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Investigations of Early Plant Succession on Abandoned Farmland in Everglades National Park

NATIONAL PARK SERVICE
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INTRODUCTION

Over 4000 ha within the present boundaries of Everglades National Park have been farmed at one time or another during the past 60 years. During the 1920's through 1940's, farming was carried out in marl prairies along the Ingraham Highway--in the vicinity of Pine Island, Royal Palm State Park, and westward toward Flamingo. The Act of May 30, 1934 which provided for the establishment of Everglades National Park omitted an extensive area of private land from the park. Since this area was virtually surrounded by park land, it came to be known as the "Hole-in-the-Donut." An Act of July 2, 1958, altered park boundaries to include the "Donut" and authorized purchase of private inholdings within park boundaries. Meanwhile, the technology of rockplowing had become available. During the 1950's and early 1960's, an area of approximately 2000 hectares including pinelands and marl glades was rockplowed, breaking up the limestone bedrock to create a "soil" suitable for growing crops, especially tomatoes. At this time, the formerly farmed marl lands which had not been rockplowed were abandoned.

In 1970, as a result of concerns regarding impacts caused by the use of pesticides, fertilizers, and other activities associated with farming upon the resources of one of the prime regions of Everglades National Park in terms of visitor use and biological diversity, Congress authorized funds for purchase of the remaining 2000 ha of private land of the Hole-in-the-Donut. Farming was gradually eliminated within three years after land was acquired by the government. The last farming in the Hole-in-the-Donut occurred in the spring of 1975.

Elimination of farming in the Hole-in-the-Donut aroused much opposition from local agricultural interests (Cornwell and Atkins, 1975). And although elimination of farming stopped many of the adverse impacts, the problem of exotic plant invasion of park ecosystems, especially of Schinus terebinthifolius (Brazilian pepper), was greatly intensified. Wildlife populations in the Donut area increased dramatically within the years following abandonment of the fields. Bobcats and predatory birds became abundant, and there were numerous sightings of the endangered Florida panther. The National Park Service explored various means of restoring some semblance of the original vegetation (Resources Management Staff, 1976), with little success since the substrates had been so drastically altered by farming.

Objectives were quickly shifted from restoration of original ecosystems to maintenance of biotic diversity and minimizing the impact of exotic species on adjacent native vegetation. The investigations reported here were begun in late 1977 with the aim of gaining an understanding of old-field succession on these lands. Four separate studies are reported: (1) Succession on farmland abandoned in 1973-1975; (2) Succession on farmland abandoned for 14 years and bulldozed in April-June, 1979; (3) Comparison of pre-and post-bulldozing vegetation on abandoned farmland; and (4) Establishment of exotic trees on abandoned farmland. Each of these studies is a summary of data from initial observations on early plant succession. This report documents these preliminary results and attempts to formulate some general conclusions concerning vegetative recovery on abandoned farmland. In all the following sections, nomenclature of vascular plants follows Avery and Loope (1980b).

SUCCESSION ON FARMLAND ABANDONED IN 1973-1975

Investigation of successional patterns representative of the 2000+ ha of rockplowed farmland abandoned in the 1973-75 period utilized plots set up initially to test the effectiveness of various mowing and burning treatments, described by Hilsenbeck (1976). These plots were originally selected as representative of the environmental variation within the 2000+ ha area. The 52 ha successional research area described by Hilsenbeck (1976) was composed of eight plots grouped into four blocks of two plots each on the basis of ecological similarity (Figure 1). Plots 1-4 were located on "Rockdale loam" soil (Gallatin et al., 1958), which prior to rockplowing supported pine forests and high prairies. Plots 5-8 were placed on "Perrine marl" soils, which prior to rockplowing and cultivation supported Muhlenbergia and sawgrass wetlands. The plots were ranked from mesic (highest elevation) to hydric (lowest elevation): 1, 2, 3, 4, 8, 7, 6, 5. Each of the eight plots contained sixteen 0.4 ha (1-acre) permanently marked units to which the mowing/burning treatments were applied according to a prescribed time sequence. Within each of the eight plots, four randomly placed "control" units were left untreated.

As reported by Hilsenbeck (1976), the vegetation of the plots was removed by double disking in the interval of October 14 to November 6, 1975. At three month intervals thereafter, vegetation analysis was carried out and treatments applied. Density and biomass samples were obtained in each unit every three months. Biomass estimates were obtained from two independent randomly located 0.5 m x 0.5 m samples per unit. Two density counts were obtained from the biomass samples and two from 0.5 m x 0.5 m subquadrats, each of which was nested in the corner of a randomly located, permanently marked, 4 m x 4 m quadrat.

Hilsenbeck (1976) reported results of vegetation sampling in January-February 1976. Data were collected and treatment applied thereafter at three-month intervals until mid-1977, when the experiment was abandoned because of its logistic complexity, difficulties in implementing the rigid schedule, and apparent ineffectiveness of the treatments for reaching desired objectives. All data collected by Hilsenbeck and his coworkers are available in the Plant Ecology files at the South Florida Research Center.

Methods

The current investigation utilized the "control" units of the previously described study design, since they had not been disturbed since late 1975. Vegetation analysis was conducted using procedures which would allow some comparison to data collected earlier, but which were much easier to apply and allowed comparison with other ongoing studies within Everglades National Park. The density of plants greater than or equal to ($\geq$) 2 m in height was obtained in a 5 m x 5 m quadrat established in the northwest corner of each unit. Four 0.5 m x 0.5 m subquadrats, nested within the 5 m x 5 m quadrat, were used for density of all species, subdivided by size classes of $<$ 60 cm and $>$ 60 cm. Percentage of the ground covered by each species, subdivided by the same size classes, was also determined. Sampling was carried out in April-May 1978 and April-June 1980. Plots 3 and 4 were burned in April of 1980 and were not sampled that year.

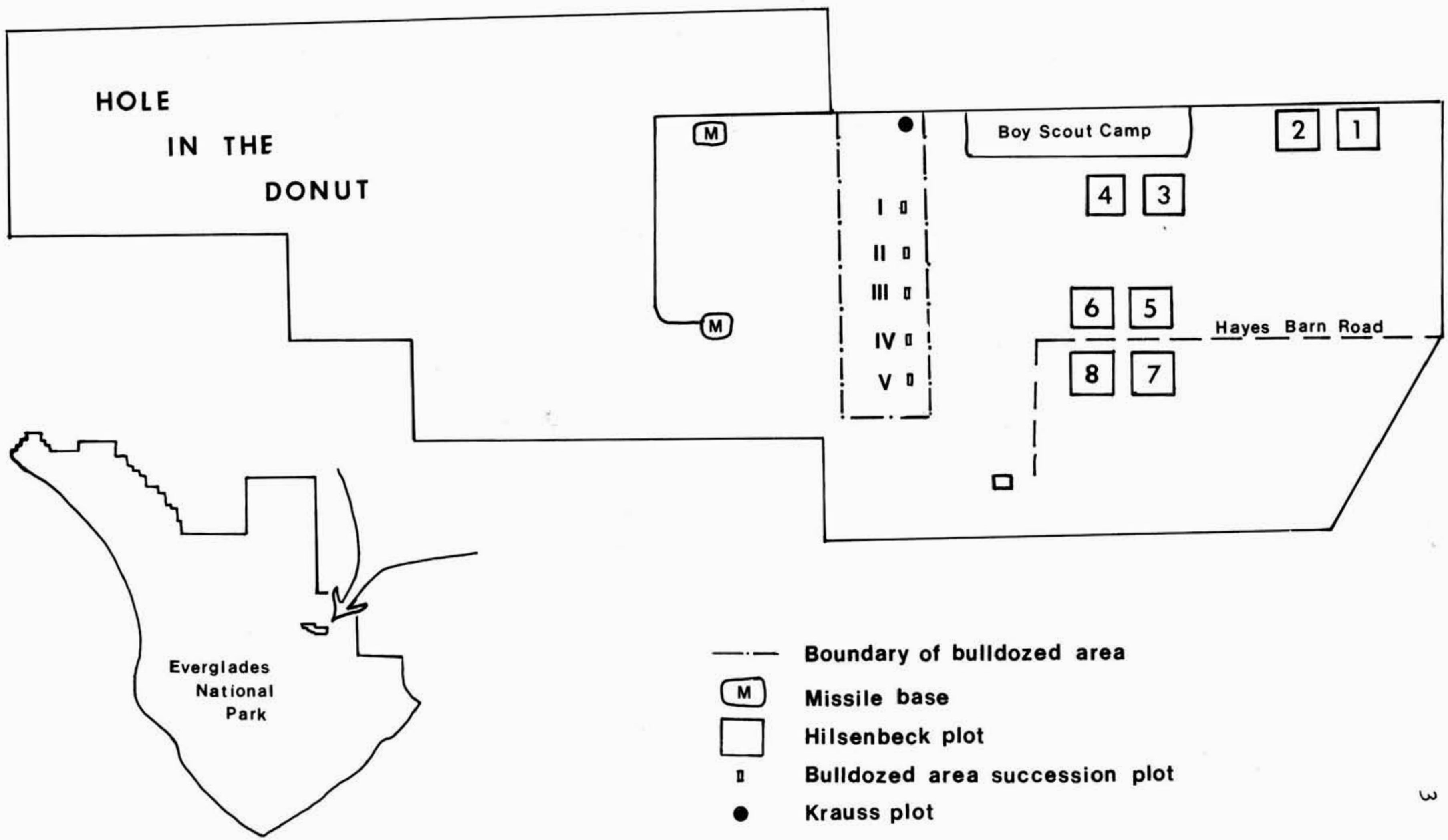

Figure 1. Map of Hole-in-the-Donut and its location in Everglades National Park, with locations of study plots.

Results and Discussion

A summary of mean density of individuals <2 m tall for plots 1, 2, 5, 6, 7, and 8 in 1980 is given in Table 1. Mean cover values for these same plots for 1980 are given in Table 2. Summaries of density and cover for 1978 as well as all raw data are available in the Plant Ecology files at the South Florida Research Center.

Density and cover values for 1980 by species for plants ≥ 2 m tall are given in Table 3. Table 4 shows the increase or decrease in these density values between 1978 and 1980.

Table 5 shows the total number of species recorded per plot (for the sixteen 1/4 m^2 quadrats per plot) for 1976, 1978, and 1980. In 1976, the higher plots had a greater number of species, whereas in 1978 and 1980, the lower, wetter plots had a greater number of species. Total number of species recorded increased from 48 in 1976, to 56 in 1978, to 71 in 1980.

These data, in combination with information provided by Hilsenbeck (1976), allow the following interpretation of the first five years of succession in areas characterized by Plots 1-2, 3-4, 5-6, and 7-8.

Plots 1 and 2

As described by Hilsenbeck (1976), these plots are representative of the highest rockplowed land in the Hole-in-the-Donut. The soil is Rockdale loam, with a few scattered pockets of very shallow marl.

Hilsenbeck states that in 1975, prior to disking, the dominant species on the recently abandoned farmland were *Bidens alba*, *Ambrosia artemisiifolia*, *Sida acuta*, *Brachiaria mutica* (then called *Panicum purpurascens*, paragrass), and *Rottboellia exaltata*. In January-February 1976, 2-3 months after disking, *Bidens* and *Ambrosia* were the overwhelming dominants in Plots 1 and 2, jointly accounting for about 80% of the relative biomass. *Cynodon dactylon* was codominant in Plot 2. *Ludwigia octovalvis* and *Brachiaria* were becoming established. No *Baccharis* was recorded. *Melilotus alba* was sparse in January-February, but assumed aspect dominance in April-May of 1976.

Our data from April-May 1978 show that *Bidens* was the overwhelming dominant based on cover values, but was rivalled in density by *Ambrosia*. *Ludwigia octovalvis* had 90% cover in Plot 1. Other important species included *Boehmeria cylindrica*, *Cynodon*, *Melilotus*, *Brachiaria* and *Solidago leavenworthii*.

Our data from April-June 1980 (Tables 1 and 2) show that *Bidens* is still by far the dominant (based on cover), followed by *Boehmeria*, *Andropogon glomeratus*, and *Sida rhombifolia*. Both *Ambrosia* and *Melilotus* have 1% cover or less. However, *Ambrosia* has very high densities. *Ludwigia octovalvis* appears to have declined since 1978.

Plots 3 and 4

These plots are located primarily on Rockdale loam upland soil, but are lower on the average than Plots 1 and 2. About 10% of Plot 3 and 5% of Plot 4 is underlain by marl soil.

Hilsenbeck (1976) states that the pre-disking community in 1976 was dominated by Sesbania exaltata mixed with Ipomoea trichocarpa, Panicum bartowense, and Brachiaria. In January-February 1976, the area was dominated by annual composites (Parthenium hysterophorus and Ambrosia) and perennial grasses (Brachiaria) and "contained 25 species of flowering plants not previously found there." Alternanthera philoxeroides had the highest density of any species. Ipomoea was still important. Woody species (Baccharis halimifolia and Ludwigia octovalvis) were colonizing rapidly and Hilsenbeck predicted imminent dominance by Ludwigia, which already occurred at a density of 5,238 individuals/0.4 ha. Baccharis occurred at a density of 54 plants/0.4 ha.

In April-May 1978, Ludwigia had become the species with by far the highest cover, followed by Brachiaria which was far more important here than in any other pair of plots. Medicago lupulina ranked third in cover. Bidens had 7% cover in Plot 4. Parthenium and Alternanthera, dominants two years earlier, were still present but had less than 1% cover.

These plots burned in April of 1980 and were therefore not sampled in 1980.

Plots 5 and 6

These plots are located on land which is quite variable in elevation, but is on the average some of the lowest land in the Hole-in-the-Donut.

Hilsenbeck (1976) reported that vegetation prior to disking was composed of annuals including Sesbania, Panicum bartowense, Ipomoea, and Polygonum densiflorum. In January-February 1976, the recovery vegetation was very sparse, especially on Plot 5. The dominants (based on density) were Alternanthera philoxeroides and Cyperus polystachyos. Amaranthus hybridus, Chenopodium album, and Sonchus asper dominated in terms of biomass. Ludwigia octovalvis seedlings were already found throughout the plot, but Baccharis was not recorded.

Our data for April-May 1978 show that Alternanthera was the overwhelming dominant, with Ludwigia also very important. Verbena scabra, Solidago, Sporobolus domingensis, and Ambrosia were also important.

Our data for April-June 1980 (Tables 1 and 2) show that dominance of Alternanthera and Ludwigia continues. Other important species include Thelypteris kunthii, Sporobolus, Sarcostemma clausum, Diodia virginiana, and Andropogon. Little change from 1978 is apparent. Very little Baccharis is present.

Plots 7 and 8

Topography on these plots is similar to that of Plots 5 and 6, but some very low land occurs in Plot 7 and a generally increasing east to west gradient occurs across the plots, culminating in a high "island" of Rockdale loam in Plot 8.

Hilsenbeck (1976) states that pre-disking vegetation was similar to that described for Plots 5 and 6. He was told by farmers that taro (Colocasia esculentum) had been introduced to the area of Plot 8 in 1967. In January-February 1976, small individuals of Ludwigia were already widely established. Dominants included Amaranthus, Chenopodium, Ipomoea, and Digitaria ciliaris. Hilsenbeck recorded Colocasia as present only in Plot 8. Baccharis was not recorded.

Our data for April-May 1978 show that Ludwigia was the overwhelming dominant in Plot 7 and Colocasia dominant in Plot 8. Colocasia also had a 2% cover in Plot 7. Baccharis halimifolia, Eupatorium capillifolium and Andropogon were also important.

Our data for April-June 1980 indicate a substantial decline for Colocasia in Plot 8 and a small increase in Plot 7. Ludwigia octovalvis, Baccharis halimifolia, and Baccharis glomeruliflora are dominants in the stand. Data suggest a large increase in Baccharis over 1978 and a possible slight decline in Ludwigia. (These and other trends must be regarded as tentative, since sampling error may be large.) Alternanthera is not abundant here, in marked contrast to environmentally similar Plots 5 and 6.

SUCCESSION ON ABANDONED FARMLAND BULLDOZED IN 1979

Areas of older successional forest vegetation on former farmland abandoned for many years were experimentally bulldozed in 1974 and 1978, removing woody vegetation, mostly exotic species, in an attempt to restore some semblance of native prairie. Preliminary results were quite encouraging. An area of several hectares on the eastern side of the "Donut," occupied primarily by Schinus and Psidium guajava (guava) and bulldozed in 1974, still showed minimal shrub invasion in 1980. To test this technique for restoring near-natural vegetation, a 120 ha area was bulldozed in April-June, 1979. This area, originally with mostly prairie vegetation, had been abandoned from farming in 1965 and was dominated by Schinus and Baccharis, with Myrica cerifera prominent on the portion of the area which was formerly pineland (on higher ground). The investigation described below was carried out to determine patterns of revegetation of this area.

Methods

We established five permanently marked 5 m x 20 m plots in the bulldozed area at approximately 0.5 km intervals along a north-south transect (Figure 1). The land slopes from north to south, so that plots I, II, and III were located on high ground, formerly high prairie and/or pinelands, whereas Plots IV and especially V were formerly lower prairie, based on current conditions of flooding during summer months.

Vegetation sampling included determination of density and cover values for each vascular plant species within the plots at three month intervals from August, 1979, through May, 1980. Each plot was subdivided into four 5 m x 5 m quadrats. Four 0.5 m x 0.5 m subquadrats, located in the same areas within each larger quadrat each time, were used for density counts of individuals and estimates of percentage cover of individuals less than 60 cm tall for all species. During the first year of sampling, no plants greater than 60 cm tall were encountered. When plots are reanalyzed in the future, the larger size quadrats (5 m x 5 m) will be used for sampling vegetation taller than 60 cm.

Results and Discussion

Density values of all species at each sampling date (August, 1979; November, 1979; February, 1980; and May, 1980) in Plots I-V are shown in Tables 6-10. Cover values of all species at each sampling date are shown in Tables 11-15. Table 16 shows mean cover for all species at each of the four sampling dates. Table 17 shows the five dominant species in each plot at each sampling date, based on percentage cover values. Table 18 shows the number of vascular plant species recorded in the sixteen 1/4 m^2 subquadrats of Plots I-V on the various sampling dates.

A total of 79 species was recorded within the subquadrats sampled in the study. Only 14 additional species were recorded from the plots and adjacent portions of the bulldozed area, suggesting that an adequate sample had been used. Table 18 shows that species richness increased consistently in each of Plots I-V from August through May. At the end of the sampling (in May, 1980) species richness was greatest in the lowest (wettest) plots, in marked contrast to Hilsenbeck's (1976) preliminary findings of lower species richness in the wettest areas of very recently abandoned farmland.

Trends of changes in density and cover on these plots are illustrated in Figures 2 and 3. Figure 3 shows that total percent cover (sum of individual % cover for all species) increased steadily with few exceptions in all plots from August through May, with initial values of 6-25% and final values of 46-71%. In contrast, total density values (sum of individual densities of all species), illustrated in Figure 2, showed no consistent trends other than to remain roughly within the same order of magnitude. For a given species, cover can increase while number of individuals decreases due to growth of some individuals and mortality of others. Some species germinate and become established in large numbers one season, then decline. Others germinate and become established throughout the year. The data presented in Tables 6 through 17 should prove to be a useful source of life history information for individual successional species of the Hole-in-the-Donut when interpreted in view of results of seed dispersal and seed storage studies by J. J. Ewel and his colleagues (scheduled for completion in 1981) and of an examination of flowering and fruiting phenology by Loope (1980).

A rough comparison, relating mean species composition in the "bulldozed" plots (abandoned for 14 years) to that of the plots documenting years 1-5 of succession on recently abandoned fields is given in Table 19. This table also characterizes growth form; presence or absence in adjacent native ecosystems; occurrence in dry or seasonally flooded habitats; and status as a native or introduced member of the flora of southern Florida for the major species encountered in early succession on former farmland.

From a management standpoint, the following generalizations can be drawn from the data in Tables 6-19:

1. Schinus was temporarily eliminated fairly effectively from most of the bulldozed area in spite of high Schinus seedling densities noted locally on the highest ground in July of 1979. Within the subquadrats of Plots I-V, Schinus seedlings were present at a density of one per 5 m^2 in May 1980. Prior to bulldozing, much of the vegetation was a nearly pure stand of Schinus.

2. Bulldozing 14-year-old successional vegetation seems to have produced an early successional vegetation which differs markedly in species composition from that reported by Hilsenbeck (1976) and by this report for the areas of Plots 1-8, which are believed to be quite representative of recently abandoned farmland of the Hole-in-the-Donut.

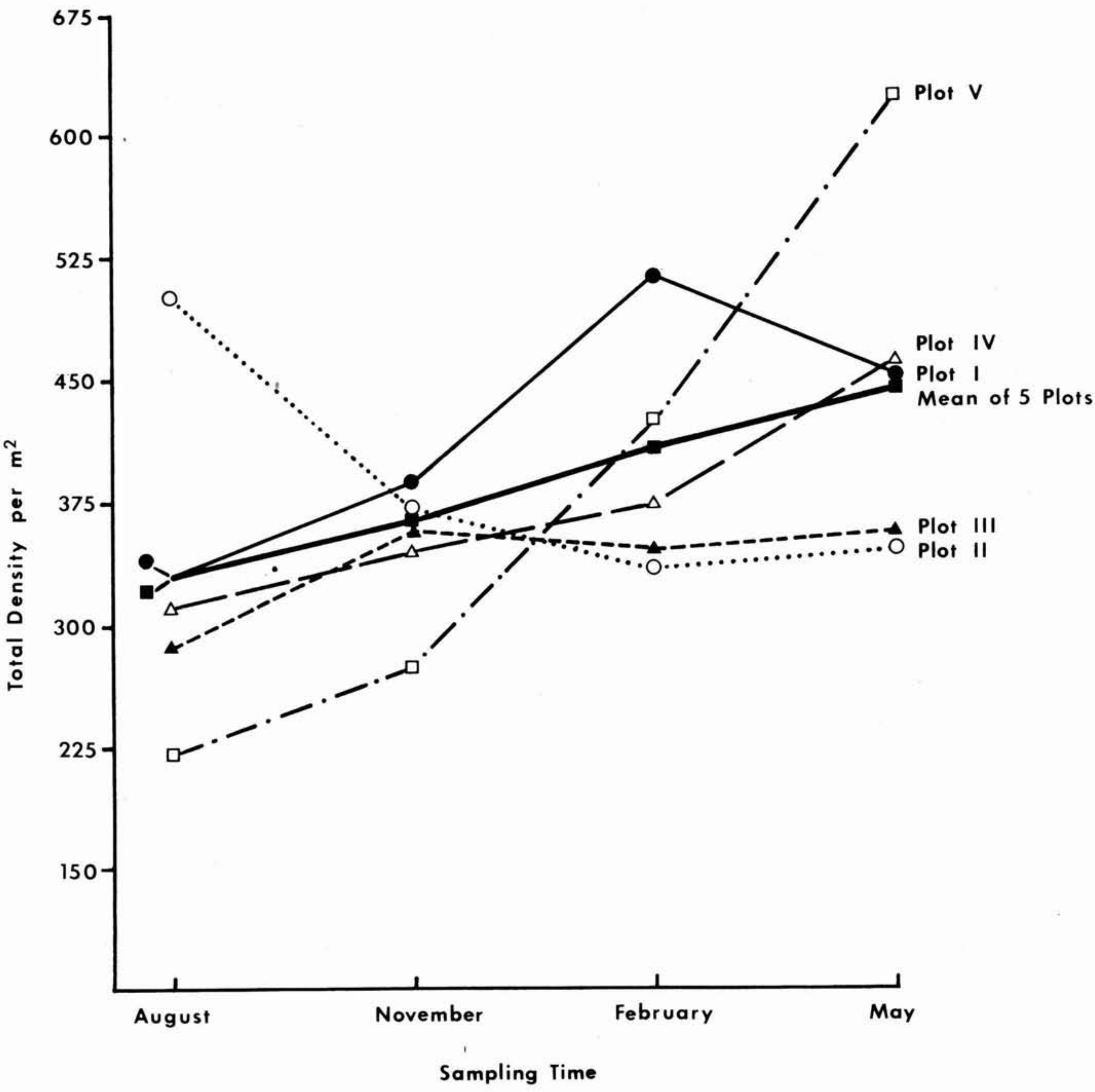

Figure 2. Changes in total density in plots I-V over the period of sampling from August 1979 through May 1980.

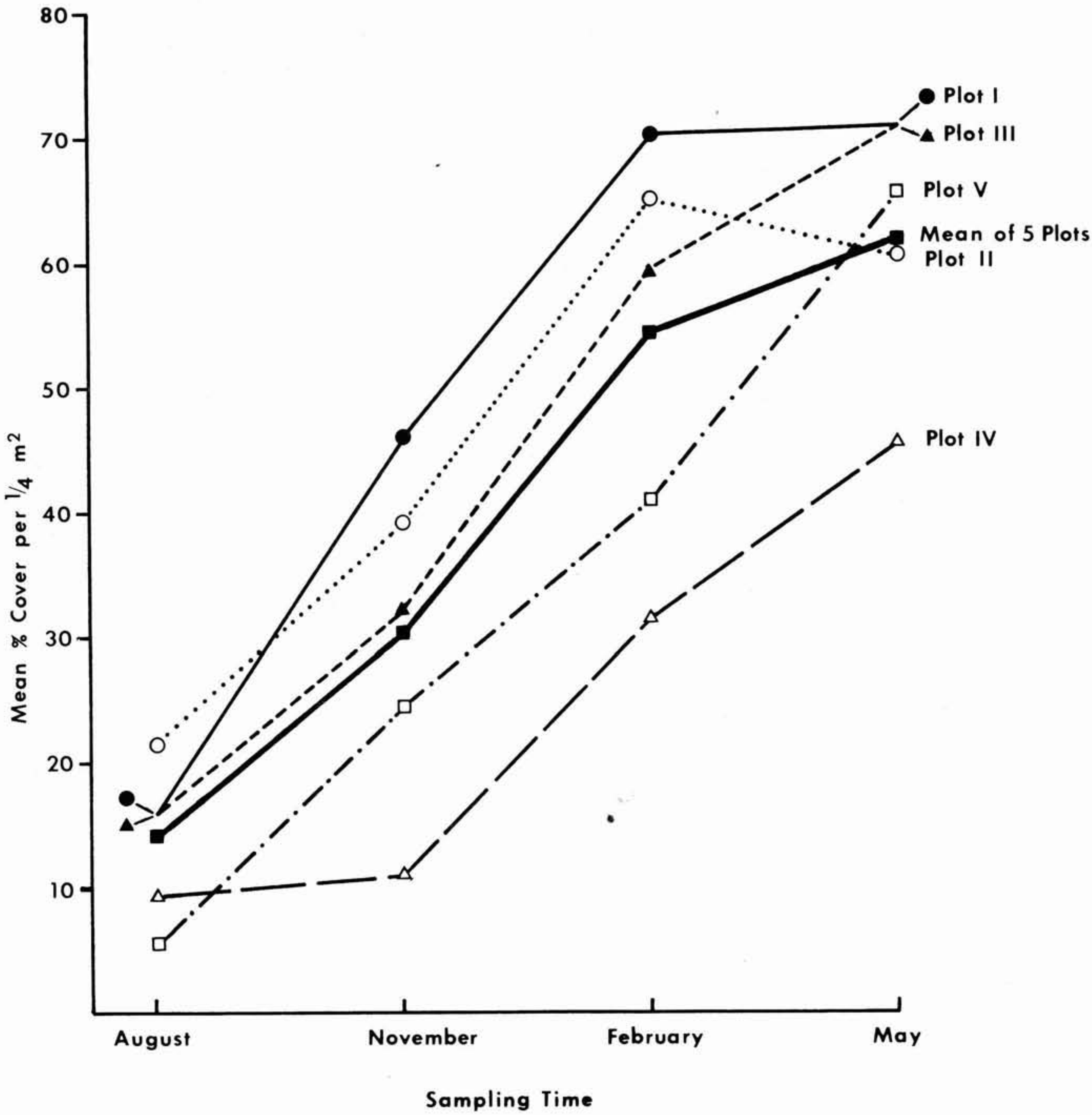

Figure 3. Changes in total % cover in Plots I-V over the period of sampling from August 1979 through May 1980.

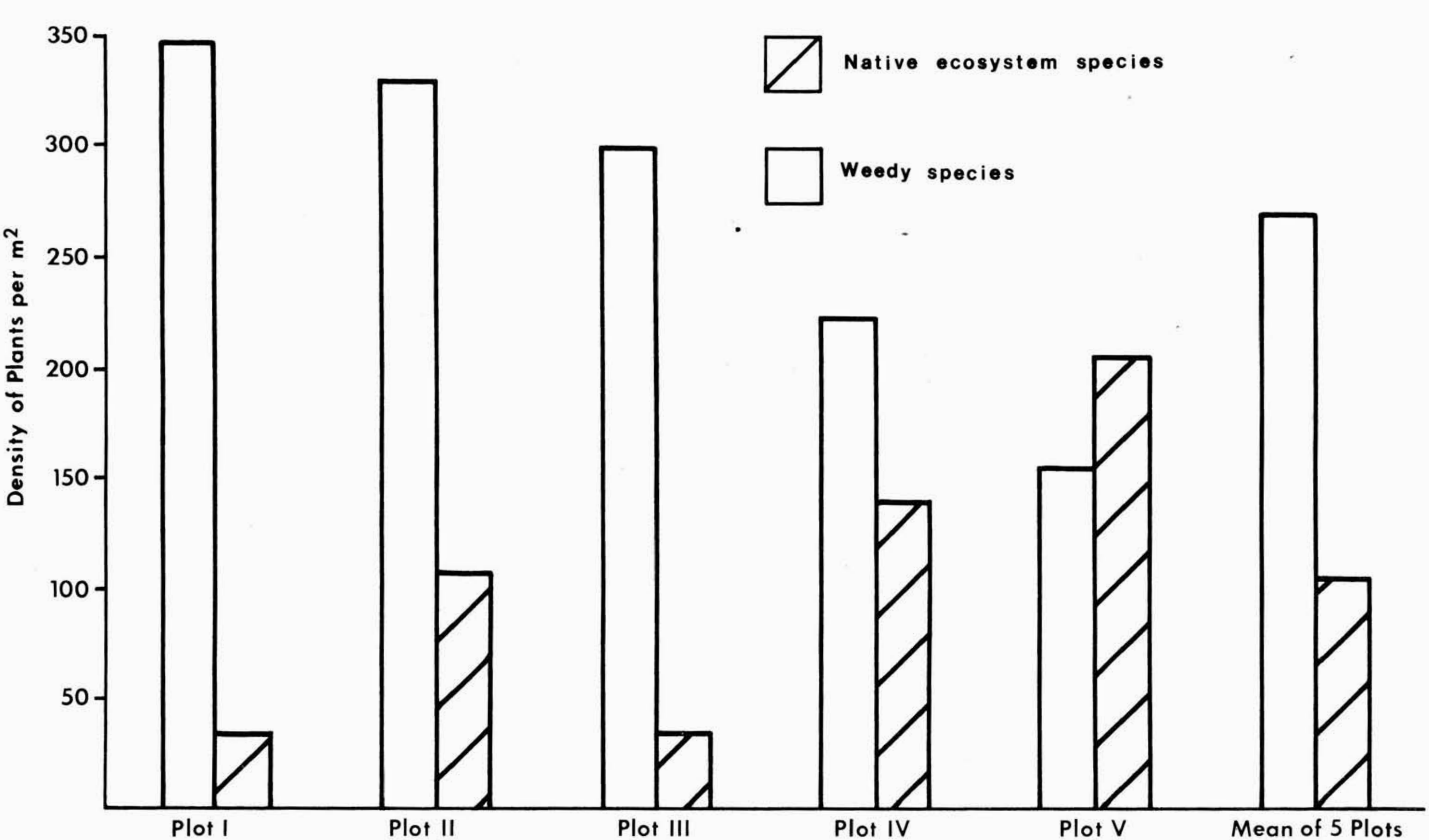

Figure 4. Comparison of mean density values for weedy species and species of native ecosystems in Plots I-V.

3. Figure 4 shows that even though vegetation of this bulldozed area differs greatly from that of recently abandoned farmland sampled, it is still overwhelmingly dominated by weedy species which are not part of nearby native plant communities. The sole exception is the recovery vegetation of Plot V, where important "native ecosystem species" occur, notably Eleocharis caribaea.

4. Successional vegetation on the bulldozed area is characterized by fairly high densities of seedlings of the woody species Ludwigia octovalvis, Baccharis halimifolia, and Baccharis glomeruliflora.

COMPARISON OF PRE-BULLDOZING AND POST-BULLDOZING VEGETATION ON FORMER PINELAND LAST FARMED IN 1965

The highest portion of the area bulldozed in 1979 was the site of a plot established by Pamela Krauss as part of a study of older stages of succession on abandoned farmland (Krauss, in preparation). The location is shown in Figure 1. When this plot was inadvertently bulldozed during the bulldozing project of April-May 1979, we realized that here was an opportunity to compare early-successional vegetation with the successional vegetation which had developed following abandonment from farming in 1965.

Methods

The plot layout was exactly as used for Plots I-V, post-bulldozing vegetation, described above (5 m x 20 m plot, 5 x 5 m subplot, four 1/4 m^2 quadrats within each subplot, etc). It was necessary to relocate the plot very slightly following bulldozing.

Results and Discussion

Density and cover values before and after bulldozing are given in Table 20 for each species encountered. The post-bulldozing vegetation has a much higher species richness, with 39 species vs. only 9 species in the 13-year-old successional stand which had been dominated by Baccharis glomeruliflora, Schinus, Bidens, Parthenocissus quinquefolia, and Myrica. The total cover of live vegetation, which was only 27.4% prior to bulldozing, was 85.5% after bulldozing.

ESTABLISHMENT OF EXOTIC TREES ON RECENTLY ABANDONED FARMLAND

The primary management concern at present for the Hole-in-the-Donut of Everglades National Park is the potential impact of exotic trees upon adjacent native ecosystems. With this in mind, it is clear that the rate and extent of spread of Schinus terebinthifolius and other exotics and their role as a seed source for invasion of adjacent ecosystems must be monitored and perhaps ultimately limited through manipulative management.

Methods

In the fall of 1977, a detailed survey of the density of Schinus in the Hole-in-the-Donut was carried out within the 128 0.4 ha (1-acre) plots established on land disked in 1975 and described by Hilsenbeck (1976). The survey was repeated in the fall of 1978, and partially repeated in early 1980. All surveys were done by walking through the plots and mapping the approximate locations of all individuals of Schinus. In 1978 and 1980, Psidium guajava individuals were recorded also. In 1980, vegetation was too tall and dense to allow an accurate survey to be made, so that an attempt was made only to record individuals ≥ 1.5 m in height. Also, due to various logistical difficulties, the sample size was drastically reduced to those undisturbed plots which were easily accessible.

In January 1980, a detailed count of Schinus and Psidium by 0.5 m size classes was carried out in two 0.4 ha quadrats.

In April 1981, a helicopter survey of the eight plots was conducted. There were 35 quadrats in Plots 1, 2, 5, and 6 which had been delineated by mowing around their perimeters and which had not been burned the previous year. The numbers of Schinus individuals in the 35 quadrats were counted while the helicopter slowly circled over each plot.

Results and Discussion

Table 21 shows an increase of nearly twenty-fold in Schinus between late-1977 and late-1978. Psidium was becoming quite abundant in former pineland by late-1978.

The 1979 density counts on twelve 0.4 ha quadrats, all on former pineland, showed a five-fold increase from 20 plants in 1978 to 108 plants 1 year later (Table 22). Since only plants over 1.5 m in height were counted in 1979, that density count represents a minimum. The twelve quadrats nearly doubled their Schinus density in the 15 months between the 1979 and 1981 counts.

The change in Schinus density on all quadrats sampled in 1981 is summarized in Table 23. A five-fold increase over the two-year period between 1978 and early 1981 reflects the change on 2 plots on former pineland (1 and 2) and 2 plots on former prairie (5 and 6). The average increase was faster on former prairie, but end results were greater on former pineland. It was difficult to discern individual Schinus trees from the heliopter, so each clump was counted as one tree. Thus the 1981 count of 524 trees per 14 ha, or 15 trees per acre, is probably lower than the actual density. Factors accounting for the reduced rate of expansion of Schinus each year may include increased competition from herbaceous and woody plants in the vicinity, and less available favorable sites for germination and growth.

Table 24 shows that by early 1980, after about 5 years of succession following abandonment, abundant and complex (in size structure and presumably in age structure) populations of Schinus and Psidium exist in the areas of Plots 1 and 2. The Schinus population here is probably somewhat representative of the situation throughout the Hole-in-the-Donut.

GENERAL DISCUSSION: THE HOLE-IN-THE-DONUT IN PERSPECTIVE

Contribution of Investigations Reported Here

The investigations reported upon here in addition to providing baseline data, contribute necessary facets to the overall objective of understanding ecological relationships within and adjacent to the Hole-in-the-Donut area and will ultimately assist in formulating a program for long-term management of the area. Other important contributions will include a paper on "Impact of fire exclusion and invasion of Schinus terebinthifolius on the vegetation of limestone rockland pine forests of southeastern Florida" (Loope and Dunevitz, 1981); a M.S. Thesis (Florida Atlantic University) by Pamela Krauss dealing with later stages of plant succession on abandoned farmland; and a study of the ecology of Schinus and other aspects of successional ecosystems on abandoned farmland being carried out by Dr. Jack Ewel and colleagues of the University of Florida, scheduled for completion in early 1981.

Native Vegetation and Flora of the Vicinity of the Hole-in-the-Donut

The area adjacent to the Hole-in-the-Donut is ecologically some of the most valuable land in south Florida. Approximately one half of the 830 plant species recorded from Everglades National Park (Avery and Loope, 1980b) are restricted to the 3-4% of the park which is dry most of the year. Most of this "upland" area lies just to the north of the Hole-in-the-Donut and includes pineland and tropical hardwood hammock vegetation.

Miami Rock Ridge pinelands occupy a rough limestone (Miami oolite) substrate with abundant crevices and solution holes, but very little soil development. The overstory species is the South Florida slash pine or Dade County pine (Pinus elliottii var. densa). These forests have a shrub understory with 30-40 species of West Indian hardwoods and an herbaceous understory with over 100 species, including one-half the plant taxa endemic to South Florida (Loope et al., 1979; Avery and Loope, 1980a). Numerous rare, threatened, and endangered species occur in these pinelands and in the associated tropical hardwood hammocks (Loope and Avery, 1979; Ward, 1979).

Miami Rock Ridge pineland is one of the most endangered ecosystems of the United States. About 85% of its original extent has been eliminated by urban expansion and agriculture (Shaw, 1975). This ecosystem may virtually cease to exist outside Everglades National Park by the year 2000, since the few pineland remnants outside the park are being invaded by Schinus.

Pinelands within Everglades National Park are maintained by a program of prescribed burning which was first applied in 1958 following Robertson's (1953) findings concerning fire's natural role in maintaining pineland.

Over 100 discrete units of tropical hardwood hammock forest are scattered throughout Long Pine Key pinelands (Craighead, 1974). They are composed of nearly 200 plant species of which nearly half are trees and shrubs (Olmsted, Loope, and Hilsenbeck, 1980).

Olmsted, Loope, and Rintz (1980) have described the plant communities of Taylor Slough, which adjoins the Hole-in-the-Donut to the east. That report describes in detail the Muhlenbergia and sawgrass prairies which dominate much of Taylor Slough and which occupied much of the Hole-in-the-Donut prior to farming. Although the dominants (Muhlenbergia and sawgrass, Cladium jamaicense) provide most of the plant cover in these communities, these prairies are composed of nearly 100 plant species.

Vegetation of the Hole-in-the-Donut: Past and Present Vegetation Mosaic

Most of the land formerly farmed in Everglades National Park was either Muhlenbergia or sawgrass prairie. Large areas at the western end of the Hole-in-the-Donut and along the Old Ingraham Highway, where farming of marl glades was carried out in the 1920's and 1930's, have reverted to Muhlenbergia and sawgrass prairies. In such areas, often only the remaining furrows in the former fields give clear evidence that farming once took place. Other former marl prairie farmlands, when abandoned, especially those around Pine Island and the east and southeast portion of the Hole-in-the-Donut, have become stands of successional hardwood vegetation.

Of the portion of the Hole-in-the-Donut which was rockplowed in the 1950's and 1960's, approximately 90% was originally Muhlenbergia and sawgrass prairie or slough and about 10% was pineland. About 300 ha of this rockplowed land, both north and south of the present Research Center site, was abandoned in 1965 and largely became occupied by Schinus/Baccharis scrub. Near a seed source for the native shrub Myrica cerifera at the edge of pineland, Myrica became established and now dominates the vegetation. In 1979, 120 ha of the Schinus/Baccharis scrub was removed by bulldozing.

About 1700 ha of rockplowed land was abandoned during the 1973-75 period. This land is now dominated by a complex mosaic of early successional vegetation. It was dominated in the earliest stages by herbaceous species, but the component of native and exotic shrubs has rapidly increased with time.

Plant Succession in the Hole-in-the-Donut

Soon after a field is abandoned or vegetation is removed from an area, an assortment of colonizing species occupies the site. Some factors affecting the early species composition include time of year of the initiation of succession, local seed rain, seed storage in the soil, soil moisture, and soil nutrient level. Differences in species composition tend to become reduced with the passage of time. Bidens alba, Ambrosia artemisiifolia, Boehmeria cylindrica, Cynodon dactylon, Melilotus alba, Medicago lupulina, and Solidago leavenworthii are prominent species in the first five years of succession. Brachiaria mutica locally forms pure stands.

Alternanthera philoxeroides is locally dominant on wet sites. By the end of the first year, wind-dispersed shrubs are beginning to become noticeably established--Ludwigia octovalvis, Ludwigia peruviana, Baccharis halimifolia, and Baccharis glomeruliflora. These shrubs are locally dominant in many areas by the third year. The exotic Schinus terebinthifolius, with large, animal-dispersed seeds, is present in erratic groups by the third year. By the fourth year the concentration of Schinus plants may be 10-20 plants/acre. Schinus typically continues to invade for 15 years or more, forming nearly pure stands or mixed stands with Baccharis. After 15 years, change occurs very slowly in these stands, but Baccharis can gradually be expected to decline in importance.

Prior to the introduction of Schinus to the Hole-in-the-Donut area, stands of Myrica cerifera, Ilex cassine, and Persea borbonia developed on abandoned farmland. These species now dominate 30-40 year old successional stands of the southeast margin of the Hole-in-the-Donut. These species still colonize abandoned farmland, but at a much slower rate than Schinus. In areas of locally abundant seed sources for these species, they may come to dominate successional stands. One area where this has occurred is north of the Research Center on high ground at the margin of pinelands. Myrica is the dominant overstory species in this area and Schinus seedlings do poorly. Dunevitz and Ewel (1981) have demonstrated allelopathic effects of Myrica extracts on Schinus. Allelopathy and interspecific competition with Myrica, which has an ecological niche similar to that of Schinus, may combine to largely exclude Schinus from the area.

Residual Environmental Effects of Farming

Wherever rockplowing and farming have occurred in former pinelands there appears to be no possibility of restoring original vegetation. Native pineland communities contain nearly 200 plant species, most of which are adapted to very specialized substrate conditions--with little soil and low nutrient levels. These plants are able to exploit crevices in the Miami oolite bedrock. They store substantial amounts of carbohydrate underground and are thereby able to survive periodic fires. Rock-plowing has irreversibly altered pineland substrates, creating a soil on which pineland species are outcompeted by successional vegetation.

Native prairie communities are also adapted to rather severe growing conditions--with seasonal inundation, poorly aerated soils, and low nutrient levels. Very few of the approximately 100 native prairie species are able to compete with the successional vegetation which becomes established on abandoned farmland, the soil of which is relatively well aerated, nutrient rich and of greater volume (due to rockplowing) than native prairie soils (Meador, 1977). Even without rockplowing, where marl prairies were farmed in the 1920's-1940's, soils were often sufficiently modified so that forest vegetation came to occupy the sites. As discussed above, such forest stands are now dominated by a varying mix of such species as Ilex cassine, Persea borbonia, Myrica cerifera, and Salix caroliniana.

Orth and Conover's report (1975) suggests the extent to which nutrient enrichment has occurred in farmed soils of the Hole-in-the-Donut. They summarized their results as follows:

> "On the average, samples from the unfarmed park land contained 260 ppm total P, 610 ppm total K, 6400 ppm total N, 0.5 ppm water soluble P, and 8 ppm nitrate N. Farming in the Doughnut increased total P about 500%, total K 17%, water soluble P 150% and nitrate N 12% while total N decreased 30%. Micronutrients also increased: total Cu increased four times to 48 ppm and Zn increased three times to 35 ppm."

Meador (1977) carried out a study of the role of mycorrhizae in influencing succession on abandoned farmland in the Hole-in-the-Donut. He found that sawgrass/Muhlenbergia "glades" communities do not have mycorrhizae (fungal-plant root associations which apparently aid efficiency of metabolism in plant roots), presumably due mainly to lack of sufficient oxygen within the seasonally inundated marl soils. Woody species (which apparently require mycorrhizal associations to thrive) are able to invade former sawgrass/Muhlenbergia sites after farming, probably because altered soil conditions as a result of farming include increased soil aeration, which results in favorable conditions for mycorrhizae.

The question of whether enough of the environmental modifications resulting from farming may be reversible to allow reestablishment of some types of prairie vegetation in rockplowed areas cannot now be answered. With time, compaction of soils and leaching of nutrients may occur. Removal of hardwood species with bulldozing 10-20 years after abandonment is a promising, if not proven, method of prairie restoration which may prove effective in situations in the Hole-in-the-Donut where water tables remain high.

Biology of Schinus

Schinus terebinthifolius, a native of Brazil, was introduced to Florida as an ornamental in 1898, but did not become widely naturalized until much later (Austin, 1978). The species probably entered Everglades National Park in the 1940's (Bancroft, 1973). A report by Dr. Frank Craighead, Sr. (1961), cited the presence of Schinus at several locations in the park and the possibility that it might become a serious problem. Schinus is currently widely recognized as a menace to natural ecosystems of South Florida as well as to human health (Morton, 1979). It becomes dominant on abandoned farmlands or other disturbed sites throughout Dade County within 5-15 years of abandonment.

Work by Dr. Jack Ewel of the University of Florida (Ewel, 1979; Ewel, Ojima, and DeBusk, 1979) in the Hole-in-the-Donut has done much to clarify the reasons for the great success of Schinus in the area and has provided insight into useful management strategies. Ewel et al. (1979) have summarized their findings as follows:

> ". . . our studies indicate that Schinus has many characteristics typical of other weedy pioneer species. It grows rapidly, it is a prolific seed producer, its foliage flushes nearly continuously, it coppices vigorously, and it tolerates a wide range of sites. As a weed tree, however, it is nearly unique in terms of the broad spectrum of characteristics that it possesses which are more typical of mature ecosystem species. It produces large, animal-dispersed seeds, its large cotyledons aid seedling survival, it is dioecious and insect-pollinated, its seedlings are remarkably shade tolerant, and its reproductive activity is synchronous and compressed into an extremely short period."

Ewel and his colleagues have documented the synchronous flowering of Schinus in October and fruiting in November and December followed by seed fall and germination in January. A peak in numbers of seedlings occurs in the February-March period, dropping off in April. High seedling mortality occurs in very dry and very wet periods, but some seedlings survive under reproductive females at all times of the year.

Ewel et al. (1979) found that flushing of new leaves occurs continuously, except when plants are in flower or fruit. This suggests that the species is susceptible to attack by herbicides for most of the year. Schinus is capable of extremely rapid growth in open stands with exposure to full sunlight, yet can survive for long periods in very dense stands, even though it does not grow rapidly.

Schinus surveys in Long Pine Key pinelands (Loope and Dunevitz, 1981) and observations by Fire Ecology and Resource Management personnel show that very little Schinus is established there. Growth of Schinus seems to be considerably slower in pinelands than in other types of sites with comparable exposure to sunlight. This may very likely be due to the scarcity of available nutrients in pinelands. The scarcity of Schinus establishment here may be because Schinus is rarely able to surpass the size critical for survival of fire in the 4-5 year period between prescribed fires in Long Pine Key. Once Schinus attains a height of about 1 m, it consistently survives pineland fires by resprouting from the base. The abundance of Schinus in pinelands of Dade County outside Everglades National Park seems to be the result of long periods (at least 5-10 years) without fire.

Other Exotic Plant Species

Although Schinus terebinthifolius is by far the most serious problem species in the Hole-in-the-Donut, at least two others warrant special concern. Psidium guajava is an associate of Schinus in invading abandoned fields in much of the Hole-in-the-Donut. It is also a major component of old successional forest stands in the area. Fortunately Psidium seems to have little potential for invading stands of native vegetation in South Florida. Ardisia solanacea may present a more serious threat. This exotic shrub dominates the understory of large areas (perhaps 40 ha or more) of successional forest vegetation on abandoned farmland at the southeast edge of the Hole-in-the-Donut. Individual plants are occasionally found in undisturbed hammocks. Both Psidium and Ardisia were affected very strongly by the severe freeze of January 1977. They may become more conspicuous in the absence of major freezes.

Individuals of Albizzia lebbek and Bischofia javanica have been found in the area. They could become future problems; Albizzia particularly is an aggressive invader in the Miami-Homestead area.

Numerous exotic herbaceous species have been introduced to the Hole-in-the-Donut area, as shown by the list compiled by Krauss (1979). Some plants first collected in the area by George Avery are new to South Florida. Stemodia durantifolia, found by Avery near Hayes Barn, is a new record for the United States.

Use of the Hole-in-the-Donut by Wildlife

Casual observations suggest that the relatively high production of herbaceous vegetation in early successional stages following abandonment of fields has resulted in high populations of certain wildlife species in the Hole-in-the-Donut during the 1976-80 period. That rodent populations are high can be inferred from the conspicuous presence of raptors in the area. Bobcats are seen quite often. There have been dozens of sightings of the endangered Florida panther in the area, including at least two individuals. The panthers may be attracted to the area by the deer population, which is highly visible along the Research Center road.

In particular, we know little about 1) the relationships between wildlife populations of the Hole-in-the-Donut and adjacent native ecosystems, and 2) the relationships between wildlife populations and successional changes in the vegetation mosaic.

SUMMARY

1. Plant succession on abandoned farmland in the Everglades results in a mosaic of recovery communities. Factors affecting species composition include differing farming treatments, hydroperiod, availability of seed sources, amount and type of soil, and post-abandonment disturbance such as fire, frost, and bulldozing.

2. Five years after abandonment, recovery communities on dry (former pineland) sites were composed mostly of herbaceous species, dominated by Bidens alba, Boehmeria cylindrica, Andropogon glomeratus, and Sida rhombifolia, all natives. On wetter sites, there was more species variability, but Ludwigia octovalvis, Baccharis glomeruliflora, B. halimifolia, Alternanthera philoxeroides, and Colocasia esculentum are prominent species. The latter two are exotic species.

3. Recovery communities on farmland abandoned in 1965 and bulldozed in 1979 showed a predominance of "weed" species not found in adjoining native ecosystems. After one year, the dominants were Spermacoce floridana, Ludwigia octovalvis, Andropogon glomeratus, Eleocharis caribaea, Mikania scandens, Vigna luteola, and Cyperus surinamensis. These are all native species, with the possible exception of Vigna. Total species richness and density values were greatest in the lowest (wettest) plots.

4. Schinus terebinthifolius is present throughout the Hole-in-the-Donut at varying densities and is continuing to spread, perhaps by as much as 20 times its population density per year. Bulldozing appears to be an effective method of temporarily removing Schinus from areas in which it dominates, but unless additional control methods are implemented it may reestablish along with other successional species and eventually come to dominate once again.

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Table 1. Mean density (individuals/m^2) for individuals less than 2 m tall for each species in Plots 1, 2, 5, 6, 7, and 8 in 1980. (A = individuals < 60 cm tall, B = individuals ≥ 60 cm and < 200 cm tall); T = trace (< 0.05 individuals/m^2).

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\overline{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Alternanthera philoxeroides					202.0		748.0				6.5		159.4	
Ambrosia artemisiifolia	18.2		26.0	0.2	0.2	0.2	5.2	2.5	1.0		1.0		8.6	1.1
Ampelopsis arborea									0.7		3.5		0.7	
Andropogon glomeratus	10.2		1.5		2.0		7.5		3.2	0.7	0.7	1.0	4.2	0.3
Baccharis glomeruliflora	0.5						0.2		36.5		4.7	0.2	7.0	T
Baccharis halimifolia	4.5						1.0		2.5	0.5	2.5	1.5	1.7	0.3
Bacopa monnieri									1.0				0.2	
Brachiaria mutica	3.0		12.5						2.0		0.7		3.0	
Bidens alba var. *radiata*	97.7	0.7	166.7	1.0									44.1	0.3
Boehmeria cylindrica var. *drummondiana*	22.2	7.7					2.5	2.7	6.5	0.2	1.7		5.5	1.8
Borreria laevis	3.7		25.5		0.2								4.9	
Cassia obtusifolia					0.2				3.5				0.6	
Centella asiatica					15.0								2.5	
Chamaesyce hypericifolia			0.7										0.1	
Colocasia esculentum									11.7	2.5	20.0	1.0	5.3	0.6
Commelina diffusa							4.2		5.7		3.7		2.3	
Conyza canadensis			0.2		0.2		0.2		1.5		2.7	0.5	0.8	0.1
Cynoctonum mitreola					0.2								T	
Cynodon dactylon			5.2				13.0						3.0	
Cyperus odoratus							19.2		1.7		1.2	0.2	3.7	T
Cyperus sp.			2.2		3.2		12.7		3.2		2.5		4.0	
Digitaria ciliaris			2.0		0.7		1.2	0.2	1.0		1.0		1.0	T
Diodia virginiana					7.5		2.2				0.2		1.6	
Eclipta alba					1.7		0.5		1.7		1.5		0.9	
Erechtites hieracifolia	2.7				5.5	2.5	4.0	1.0	5.2	2.2	3.7	0.7	3.5	1.1

Table 1 continued

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\overline{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Erigeron quercifolius							3.0		0.5				0.6	
Eupatorium capillifolium										0.5	0.7		0.1	0.1
Galium hispidulum	1.2												0.2	
Galium obtusum	0.2				1.0	0.2	27.7		7.0		3.0		6.5	T
Geranium carolinianum	0.5				0.5								0.2	
Hydrocotyle umbellata					0.2	•					T			
Ipomea indica							0.7		3.7		0.7			
Kosteletzkya virginica								0.2						T
Ludwigia alata									0.2		0.5		0.1	
Ludwigia microcarpa					0.7				3.0				0.6	
Ludwigia octovalvis	0.5	0.5			2.0	4.0	2.7	3.2	1.0	2.0	0.5	0.7	1.1	1.7
Ludwigia peruviana	0.7								0.2		0.2		1.2	
Lythrum alatum var. lanceolatum														
Medicago lupulina	0.5						0.5		3.5				0.7	
Melilolus alba	6.5												1.1	
Melothria pendula	4.5				0.2	0.2			1.5		1.0		1.2	T
Mikania scandens														
Myrica cerifera					0.5	0.2			0.2				0.1	T
Parthenocissus quinquefolia									0.7				0.1	
Paspalum conjugatum					0.7		5.2						1.0	
Phyla nodiflora							0.2				1.7		0.3	
Pluchea odorata					0.2				0.2		1.2	0.2	0.3	T
Polygonum punctatum					0.7		0.2						0.1	
Psidium guajava	0.7												0.1	
Ptilimnium capillaceum					0.5								0.1	
Sarcostemma clausum							0.7		0.2	0.2			0.1	T
Schinus terebinthifolius									0.5				0.1	

Table 1 continued

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\bar{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Sesbania macrocarpa					1.5	0.7	2.0						0.6	0.1
Setaria geniculata			0.2										T	
Sida rhombifolia	13.2		2.7		274.5	9.0	29.5	1.2	7.5	0.5			54.6	1.8
Solidago leavenworthii	1.0				16.0	4.5	24.7	7.7	16.5	0.2	2.2	0.5	10.1	2.1
Spermacoce floridana	1.0		0.5										0.2	
Sonchus asper			2.5				0.5		0.2				0.5	
Sporobolus domingensis														
Thelypteris kunthii							0.5	1.5	1.0	0.2			0.2	0.3
Verbena scabra							0.2		0.2				T	T
Vicia acutifolia					0.5								0.1	
Vigna luteola	0.7										0.2		0.1	
Vitis aestivalis														
Vitis munsoniana	0.2												T	
Vitis shuttleworthii	0.2												T	

Table 2. Mean cover (%) for individuals less than 2 m tall for each species in Plots 1, 2, 5, 6, 7, and 8 in 1980. (A = cover of individuals < 60 cm tall, B = cover of individuals ≥60 cm and < 200 cm tall; T = trace (< 1% cover), T+ = trace occurring in more than one quadrat)

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\overline{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Alternanthera philoxeroides					15.9		31.0				0.7		7.9	
Ambrosia artemisiifolia	0.5		0.7	0.3	T	0.9	0.6	1.6	T		0.4		0.4	0.5
Ampelopsis arborea			0.3						1.6	0.2	7.6	0.9	1.6	0.2
Andropogon glomeratus	2.5		2.8		1.3	5.3	1.7		1.4	3.4	2.6	4.6	2.0	2.2
Baccharis glomeruliflora	T						T		1.6		0.7	11.2	0.4	1.9
Baccharis halimifolia	0.6						T+		0.1	6.1	0.4	9.9	0.2	2.7
Bacopa monnieri									0.1				T	
Brachiaria mutica	0.8		0.9	0.3					0.9	0.5	1.0		0.6	0.1
Bidens alba var. *radiata*	14.0	0.8	23.4	2.7				1.6					6.2	0.8
Boehmeria cylindrica var. *drummondiana*	6.0	10.9					0.6		0.9	0.7	0.2	0.4	1.3	2.0
Borreria laevis	0.2		1.5		T								T	
Cassia obtusifolia					T				0.4				1.0	
Centella asiatica					0.4								0.1	
Chamaesyce hypericifolia	T		0.2										T	
Colocasia esculentum									3.5	1.5	6.5	0.1	1.7	0.3
Commelina diffusa							0.3				0.4		0.1	
Conyza canadensis			T		T		T		0.1		0.7	1.2	0.1	0.2
Cynoctonum mitreola					T								T	
Cynodon dactylon			0.2				1.9						0.3	
Cyperus odoratus			T				1.2		0.2		T+	T	0.2	T
Cyperus sp.			T		1.2		0.7		0.2		0.4		0.4	
Digitaria ciliaris			T+		0.9		0.2	0.4	0.1		T+		0.2	0.1
Diodia virginiana					5.3		0.2				T		0.9	
Eclipta alba					0.7		0.1		0.2		0.2		0.2	

Table 2 continued

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\overline{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Erechtites hieracifolia	0.4				2.2	1.3	1.2	0.7	1.7	1.0	2.5	0.6	1.3	0.6
Erigeron quercifolius							0.3		T				T	
Eupatorium capillifolium									T	2.9	0.6		0.1	0.5
Galium hispidulum	T+												T+	
Galium obtusum	T				0.2	T	0.5		0.4		0.2		0.2	T
Geranium carolinianum	T				T+								T+	
Hydrocotyle umbellata	T				T								T+	
Ipomea indica							0.2		0.3				0.1	
Kosteletzkya virginica								0.9						0.1
Ludwigia alata									T+		T		T+	
Ludwigia microcarpa					T				T				T+	
Ludwigia octovalvis	0.4	0.9			3.7	23.2	1.7	10.9	1.2	14.4	2.4	7.2	1.6	9.4
Ludwigia peruviana	0.2	T							T		T		T+	T
Lythrum alatum var. lanceolatum					0.1								T	
Medicago lupulina	T+								0.2				T+	
Melilotus alba	0.2						0.1						T+	
Melothria pendula	0.4		T		0.6	0.5	0.4		0.2		1.0	0.9	0.4	0.2
Mikania scandens							T						T	
Myrica cerifera					0.2	1.2			T				T+	0.2
Parthenocissus quinquefolia									0.9		T		0.1	
Paspalum conjugatum					0.2		3.9						0.7	
Phyla nodiflora							T				0.9		0.1	
Pluchea odorata					T				0.1		0.2	0.4	T+	0.1
Polygonum punctatum					0.2		T						T+	
Psidium guajava	T												T	
Ptilimnium capillaceum					T								T	

Table 2 continued

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8		$\overline{X}$	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Sarcostemma clausum	T	T			0.5		10.6	1.0	1.5	0.9	T	0.4	2.1	0.4
Schinus terebinthifolius					0.3				T				T+	
Sesbania macrocarpa					0.2	1.7	0.3						0.1	0.3
Setaria geniculata			T										T	
Sida rhombifolia	3.1	0.4	T		6.4	7.0	1.2	3.7	0.6	0.6			1.9	1.9
Solidago leavenworthii	T+				2.5	1.6	3.9	4.7	0.6	0.2	0.6	0.4	1.3	1.1
Spermacoce floridana	T+		T+										T+	
Sonchus asper			T+				0.1		0.2				T+	
Sporobolus domingensis					5.6	0.2							0.9	T
Thelypteris kunthii							T+	5.6	T+	0.4			T+	1.0
Verbena scabra						0.6	T			0.5			T	0.2
Vicia acutifolia					T								T	
Vigna luteola	1.4	1.2	0.7	1.6							1.5		0.6	0.5
Vitis aestivalis											T		T	
Vitis munsoniana	0.4	0.3	0.4										0.1	T
Vitis shuttleworthii	T												T	

Table 3. Density (individuals/100 m^2) and cover (%) for all individuals of all species taller than 2 m in Plots 1, 2, 5, 6, 7 and 8 in April - June 1980.

	Plot 1		Plot 2		Plot 5		Plot 6		Plot 7		Plot 8	
	Density	Cover	Density	Cover	Density	Cover	Density	Cover	Density	Cover	Density	Cover
<u>Baccharis halimifolia</u>	2	1.7%			-	0.5%	2	1.2%	13	33.2%	2	6.5%
<u>Ilex cassine</u>									1	0.5%		
<u>Ludwigia octovalvis</u>	1	1.2%			16	23.2%	4	2.2%	5	3.2%	4	2.0%
<u>Myrica cerifera</u>							1	1.0%				
<u>Sarcostemma clausum</u>									-	0.5%		
<u>Schinus terebinthifolius</u>					1	2.5%						

Table 4. Comparison of density (individuals/100 m^2) in 1978 and 1980 of all individuals taller than 2 m in Plots 1 through 8.

	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8	
	1978	1980	1978	1980	1978	1980	1978	1980	1978	1980	1978	1980	1978	1980	1978	1980
Baccharis halimifolia	1	2			5	X	10	X			0	2	7	13	0	2
Eupatorium capillifolium													1	0		
Ilex cassine													0	1		
Ludwigia octovalvis	8	1					7	X	14	16	9	4	28	5	10	4
Myrica cerifera											0	1				
Schinus terebinthifolius									0	1						
Sida rhombifolia									1	0	2	0				

X = Plots 3 and 4 burned in 1980 so that no sampling was possible in that year.

Table 5. Number of species per plot in the 8 plots representative of farmland abandoned in 1973-75, for 1976, 1978, and 1980. Species numbers recorded from sixteen 1/4 m^2 quadrats within "control" plots of Hilsenbeck (1976).

	Plot	1976	1978	1980
	1	28	24	29
former pineland	2	18	10	24
	3	19	17	-
	4	28	21	-
	Mean of 1-4	23.25	18.0	26.5
	5	14	16	39
former prairie	6	21	24	40
	7	17	20	43
	8	18	26	34
	Mean of 5-8	17.5	21.5	39.0
Total		48	56	71

Table 6. Total number of individuals recorded for each species at four sampling dates for Plot I (within 4 m^2 area, in sixteen 1/4 m^2 subquadrats).

Species	August	November	February	May
Ambrosia artemisiifolia		1		
Ammannia latifolia	26	115	105	60
Andropogon glomeratus	1	3	13	30
Baccharis halimifolia				19
Baccharis sp.		6	41	40
Bidens alba var. radiata	1	2	51	171
Boehmeria cylindrica		10	24	19
Brachiaria mutica		1		
Borreria laevis	625	51	42	158
Chamaesyce hypericifolia	28			25
Conyza canadensis	1			
Cynoctonum mitreola		18	16	19
Cyperus brevifolius	1	5		8
Cyperus odoratus	4	2	7	2
Cyperus polystachyos	27	84	51	40
Cyperus surinamensis	15	121	169	63
Cyperus sp.	215	101	108	178
Diodia virginiana		9	5	6
Eclipta alba	2	3	14	11
Erechtites hieracifolia	2		23	30
Eupatorium capillifolium	4	1	1	1
Eupatorium coelestinum	1	22	48	67
Eustachys glauca	1	4		
Galium obtusum var. floridanum		1	24	16
Hydrocotyle sp.			5	
Ludwigia microcarpa	1	6	5	7
Ludwigia octovalvis	102	84	56	104
Ludwigia peruviana		33	125	3
Ludwigia sp. seedlings	11	129		
Mecardonia vandellioides	18	75	120	88
Mikania scandens	21	25	71	35
Myrica cerifera			11	8

Table 6 continued

Species	August	November	February	May
Phyllanthus caroliniensis			17	
Pluchea odorata	1	7	53	57
Polygonum punctatum		1	3	2
Portulaca oleracea	10			
Ptilimnium capillaceum				10
Schinus terebinthifolius	1		1	
Sesbania exaltata				11
Setaria geniculata		1		1
Sida rhombifolia		5	7	8
Solidago stricta				2
Sonchus asper	1			2
Spermacoce floridana		332	686	423
Spermacoce tetraquetra	107	98	72	1
Thelypteris kunthii			7	1
Verbena scabra	2	13	47	25
Vicia acutifolia			17	32
Vigna luteola	15	5	17	15
Unknown seedlings	50	152		11
Unknown grass	1		6	5
Total Density	1295	1526	2068	1814

Table 7. Total number of individuals recorded for each species at four sampling dates for Plot II (within 4 m^2 area, in sixteen 1/4 m^2 subquadrats).

Species	August	November	February	May
Ambrosia artemisiifolia	1	1		
Ammannia latifolia	69	33	7	4
Andropogon glomeratus	10	18	29	68
Baccharis glomeruliflora				46
Baccharis halimifolia				23
Baccharis sp.	13	20	46	17
Boehmeria cylindrica			1	1
Borreria laevis	193	21	22	61
Chamaesyce hypericifolia			1	1
Cissus sicyoides		1		
Commelina diffusa	1	2	1	4
Cynoctonum mitreola		14	11	10
Cyperus brevifolius				2
Cyperus odoratus	3	2	1	8
Cyperus polystachyos	19	27	7	2
Cyperus surinamensis	22	426	469	73
Cyperus sp.	1037	181	5	510
Diodia virginiana		5	3	5
Eclipta alba	8	1	20	7
Erechtites hieracifolia	2	3	26	25
Erigeron quercifolius			1	
Eupatorium capillifolium		2	4	3
Eupatorium coelestinum				3
Eustachys glauca		1		
Flaveria trinervia				7
Galium obtusum var. floridanum	7	4	42	32
Kosteletzkya virginica				2
Ludwigia microcarpa		1	2	4
Ludwigia octovalvis	253	165	97	157
Ludwigia peruviana		47	13	3
Ludwigia sp. seedlings	128	162	133	
Mecardonia vandellioides		1		
Mikania scandens	2	2	14	9

Table 7 continued

Species	August	November	February	May
Myrica cerifera			2	
Pinus elliottii			1	1
Pluchea odorata	28	22	69	42
Polygonum punctatum		1		
Ptilimnium capillaceum				2
Schinus terebinthifolius	2	1	2	2
Sesbania exaltata	19	1		
Setaria geniculata				8
Solanum nigrescens			1	3
Solidago stricta				17
Spermacoce floridana		161	164	164
Spermacoce tetraquetra	20	17		
Thelypteris kunthii		12	9	8
Typha domingensis	4	3	3	1
Vigna luteola	23	16	23	24
Unknown seedlings	133	102	1	7
Unknown grass		6		4
Total Density	1997	1482	1337	1370

Table 8. Total number of individuals recorded for each species at four sampling dates for Plot III (within 4 m^2 area, in sixteen 1/4 m^2 subquadrats).

Species	August	November	February	May
Ammannia latifolia	15	65	46	15
Andropogon glomeratus	3	13	22	53
Baccharis glomeruliflora				26
Baccharis halimifolia				21
Baccharis sp.	11	34	44	6
Bacopa monnieri				2
Boehmeria cylindrica	2	1	2	3
Borreria laevis	418	43	28	33
Chamaesyce hypericifolia			2	4
Cynoctonum mitreola	10	23	15	7
Cyperus brevifolius	1			
Cyperus odoratus	10	15	7	10
Cyperus polystachyos	15	16	20	20
Cyperus surinamensis	72	529	404	56
Cyperus sp.	448	101	35	479
Dichromena floridensis		10	3	1
Eclipta alba	3	2	14	4
Eleocharis caribaea			1	1
Erechtites hieracifolia	2	3	36	14
Eriochloa michauxii		1		
Eupatorium capillifolium	2	3	3	5
Eupatorium coelestinum		3	10	12
Eustachys glauca	1	2		
Galium obtusum var. floridanum	4	7	32	33
Hydrocotyle sp.			11	24
Ludwigia microcarpa			2	2
Ludwigia octovalvis	6	13	20	69
Ludwigia peruviana	2	40	2	
Ludwigia sp. seedlings	29	25	81	
Mecardonia vandellioides		1		1
Mikania scandens	18	28	47	35
Myrica cerifera			4	4

Table 8 continued

Species	August	November	February	May
Phaseolus lathyroides	3	3	4	
Phyllanthus caroliniensis		1	1	2
Pluchea odorata	39	31	44	28
Polygonum punctatum		1	1	1
Ptilimnium capillaceum				2
Scoparia dulcis	3	4	3	4
Sesbania exaltata	5			
Sonchus asper				1
Spermacoce floridana		387	381	406
Spermacoce tetraquetra			1	
Thelypteris kunthii		3	7	4
Typha domingensis	3	3	3	
Verbena scabra	16	9	19	13
Vigna luteola	1	3	4	31
Waltheria indica		1		
Zeuxine strateumatica		1	2	
Unknown seedlings	5	20		
Unknown grass	1	1	1	
Total Density	1148	1446	1362	1432

Table 9. Total number of individuals recorded for each species at four sampling dates for Plot IV (within 4 m^2 area, in sixteen 1/4 m^2 subquadrats).

Species	August	November	February	May
Aeschynomene americana		1		
Ammannia latifolia	1	28	28	34
Andropogon glomeratus	3	10	118	187
Baccharis halimifolia				79
Baccharis sp.	4	7	34	0
Bacopa monnieri	1	61	43	58
Boehmeria cylindrica	16	19	78	45
Brachiaria mutica	4		3	
Borreria laevis	271	39	39	108
Chamaesyce hypericifolia	1		1	7
Conyza canadensis				4
Cynoctonum mitreola	85	104	28	10
Cyperus ligularis	1	1	1	1
Cyperus odoratus		2		9
Cyperus polystachyos	8	33	56	27
Cyperus surinamensis	4	160	201	17
Cyperus sp.	319	179	31	313
Dichromena floridensis	15	20	61	60
Diodia virginiana		8		
Eclipta alba	2		1	3
Eleocharis caribaea		3	1	
Erechtites hieracifolia	3	1	24	4
Eupatorium capillifolium	7	7	6	11
Eupatorium coelestinum	1	1	3	8
Eustachys glauca	6	8	3	7
Galium obtusum var. floridanum		1	51	41
Ludwigia microcarpa	72	131	146	127
Ludwigia octovalvis	6	9	33	30
Ludwigia peruviana		6		
Ludwigia sp. seedlings	8	63	7	8
Lythrum alatum		1	4	3
Mikania scandens	53	71	108	149

Table 9 continued

Species	August	November	February	May
Myrica cerifera				1
Paspalum conjugatum		12	41	90
Phyllanthus caroliniensis	4	5	6	5
Pityrogramma trifoliata				4
Pluchea odorata	63	56	45	24
Pluchea rosea			1	
Ptilimnium capillaceum				1
Sagittaria lancifolia			1	1
Schinus terebinthifolius	6	1	3	2
Scoparia dulcis	6	9	7	11
Setaria geniculata				33
Solidago stricta			3	3
Sonchus asper				3
Spermacoce floridana		186	245	278
Spermacoce tetraquetra	16			
Thelypteris kunthii	9	2	10	11
Typha domingensis	175	77	11	1
Verbena scabra	59	42	33	21
Vigna luteola	1		4	10
Unknown seedlings		3		
Unknown grass	1	5		3
Total Density	1231	1372	1488	1853

Table 10. Total number of individuals recorded for each species at four sampling dates for Plot V (within 4 m^2 area, in sixteen 1/4 m^2 subquadrats).

Species	August	November	February	May
Ammannia latifolia	12	19	25	28
Andropogon glomeratus			13	133
Baccharis glomeruliflora				2
Baccharis halimifolia				72
Baccharis sp.	3	3	45	
Bacopa monnieri		1		1
Boehmeria cylindrica	3		7	5
Brachiaria mutica		2	1	31
Borreria laevis	43	5	1	10
Chamaesyce hypericifolia				1
Commelina diffusa		2	14	
Conyza canadensis				6
Cynoctonum mitreola	23	81	117	105
Cyperus odoratus		2	2	7
Cyperus polystachyos		19	5	46
Cyperus surinamensis		25	48	16
Cyperus sp.	107	42	201	415
Dichromena floridensis	1	4	12	27
Diodia virginiana		7	3	25
Eclipta alba	6	3	13	9
Eleocharis caribaea	175	430	378	470
Erechtites hieracifolia	1		24	27
Eupatorium capillifolium		1	4	6
Eupatorium coelestinum		6	45	117
Eustachys glauca	4	11	80	
Fuirena squarrosa		3	1	3
Galium obtusum var. floridanum			45	47
Hydrocotyle sp.			6	37
Leptochloa fascicularis				35
Ludwigia microcarpa	29	42	45	83
Ludwigia octovalvis	18	3	51	150
Ludwigia peruviana		16	3	15

Table 10 continued

Species	August	November	February	May
Ludwigia sp. seedlings	122	71	57	
Lythrum alatum			6	3
Mikania scandens	33	29	87	167
Myrica cerifera			3	4
Paspalum conjugatum				1
Pityrogramma trifoliata			2	2
Pluchea odorata	15	60	136	144
Pluchea rosea				2
Polygonum punctatum		5	5	8
Sabatia grandiflora		1	10	14
Salix caroliniana				6
Sarcostemma clausum		4	3	3
Scoparia dulcis	1			
Sesbania exaltata	38			
Setaria geniculata	2	1	10	42
Solidago stricta			12	35
Sonchus asper			5	
Sorghum halapense			33	
Spermacoce floridana		14	35	60
Spermacoce tetraquetra				3
Sporobolus domingensis				3
Thelypteris kunthii		5	17	18
Typha domingensis	10	48	45	47
Verbena scabra	2	3	8	11
Unknown seedlings	221	95	4	1
Unknown grass	10	19	7	1
Total Density	879	1082	1674	2504

Table 11. Mean cover values for each species at four sampling dates for Plot I. Each value is mean of cover values within sixteen 1/4 m^2 subquadrats. T = trace, cover of less than 1% recorded in one 1/4 m^2 subquadrat; T+ = trace recorded in more than one 1/4 m^2 subquadrat.

Species	August	November	February	May
Ambrosia artemisiifolia		T		
Ammannia latifolia	0.3	1.1	1.5	1.1
Andropogon glomeratus	T	.25	2.1	4.6
Baccharis halimifolia				0.4
Baccharis sp.		T	0.8	0.7
Bidens alba var. radiata	0.2	T	2.75	3.75
Boehmeria cylindrica		0.1	1.0	0.8
Brachiaria mutica		T		
Borreria laevis	2.4	0.5	2.1	4.8
Chamaesyce hypericifolia	0.5			0.1
Cynoctonum mitreola		0.1	0.7	0.6
Cyperus brevifolius	0.1	0.1		0.1
Cyperus odoratus	1.0	0.4	0.4	0.2
Cyperus polystachyos	2.1	3.9	2.8	0.6
Cyperus surinamensis	1.0	5.7	6.1	1.6
Cyperus sp.	2.4	1.3	2.9	3.4
Dichromena floridensis		0.3	0.7	0.4
Diodia virginiana		0.3	0.7	0.4
Eclipta alba	0.9	0.3	0.1	0.3
Erechtites hieracifolia	0.1		0.3	0.3
Eupatorium capillifolium	T+	0.1	0.3	0.8
Eupatorium coelestinum	T	0.8	3.3	3.7
Eustachys glauca	T	0.1		
Galium obtusum var. floridanum		T	0.3	0.3
Hydrocotyle sp.			0.1	
Ludwigia microcarpa	T	0.1	0.2	0.1
Ludwigia octovalvis	0.7	1.9	1.6	4.1
Ludwigia peruviana		1.5	3.8	0.1
Ludwigia sp. seedlings	0.1	0.9		
Mecardonia vandellioides	0.2	1.0	3.5	6.0
Mikania scandens	0.2	0.8	4.1	4.6

Table 11 continued

Species	August	November	February	May
Myrica cerifera			T+	T+
Phaseolus lathyroides			T	
Phyllanthus caroliniensis			0.1	
Pluchea odorata	0.1	0.8	1.1	1.3
Polygonum punctatum		0.2	0.1	0.2
Portulaca oleracea	T+			
Ptilimnium capillaceum				0.4
Schinus terebinthifolius	T		0.1	
Sesbania exaltata				T+
Setaria geniculata		T		0.1
Sida rhombifolia		0.4	0.8	0.9
Solidago stricta				0.2
Sonchus asper	T			T
Spermacoce floridana		5.4	15.1	11.0
Spermacoce tetraquetra	1.5	17.8	5.8	T
Thelypteris kunthii			0.1	T
Verbena scabra	T+	0.25	2.9	3.4
Vicia acutifolia			0.2	1.2
Vigna luteola	2.9	1.1	1.3	9.3
Unknown seedlings	0.2	0.3		T
Unknown grass	T		0.7	0.1
Live Cover (%)	16.4	47.5	69.7	71.9
Dead Cover (%)	4.0	3.25	2.6	6.1

Table 12. Mean cover values for each species at four sampling dates for Plot II. Each value is mean of cover values within sixteen 1/4 m^2 subquadrats.

Species	August	November	February	May
Ambrosia artemisiifolia	T	T		
Ammannia latifolia	1.25	0.5	0.1	0.1
Andropogon glomeratus	0.2	0.6	4.75	6.9
Baccharis glomeruliflora				1.2
Baccharis halimifolia				0.4
Baccharis sp.	T	0.3	1.5	0.4
Boehmeria cylindrica			T	T
Borreria laevis	1.25	0.1	0.7	1.3
Chamaesyce hypericifolia			T	T
Cissus sicyoides		0.1		
Commelina diffusa	0.1	T	T+	0.1
Cynoctonum mitreola		0.3	0.3	0.3
Cyperus brevifolius				T
Cyperus odoratus	0.2	0.1	0.1	0.2
Cyperus polystachyos	0.7	0.6	0.3	T+
Cyperus surinamensis	0.8	4.6	11.6	1.5
Cyperus sp.	4.4	2.1	0.1	8.9
Diodia virginiana		0.2	0.25	0.4
Eclipta alba	0.4	T	0.3	0.1
Erechtites hieracifolia	T+	0.25	1.1	0.6
Erigeron quercifolius			T	
Eupatorium capillifolium		0.2	0.4	0.4
Eupatorium coelestinum				T
Eustachys glauca		T		
Flaveria trinervia				T+
Galium obtusum var. floridanum	T+	T+	0.7	1.0
Kosteletzkya virginica			0.1	0.1
Ludwigia microcarpa		T	0.1	0.1
Ludwigia octovalvis	1.6	3.4	4.4	5.2
Ludwigia peruviana		1.9	1.4	T
Ludwigia sp. seedlings	0.6	0.5	0.5	
Mecardonia vandellioides		T		

Table 12 continued

Species	August	November	February	May
Mikania scandens	0.1	0.1	1.1	2.1
Myrica cerifera			T	
Pinus elliottii			T	0.1
Pluchea odorata	0.5	2.6	6.2	6.5
Polygonum punctatum		T		
Ptilimnium capillaceum				T+
Schinus terebinthifolius	T	T	T+	0.1
Sesbania exaltata	8.2	T		
Setaria geniculata				0.25
Solanum nigrescens			0.1	0.1
Solidago stricta			0.1	0.25
Spermacoce floridana		2.25	3.4	2.2
Spermacoce tetraquetra	0.4	1.7	0.1	
Thelypteris kunthii		0.1	0.1	0.1
Typha domingensis	0.2	0.2	0.1	0.1
Vigna luteola	2.6	12.2	26.1	19.6
Unknown seedlings	0.1	0.1	T	T+
Unknown grass		1.6		T+
Live Cover (%)	23.2	39.4	65.5	61.4
Dead Cover (%)	0.7	7.6	2.6	6.25

Table 13. Mean cover values for each species at four sampling dates for Plot III. Each value is mean of cover values within sixteen 1/4 m^2 subquadrats.

Species	August	November	February	May
Ammannia latifolia	T+	0.6	1.1	0.3
Andropogon glomeratus	0.1	0.6	8.75	14.1
Baccharis glomeruliflora			0.1	0.6
Baccharis halimifolia				0.7
Baccharis sp.	0.1	0.1	0.75	0.1
Bacopa monnieri				T+
Boehmeria cylindrica	T+	T	0.1	0.1
Borreria laevis	2.9	0.1	1.1	0.1
Chamaesyce hypericifolia			T	T+
Commelina diffusa				0.1
Conyza canadensis				T
Cynoctonum mitreola	0.1	0.7	1.1	0.2
Cyperus brevifolius	T			
Cyperus odoratus	1.2	0.7	0.4	0.6
Cyperus polystachyos	0.5	0.4	1.2	0.9
Cyperus surinamensis	3.2	13.75	7.6	1.2
Cyperus sp.	3.1	1.1	0.2	4.2
Dichromena floridensis		0.25	0.1	0.1
Eclipta alba	0.2	0.25	T+	T+
Eleocharis caribaea			0.1	0.1
Erechtites hieracifolia	T+	0.1	0.7	0.6
Eriochloa michauxii		0.1		
Eupatorium capillifolium	T+	0.3	0.4	1.4
Eupatorium coelestinum		0.1	0.7	1.1
Eustachys glauca	T	0.1		
Galium obtusum var. floridanum	T+	0.1	0.4	0.6
Hydrocotyle sp.			0.3	0.1
Ludwigia microcarpa			0.1	T+
Ludwigia octovalvis	0.1	0.3	2.6	1.7
Ludwigia peruviana	T	1.7	0.1	
Ludwigia sp. seedlings	0.25	T+	1.1	
Mecardonia vandellioides		T		T

Table 13 continued

Species	August	November	February	May
Mikania scandens	0.3	1.1	6.1	6.9
Myrica cerifera			T+	T+
Phaseolus lathyroides	0.7	0.5	0.5	0.4
Phyllanthus caroliniensis		T	T	T+
Pluchea odorata	1.7	4.25	6.3	3.9
Polygonum punctatum		0.1	0.1	T
Ptilimnium capillaceum				T+
Scoparia dulcis	T+	0.1	0.3	0.3
Sonchus asper				T
Spermacoce floridana		3.3	6.8	4.4
Spermacoce tetraquetra			0.1	
Thelypteris kunthii		T	0.1	T+
Typha domingensis	0.1	0.1	0.2	
Verbena scabra	0.2	0.4	2.2	1.1
Vicia acutifolia				T
Vigna luteola	0.1	1.3	6.9	25.5
Waltheria indica		0.1		
Zeuxine strateumatica		T	T+	
Unknown seedlings	T+	T+		
Unknown grass	0.1	0.1	T	
Live Cover (%)	16.1	33.25	57.75	71.6
Dead Cover (%)	0.7	3.6	4.7	3.9

Table 14. Mean cover values for each species at four sampling dates for Plot IV. Each value is mean of cover values within sixteen 1/4 m^2 subquadrats.

Species	August	November	February	May
Aeschynomene americana		T		
Ammannia latifolia	T	T+	0.2	0.2
Andropogon glomeratus	T+	0.2	2.25	5.8
Baccharis halimifolia				0.2
Baccharis sp.	T+	T+	T+	
Bacopa monnieri	0.1	.4	.3	.5
Boehmeria cylindrica	0.1	0.1	0.25	0.2
Brachiaria mutica	T+		0.1	
Borreria laevis	1.2	0.1	1.1	1.5
Chamaesyce hypericifolia	T		T	T+
Conyza canadensis				T+
Cynoctonum mitreola	0.4	1.5	1.0	0.2
Cyperus ligularis	T	T	0.1	0.1
Cyperus odoratus		T+		0.2
Cyperus polystachyos	0.25	0.5	1.5	1.4
Cyperus surinamensis	0.1	1.8	3.2	0.5
Cyperus sp.	0.9	0.6	0.1	2.5
Dichromena floridensis	T+	0.1	0.4	0.9
Diodia virginiana		T+		
Eclipta alba	0.1		T	T+
Eleocharis caribaea		T+	T	
Erechtites hieracifolia	T+	T	T+	T+
Eupatorium capillifolium	0.1	0.1	0.3	0.75
Eupatorium coelestinum	T	T	0.1	0.1
Eustachys glauca	T+	0.1	0.2	0.4
Galium obtusum var. floridanum		T	0.4	0.5
Ludwigia microcarpa	0.3	0.75	2.0	0.8
Ludwigia octovalvis	T+	0.1	0.5	0.6
Ludwigia peruviana		T+		
Ludwigia sp. seedlings	T+	T+	T+	T
Lythrum alatum		T	0.2	0.3
Mikania scandens	0.8	1.0	3.6	5.3

Table 14 continued

Species	August	November	February	May
Myrica cerifera				T
Paspalum conjugatum		T+	1.1	1.5
Phyllanthus caroliniensis	T+	T+	T+	T+
Pluchea odorata	1.2	1.6	2.7	1.1
Pluchea rosea			0.1	
Ptilimnium capillaceum				0.1
Sagittaria lancifolia			0.1	T
Sarcostemma clausum			0.1	0.1
Schinus terebinthifolius	0.1	0.1	0.2	0.25
Scoparia dulcis	T+	T+	0.2	0.2
Sesbania exaltata	0.1			
Setaria geniculata				1.0
Solidago stricta			T	0.1
Sonchus asper				T+
Spermacoce floridana		1.1	1.9	2.2
Spermacoce tetraquetra	0.2			
Thelypteris kunthii	0.1	T+	0.2	0.25
Typha domingensis	0.8	1.2	0.9	0.3
Verbena scabra	0.7	0.3	1.1	0.5
Vigna luteola	0.2		7.3	15.0
Unknown fern				T+
Unknown seedlings		T+		
Unknown grass	T	T+		T+
Live Cover (%)	8.75	12.3	33.4	46.3
Dead Cover (%)	1.6	1.7	2.5	2.4

Table 15. Mean cover values for each species at four sampling dates for Plot V. Each value is mean of cover values within sixteen 1/4 m^2 subquadrats.

Species	August	November	February	May
Ammannia latifolia	0.1	T+	0.5	0.7
Andropogon glomeratus			2.1	8.6
Baccharis glomeruliflora				T
Baccharis halimifolia				1.8
Baccharis sp.	T+	0.1	0.6	*
Bacopa monnieri		0.1		T
Boehmeria cylindrica	T+		0.1	0.2
Brachiaria mutica		0.1	0.1	0.9
Borreria laevis	0.1	0.1	T	0.1
Chamaesyce hypericifolia				0.1
Commelina diffusa		0.1	0.25	
Conyza canadensis				0.25
Cynoctonum mitreola	T+	0.4	2.8	2.25
Cyperus odoratus		0.7	0.4	0.25
Cyperus polystachyos		1.0	0.6	1.7
Cyperus surinamensis		1.0	1.3	0.8
Cyperus sp.	1.3	0.1	0.6	2.4
Dichromena floridensis	T	0.1	0.2	0.7
Diodia virginiana		0.4	0.4	1.6
Eclipta alba	0.4	0.2	0.4	0.3
Eleocharis caribaea	1.7	10.6	13.25	10.8
Erechtites hieracifolia	T		0.25	1.0
Eupatorium capillifolium		T	0.2	0.2
Eupatorium coelestinum		0.2	1.0	3.9
Eustachys glauca	0.1	0.4	0.75	
Fuirena squarrosa		T+	T	0.2
Galium obtusum var. floridanum			1.0	1.4
Hydrocotyle sp.			0.1	0.6
Leptochloa fascicularis				0.5
Ludwigia microcarpa	0.1	0.2	0.8	0.5
Ludwigia octovalvis	0.1	0.1	1.0	2.75
Ludwigia peruviana		0.8	0.2	0.25

Table 15 continued

Species	August	November	February	May
Ludwigia sp. seedlings	0.1	0.4	0.4	
Lythrum alatum			0.2	0.3
Mikania scandens	0.5	0.8	2.8	5.75
Myrica cerifera			T+	0.1
Paspalum conjugatum				T
Pluchea odorata	0.2	1.4	3.4	3.75
Pluchea rosea				T+
Polygonum punctatum		T+	0.25	0.3
Sabatia grandiflora		T+	0.2	0.7
Salix caroliniana				T+
Sarcostemma clausum		0.1	0.25	0.3
Scoparia dulcis	T			
Sesbania exaltata	0.4			
Setaria geniculata	T+	T	0.75	1.6
Sida rhombifolia			0.2	
Solidago stricta			0.2	1.8
Sorghum halapense			0.5	
Spermacoce floridana		0.1	0.5	0.7
Spermacoce tetraquetra				T
Sporobolus domingensis				T+
Thelypteris kunthii		T	0.1	T+
Typha domingensis	0.2	2.6	3.75	4.25
Verbena scabra	T	0.4	0.6	1.3
Unknown fern			0.1	T
Unknown seedlings	0.1	0.2	0.1	T+
Unknown grass	T	T+	0.1	T
Live Cover (%)	6.1	24.4	42.4	66.1
Dead Cover	1.4	6.9	3.1	3.6

Table 16. Cover values for each species: mean % cover for all plots (I-V). Each value is mean of cover values within eighty 1/4m^2 subquadrats. T = trace, cover of less than 1% recorded in one 1/4 m^2 subquadrat; T+ = trace recorded in more than one subquatrat.

Species	August	November	February	May
Aeschynomene americana		T		
Ambrosia artemisiifolia	T	T+		
Ammannia latifolia	0.3	0.4	0.7	0.5
Andropogon glomeratus	0.06+	0.3	4.0	8.0
Baccharis glomeruliflora			0.02	0.4
Baccharis halimifolia				0.7
Baccharis sp.	0.02+	0.1	0.7	0.2
Bacopa monnieri	0.02	0.1	0.06	0.1
Bidens alba var. radiata	0.04	T	0.5	0.7
Boehmeria cylindrica	0.02+	0.04+	0.3	0.3
Brachiaria mutica	T+	0.02+	0.04	0.2
Borreria laevis	1.6	0.2	1.0	1.6
Chamaesyce hypericifolia	0.1		T+	0.04
Cissus sicyoides		0.02		
Commelina diffusa	0.02	0.02+	0.05	0.04
Conyza canadensis				0.05+
Cynoctonum mitreola	0.1	0.6	1.2	0.7
Cyperus brevfolius	0.02+	0.02		0.02
Cyperus ligularis	T	T	0.02	0.02
Cyperus odoratus	0.5	0.4	0.3	0.3
Cyperus polystachyos	0.7	1.3	1.3	0.9
Cyperus surinamensis	1.0	5.4	6.0	1.1
Cyperus sp.	2.4	1.0	0.8	4.3
Dichromena floridensis	T+	0.1	0.3	0.4
Diodia virginiana		0.2	0.3	0.5
Eclipta alba	0.4	0.1	0.2	0.1
Eleocharis caribaea	0.3	2.1	2.7	2.2
Erechtites hieracifolia	0.02+	0.07	0.5	0.5
Erigeron quercifolius			T	
Eriochloa michauxii		0.02		

Table 16 continued

Species	August	November	February	May
Eupatorium capillifolium	0.02+	0.1	0.3	0.7
Eupatorium coelestinum	T+	0.2	1.0	1.8
Eustachys glauca	0.02+	0.1	0.2	0.08
Flaveria trinervia				T+
Fuirena squarrosa		T+	T	0.04
Galium obtusum var. floridanum	T+	0.02+	0.6	0.8
Hydrocotyle sp.			0.1	0.1
Kosteletzkya virginica			0.02	0.02
Leptochloa fascicularis				0.1
Ludwigia microcarpa	0.08	0.2	0.6	0.3
Ludwigia octovalvis	0.5	1.2	2.0	2.9
Ludwigia peruviana	T	1.2	1.1	0.07
Ludwigia sp. seedlings	0.2	0.4	0.4	T
Lythrum alatum		T	0.08	0.1
Mecardonia vandellioides	0.04	0.2	0.7	1.2
Mikania scandens	0.4	0.8	3.5	4.9
Myrica cerifera			T+	0.2
Paspalum conjugatum		T+	0.2	0.3
Phaseolus lathyroides	0.1	0.1	0.1	0.1
Phyllanthus caroliniensis	T+	T+	0.02+	T+
Pluchea odorata	0.7	2.1	3.9	3.3
Pluchea rosea			0.02	T+
Pinus elliottii var. densa			T	0.02
Polygonum punctatum		0.06+	0.09	0.1
Portulaca oleracea	T+			
Ptilimnium capillaceum				0.1
Sabatia grandiflora		T+	0.04	0.1
Salix caroliniana				T+
Sarcostemma clausum		0.02	0.07	0.08
Schinus terebinthifolia	0.02+	0.02+	0.06	0.05
Scoparia dulcis	T+	0.02+	0.1	0.1
Sesbania exaltata	1.7	T		T+

Table 16 continued

Species	August	November	February	May
Setaria geniculata	T+	T+	0.1	0.6
Sida rhombifolia		0.08	0.2	0.2
Solanum nigrescens			0.2	0.02
Solidago stricta			0.06	0.5
Sonchus asper	T			T+
Sorghum halapense			0.1	
Spermacoce floridana		2.4	5.5	4.1
Spermacoce tetraquetra	0.4	3.9	1.2	T+
Sporobolus domingensis				T+
Thelypteris kunthii	0.02	0.02+	0.1	0.07
Typha domingensis	0.3	0.8	1.0	0.9
Verbena scabra	0.2	0.3	1.4	1.3
Vicia acutifolia			0.04	0.2
Vigna luteola	1.2	2.9	8.3	13.9
Waltheria indica		0.02		
Zeuxine strateumatica		T	T+	
Unknown seedlings	0.08	0.1	0.02	T+
Unknown grass	0.02+	0.3	0.2	0.02+

Table 17. Summary of mean % cover for the five dominant species on each of Plots I - V at the four sampling dates.

Plot I

August		November		February		May	
Vigna luteola	2.9	Spermacoce tetraquetra	17.8	Spermacoce floridana	15.1	Spermacoce floridana	11.0
Cyperus sp.	2.4	Cyperus surinamensis	5.7	Cyperus surinamensis	6.1	Vigna luteola	9.3
Borreria laevis	2.4	Spermacoce floridana	5.4	Spermacoce tetraquetra	5.8	Mecardonia vandellioides	6.0
Cyperus polystachyos	2.1	Cyperus polystachyos	3.9	Mikania scandens	4.1	Borreria laevis	4.8
Spermacoce tetraquetra	1.5	Ludwigia octovalvis	1.9	Ludwigia octovalvis	3.8	Andropogon glomeratus Mikania scandens	4.6

Plot II

Sesbania exaltata	8.2	Vigna luteola	12.2	Vigna luteola	26.1	Vigna luteola	19.6
Cyperus sp.	4.4	Cyperus surinamensis	4.6	Cyperus surinamensis	11.6	Cyperus sp.	8.9
Vigna luteola	2.6	Ludwigia octovalvis	3.4	Pluchea odorata	6.2	Andropogon glomeratus	6.9
Ludwigia octovalvis	1.6	Pluchea odorata	2.6	Andropogon glomeratus	4.75	Fluchea odorata	6.5
Ammannia latifolia	1.2	Spermacoce floridana	2.25	Ludwigia octovalvis	4.4	Ludwigia octovalvis	5.2
Borreria laevis	1.2						

Plot III

Cyperus surinamensis	3.2	Cyperus surinamensis	13.75	Andropogon glomeratus	8.75	Vigna luteola	25.5
Cyperus sp.	3.1	Pluchea odorata	4.25	Cyperus surinamensis	7.6	Andropogon glomeratus	14.1
Borreria laevis	2.9	Spermacoce floridana	3.3	Vigna luteola	6.9	Mikania scandens	6.9
Pluchea odorata	1.7	Ludwigia octovalvis	1.7	Spermacoce floridana	6.8	Spermacoce floridana	4.4
Cyperus odoratus	1.2	Vigna luteola	1.3	Pluchea odorata	6.3	Cyperus sp.	4.2

Plot IV

Borreria laevis	1.2	Cyperus surinamensis	1.8	Vigna luteola	7.3	Vigna luteola	15.0
Pluchea odorata	1.2	Pluchea odorata	1.6	Mikania scandens	3.6	Andropogon glomeratus	5.8
Cyperus sp.	0.9	Cynoctonum mitreola	1.5	Cyperus surinamensis	3.2	Mikania scandens	5.3
Mikania scandens	0.8	Spermacoce floridana	1.1	Pluchea odorata	2.7	Cyperus sp.	2.5
Typha domingensis	0.8	Typha domingensis	1.2	Andropogon glomeratus	2.2	Spermacoce floridana	2.2

Table 17 continued

Plot V

Elocharis caribaea	1.7	Eleocharis caribaea	10.6	Eleocharis caribaea	13.25	Eleocharis caribaea	10.8
Cyperus sp.	1.3	Typha domingensis	2.6	Typha domingensis	3.75	Andropogon glomeratus	8.6
Mikania scandens	0.5	Pluchea odorata	1.4	Pluchea odorata	3.4	Mikania scandens	5.75
Pluchea odorata	0.2	Cyperus polystachyos	1.0	Mikania scandens	2.8	Typha domingensis	4.25
Typha domingensis	0.2	Cyperus surinamensis	1.0	Cynoctonum mitreola	2.8	Eupatorium coelestinum	3.9

Total Dominants (Plots I-V)

Cyperus sp.	2.4	Cyperus surinamensis	5.4	Vigna luteola	8.3	Vigna luteola	13.9
Sesbania exaltata	1.7	Spermacoce tetraquetra	3.9	Cyperus surinamensis	6.0	Andropogon glomeratus	8.0
Borreria laevis	1.6	Vigna luteola	2.9	Spermococe floridana	5.5	Mikania scandens	4.9
Vigna luteola	1.2	Spermacoce floridana	2.4	Andropogon glomeratus	4.0	Cyperus sp.	4.3
Cyperus surinamensis	1.0	Eleocharis caribaea	2.1	Pluchea odorata	3.9	Spermacoce floridana	4.1
		Pluchea odorata	2.1				

Table 18. Number of vascular plant species recorded in Plots I - V (based on sixteen 1/4 m^2 subquadrats per plot) on the various sampling dates.

Plot	August	November	February	May	Total/plot
I	25	34	36	39	47
II	20	31	33	36	44
III	24	33	35	39	47
IV	32	34	38	42	50
V	20	33	41	47	53
Total/ sampling date	46	58	62	73	79 (total for all plots, all dates)
mean number/plot	24.2	33.0	36.6	47.9	

Table 19. Comparision of selected attributes and parameters for the major species encountered in early succession in the Hole-in-the-Donut of Everglades National Park.

LEGEND

Growth Form: T = tree, S = shrub, V = vine, P = herbaceous perennial, A = herbaceous annual.

Native Ecosystem Component?: Dist. = Confined to disturbed sites; P = present in native pineland ecosystems; Pr = present in native prairie, slough, or bayhead ecosytems.

Flooded or Dry Sites?: F = flooded, D = dry

Exotic or Native: E = exotic, N = native

H - 1976: Refers to mean density for Plots 1 - 8 for Jan. - Feb. 1976, determined by referring to field data of Hilsenbeck (1976) in Plant Ecology files at South Florida Research Center.

H - 1980: Refers to mean density for Plots 1, 2, 5, 6, 7, 8 for April - May 1980 (based on data from Table 1).

Bulldozed: Mean density in Plots I-V in May, 1980.

	Growth Form	Native Ecosystem Component?	Flooded or Dry Sites?	Exotic or Native?	H-1976 $\bar{x}$ density per m^2	H-1980 $\bar{x}$ density per m^2	Bulldozed May, 1980 $\bar{x}$ density/m^2
Alternanthera philoxeroides	P	Dist	F	E	3.6	159.4	-
Amaranthus hybridus	A	Dist	F,D	N	1.6	-	-
Ambrosia artemisiifolia	A	Dist	F,D	N	23.8	9.7	
Ammannia latifolia	A	Dist	F,D	N	-	-	7.0
Ampelopsis arborea	V	Pi	F,D	N	-	0.7	-
Andropogon glomeratus	P	Pi-Pr	F,D	N	-	4.5	23.5
Argemone mexicana	A	Dist	D	N	3.9	-	-
Baccharis glomeruliflora	S	Pi-Pr	F,D	N	-	7.0	3.7
Baccharis halimifolia	S	Pi-Pr	F,D	N	-	2.0	13.8
Bacopa monnieri	P	Pr	F	N	-	P	3.0
Bidens alba var. radiata	A	Dist.	D	N	74.8	44.4	8.5
Boehmeria cylindrica var. drummondiana	P	Pr	F,D	N	0.5	7.3	3.6
Borreria laevis	A	Dist	F,D	N	1.5	4.9	18.5
Brachiaria mutica	P	Dist	F,D	E	0.3	3.0	1.5
Centella asiatica	P	Pr	F	E	-	2.5	-

Table 19 continued

	Growth Form	Native Ecosystem Component?	Flooded or Dry Sites?	Exotic or Native?	H-1976 $\bar{x}$ density per m^2	H-1980 $\bar{x}$ density per m^2	Bulldozed May, 1980 $\bar{x}$ density/m^2
Chamaesyce hirta	A	Dist	D	N	0.8	-	-
Chamaesyce hypericifolia	A	Dist	F,D	N	-	0.1	1.9
Chamaesyce hyssopifolia	A	Dist	D	N	2.0	-	-
Chenopodium album	A	Dist	F,D	N	1.1	-	-
Colocasia esculentum	P	Dist	F	E	0.9	5.9	-
Commelina diffusa	P	Dist	F,D	N	34.3	2.3	0.2
Conyza canadensis	A	Dist	F,D	N	0.9	0.9	0.5
Cynoctonum mitreola	A	Pr	F	N	-	P	7.5
Cynodon dactylon	P	Dist	F,D	E	34.4	3.0	-
Cyperus odoratus	A	Dist	F,D	N	4.1	3.7	1.8
Cyperus polystachyos	A	Dist	F,D	N	5.6	P	6.7
Cyperus surinamensis	P	Dist	F,D	N	-	P	11.2
Dichromena floridensis	P	Pi	F,D	N	-	-	4.4
Digitaria ciliaris	P	Dist	F,D	E	3.5	1.0	-
Diodia virginiana	P	Pi-Pr	F,D	N	-	1.6	1.8
Eclipta alba	A	Dist	F,D	N	P	0.9	1.7
Eleocharis caribaea	A	Pr	F	N	-	-	23.5
Erechtites hieracifolia	A	Dist	F,D	N	-	4.6	5.0
Eupatorium capillifolium	P	Dist	F	N	-	0.2	1.3
Eupatorium coelestinum	P	Pi-Pr	F,D	N	-	-	10.3
Eustachys glauca	P	Pr	F,D	N	-	-	0.3
Galium obtusum var. floridanum	P	Dist	F,D	N	-	6.5	8.4
Geranium carolinianum	A	Dist	F,D	N	0.1	0.2	-
Hydrocotyle umbellata	P	Pr	F	N	-	P	3.0
Ilex cassine	T	Pi-Pr	F,D	N	-	P	-
Ipomea indica	V	Dist	F	N	-	0.7	-

Table 19 continued

	Growth Form	Native Ecosystem Component?	Flooded or Dry Sites?	Exotic or Native?	H-1976 $\bar{x}$ density per m^2	H-1980 $\bar{x}$ density per m^2	Bulldozed May, 1980 $\bar{x}$ density/m^2
Ipomea trichocarpa	V	Dist	F,D	N	2.4	-	-
Kosteletzkya virginica	P	Pr	F,D	N	-	P	0.1
Ludwigia microcarpa	P	Pi-Pr	F,D	N	-	0.6	11.1
Ludwigia octovalvis spp. octovalvis	S	Dist	F,D	N	1.9	2.8	25.5
Ludwigia peruviana	S	Dist	F,D	N	-	1.2	1.0
Lythrum alatum var. lanceolatum	P	Dist	F,D	N	-	P	0.3
Macroptilium lathyroides	P	Dist	D	E	-	-	P
Mecardonia vandellioides	P	Dist	F,D	N	-	-	4.4
Medicago lupulina	A	Dist	F,D	E	0.1	0.7	-
Melilotus alba	A	Dist	F,D	E	2.5	1.1	-
Melothria pendula	V	Dist	F,D	N	-	1.2	-
Mikania scandens	V	Pi-Pr	F,D	N	-	P	19.7
Myrica cerifera	S	Pi-Pr	F,D	N	-	0.1	0.8
Panicum bartowense	P	Dist	F,D	N	0.5	-	-
Parthenium hysterophorus	A	Dist	F,D	E	0.2	-	-
Parthenocissus quinquefolia	V	Pi-Pr	F,D	N	-	0.1	-
Paspalum conjugatum	P	Dist	F	N	-	1.0	4.5
Persea borbonia	T	Pi-Pr	F,D	N	-	-	-
Phyla nodiflora	P	Dist	F,D	N	-	0.3	-
Phyllanthus caroliniensis ssp. saxicola	A	Dist	F,D	N	-	-	0.3
Pluchea odorata	P	Dist	F,D	N	-	0.3	14.7
Pluchea rosea	P	Pi-Pr	F	N	-	-	0.1
Polygonum densiflorum	P	Pr	F,D	N	0.1	-	-
Polygonum hydropiperoides	P	Pr	F,D	N	-	-	-
Polygonum punctatum	P	Pr	F,D	N	-	0.1	0.5

Table 19 continued

	Growth Form	Native Ecosystem Component?	Flooded or Dry Sites?	Exotic or Native?	H-1976 $\bar{x}$ density per m^2	H-1980 $\bar{x}$ density per m^2	Bulldozed May, 1980 $\bar{x}$ density/m^2
Portulaca oleracea	P	Dist	F,D	E	0.3	-	-
Psidium guajava	T	Dist	F,D	E	-	0.1	-
Ptilimnium capillaceum	A	Dist	F,D	N	-	0.1	0.7
Sabatia grandiflora	A	Pr	F	N	-	-	0.7
Sarcostemma clausum	V	Pr	F,D	N	-	0.1	0.2
Schinus terebinthifolius	S	Dist	F,D	E	-	0.1	0.2
Scoparia dulcis	A	Dist	F	N	-	-	0.7
Sesbania macrocarpa	A	Dist	F,D	N	0.2	0.7	0.5
Setaria geniculata	P	Pi-Pr	F,D	N	-	P	4.2
Sida acuata	A	Dist	D	N	P	P	-
Sida rhombifolia	A	Dist	F,D	N	-	56.4	0.4
Solidago leavenworthii	A	Dist	F,D	N	-	12.2	-
Solidago stricta	P	Pi-Pr	F,D	N	-	P	2.8
Sonchus asper	A	Dist	F,D	N	0.7	0.5	0.3
Spermacoce floridana	A	Dist	F,D	N	0.4	0.2	66.5
Spermacoce tetraquetra	A	Dist	F,D	N	6.3	-	P
Thelypteris kunthii	P	Pi-Pr	F,D	N	-	1.0	2.1
Typha domingensis	P	Pi-Pr	F,D	N	-	-	2.4
Verbena scabra	P	Dist	F,D	N	-	0.1	3.5
Vicia acutifolia	A	Dist	F,D	E?	-	0.1	1.6
Vigna luteola	A	Dist	F,D	E?	-	0.1	4.0
Vitis aestivalis	V	Dist	F,D	N	-	P	-
Vitis munsoniana	V	Pi-Pr	F,D	N	-	P	-

Table 20. Density (D, individuals per 4 m^2) and mean cover (C, %) for vascular plant species of plot established in area of 13-year post-farming vegetation on rock plowed former pineland and sampled prior to bulldozing. Plot was resampled after bulldozing, which occurred in April - June, 1979.

	February 1978		January 1980	
	D	C	D	C
Ammannia latifolia			1	.1
Andropogon glomeratus	2	.1	5	3.4
Baccharis glomeruliflora	68	16	34	1.6
Bidens alba var. radiata	23	2.8	43	.7
Borreria laevis	25	.4	397	9.9
Chamaesyce hirta			3	.2
Commelina diffusa			1	.3
Cyperus esculentus			4	0.2
Cyperus odoratus			2	.1
Cyperus polystachyos			13	1.3
Cyperus surinamensis			9	.6
Cyperus sp.			99	1.9
Erechtites hieracifolia			35	.4
Eupatorium capillifolium			3	2.1
Eupatorium coelestinum			16	1.0
Kosteletzkya virginica			5	4.1
Ludwigia microcarpa			10	.5
Ludwigia octovalvis	1	T	9	.4
Ludwigia peruviana			129	6.3
Ludwigia sp. seedlings			9	.1
Mecardonia vandellioides			28	1.6
Metopium toxiferum			1	0.1
Mikania scandens			20	1.4
Myrica cerifera	9	1.3	5	1.0
Myrsine floridana			1	T
Parthenocissus quinquefolia	35	1.6	1	0.2
Phyllanthus caroliniensis			4	T+
Pluchea odorata			83	.9

Table 20 continued

	February 1978		January 1980	
	D	C	D	C
Rhus copallina			1	0.6
Rhynchosia minima			0	1.2
Schinus terebinthifolius	45	4.7	11	2.9
Solanum nigrescens			1	0.1
Spermacoce floridana			270	16.9
Spermacoce tetraquetra			4	2.4
Tetrazygia bicolor			16	2.3
Thelypteris kunthii	1	0.5	9	0.3
Verbena bonariensis			2	0.6
Verbena scabra			37	2.5
Vitis rotundifolia			2	0.6
Total	209	27.4	323	85.5
	9 spp.		39 spp.	

Table 21. Numbers of Schinus terebinthifolius and Psidium guajava in 8 plots of 6.7 ha (16 acres) each. Psidium was counted in 1978 only.

	Schinus 1977	Schinus 1978	Psidium 1978
Plot 1	1	33	137
2	1	36	24
3	0	7	2
4	0	10	9
5	5	72	3
6	0	32	1
7	4	31	1
8	3	27	1
Total	14	248	178

Table 22. Numbers of Schinus terebinthifolius in twelve 0.4 ha quadrats. In 1977 and 1978, all individuals were counted. In 1980, only individuals taller than 1.5 m were counted.

Plot-Quadrat	Late 1977	Late 1978	Late 1979	Early 1981
1-8	0	3	8	7
1-9	0	1	0	10
1-10	0	2	4	23
1-12	0	0	0	5
1-15	0	0	12	7
2-1	0	2	13	20
2-3	0	1	4	20
2-6	0	3	18	23
2-8	0	2	6	11
2-9	0	1	9	28
2-11	0	1	20	19
2-14	0	4	14	30
Total	0	20	108	203
Mean	0	1.7	9.0	16.9

Table 23. Mean densities of Schinus terebinthifolius in thirty-five 0.4 ha quadrats.

Plot	Number of quadrats counted	Mean density of Schinus/0.4 ha quadrat late 1977	late 1978	early 1981
1	7	0.1	1.0	12.4
2	7	0	2.0	21.6
5	13	0.3	4.7	13.8
6	8	0	2.0	13.4
Total Density	35	5	98	524
Total mean density/quadrat		0.1	2.8	15.0
Range of density/quadrat		0-3	0-11	4-30

Table 24. Numbers of Schinus terebinthifolius and Psidium guajava in two 0.4 ha quadrats, about 5 years after abandonment of fields, by 0.5 m height classes.

	Height Class (m)	Number of Plants per 0.4 ha Plot	
		Plot Number	
		1-8 (P_1-C_2-R_4)	2-8 (P_2-C_2-R_4)
Schinus	0 - .49	0	* 28
	.5 - .99	0	48
	1 - 1.49	2	18
	1.5 - 1.99	2	3
	2 - 2.49	4	3
	2.5 - 2.99	2	0
	3.0 - 3.5	0	0
	Total	10	100
Psidium	0 - .49	**(16) x 5 = 80	0
	.5 - .99	**(34) x 5 = 170	0
	1 - 1.49	52	0
	1.5 - 1.99	17	1
	2 - 2.49	30	0
	2.5 - 2.99	16	1
	3.0 - 3.5	1	0
	Total	366	2

* The only Schinus plants in this size class were those in the midst of large clumps of Schinus which were extremely crowded.

** Psidium less than 1 m tall in these plots were counted in only 1/5 of the plot. Since they were fairly evenly distributed, the number was multiplied by 5 to get an estimate for the plot.