (pine-palmetto), which are imperfectly drained acid sands with organic-stained pan, and Charlotte (wet prairie), which are poorly drained shallow sands over calcareous materials. The soils are saturated much of the year, and during most of the summer the water table is at or near the surface of Immokalee soils to several centimeters above the surface on the Charlotte series. The average annual rainfall is 135 centimeters, of which 75 percent falls during the summer months.

Wildlife Potential

Hammocks are found on soils that are slightly elevated and better drained than the surrounding area (Laessle 1942). They often have a marl substratum, and an acidic humus usually builds up with the developing vegetation. As a result, they are comparatively high in plant nutrients and organic matter, and are rated as one of the more productive sites in the State (Davis 1943; Harlow 1959). Several species of wildlife use them as refuge and as a source of food (Frye 1954; Harlow 1959), although these oases are too scattered to be effective habitats.

Establishing such hammocks throughout the flatlands has the potential for enhancing wildlife populations. Game species such as white-tailed deer (*Odocoileus virginianus Osceola* Bangs), wild turkey (*Meleagris gallopavo* L.), and gray squirrel (*Sciurus carolinensis* Gmelin)-as well as many nongame species-would be expected to benefit.

The Study

Plants that can be successfully established and

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maintained with minimum effort and that are of known value to wildlife can be used to develop hammock communities. Oaks were selected for this study because they are native to the region and have the potential to produce overhead cover and an abundance of acorns-a staple food of many wildlife species.

This study was designed to determine minimum site preparation and protection requirements for the establishment of live oak (Q. *virginiana* Mill.) or laurel oak (Q. *laurifolia* Michx.).

The study was installed during the spring of 1969 in Charlotte County, Florida, in cooperation with the Florida Game and Fresh Water Fish Commission that provided land (Webb Wildlife Management Area) and prepared the planting sites.

METHODS

The experimental design consisted of a randomized complete block replicated two times. Treatment plots were established to compare species of oak (live vs. laurel), flatwoods sites (wet prairie vs. pine-palmetto), livestock grazing (no grazed vs. grazed), and site preparation (bedding vs. tilling).

High, wide beds were constructed by making a series of overlapping passes with a road grader; beginning near the center and working outward on both sides, soil was rolled or worked inward on each pass. Beds were 4 to 5 meters across, 45 to 60 centimeters high, well drained, devoid of vegetation, and surrounded by ditches. The relatively large planting area was designed to simulate the elevation of natural hammocks and to provide the opportunity for associated vegetation to develop naturally after the establishment of the oaks.

Tilled sites were prepared near the bedded plots. A heavy-duty garden roto-tiller was used to remove existing vegetation and prepare a planting area 2 by 2 meters for each tree.

All study plots were protected from burning.

There was moderately heavy grazing by range cattle the year round.

Trees were 2-year-old potted seedlings. Five laurel oak and eight live oak were randomly planted in each plot 6 meters apart. At the time of outplanting, tree height averaged 61 centimeters and crown diameter averaged 30 centimeters. Cumulative data on survival and growth for eight growing seasons after outplanting are presented.

Data were analyzed by analysis of variance, with significant differences at $P < 0.01$.

RESULTS AND DISCUSSION

SURVIVAL

After 8 years, survival of live oak (95 percent) was greater than that of laurel oak (76 percent). No significant differences were found between sites, site preparation, and grazing treatment.

Rainfall was below average the year following outplanting. Live oak seemed better able to survive on the dryer planting sites and also had a tendency to more readily sprout back after dieback that resulted from stress or injury. However, many individual trees of both species continue to die back after 8 years, especially on tilled sites.

HEIGHT GROWTH

Height growth was influenced by species, site preparation, and grazing treatment. Of these, site preparation was the most important factor affecting tree growth. Trees planted on tilled plots at the existing elevation grew very little (averaged 0.1 m) regardless of other treatments. Summer rains typically result in high water tables near or above the surface during most of the growing season and undoubtedly account for the slow growth and continued dieback. It is apparent that few of the trees will survive or attain a site useful to wildlife (fig. 1).

Figure 1 .-A typical live oak on tilled plot at existing elevation, 8 years after outplanting, 1977.

On beds, height growth was affected by species and grazing treatment. On average, live oak grew 60 percent faster than laurel oak, and all trees protected from grazing grew more than those subjected to grazing (table 1). Live oaks planted on protected beds apparently grew faster than any other treatment combination (fig. 2) and laurel oak on unprotected beds

Table 1 .-Average height growth and crown diameter growth of live and laurel oaks on bedded plots for the first 8 years after outplanting, by grazing treatment (in meters)

Species	Not grazed	Grazed	Average
	HEIGHT GROWTH		
Live oak	2.6	1.6	2.1
Laurel oak	1.7	0.9	1.3
Average	2.2	1.3	1.7
	CROWN DIAMETER GROWTH		
Live oak	2.5	1.6	2.1
Laurel oak	1.9	0.7	1.3
Average	2.2	1.2	1.7

Species effect, grazing effect, and grazing x species interaction are significant at $P < 0.01$.

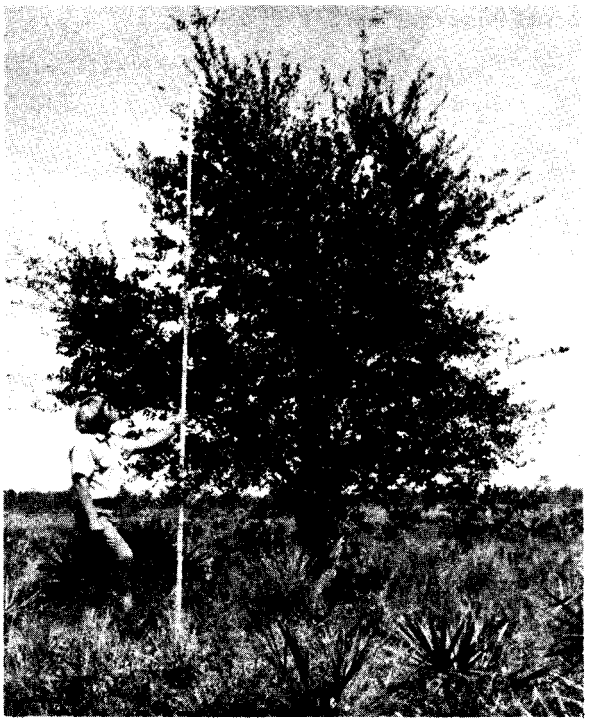

Figure 2.-A typical live oak 8 years after outplanting on bed protected from cattle, 1977.

had less growth than the other treatment combinations (table 1). Growth rates on beds were similar for protected laurel oak and live oak exposed to grazing.

On native ranges of south Florida where roughage is abundant, cattle normally browse oak only lightly, but they tend to use beds as refuge from high water during the summer and as a dry place to bed down. However, cattle were attracted to these beds to graze the high-quality grasses (***Andropogon*** spp., ***Panicum*** spp., ***Paspalum*** spp.) that became established there. As a result, young trees often were rubbed, trampled, and heavily browsed. Most oaks, however, were in reasonably good condition and, for the most part, will survive and eventually grow out of reach of cattle. Live oaks, as reflected by their greater growth on grazed beds. appear better able to withstand cattle activity.

CROWN GROWTH

As with height growth, crown growth varied by species, site preparation, and grazing treatment. Site preparation was the most important factor influencing growth. There was crown development only on the bedded trees (table 1), and trees planted on tilled sites grew very little regardless of species or grazing treatment.

On beds, live oak generally outperformed laurel oak, and crowns of both species grew considerably faster when protected from grazing (table 1). Live oaks protected from grazing developed crowns faster, while laurel oaks exposed to grazing performed the poorest. Crowns of grazed live oak grew about as well as crowns of protected laurel oak.

CROWN VOLUME

Crown volume, rather than crown growth, is probably of more significance for wildlife because it better expresses extent of cover and potential acorn production. Total crown volume after 8 years was computed assuming crowns to be spherical. This assumption, though not entirely true, serves to illustrate the vast differences in crown size among species and treatments. Means were not statistically tested, but differences are undoubtedly similar to those shown for crown diameters. After 8 years, live oaks planted on protected beds had crown volumes that averaged almost 2 times that of protected laurel oak, 3 times that of grazed live oak, and 12 times that of grazed laurel oak (table 2). Total heights and crown areas after eight growing seasons are compared in figure 3.

Table 2.-Computed crown volume of live and laurel oaks on bedded plots 8 years **after nutplanting (in cubic meters)**

Species	Not grazed	Grazed	Average
Live oak	11.4	4.2	7.8
Laurel oak	6.4	1.0	3.7
Average	8.9	2.6	5.7

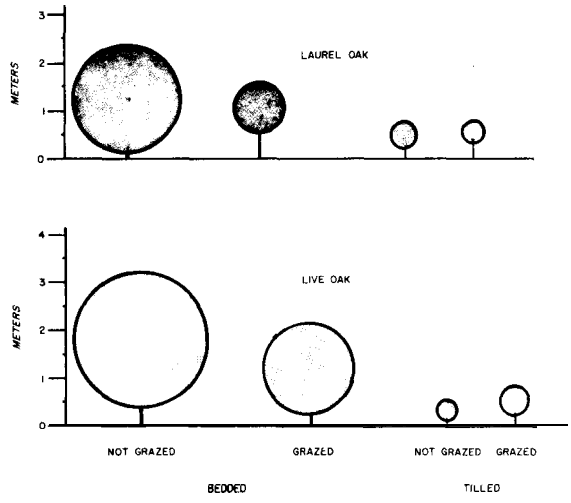

Figure 3.-Comparison of total growth 8 years after outplanting, 1977.

CONCLUSIONS

Results indicate that bedding will be required to establish oaks in the low flatwoods of south Florida. Optimum bed size was not determined, but apparently beds must be sufficiently high to permit root development above the high summer water table. Although beds were constructed to allow associated hammock vegetation to develop after the oaks were established, with the exception of species of ***Andropogon, Panicum,*** and ***Paspalum,*** this has not yet occurred. The sites are still young, and seed sources of hammock vegetation are widely scattered. As the oaks mature, hammock dwelling birds and other wildlife can be expected to increasingly use these sites and deposit seeds ingested in natural hammocks.

In this study, live oak was clearly superior to laurel oak, and it developed much better when protected from cattle. Protection from grazing would seem desirable for a few years; however, it may not be essential because many live oaks exposed to the moderately heavy year-long grazing now have crowns above the reach of cattle. Laurel oak would provide an additional element of variety in these artificial hammocks, but it is more essential that they be protected from cattle for an undetermined period of time.

Live and laurel oaks must be protected from fire for many years, if not always. When the beds were constructed for this study, surrounding ditches were made sufficiently deep and wide to function as protective moats. These ditches were flooded part of the year and supported vegetation too sparse to carry fire.

Several live oaks have produced a few acorns since the 3rd year after outplanting, but production is not yet significant. Mockingbirds (*Mimus polyglottos* L.) have been observed nesting in several of the larger live oaks for several years.

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