Hendee and Potter (1971) have reminded the wildlife manager that people management is an important part of wildlife management. Can we and should we, manage for the displaced Canaan Valley type hunter? Will it be possible and acceptable to provide the necessary rough road experience? Perhaps the best management we can provide for this type of hunter is no management by neglecting to provide and maintain physical improvements. Every wildlife manager probably has some roads and trails which are expensive to maintain for all-purpose use. Allowing these areas to follow their natural course may be a good management practice.

If no effort is made to meet the recreational demands of the Canaan Valley type hunter another segment of the hunting population may be lost. There presently exist many different populations of hunter each with its own recreation requirements. Wildlife managers may find it necessary to provide several different types of hunting experience if the hunter is to be kept from hanging up his guns for good.

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EFFECTS OF INTENSIVE FORESTRY ON SUCCESSION AND WILDLIFE IN FLORIDA SANDHILLS[1]

by

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ABSTRACT

Twelve 259 ha (1 mi²) plots of varying clearcut percentages were established in a randomized complete block design in the central Florida sandhills. Response variables ranged from understory vegetation changes to game species abundance over a period of 13 years. Pine *(Pinus spp.)* plantation establishment resulted in an increase ($P < .05$) in understory vegetation biomass and diversity. White-tailed deer *(Odocoileus virginanus)* seemed to prefer the partial plantation plots, but there was also a significant seasonal interaction between habitat type and deer usage. Passeriform and Piciform birds and fox squirrels *(Sciurus niger)* preferred the uncleared plots while gopher tortoises *(Gopherus polyphemus)* and cottontail rabbits *(Sulvilagus floridanus)* seemed to prefer the plantations. Rodents increased markedly in the first three years after site preparation, but numbers quickly decreased to typically low levels. Arthropod polulations were greater ($P < .05$) in the plantations than native areas although no differences were found in ordinal level diversities.

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INTRODUCTION

Increased environmental awareness and high intensity land use has caused many open conflicts of interest in Florida. Intensive forestry is a major concern since approximately 46% of the land area of the state is covered by commercial forests (Knight and McClure 1971). Since wildlife is also an important product of forested land, present and future demands for it should also be considered.

Large closed canopy conifer plantations have been found to support less wildlife than surrounding native areas (Smith 1958, Bailey and Alexander 1960). This is in part because wildlife food production is largely controlled by canopy density and shading (Lay and Taylor 1943, Johnson *et al.* 1962, Halls and Schuster 1965). Species of wildlife that frequent homogeneous forest stands usually occur where the habitat diversity is greatest, i.e. around the edges and openings (Pearson 1968, Gray and Hermel 1939).

This study was designed to evaluate the effects of clear cut size and interspersion and was initiated in 1959 through the cooperative efforts of the University of Florida Agricultural Experiment Stations, The Florida Forest Service and the Florida Game and Freshwater Fish Commission. Primary attention was initially directed towards understory vegetation, white-tailed deer *(Odocoileus virginanus)*, rodents and turkey oak *(Quercus laevis)* acorn production; but birds, fox squirrels *(Sciurus niger)*, Gopher toitoises *(Gopherus polyphemus)* and arthropods were later considered.

We are grateful for the assistance of Drs. S. L. Beckwith, professor emeritus, and Ramon Littell, statistician, University of Florida, Mr. Jeff Lewis, Forest Supervisor, Florida Forest Service and Mr. Carlton Chappell, Florida Game and Freshwater Fish Commission.

METHODS

The study area is located on the 16,600 ha Citrus Tract of the Withlacoochee State Forest approximately 128 km south of Gainsville, Florida. The typical vegetation of the underlying sandhills is the longleaf pine *(Pinus palustris)* - turkey oak association (Laessle 1942). In addition, considerable amounts of blue-jack oak *(Quercus incana)* and live oak *(Q. virginiana)* are also present in the overstory. Understory vegetation is composed largely of wiregrass *(Aristida stricta)* and various shrubs and herbaceous plants.

The experimental design consisted of four 259 ha (1 mi^2) plots in each of three blocks in a randomized complete block design. Treatments were 100, 75, 50 percent clearing while the fourth plot of each block was left as a control (Fig. 1). The cleared areas were site prepared and planted to slash pine *(Pinus elliottii)* with a few strips of sand pine *(P. clausa)* and longleaf pine (Beckwith 1964).

Plot implementation was started in 1960 and completed in 1965. Understory vegetation was analyzed by the forage-weight method (Campbell and Cassidy 1955), while all acorns were counted directly on oaks selected by means of the point-centered quarter method (Cottam and Curtis 1956). Since Sherman live traps were used for censusing rodents, each captured individual was sexed, aged, toe-clipped and released for future recapture. The trap layout varied over the course of the study but finally evolved to a 12 X 12 trap grid with 15 m trap spacings unit and a 10 X 12 trap grid on a native sampling unit. The trapping period consisted of five consecutive nights. In addition, six Museum Special traps per grid were used on the last trapping night to ascertain trap selectivity (Cockrum 1947 and Wiener and Smith 1972) and to obtain sacrificed animal data.

Deer abundance was estimated from track counts along the central road crossing the strips of each plot (Tyson 1952) and Cottontail rabbits were censused by three morning and three evening roadside counts along the same roads (Lord 1959). Birds were censused along a 1.6 km transect in each half of each plot by use of the Hayne (1949) strip census method. Gopher tortoise burrows were counted in a 30 m strip along the same transects. Arthropod populations were sampled on three plantations and three native 8 ha sampling units using a 30.5 cm circular sweep net (Gray and Treloar 1933, Morris 1960 and Southwood 1966).

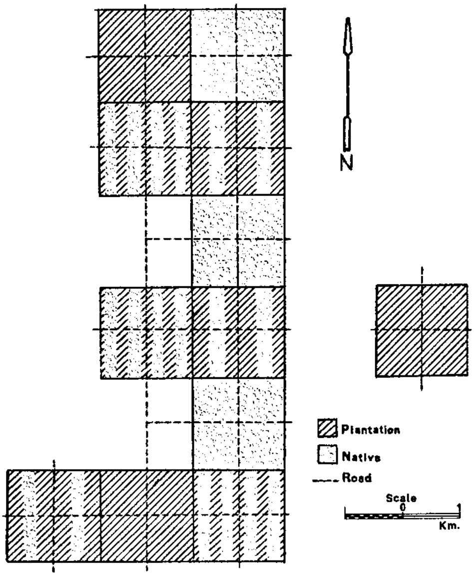

Figure 1. The spatial relationship of the block and plot treatments in the Citrus Tract of the Withlacoochee State Forest. Each of the three blocks contains four treatment plots; 0, 50, 75, and 100 percent cleared and planted. Central east-west roads were used for transect counts.

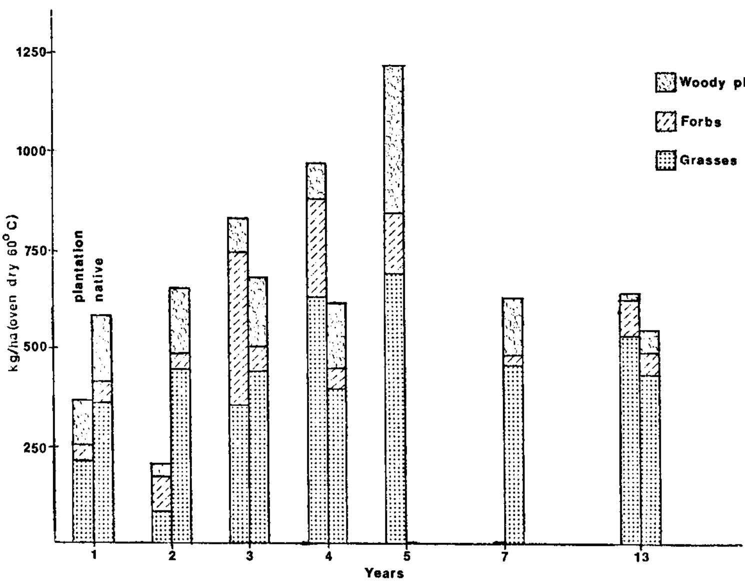

Figure 2. Relative springtime amounts of three major understory vegetation classes for 13 years following plantation implementation.

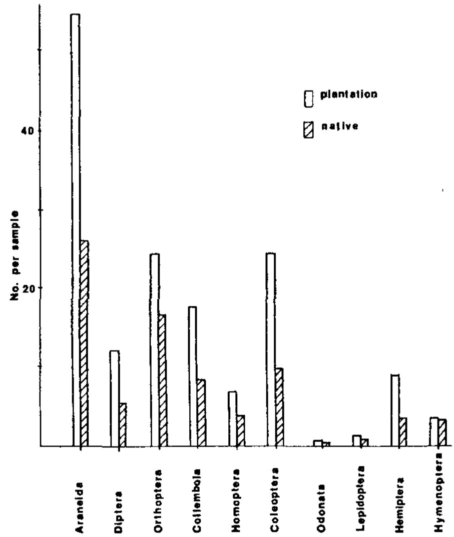

Figure 3. Numbers and distribution of arthropods by order in understory sweep net samples (500 sweeps per sample) in plantation and native areas.

RESULTS AND DISCUSSION

Pine plantation establishment resulted in changes in the proportions of understory vegetation types compared to native areas and through successional time. Forb production seemed to peak in years two through four while woody plant production peaked somewhat later and, thus, the proportion constituted by grasses continues to increase to the present (Fig. 2). Although there are no significant differences between plantations and mature native areas with regard to life form classes, there are many differences at the species level. The forage diversity is significantly greater ($P < .05$) in plantations than the native areas (x H' = .95 vs .41).

Greater quantities of the palatable grasses *Andropogon spp.*, and *Paspalum spp.* occurred in plantations than in native areas ($P < .05$). But after 13 years since plot establishment, only one forb, *Crotonopsis sp.*, occurred in greater amounts in plantations than in native areas ($P < .05$). [Species of marginally greater abundance were: *Crotolaria sp.* (P = 0.10), *Dyschoriste humistrata* (P = 0.09), *Eriogonum tomentosum* (P = 0.08), *Eupatorium capillifolium* (P = 0.11), *Galactea sp.* (P= 0.08) and *Helianthella grandiflora* (P = 0.09)].

There were differences (P .05) in acorn production between sites even though no one site consistently outproduced the other. Production was quite variable through time and therefore differences between years or the different size classes are not significant.

As expected, plantations supported a significantly greater number of arthropods (insects and spiders) than did the native areas (28.5/100 sweeps and 15.5/100 sweeps respectively). But interestingly, the differences between the two areas were reasonably uniform across all orders and so the arthropod fauna of the two areas was quite similar (Fig. 3). There was no significant difference in diversity or the ratio of carnivorous to herbivorous forms between the two habitat types.

The combined data from 10,680 trap nights of effort reflect an overall success rate of 2.3 percent. The majority of the captures were made in the first few years following plot implementation and the responses appear to be directly related to habitat (Fig. 4). Old-field mice (*Peromyscus polionotus*) increased rapidly in the site prepared areas for the first three years and then returned to characteristic low levels. They seemed to favor recently disturbed sites with little vegetation present. Florida mice *(P. floridanus),* on the other hand, were more characteristically captured in native areas (only about 20 percent of the captures were in plantations) and did not demonstrate the same dramatic increase as exhibited by old-field mice. A decline in population levels in the later years may be due to the prevention of fire on the sample units since 1960. Cotton rats *(Sigmodon hispidus)* were not captured until a few years after plot implementation when approximately equal numbers occurred in both areas. The abundance of cotton rats is probably associated with the amount of herbaceous cover present.

When all plots and blocks are considered there is no significant difference in cottontail rabbit abundance but yet the 75 percent plantation plots support greater numbers ($P<.05$) than do the control plots. And, in general, cottontails seem to prefer the plantations (0.23/km) over the native areas (0.06/km). The greater understory plant diversity in plantations appears to benefit the rabbits. Both evenings and early morning roadside counts showed night censuses to be generally lower than early morning counts (0.58 and 0.92 rabbits/km respectively).

In general, birds seemed to prefer the native areas over plantations, even though specific treatment differences were not significant. Chickadees *(Parus carolinensis),* tufted titmice *(P. bicolor)* and woodpeckers *(Dendrocopos spp.)* were observed almost exclusively in native areas. Warblers *(Dendroica spp.)* occurred in both areas, but were more abundant in native areas. Bluejays *(Cyanocitta cristata)* and cardinals *(Richmondena cardinalis)* also occurred in both areas, but unlike the warblers they were usually associated with scrub oaks when in plantations. Ground sparrows were found in both types (Table 1).

Using burrows as an index to abundance, it appears that gopher tortoises prefer plantations over native areas (3.08 + 0.44/ha vs 1.37 + 0.28 ha) $P<.05$). This preference for plantations is probably a result of the greater understory vegetation diversity, especially forbs, in plantations.

Because of complexities of interpretation due to delayed implementation of certain plots, only the deer track data from 1964 to 1974 are presented here. Although the 75 percent plantation plots support greater ($P<.05$) usage than did the 100 percent plantation plots, no overall treatment differences were found. The 50 percent and control plots showed intermediate levels of utilization (viz 75% = 27.0 + 2.6, 50% = 24.3 + 2.1, Control = 21.9 + 2.1, and 100% + 16.3 + 2.0 tracks per day). There was also a significant season versus treatment interaction effect ($P<.05$). The native areas were more heavily utilized in the fall than in the spring while the clearcut areas were more heavily used in the spring than in the fall. This response is most probably a result of the mast availability on native areas in the fall but greater forage diversity and perhaps nutritional value in the plantations during the spring.

Seasonal usage of plantation and native strips within the partial plantation plots also supports the above conclusion. In addition, the narrower plantation strips (100, 200 and 300 m) received greater usage on a per unit area basis, than did the wider strips (400 and 600 m) or the native strips (200 m) (Fig. 5).

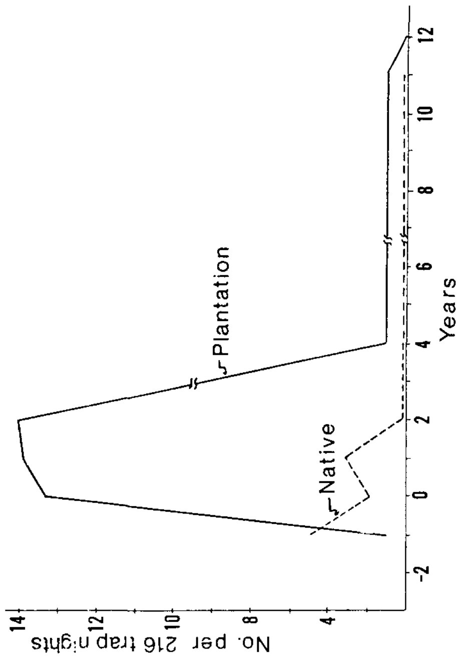

Figure 4. Rodent response in plantation and native areas in relation to time since plot implementation.

Table 1. Total numbers of birds observed by plot during September, 1973, and January, 1974, during 19.2 km of transect.

	Percent Plantation			
Taxa	100	75	50	0
Tufted titmouse	0	2	1	1
Carolina chickadee	0	2	0	10
Nuthatch	0	0	0	2
Bluejay	2	1	4	2
Bluebird	0	0	0	7
Blue-gray gnat catcher	0	1	0	4
Warblers (spp.)	6	3	12	85
Meadowlark	0	0	0	3
Cardinal	2	3	2	2
Rufous-sided towhee	0	2	0	0
Sparrow (spp.)	2	12	2	3
Downy woodpecker	0	0	1	3
Red-cockaded woodpecker	0	0	0	7
Red-bellied woodpecker	0	0	0	3
Mourning dove	6	1	2	0
No. of taxa	5	9	7	13
No. of individuals	18	27	24	132

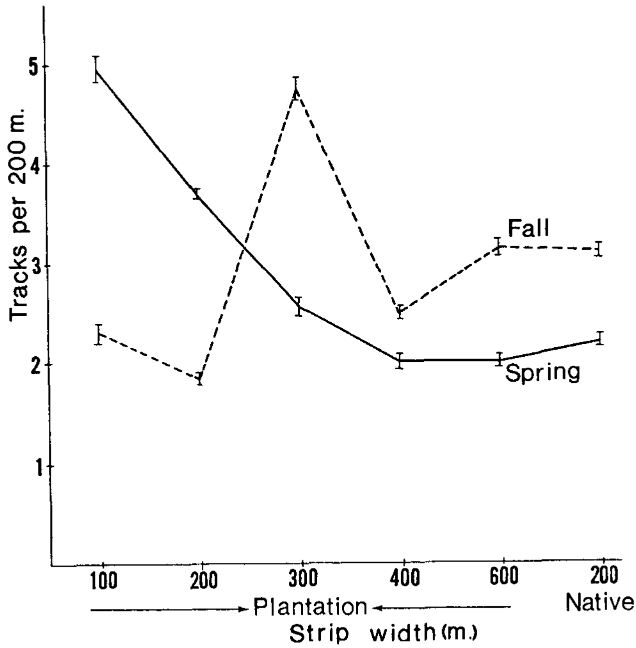

Figure 5. Comparative white-tailed deer usage of different width plantation and native strips over eleven years. Being located on the plot edges, the 100 and 300 m plantation strips may reflect additional use from surrounding deer. Observations represent means + standard errors.

CONCLUSIONS

Pine plantation establishment initially brings the photosynthetic layers close to the ground and thus enhances understory vegetation biomass. The longevity of this increased understory vegetation phase is predominantly site and overstory species dependent. This phase probably lasts a greater number of years in slash pine plantations on central Florida sandhills than on many other sites because of poor slash pine growth and survival there. Taxa of animals such as understory arthropods, old-field mice, cottontail rabbits and gopher tortoises which are predominantly influenced by the understory vegetation, tend to be more abundant in plantations. Other species such as many birds and fox squirrels, which appear to be more dependent upon a vertical as well as horizontal heterogeneity component in their habitat, tend to be adversely affected by pine plantations. Spatial habitat heterogeneity, which seems to be increased by a close mixing of plantation and native areas, tends to enhance other species such as the white-tailed deer. By increasing the total plant community complexity, wildlife in general tends to be enhanced.

Therefore, a management strategy for sandhill wildlife should include retaining the longleaf pine and many of the larger oak trees while somehow enhancing the understory diversity by site disturbance. The disturbed areas should be less than 259 ha in size with adjacent areas being manipulated in different years. If intensive forestry is also a consideration, slash pine should not be used, as sand pine is apparently a better adapted species for this site. On the other hand, seedlings should be spaced wide enough to prevent 100% canopy closure. Plantations should not cover more than about 75 percent of a 259 ha management block. Native and plantation strips should be interspersed in order to take advantage of the important seasonal interaction with deer usage.

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