A Comparative Study of the Age Class Structures of *Quercus alba, Quercus coccinea*, *Quercus velutina* and *Pinus rigida* as an Indicator of Forest Health Within the Long Island Pine Barrens Core Area

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ABSTRACT

Investigation of the age class structure of *Quercus* species and *Pinus rigida* within the Long Island Pine Barrens core area is an important aspect of monitoring the health of the Pine Barrens. The age class structures of *Quercus alba*, *Quercus coccinea*, *Quercus velutina,* and *Pinus rigida* are primary indicators of successful reproduction and the possibility of the successional change between community types. By comparing the numbers of seedlings, saplings and mature trees, the success of reproduction for these three *Quercus* species and *Pinus rigida* was analyzed. The numbers of seedlings and saplings were recorded through the use of four two-meter wide belt transects within 16 by 25 meter plots. These plots were located within the Pine Barrens subtargets of Pitch Pine, Pine-Oak, Oak-Pine, Coastal Oak, Scrub Oak and Dwarf Pine forests. This study found the success of reproduction for all the study tree species within the six community types to be varied. *Q. alba*, *Q. coccinea* and *Q. velutina* all displayed a low number of saplings in all community types surveyed, indicating that current reproduction is not very successful. In Coastal Oak and Oak-Pine communities, *Q. alba* was the most successful in reproduction. The reproduction of *P. rigida* was dominant within Pine-Oak, Pitch Pine and Pitch Pine-Scrub Oak Woodland communities. However, the low average number of *P. rigida* saplings found could possibly indicate the succession from pine-dominated forest to oak dominated forest. There are several factors that may influence these trends in reproduction, including exposure to light, levels of litter and duff, and deer browse. Although the current levels of reproduction for *Quercus* species and *P. rigida* are varied and range across the different community types, they are still an important indicator of forest succession within the Long Island Pine Barrens core area. Forest succession is an important factor in this ten-year longitudinal

study of the Long Island Pine Barrens core area, as forest succession and species competition are primary indicators of forest health.

INTRODUCTION

The Long Island Pine Barrens, an area comprising 102,500 acres of central and eastern Long Island, is a region of ecological importance [1: 1]. In order to understand the dynamics of the Long Island Pine Barrens, the Foundation for Ecological Research in the Northeast (FERN) developed a monitoring program to collect data to measure indicators of primary ecological attributes of the region. FERN is partially funded by the Central Pine Barrens Joint Planning and Policy commission, and works in cooperation with the Nature Conservancy, the Upton Ecological Research Reserve and Brookhaven National Lab. By collecting data on the current conditions of the Pine Barrens, the monitoring program will be able to provide a baseline of forest health in order to determine the actions of further conservation efforts. When the data is collected again in ten years, the monitoring program will also serve to detect and document the degree and direction of change in forest health, and to identify the priorities of research within the Long Island Pine Barrens [2: 3].

The successful reproduction of *Quercus* species is indicative of the possibility of forest succession from a pine-dominated forest to an oak dominated forest [4: 14]. In this paper, the age class structures of *Q. alba, Q. coccinea, Q. velutina* and *P. rigida* were compared in order to investigate success of reproduction for each of these species and potential changes in forest type. In studying the age class structures, it is important to survey across the six different subtargets (Pitch Pine Forest, Scrub Oak Forest, Pine-Oak Forest, Oak-Pine Forest and Dwarf Pine Plains). The pattern of succession from a pine dominated forest to an oak dominated forest is from Pitch

Pine forest, to Scrub Oak Forest, to Pine-Oak forest, to Oak-Pine forest, and finally to Coastal Oak forest [3: 8]. By studying the recruitment of *Quercus* species and *P. rigida* across the different stages of forest succession, indications of succession from one forest community to another can be observed and documented. Additionally, the success of reproduction of any one *Quercus* species in the stages of succession can be observed and documented. In the Dwarf Pine Plains, the age class structure of *P. rigida* can also be viewed as an indicator of forest health within that specific community. These findings will help to determine both the current and future ecological integrity of the Long Island Pine Barrens Core Area.

METHODS

The data for this research was collected by following the Monitoring Protocols for Central Pine Barrens Field Plots in the summers of 2005 and 2006 [2: 2]. Data from 90 randomly generated plots has been collected. The randomly generated plots were established across the six different community types. The numbers of seedlings, saplings and mature trees were recorded within various randomly generated plots within the core area of the Central Pine Barrens of Long Island. These plots within the different subtargets of the Central Pine Barrens target were generated using Geographic Information System (GIS) software. The plots had dimensions of sixteen by twenty-five meters, and were located at least fifty meters from any human disturbances (roads, houses, etc) and at least twenty meters from any ecological boundaries or differing community types. Within these plots, the numbers of seedlings, saplings and mature trees were measured.

The subtargets studied were the communities of Pitch Pine forest, Pine-Oak forest, Oak-Pine forest, Coastal Oak forest, Scrub Oak forest, and Dwarf Pine Plains. Pitch Pine forest is characterized as having over 90% of total tree cover and a subcanopy comprised of scattered scrub oak (*Quercus ilicifolia*) and having a nearly continuous shrub layer of blueberry (*Vaccinium pallidum, Vaccinium angustifolium*) and huckleberry (*Gaylussacia baccata*) [2: 4]. Pine-Oak forest differs from Pitch Pine forest in that it has a canopy of both pine and oak, with pine cover ranging between 51-90%. The understory is similar to that of Pitch Pine, but contains less scrub oak [2: 4]. Oak-Pine forest is defined as having a canopy that consists of 51-90% cover from oak, and an understory that consists of blueberry, huckleberry and scattered scrub oak [2: 4]. Coastal oak forest has a canopy dominated by oaks and a subcanopy with nearly continuous coverage from huckleberry and blueberry species. Coastal Oak forest generally has greater species diversity than other subtargets [2:3]. The Scrub Oak community has less than 60% canopy cover and is dominated by Scrub Oak, with scattered pitch pine and low bush huckleberry and blueberry. The Dwarf Pine Plains community has low canopy cover and is primarily comprised of dwarf pitch pine and scrub oak, with a low shrub layer of huckleberry and blueberry and herbaceous species.

To estimate the number of seedlings and saplings within each of the plots, four two by twenty-five meter transects were sampled. The entire area that was sampled for seedlings and saplings of different pine and hardwood species was eight by twenty-five meters, or half of the surveyed plot. Individuals that were found within these transects were identified and recorded according to genus and species. Seedlings and saplings that had multiple stems were counted as only one seedling.

To measure the number of mature trees within each of the plots, hardwood and pine species that had a dbh (diameter at breast height) greater than 2.5 cm and less than or equal to 10 cm, and those that had a dbh greater than 10 cm were recorded. The diameter of the trees was measured at 1.37 meters from the ground using either calipers or a dbh tape. Trees that fell in these categories were measured by dbh to the nearest millimeter and then tallied. As was the case with seedlings and saplings, if tree split below the diameter at breast height into two or more stems, the tree was still counted as being singular.

The numbers of seedlings, saplings and trees collected throughout the surveying of these plots were compiled in a Microsoft Access database. After the completion of 90 plots, the averages of the numbers of seedlings, saplings and mature trees were calculated and analyzed in graphs.

RESULTS

In each of the figures and tables used for this research, the stages of growth are shown for each species across the six different community types. By viewing the transformation of *Pinus rigida* and the *Quercus* species from seedlings to saplings to mature trees, the age class structure of each species can be studied. For successful reproduction, each of the species studied will have a moderate to high number of seedlings, followed by a lower number of saplings (both between 0.5m and 2m and >2m with a dbh <2.5 cm). In healthy reproduction, the number of trees (both trees with a dbh <10cm and trees with a dbh >10cm) will increase to an average number higher than the average number of seedlings found.

For all figures and tables, the different stages of growth are represented with letters. Seedlings are represented with A; saplings between 0.5m and 2m with B; saplings >2m and having a dbh less than 2.5cm with C; trees having a dbh less than 10cm with D; and trees with a dbh >10cm with E. The average numbers of and standard deviations for seedlings, saplings and mature trees found within the six different community types were found using the Microsoft Excel program.

Table 1 shows the average number of seedlings, saplings and trees for the studied species within the 19 Coastal Oak plots surveyed. Table 1 also displays the averages and standard deviations for the different stages of growth within the Coastal Oak community. Figure 1 displays the average number of seedlings, saplings and trees for the studied species within the Coastal Oak community as a line graph, with each line on the graph representing the age class structure for one species, and each point representing a different stage of growth. Within Coastal Oak forest, each species had a higher average number of seedlings than either category of saplings. Following the decline in the average number of seedlings and saplings, the average number increased from saplings to trees for all of the tree species. *Q. alba* displayed the highest average number seedlings per plot (9.8), with an average number higher than one standard deviation above the mean of 5.3 seedlings. *Q. velutina* had the highest average number of mature trees per plot (8.6), with an average number higher than one standard deviation above the mean of 4.5 mature trees. *Q. coccinea* displayed average numbers that fell between the average numbers for *Q. alba* and *Q. velutina*. *P. rigida* had relatively low numbers of seedlings, saplings and trees in comparison with the three *Quercus* species within Coastal Oak forest. Both the average number of *P. rigida* seedlings and mature trees fell below one standard deviation from their respective means.

Table 2 shows the average number of seedlings, saplings and trees for the studied species within the 31 Oak-Pine plots surveyed. Table 2 also displays the averages and standard deviations for the different tree species in each stage of growth. Figure 2 displays the average number of seedlings, saplings and trees for the studied species within the Oak-Pine community as a line graph, with each line on the graph representing the age class structure for one species, and each point representing a different stage of growth. Within Oak-Pine forest, each species had a higher average number of seedlings than either category of saplings. Following the decline in the average number seedlings and saplings, the average number increased from saplings to trees for all of the tree species. *Q. alba* displayed both the highest average number of seedlings and mature trees per plot. The average number of *Q. alba* seedlings (14.35) fell above one standard deviation from the mean of 6.2 seedlings found per plot. However, the number of mature *Q. alba* trees (6.55) was lower than the average number of seedlings (14.35). The average numbers of mature trees for all tree species studied fell within one standard deviation from the mean of 5.24 trees found per plot. *Q. coccinea*, *Q. velutina* and *P. rigida* displayed a higher average number of mature trees than seedlings or saplings.

Table 3 shows the average number of seedlings, saplings and trees for the species studied within the 12 Pine-Oak plots surveyed. Table 3 also displays the averages and standard deviations for the different tree species in each stage of growth. Figure 3 displays the average number of seedlings, saplings and trees for the studied species within the Pine-Oak community as a line graph, with each line on the graph representing the age class structure for each of the species, and each point representing a different stage of growth. Within the Pine-Oak forest, all Quercus species had a higher average number of seedlings than either category of saplings. For *P. rigida*, however, the average number of seedlings and saplings >2m was the same. The age class structures for all the *Quercus* species and *P. rigida* also differed in that *P. rigida* was the only species that had a higher average number of mature trees than seedlings. The average number of *P. rigida* mature trees (17.58) fell above one standard deviation of from the mean of 5.93 mature trees found per plot. However, the average number of *P. rigida* seedlings (0.25) fell below one standard deviation from the mean of 3.08 seedlings found per plot. The average number of species found per plot increased from saplings to mature trees for all of the *Quercus* species, but the average number of seedlings remained higher than the average number of mature trees for both *Q. alba* and *Q. velutina*.

Table 4 shows the average number of seedlings, saplings and trees for the studied species within the 18 Pitch Pine plots surveyed. Table 4 also displays the averages and standard deviations for the different tree species in each stage of growth. Figure 4 displays the average number of seedlings, saplings and trees for the studied species as a line graph, with each line on the graph representing the age class structure for each of the species, and each point representing a different stage of growth. Within the Pitch Pine forest, the average number of seedlings for *P. rigida* and all the *Quercus* species was higher than the average number of either category of saplings. All averages for *Quercus* species fell within one standard deviation from their respective means. For *Q. alba* and *Q. coccinea*, the average number of mature trees was lower than the average number of seedlings. For *Q. velutina*, the average number of trees <10cm dbh was higher than either the average number of seedlings or mature trees. For *P. rigida*, the average number of mature trees (25.17) increased from the number of saplings (12.67 for saplings >2m and <2.5 cm dbh), and was higher than the average number of seedlings (5). Each of these numbers for *P. rigida* fell above one standard deviation from their respective means.

Table 5 shows the average number of seedlings, saplings and trees for the studied species within the 7 Pitch Pine-Scrub Oak Woodland plots surveyed. Table 5 also displays the averages and standard deviations for the different tree species in each stage of growth. Figure 5 displays the average number of seedlings, saplings and trees for the studied species as a line graph with each line on the graph representing the age class structure for each of the species, and each point representing a different stage of growth. Within the Pitch Pine-Scrub Oak Woodland, all the *Quercus* species displayed a declining average number of species found from seedlings to saplings to mature trees. All *Quercus* species at each stage of growth fell within one standard deviation from the respective means. For *P. rigida*, the average number of seedlings was lower than the average number for the first category of saplings. The average number of *P. rigida* species found decreased for the second category of saplings, and increased slightly for trees <10 cm dbh before declining for the number of mature trees found within the Pitch Pine-Scrub Oak Woodland community. For *P. rigida*, the average number of seedlings (12.14), the average number of saplings between 0.5m and 2m (24.57), and the number of saplings >2m and <2.5 cm dbh all fell above one standard deviation from their respective means.

Table 6 shows the average number of seedlings, saplings and trees for the studied species within the four Dwarf Pine Plains plots surveyed. Table 6 also displays the averages and standard deviations for the different tree species in each stage of growth. Figure 6 displays the average number of seedlings, saplings and trees for the studied species within the Dwarf Pine Plains community as a line graph with each line on the graph representing the age class structure for each of the species, and each point representing a different stage of growth. Within the Dwarf Pine Plains community, there were no *Quercus* species found. For *P. rigida* within the Dwarf Pine Plains, the average number of seedlings and saplings >0.5m and <2m were the same, and declined for the saplings >2m. No saplings >2m or trees <10cm dbh were found, and the average number of mature trees was higher than the average number of seedlings for *P. rigida* within the Dwarf Pine Plains. The average number of seedlings (.25), saplings between 0.5m and 2m (0.25), and mature trees (1.5) all fell above one standard deviation from their respective means.

DISCUSSION AND CONCLUSION

The age class structures of *Q. alba*, *Q. coccinea*, *Q. velutina* and *P. rigida* normally show a high number of seedlings, followed by a decrease in numbers as seedlings mature into saplings [2:33]. In order for *P. rigida* or any of the *Quercus* species to exemplify healthy patterns of reproduction, the graph representing their age class structure should display an increased average number from saplings to mature trees, following the slight decrease in average number from seedling to sapling. A high number of mature trees indicate successful reproduction patterns and overall forest health. Therefore, graphs representing the age class structure of the studied species are supposed to resemble a "reverse J". Although the average number of species found per plot is supposed to decline from seedlings to saplings, the scarcity of seedlings or saplings is an indicator of the possibility of failure of tree reproduction. If the numbers of seedlings and/or saplings are very low, reproduction can be seen to be struggling [2: 33]. From this study, the range of success of reproduction between species and across the six different community types can be seen.

Within the Coastal Oak community, *Q. alba* is the only species that has an age class structure that represents healthy and successful reproduction, as the transition from seedling to sapling to mature tree approximately follows the pattern of the "reverse J". Additionally, the number of *Q. alba* seedlings fell above one standard deviation from the mean, indicating that it was more successful in seedling production than *Q. coccinea*, *Q. velutina* or *P. rigida*. The fact that both the average number of *P. rigida* seedlings and mature trees fell below one standard deviation from their respective means indicates that that *P. rigida* was unsuccessful in reproduction within the Coastal Oak community when compared with the *Quercus* species. However, because the Coastal Oak community is characterized as having 10% or less presence of *P. rigida*, the unsuccessful reproduction of *P. rigida* within Coastal Oak forest doesn't necessarily indicate that the Coastal Oak community itself is unhealthy [2:4]. Rather, the relative success of *Q. alba* reproduction indicates that conditions for growth are optimum for this species. Due to the fact that the Coastal Oak community is comprised primarily of *Quercus* species, the successful reproduction of *Quercus* species is more relevant to revealing forest health within the Coastal Oak community.

Within the Oak-Pine community, *Q. alba* was the only species that has an age class structure that represents healthy and successful reproduction, as the transition from seedling to sapling to mature tree approximately follows the pattern of the "reverse J". Additionally, the number of *Q. alba* seedlings fell above one standard deviation from the mean, indicating that it was more successful in seedling production than *Q. coccinea*, *Q. velutina* or *P. rigida*. The average number of *P. rigida* seedlings and mature trees found were higher than either the average number for *Q. coccinea* or *Q. velutina* seedlings or mature trees. This finding may indicate that conditions within Oak-Pine forests are more favorable for *P. rigida* reproduction than for *Q. coccinea* or *Q. velutina* reproduction, which is unexpected considering that the presence of *P. rigida* within the Oak-Pine community should be lower than *Quercus* species [2:4].

Within the Pine-Oak community, both *Q. alba* and *Q. velutina* have age class structure graphs that resemble a "reverse J". Although this generally indicates successful reproduction, that fact that the average numbers of seedlings and mature trees are relatively low indicates that *Quercus* species are not as successful in reproduction within the Pine-Oak community as they are in the Coastal Oak or Oak-Pine forests. However, like *P. rigida* within the Coastal Oak community, this is not necessarily an indicator of poor forest health, but instead is a characterization of a different community type. It may also be an indicator of the successional change from Pine-Oak to Oak-Pine forest, as *Q. alba* and *Q. velutina* are successful in reproduction, but in low average numbers that may eventually increase as forest succession continues. Within Pine-Oak forest, the presence of *P. rigida* is supposed to be between 50% and 89% [2:4]. The average number of mature *P. rigida* trees within Pine-Oak forest is much higher than the average number of mature trees for the *Quercus* species, but the average number of *P. rigida* seedlings is low in comparison to the *Quercus* species, with an average number that falls below one standard deviation from the mean. The low number of *P. rigida* seedlings can be seen as an additional indicator of the possible trend of Pine-Oak forest to Oak-Pine forest.

Within the Pitch Pine community, *P. rigida* displayed average numbers for both seedlings and mature trees that fell above one standard deviation of the mean, indicating that *P. rigida* was the most common species within the Pitch Pine community. Given that the Pitch Pine forest is comprised of more than 90% Pitch Pine, the prevalence of *P. rigida* and the very limited numbers of *Quercus* species is not unexpected [2:4]. However, the fact that *P. rigida* displays relatively low number of seedlings in comparison to mature trees may indicate that much of the Pitch Pine community exhibits an uneven stage of growth as a result from successional change from Pine-Oak forest to Pitch Pine or vice-versa. A low number of seedlings in comparison may indicate that the current numbers of mature trees are struggling to reproduce to their own levels, and is beginning to transition from pine dominated forest to oak dominated forest.

Within the scrub oak community, the average numbers of *P. rigida* for each stage of growth fell above one standard deviation from the mean, indicating that *P. rigida* was more dominant within the scrub oak community than any of the *Quercus* species. Given that Pitch Pine-Scrub Oak is characterized as having more *P. rigida* present than any of the *Quercus* species, these findings are not unexpected [2:4]. As with the Pitch Pine forest, the Pitch Pine-Scrub Oak Woodland displays a high average number of mature trees in comparison with seedlings and saplings, which may indicate the possibility of reproductive struggle and the possibility of the beginnings of succession from a pine dominated forest to an oak dominated forest.

Within the Dwarf Pine Plains, *P. rigida* was the only species found. The absence of *Quercus* species from the Dwarf Pine Plains region is one characteristic of this community type [3:24]. Instead of comparing the numbers of *P. rigida* seedlings, saplings and mature trees with *Quercus* species, however, these numbers show the reproductive patterns of *P. rigida* within a community dominated by dwarf pitch pines. Although the average numbers of standing *P. rigida* seedlings, saplings and mature trees are low, they are significant in displaying that not only dwarf pine varieties of Pitch Pine are present within the Dwarf Pine Plains community.

In studying the age class structures of the studied species, it is important to look at these trends both in terms of individual species success and overall forest succession. Within the Coastal Oak and Oak-Pine communities, *Q. alba* appeared to have the most successful reproductive patterns. Factors which may influence the success of *Q. alba* over *Q. coccinea* and *Q. velutina* include exposure to light, litter and duff depth, and the extent of deer browse [2: 34]. In order for *Quercus* species to grow, they need an adequate amount of light and fairly deep levels of litter and duff [4: 15]. If these conditions are not met, and there is deer overbrowse due to the increasing deer population in the area, the reproduction of *Q. alba, Q. coccinea* and *Q. velutina* will be unsuccessful [2: 34].

The possibility of successional change from pine dominated forest to oak dominated forest exhibited by the data from Pitch Pine and Pitch Pine-Scrub Oak Woodland communities is another aspect of reproductive patterns that are an important aspect of monitoring the Long Island Pine Barrens. Although there is some indication that these community types are undergoing succession, it is also likely that they are uneven staged forests. The reason why there are few saplings may not just be the fault of inadequate exposure to light, unsuitable levels of litter and duff, or extent of deer browse, but also may be due to different periods of growth exhibited within a surveyed community [4:14]. The number of saplings greater than two meters may be low because seedlings and saplings that are less than two meters have not had enough time to grow to further stages of maturity yet. The fact that the Pine Barrens is an uneven aged forest may also explain why there are higher average numbers of trees found within the surveyed plots while the average number of saplings was low.

Additionally, forest succession is difficult to monitor because there may not be a climax community toward which the Pine Barrens will be evolving. Rather, what the Long Island Pine Barrens appears to show us is that it is a community containing many different periods of succession. Instead of moving toward a climax community, reproductive patterns and forest succession reveal that there is an ongoing struggle between different species for light, food and nutrients contained in litter and duff. This struggle allows certain species to reproductively succeed, and others to fail in the face of varying environmental conditions [5: 70] Thus, the overall course of succession cannot necessarily be predicted. By studying the individual reproductive patterns of *Q. alba, Q. coccinea, Q. velutina* and *P. rigida* across the six different community types, the successes and failures of each species can be better understood. Future monitoring of the Long Island Pine Barrens will be needed in order to follow and preserve the natural progression of each of these species and their age class structures.

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TABLES

	A	B	C	D	E
Pinus rigida	1	0	0.16	0.05	0.89
Quercus alba	9.8	0.32	0.11	3.11	3.47
Quercus coccinea	5.1	0.47	0.11	2.47	5.05
Quercus velutina	4.68	0.11	0.47	3.36	8.6
Average of all species	5.3	0.23	0.21	2.25	4.50
Standard deviation	3.6	0.21	0.17	1.51	3.23

Table 1. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Coastal Oak community

	A	B	C	D	E
Pinus rigida	3.74	0.45	0	0.87	4.9
Quercus alba	14.35	0.87	0.06	3	6.55
Quercus coccinea	3.48	0.06	0.06	2.97	6.16
Quercus velutina	3.26	0	0	2.26	3.32
Average of all species	6.21	0.35	0.03	2.28	5.23
Standard deviation	5.43	0.40	0.03	1.0	1.46

Table 2. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Oak-Pine community

	A	**B**	**C**	**D**	**E**
Pinus rigida	0.25	0.33	0.25	14.67	17.58
Quercus alba	6.08	0.58	0	1.42	1.75
Quercus coccinea	2.17	0.33	0	2	3.67
Quercus velutina	3.83	0	0	0.92	0.72
Average of all species	3.08	0.31	0.06	4.75	5.93
Standard deviation	2.48	0.24	0.13	6.63	7.86

Table 3. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Pine-Oak community

	A	**B**	**C**	**D**	**E**
Pinus rigida	5	0	0.44	12.67	25.17
Quercus alba	2.2	1.56	0	1.78	0.06
Quercus coccinea	0.67	0.67	0.06	1.67	1.28
Quercus velutina	0.61	0.22	0	1.78	0.33
Average of all species	2.12	0.6125	0.125	4.475	6.71
Standard deviation	2.06	0.69	0.21	5.46	12.32

Table 4. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Pitch Pine community

	A	B	C	D	E
Pinus rigida	12.14	24.57	7.29	7.51	1.71
Quercus alba	2.14	0.43	0.29	0.14	0.29
Quercus coccinea	0.86	0	0	0	0.29
Quercus velutina	1.14	0	0	0.29	0
Average of all species	4.07	6.25	1.90	1.99	0.57
Standard deviation	5.41	12.22	3.60	3.69	0.77

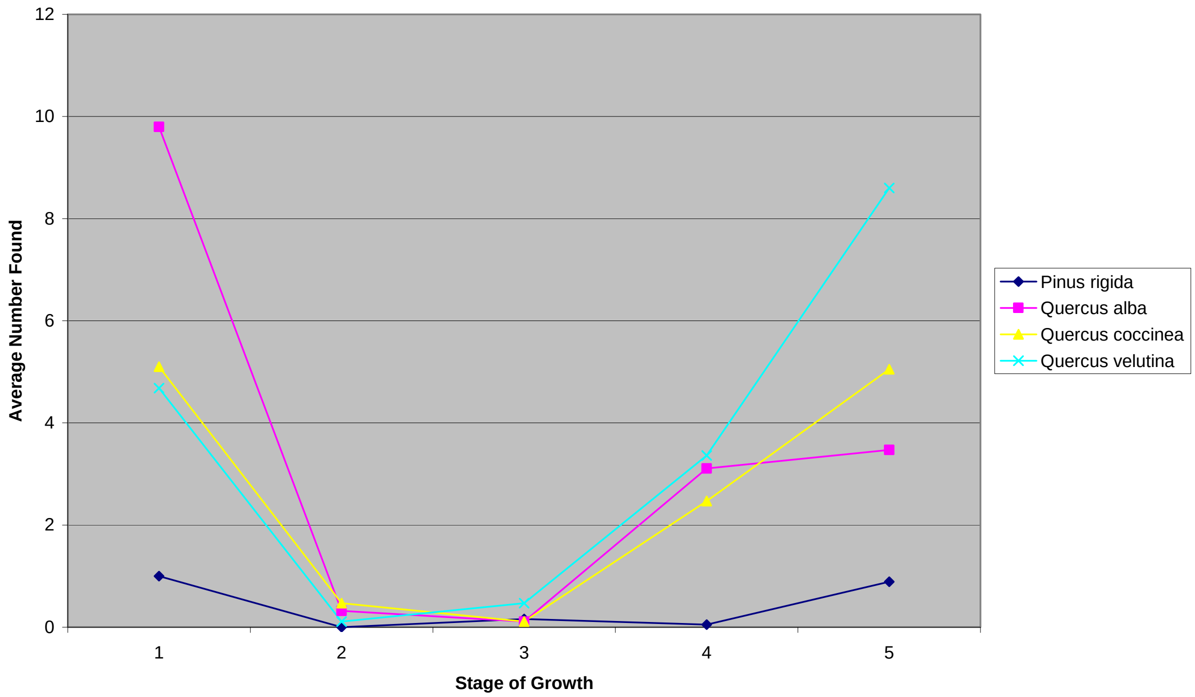
Table 5. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Pitch Pine-Scrub Oak Woodland community

	A	B	C	D	E
Pinus rigida	0.25	0.25	0	0	1.5
Quercus alba	0	0	0	0	0
Quercus coccinea	0	0	0	0	0
Quercus velutina	0	0	0	0	0
Average of all species	0.06	0.06	0	0	0.38
Standard deviation	0.13	0.13	0	0	.75

Table 6. Average Numbers of Seedlings, Saplings and Trees for Q. alba, Q. coccinea, Q. velutina and Pinus rigida within the Dwarf Pine Plains community

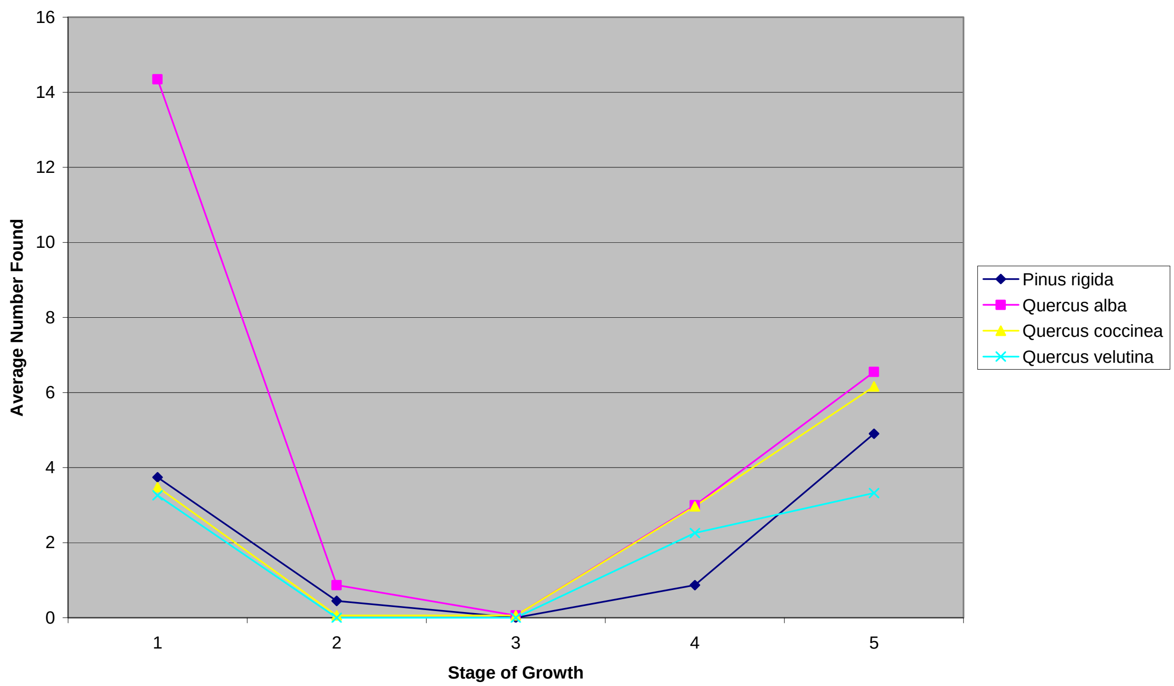
FIGURES

Figure 1



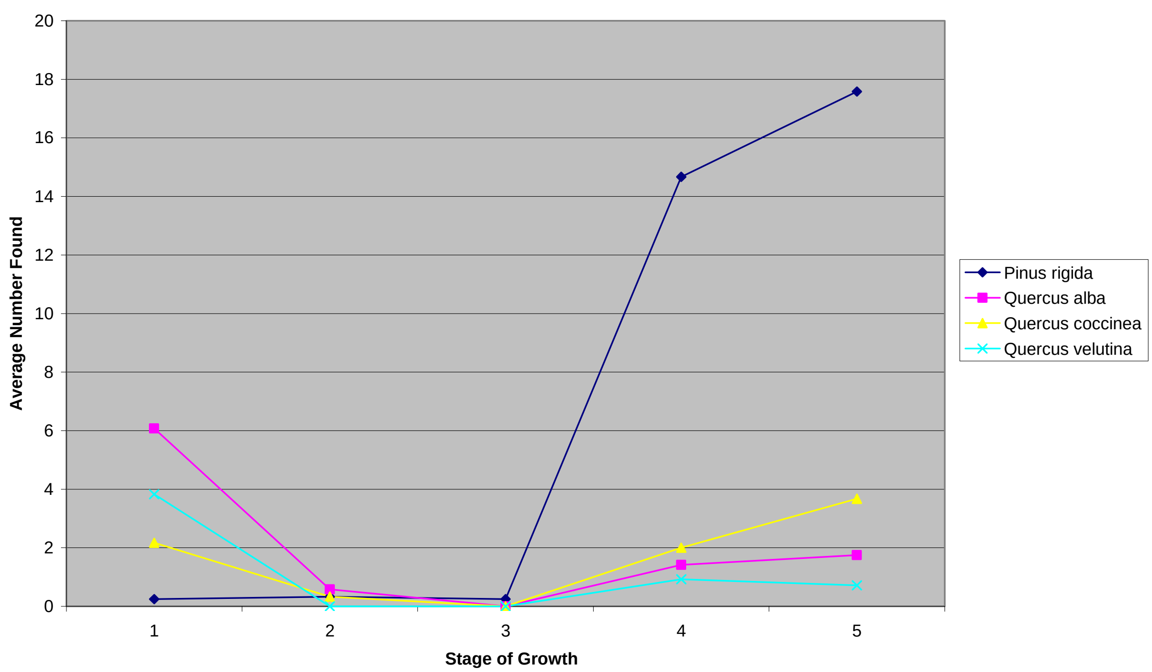
Age Class Structure within Coastal Oak community

Figure 2



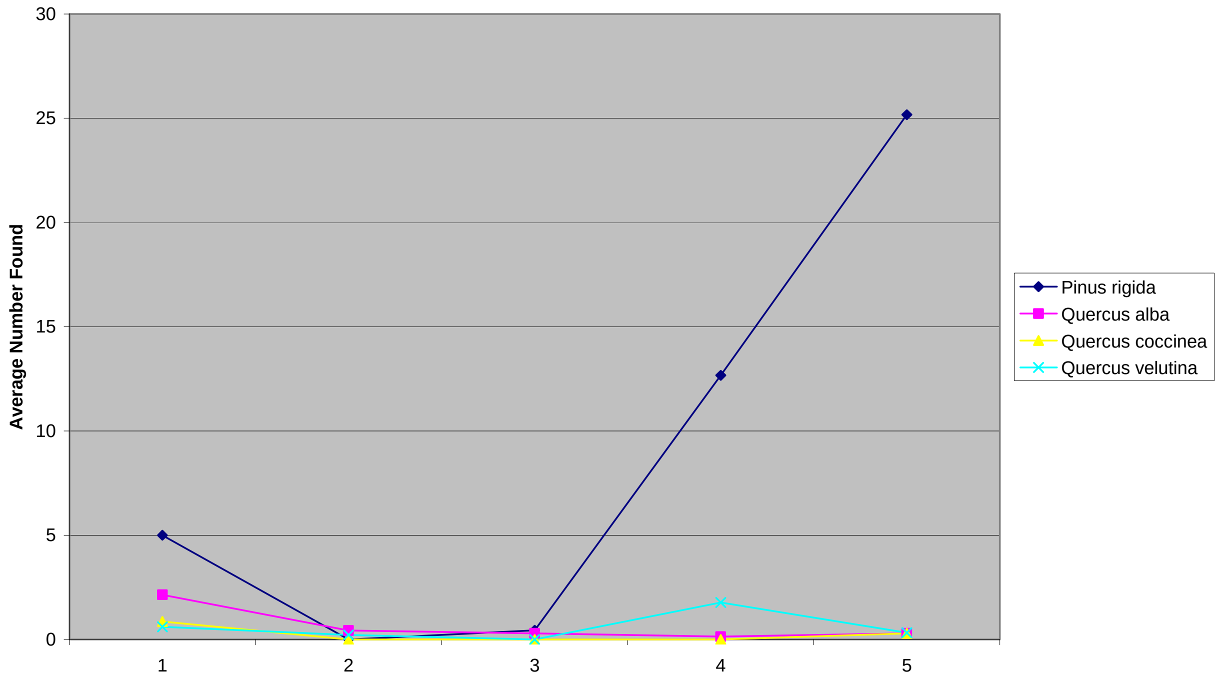
Age Class Structure within Oak-Pine community

Figure 3



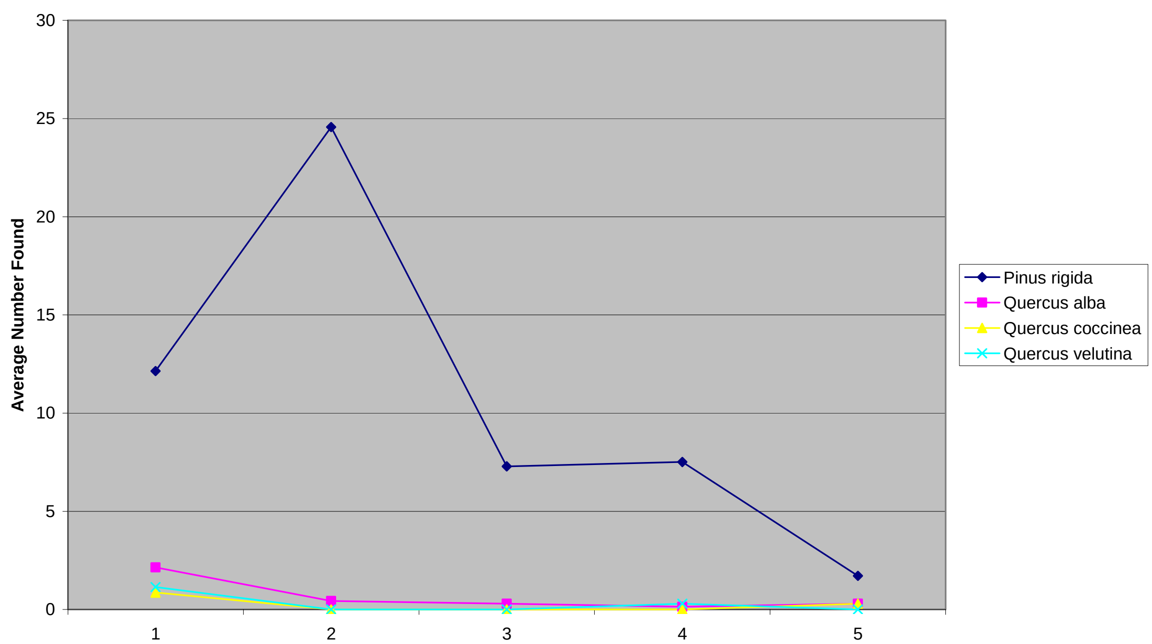
Age Class Structure within Pine-Oak community

Figure 4



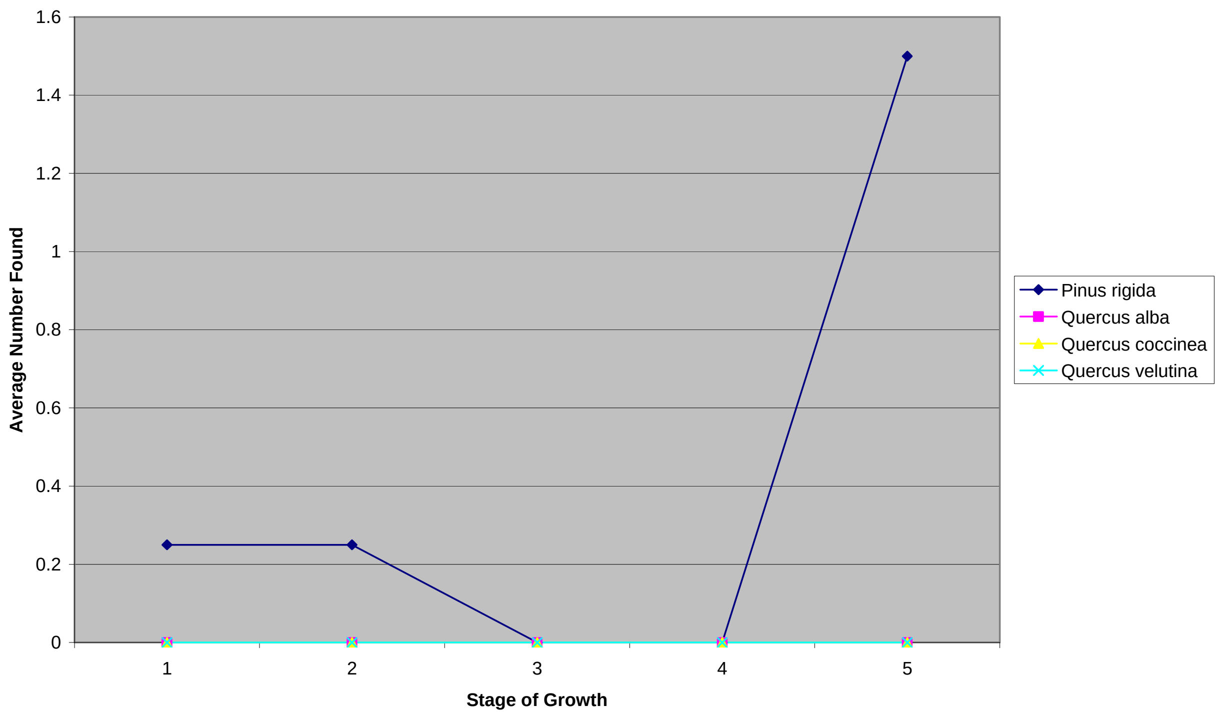
Stage of Growth
Age Class Structure within Pitch Pine community

Figure 5



Stage of Growth
Age Class Structure within Pitch Pine Scrub Oak Woodland

Figure 6



Age Class Structure within Dwarf Pine Plains community