A Study of Seedling Numbers in Relation to Canopy Cover in Six Long Island Pine Barren Community Types

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ABSTRACT

A Study of Seedling Numbers in Relation to Canopy Cover in Six Long Island Pine Barren Community Types. EMILY EFSTRATION (University of Delaware, Newark, DE 19717) TIMOTHY GREEN, PhD (Brookhaven National Laboratory, Upton, NY 11973).

Seedlings and saplings are important to forest health because they provide insight as to how the forest will develop and survive in the years to come. The canopy cover's density has much to do with how these seedlings and saplings will develop and survive. Canopy cover, density and the amount of seedlings were studied in different forest communities to help predict the future of these forests. Using a Geographic Information System (GIS) and Global Positioning System (GPS), points were selected at random and twenty five by sixteen meter plots were analyzed. By using a densitometer, the canopy cover was determined in each plot along ten transects at randomly determined intervals. Seedlings and saplings were counted in four belt transects as well as noted in the entire plot. The different communities that were compared include Pine Oak, Oak Pine, Pitch Pine, Coastal Oak areas, Dwarf Pine and Pitch Pine-Scrub Oak Woodland/Shrubland. In the Coastal Oak community, where the cover was found to be 96% hardwood cover and no pine cover, no seedlings or saplings found. On the other hand, in a Pitch Pine plot, with 72% pine cover and 1.5% hardwood cover, approximately 86 seedlings and 85 saplings were found. When this study is redone in ten years to determine the progress of the forest, the investigators will determine if human intervention is needed to aid in forest growth. If adolescent trees were found healthy and growing, this would show the progression of the Pine Barrens and would also prove that the forest is capable of recuperating without human aid.

INTRODUCTION

The Long Island Pine Barrens, the island's largest natural area, covers 100,000 acres, however, it is deteriorating as it is thought to have covered 250,000 acres at one point. The Foundation for Ecological Research in the Northeast (FERN) was founded to fund environmental and ecological research. The Central Pine Barrens Monitoring Program is a main program of FERN. This program determined the current health status of the Pine Barrens and by repeating the research in ten years, will determine future health status. By comparing the present to future data in the same plots, the condition of the Pine Barrens can be determined over time. Depending on the condition, human intervention may be needed to aid in restoration.

A main factor in determining the health of the forest is the seedlings and saplings that are thriving. Seedling numbers are dependant upon the amount of sunlight that filters through the forest canopy. There needs to be enough trees to produce seeds for germination, but there also needs to be enough sunlight reaching the forest floor to allow the seedlings to grow into saplings and adult trees. A forest or community that has a high percentage of cover, a large number of seedlings, but few saplings shows that the seeds are being germinated, but not enough light is reaching the ground for seedling to sapling development. An ideal condition would be to have a large number of seedlings and saplings to show that there is growth in the community. By conducting these experiments now and again in ten years, this will show whether the Pine Barrens are growing steadily or if human intervention is needed.

It is anticipated that a healthy forest will have a less dense canopy and more seedlings, therefore showing the progression of the Pine Barrens. Human intervention

will be necessary if a community is found without seedlings or saplings and a low density of canopy cover. Therefore, studying the ratio between seedling/ sapling number and canopy cover is very important because it determines the future of the forest and gives land managers particular areas in which to focus preservation efforts.

MATERIALS AND METHODS

The methods were performed in accordance with the Monitoring Protocols for Central Pine Barrens Field Plots [9]. The plots were generated randomly in six different community types of the Pine Barrens Forest, Coastal Oak Forest, Oak-Pine Forest, Pine-Oak Forest, Scrub-Oak Forest, Dwarf Pine Forest and Pitch Pine Forest. The established plots are sixteen by twenty five meters, with the twenty-five meter side being parallel to the road. Ten random line transects were established and each was analyzed. The position at which the transects begin and the points where data is collected are both chosen at random. The investigator collects the data along the transects at one meter intervals for twenty meters. Once the investigator reaches each point, they record the flora observed and the density of the canopy, via a densitometer. The densitometer is an instrument used to look directly upwards. By looking through this, the observer can see exactly what kind of cover is above the point they are at in the transect. The cover will be hardwood, pine or the sky.

Seedlings and saplings are recorded within the plot by forming four belt transects that are two by twenty-five meters long. Each of the four transects are sampled for seedlings and saplings of different species, hardwood and pine. Half of the plot, eight by twenty-five meters, is surveyed for seedlings and saplings. [9]

RESULTS

According to Figure 1 and Table 1, the number of seedlings in a Coastal Oak Community increases with the increase in canopy cover. When the correlation coefficient was calculated between seedlings and canopy cover, the result was 0.07, reassuring the accuracy of the information. On the other hand, the number of saplings found decreased with the increased canopy density. When the correlation coefficient was calculated between saplings and canopy cover, it was found to be -0.10.

Oak-Pine Forests provided the same results, an increase of seedlings with an increase in canopy density and a decrease in saplings with an increase in canopy cover. The correlation coefficient of the relationship between seedlings and canopy density was calculated to be 0.17. The relationship of saplings to canopy density had a correlation coefficient of -0.50. The relationship between seedlings, saplings and canopy density can be seen in Figure 2 and Table 2.

Pine-Oak Forests, according to Figure 3 and Table 3, have an increased number of seedlings with an increased canopy cover. The saplings decreased with an increased canopy cover. The correlation coefficient of seedlings to canopy cover is 0.27 and the correlation coefficient of saplings to canopy cover is -0.32.

More seedlings were found with an increased amount of canopy cover in the Pitch Pine Communities. The amount of saplings found decreased as canopy cover increased [Figure 4, Table 4]. The correlation coefficient of seedlings to canopy cover is 0.27 and the correlation coefficient of saplings in relation to canopy cover is -0.32.

In the Pitch Pine-Scrub Oak Woodland/Shrubland Community, the number of seedlings increased with the amount of canopy cover. The amount of saplings decreased

with the increased amount of canopy cover [Figure 5, Table 5]. The correlation coefficient for the relationship between seedlings and canopy cover is 0.22 and the correlation coefficient for the relationship between saplings in a Pitch Pine-Scrub Oak Woodland/Shrubland Community and canopy cover is -0.40.

The Dwarf Pine Plains Community was found to have zero canopy cover, one seedling and one sapling. The correlation constants could not be calculated due to the lack of canopy.

When the canopy cover density was separated into hardwood cover and pitch pine cover, the correlation coefficients were basically the same for each community type.

According to Figure 6, the number of seedlings in the entire Central Pine Barrens increases with canopy density and the number of saplings decreases with the increased canopy density.

DISCUSSION AND CONCLUSION

According to all of the charts and figures from the results, the amount of seedlings found in a community increased with the increase of canopy density. This is because there are more trees to produce seeds that can germinate. The apparent problem is not the germination of the seedlings, but the development thereafter. The seedlings tend to thrive best under thick canopy, but the saplings were more abundant in the areas with less canopy cover. This is because the saplings need more sunlight to thrive and grow.

Depending on the species, some trees are more tolerant of growing in the shade than others. Species are characterized according to their ability to grow in the shade. If the species is very tolerant, that means that they can grow easily with minimal sunlight.

Very intolerant species are those that require full sunlight in order to prosper and grow. A species that is intermediately tolerant of shade is a species that is in between the two extremes. [1]

Quercus alba, White Oak, is a species that is classified as intermediate in its tolerance to shade. White Oak tends to be more tolerant of shade when it is a seedlings then progressively gets less tolerant as it grows. [2,3] The intolerance to shade as the tree grows supports the data found in the different communities. When the canopy cover was more dense, there were more seeds available to germinate and grow, but there was not much sunlight reaching the forest floor. As the seedlings grew, they required more sunlight and since this was not available they did not grow past seedlings.

The Scarlet Oak, *Quercus coccinea,* is another species studied in the different communities. The Scarlet Oak is very intolerant of the shade. It does not grow unless it is a dominant or codominant species in the community. [4] Since this is the case, not many seedlings or saplings would be found unless the area has minimal canopy cover to allow sunlight to reach the forest floor.

Quercus velutina, Black Oak, is intermediate in its tolerance of shade. It is more tolerant of some species, but less tolerant of others such as *Quercus alba*. Since light is needed to progress the seedlings into their sapling stage, many seedlings eventually die under a dense canopy cover. [5]

Pitch Pine, *Pinus rigida*, needs full sunlight in order to grow, it cannot grow in the shade. Since the tree is shade intolerant, it cannot grow if there is a dense canopy cover. Pitch Pine grows especially well after a disturbance such as a forest fire. [6,7,8]

All of the data collected in each of the community types (Coastal Oak, Oak-Pine, Pine-Oak, Pitch Pine, Dwarf Pine and Pitch Pine-Scrub Oak Woodland/Shrubland) supports the fact that seedlings need sunlight in order to develop into saplings. The seedlings are able to flourish under a thick canopy because the seeds are readily available for germination. By looking at the graphs, one can see that the amount of seedlings increases with the increase in canopy in all of the communities. The problem arises when the seedlings attempt to grow into saplings and the thick canopy does not allow much light to penetrate through. If the sunlight is not available, this progress cannot be obtained and the seedlings die. This is why there are not as many saplings as seedlings under the more dense canopy.

Although the seedlings cannot develop into saplings under a dense canopy, the dense forest shows that it is thriving and doing well. It is crucial for the seedlings to develop into saplings when the forest has some sort of negative disturbance, such as a forest fire. In this case, the seedlings and saplings usually have enough sunlight to grow into adult trees and help the forest overcome the obstacle.

ACKNOWLEDGMENTS

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FIGURES

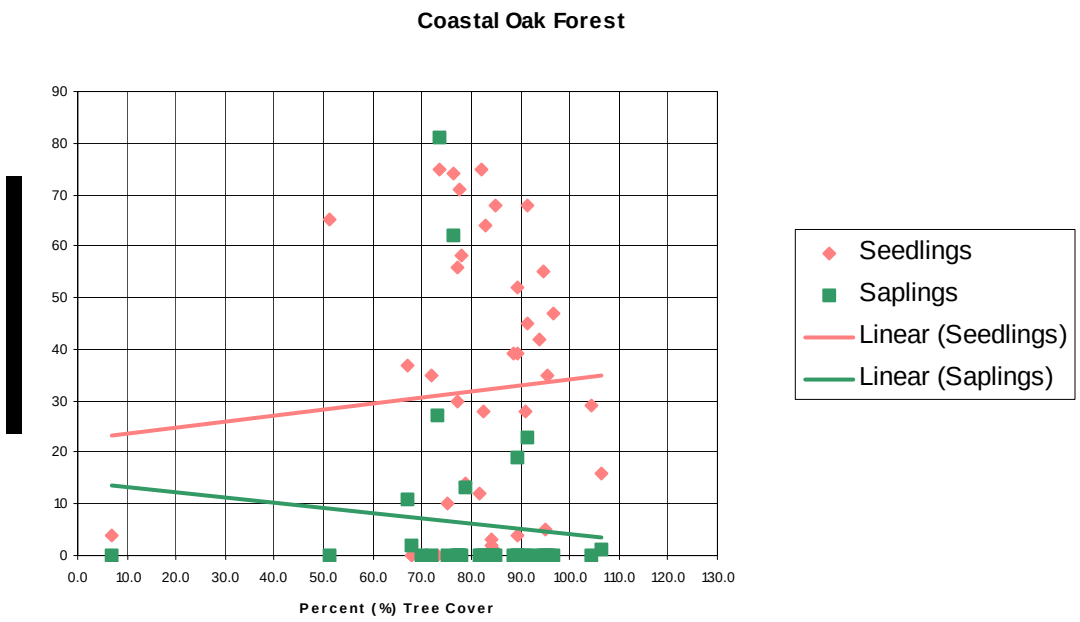

Figure 1. A graph relating percent tree cover v. seedlings and saplings in the Coastal Oak Forests.

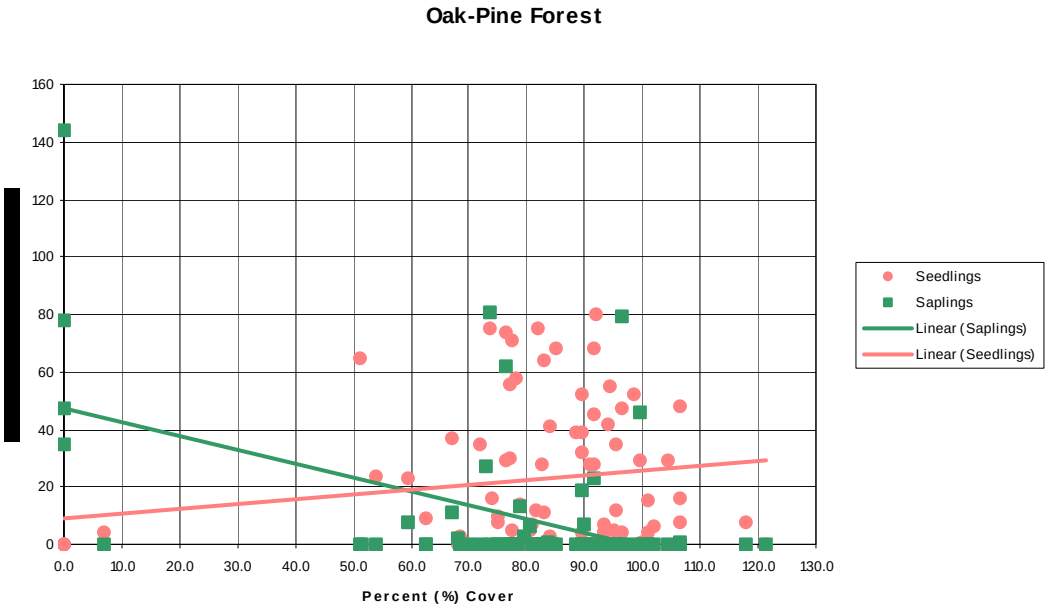

Figure 2. A graph relating percent tree cover v. seedlings and saplings in the Oak-Pine Forests.

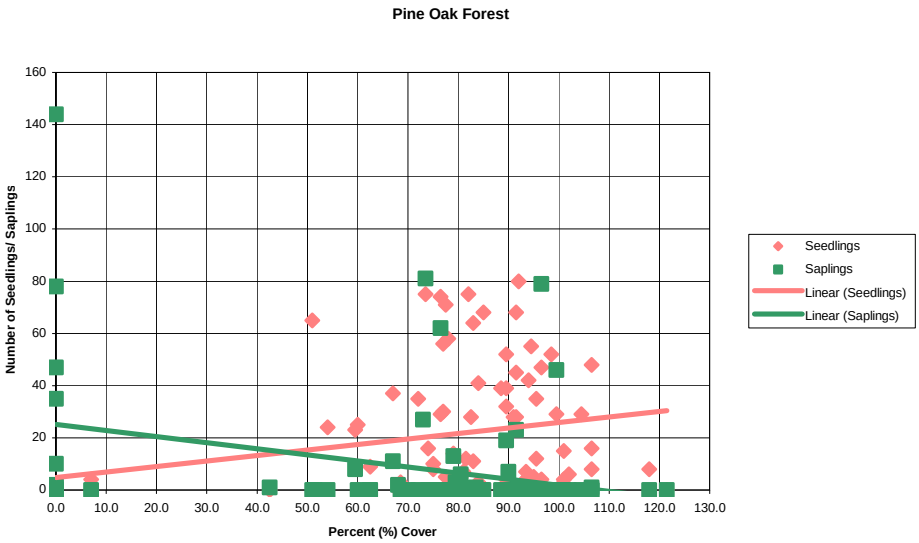

Figure 3. A graph relating percent tree cover v. seedlings and saplings in the Pine-Oak Forests.

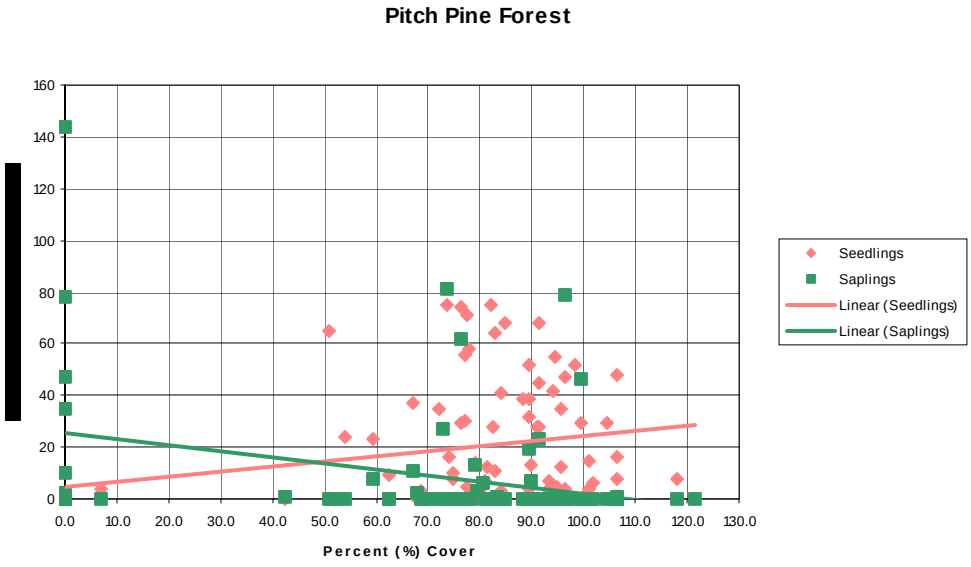

Figure 4. A graph relating percent tree cover v. seedlings and saplings in the Pitch Pine Forests.

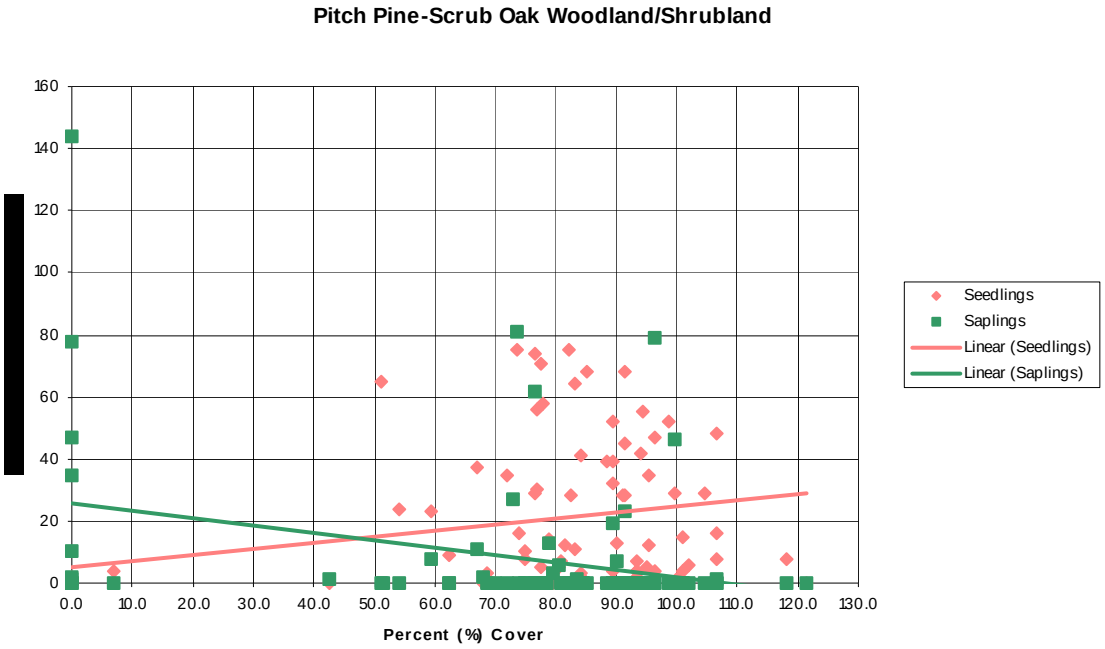

Figure 5. A graph relating percent tree cover v. seedlings and saplings in the Pitch Pine-Scrub Oak Woodland/ Shrubland Forests.

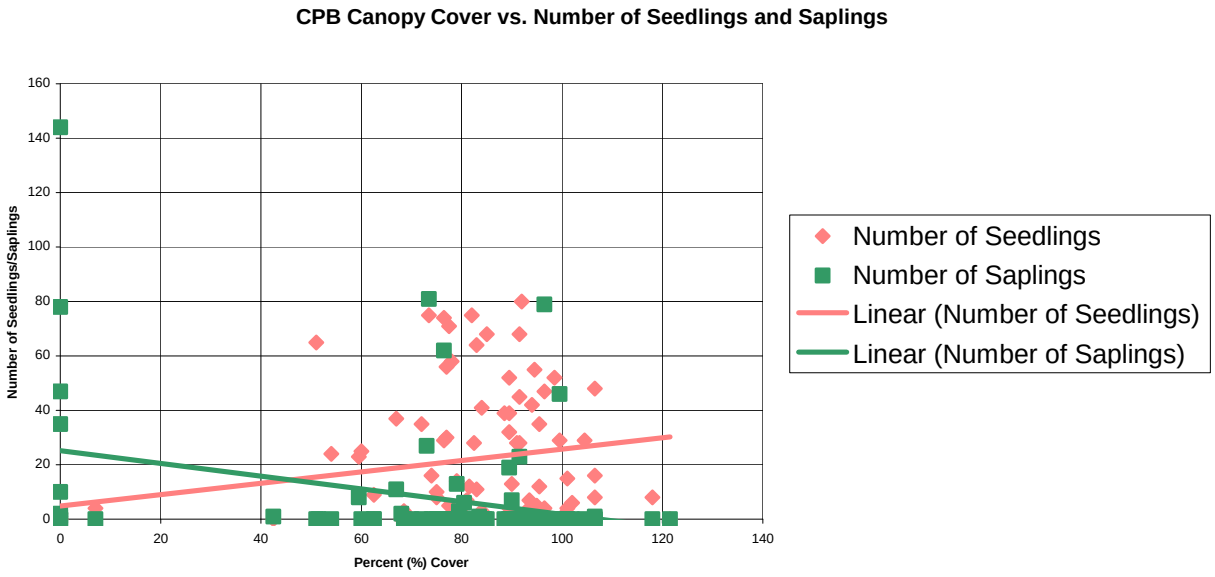

Figure 6. A graph relating percent tree cover v. seedlings and saplings in the Central Pine Barrens.

TABLES

Actual Community	Plot Number	%cover	Number of Seedlings	Number of Saplings
Coastal Oak Forest	06	84	2	0
Coastal Oak Forest	07	91.5	68	23
Coastal Oak Forest	08	96	0	0
Coastal Oak Forest	10	89.5	52	19
Coastal Oak Forest	12	77	56	0
Coastal Oak Forest	13	82	75	0
Coastal Oak Forest	18	83	64	0
Coastal Oak Forest	19	84	3	0
Coastal Oak Forest	20	79	14	13
Coastal Oak Forest	21	95.5	35	0
Coastal Oak Forest	23	77	30	0
Coastal Oak Forest	25	51	65	0
Coastal Oak Forest	26	7	4	0
Coastal Oak Forest	27	91.5	45	0
Coastal Oak Forest	31	73	0	27
Coastal Oak Forest	32	77.5	71	0
Coastal Oak Forest	39	94.5	55	0
Coastal Oak Forest	42	81.5	12	0
Coastal Oak Forest	45	91	28	0

Table 1. The percent cover distribution and the number of seedlings and saplings found in the Coastal Oak Forests.

Actual Community	Plot Number	%cover	Number of Seedlings	Number of Saplings
Oak-Pine Forest	02	92	80	0
Oak-Pine Forest	05	76.5	29	0
Oak-Pine Forest	22	89.5	39	0
Oak-Pine Forest	24	75	10	0
Oak-Pine Forest	28	67	37	11
Oak-Pine Forest	29	94	42	0
Oak-Pine Forest	30	96.5	47	0
Oak-Pine forest	33	85	68	0
Oak-Pine Forest	34	104.5	29	0
Oak-Pine Forest	35	95	5	0
Oak-Pine Forest	37	78	58	0
Oak-Pine Forest	38	82.5	28	0
Oak-Pine Forest	40	76.5	74	62
Oak-Pine Forest	43	89.5	4	0
Oak-Pine Forest	46	91.5	28	0
Oak-Pine Forest	48	95.5	12	0
Oak-Pine Forest	53	99.5	29	46
Oak-Pine Forest	54	84	41	0
Oak-Pine Forest	55	81	7	0
Oak-Pine Forest	56	62.5	0	0
Oak-Pine Forest	57	100	1	0
Oak-Pine Forest	58	62.5	9	0
Oak-Pine Forest	59	101	15	0
Oak-Pine Forest	60	77.5	5	0
Oak-Pine Forest	64	96.5	4	79
Oak-Pine Forest	65	106.5	48	0
Oak-Pine Forest	67	98.5	52	0
Oak-Pine Forest	68	75	8	0
Oak-Pine Forest	77	93.5	7	0
Oak-Pine Forest	81	101	4	0
Oak-Pine Forest	82	102	6	0

Table 2. The percent cover distribution and the number of seedlings and saplings found in the Oak-Pine Forests.

Actual Community	Plot Number	%cover	Number of Seedlings	Number of Saplings
Pine-Oak Forest	01	60	25	0
Pine-Oak Forest	11	72	35	0
Pine-Oak Forest	15	84.5	0	0
Pine-Oak Forest	36	88.5	39	0
Pine-Oak Forest	41	106.5	16	1
Pine-Oak Forest	47	89.5	32	0
Pine-Oak Forest	49	59.5	23	8
Pine-Oak Forest	50	93.5	4	0
Pine-Oak Forest	51	118	8	0
Pine-Oak Forest	52	106.5	8	0
Pine-Oak Forest	89	93	0	0
Pine-Oak Forest	90	42.5	0	1

Table 3. The percent cover distribution and the number of seedlings and saplings found in the Pine- Oak Forests.

Actual Community	Plot Number	%cover	Number of Saplings	Number of Saplings
Pitch Pine Forest	03	80.5	6	6
Pitch Pine Forest	09	73.5	81	81
Pitch Pine Forest	14	77.5	0	0
Pitch Pine Forest	16	68	2	2
Pitch Pine Forest	17	70	0	0
Pitch Pine Forest	44	84.5	0	0
Pitch Pine Forest	61	90	7	7
Pitch Pine Forest	62	78.5	0	0
Pitch Pine Forest	63	83	0	0
Pitch Pine Forest	66	93.5	0	0
Pitch Pine Forest	69	74	0	0
Pitch Pine Forest	70	121.5	0	0
Pitch Pine Forest	71	79.5	3	3
Pitch Pine Forest	72	68.5	0	0
Pitch Pine Forest	73	83.5	1	1
Pitch Pine Forest	79	93.5	0	0
Pitch Pine Forest	80	51.5	0	0
Pitch Pine Forest	91	90	0	0

Table 4. The percent cover distribution and the number of seedlings and saplings found in the Pitch Pine Forests.

Actual Community	Plot Number	%cover	Number of Seedlings	Number of Saplings
Pitch Pine-Scrub Oak Woodland/Shrubland	04	54	24	0
Pitch Pine-Scrub Oak Woodland/Shrubland	74	0	0	47
Pitch Pine-Scrub Oak Woodland/Shrubland	75	0	0	144
Pitch Pine-Scrub Oak Woodland/Shrubland	76	0	0	78
Pitch Pine-Scrub Oak Woodland/Shrubland	78	0	0	35
Pitch Pine-Scrub Oak Woodland/Shrubland	84	0	0	10
Pitch Pine-Scrub Oak Woodland/Shrubland	85	0	2	2

Table 5. The percent cover distribution and the number of seedlings and saplings found in the Pitch Pine-Scrub Oak Woodland/Shrubland Forests.