Analysis of the Under-story Vegetation within the Central Pine Barrens of Long Island

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Abstract

Understory composition of the Long Island Pine Barrens. MIRANDA DAVIS (Binghamton University, Binghamton, NY 13902). ROBERT ANDERSON (Brookhaven National Laboratory, Upton, NY 11973).

The Pine Barrens of Long Island is a unique community that must be properly managed in order to preserve the diverse array of flora and fauna it supports. Without management involving prescribed burnings it is likely that the Pine Barrens will disappear through natural succession leading to an oak-based climax community. In general the Pine Barrens are dominated by *Pinus rigida* and other shrub species that are believed to be facilitated by regular burning; however, very few studies have been conducted in this area. In order to better understand this sequence of succession and the importance of this community, we have studied the vegetational composition of the under-story in both pine and oak-based communities on Long Island. By examining random plots within both forest types we calculated the percent composition of different plant species and a diversity index for the under-story of both oak and pine-based forests. While both communities have a shrub layer dominated by the same species (*Gaylussacia baccata*, *Vaccinium palidum*, and *Quercus ilicifolia*) and have similar levels of diversity, we found that the relative proportions of these species differ between the forest types. Results illustrated the vegetational differences between these two distinct communities, which may be critical to the survival of the diverse fauna the Pine Barrens are known for.

Introduction

The Central Pine Barrens of Long Island is currently of great ecological concern. This primarily pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) based community type has been documented to host a diverse array of rare flora and fauna including quite a few state-rare Lepidoptera species (Wagner et al. 2003; Grand & Mello 2004; Forman & Boerner 1981). These Lepidoptera are often dependent on specific under-story shrub species, which are common in the Pine Barrens (Wagner et al. 2003). Much of the bird diversity is also dependent on the characteristic open canopy and extensive shrub layer provided by this habitat (Forman & Boerner 1981). Unfortunately, the fire-dependent Pine Barrens communities are under threat by the increased human development and over-zealous fire suppression, which has already resulted in the loss of 50 percent of the Pine Barrens historical range (Jordan 2003). Without frequent burning the typical pitch pine-based community of the Pine Barrens gives way to a more shade-tolerant hardwood community dominated primarily by various oaks (Quercus spp.) (Jordan 2003; Forman & Boerner 1981; Seischab 1991).

Because of the obvious need for research that would lead to a feasible management plan for the Long Island Pine Barrens, the Foundation for Ecological Research in the Northeast (FERN) has developed a protocol and has embarked on what is hoped to be the first of many years of vegetation sampling within this region (Batcher 2005). The data collected from both pitch pine and oak-based communities within this area will hopefully yield information necessary to track successional changes within these communities and to increase our ecological understanding of these vital areas. As part of this study, I have set out to examine the variation in under-story vegetation between the near-exclusive pitch-pine forest and other community types with in the Pine Barrens. Previous studies have found that under-story vegetation varies greatly across successional stages in other Pine Barrens communities (Matlack et al. 1992; Plocher 1999). It is likely that pine and oak-based communities may vary in floral diversity, under-story composition and the overall height and coverage of their shrub and herbaceous layers. To my knowledge this has yet to be documented in the Long Island Pine Barrens. In order to properly manage the Pine Barrens and conserve the faunal species they support, we must understand the ecology of the shrub and herbaceous vegetation they depend on. I will estimate the species composition of the under-story and compare the extent and diversity of this layer in pitch-pine forest as opposed to the later successional stages which incorporate a higher amount of hardwood (primarily oak) trees and which may take over if a proactive fire management plan is not implemented.

Methods and Materials

Vegetation maps of the Long Island Pine Barrens region were commissioned by the Nature Conservancy and used to distinguish pine-based areas (characterized by >90 percent pitch pine canopy cover) from other community types with a relatively higher amount of oak species in the canopy (</= 90 percent pitch pine canopy cover). Random points were then chosen for sampling using the Global Information System (GIS). These "potential plot points" were rejected if they were within 50 meters of extensive human disturbance (i.e. roadways) or habitat edges. 25 meter by 16 meter rectangular plots were

established at these random plots. Five plots were completed within pitch pine communities and thirty plots within relatively oak-based communities. The number of plots completed was restricted by time and the availability of acceptable plot locations.

Line transects were then used to measure the composition of the shrub/herb layers. A random number "*a*" between 50 and 250 was chosen. The first line transect was started at *a* centimeters along the 16 meter line and drawn parallel to the 25 meter side across the plot. Nine other tapes were laid out for line transects each starting 1.5 meters from the last along the 16-meter line. A random number "*b*" was also chosen to determine the first sample point along each line transect. Subsequent points within each transect were at one meter intervals. Points were sampled by dropping a rod (less than 1 cm in diameter) to the ground and recording the species "hit" by the rod. Plants were only recorded as a "hit" if they were less than two meters in height (comprising part of the under-story). For the purposes of this study "hits" of mosses and lichens were not included. More than one plant species could be "hit" at each sample point. This method led to a total of 200 sample points per plot. The number of hits of each species of plant was added up with in each plot.

Ocular estimations of the total percent cover and height of the shrub and herbaceous layers were conducted. This was essentially subjective and was done by examining the entire plot, after having sampled the line transects, and making an educated guess as to the parameters. Due to the subjective and overlapping nature of these estimations, it was impossible to combine these numbers into an additive estimation for the under-story cover and height as a whole. Here the herbaceous and shrub layer must be treated separately.

Simpson's diversity index was used to examine the diversity of the under-story in pine versus oak communities. The total percent composition of the under-story for these two "community types" for each shrub/herb species estimated based on the number of hits per species out of the total number of under-story vegetation hits per community. The average number of hits of a species per plot was calculated for the pitch pine communities and for all other communities (with more oak cover). A Student's t-test was then used to check for significant variation between the average numbers of hits per species between the two community types. The average estimated cover and height for the shrub and herb layer for each community type was also calculated and significance in variation between the two community types was once again analyzed through the use of Student's t-test.

Results

Simpson's diversity index yielded a value of 0.26 for the relatively oak-based communities and a value of 0.28 for the pine communities. These values indicate a rather high level of under-story diversity for each community and show that there is very little difference in diversity level between the two according to this method of estimation.

Pie charts illustrating the total percent composition of the two communities are displayed in Figures I and II . The predominant species in both pine and oak communities are *Carex pensylvanica*, *Gaylussacia baccata*, *Quercus ilicifolia*, *Vaccinium pallidum*, *Vaccinium angustifolium*, and *Pteridium aquilinum*. These six species comprise 97 and 96 percent of the total under-story vegetation in pine and oak communities respectively. Of these species *Q. ilicifolia* is more commonly hit in pine plots while the other five species are more predominant in communities with relatively more oak canopy. In particular, the variation in the prevalence of *Q. ilicifolia*, and *G. baccata* is striking. *Q. ilicifolia* comprised roughly 38 percent of the under-story in pine communities while only eight percent of the shrub layer in other communities (a difference of eight percent). *G. baccata* comprised roughly 39 percent of the under-story layer in oak communities and only 27 percent in pine communities (a difference of 11 percent) (Figures I & II). All other under-story species showed a less than ten percent change in dominance between the two community types.

When analyzing the average number of hits per plot according to community type there appears to be significantly more *Q. ilicifolia* (116 hits per plot on average) in pine communities than in oak communities (with only 24 hits per plot on average (two-tailed t-test, $p=0.0001$, $\alpha=0.05$, assuming unequal variance). While no other species show significant variation, it is necessary to note that there appears to be less *C. pensylvanica*, *G. baccata*, *P. aquilinum*, *V. pallidum*, and *V. angustifolium* on average in pine communities.

When comparing the ocular estimations of the cover and height of the shrub and herb layer between the two communities, some more interesting results are found. The estimated average height of the shrub and herbaceous layer does not vary significantly between pine and oak communities; however, the estimated cover does. While there is an estimated 86.7 percent of shrub cover in exclusively pitch pine communities, there is only an estimated 70.9 percent of shrub cover in oak communities (two-tailed t-test, $p=0.002$, $\alpha=0.05$, assuming unequal variance). On the other hand, for the herbaceous layer there is an estimated 10.6 percent cover in oak plots and only 2.7 percent of cover in pine plots (two-tailed t-test, $p=0.007$, $\alpha=0.05$, assuming unequal variance).

Discussion

While our results show that there is little variation in diversity levels between primarily pitch pine and relatively more oak-based communities within the Central Pine Barrens of Long Island, they also show that the extent and composition of the under-story vegetation varies a great deal between these two groups. This variation could prove to be very important to the conservation of the diverse fauna, which the Pine Barrens is known for. While both communities were dominated by primarily the same under-story species the relative proportions of those species varied a lot. The pitch pine communities observed in this study showed a much more extensive shrub layer (represented by overall cover) than the oak communities. This difference is most likely due to the higher amount of *Quercus ilicifolia* in the pitch pine plots sampled. The fact that the oak communities were estimated to have a higher degree of herbaceous cover coincides with the higher proportions of *Pteridium aquilinum* and *Carex pensylvanica* found in those plots and makes sense as high amounts of shrub cover most likely shade out many herbaceous plants. As pitch pine communities mature and succumb to oak-dominated communities through succession, primarily due to a lack of regular burning, it is likely that the under-story will be increasingly dominated by *Gaylussacia baccata, Vaccinium pallidum*, *Vaccinium angustifolium* and herb species, while *Q. ilicifolia* is lost. These results coincide with other studies, which found significant variation in under-story composition

(Matlack et al. 1992; Plocher 1999) and which found that *Q. ilicifolia* was more common in communities undergoing regular disturbance due to severe burning (Jordan et. al 2003; Plocher 1999).

These findings have important implications for the fauna of the Pine Barrens. The Pine Barrens are know for supporting a diverse array of bird and arthropod species, particularly Lepidoptera. Wagner et al. (2003) found that of 56 Lepidoptera species, which are of conservation concern and are known to utilize shrubland habitats in the Northeast, at least 29 percent are dependent on *Q. ilicifolia* for survival and/or reproduction. Many species are also thought to be codependent on both *V. pallidum* and *Q. ilicifolia* which are not considered in the above figure (Wagner et al. 2003). The species comprising the herbaceous layer have not, to my knowledge, been noted as especially important to any of these Lepidoptera species and may be of lesser concern in this case. Without the extensive shrub layer of these species provided by pitch pine communities, many rare Lepidoptera may be doomed to local extinction. The same fate may apply to many of the bird species inhabiting the Pine Barrens which are known to prefer these areas due to the open canopy (Forman & Boerner 1981) and it seems likely that many of these birds are ground nesting and may also be dependent on extensive shrub cover for shelter.

The extreme variation in under-story composition and the extent of cover in the herb and shrub layers in combination with the ecological importance of these factors suggest that future study in this area would be wise. In the future, FERN should continue monitoring under-story species and take their results into account when developing comprehensive management plans for the Pine Barrens. The fact that the overall extent of the herb and shrub layers showed opposite patterns suggests that in the future it would make sense to analyze the species that comprise these two layers independently. Results of this study illustrate that if the pitch pine communities are not managed properly with prescribed burns and are allowed to give way to oak forests then there will be drastic changes in the under-story composition leading to a reduced shrub layer and dire consequences for the fauna endemic to this area.

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Figure I: The relative percent of the under-story vegetation within pitch pine communities comprised by each encountered species is shown.

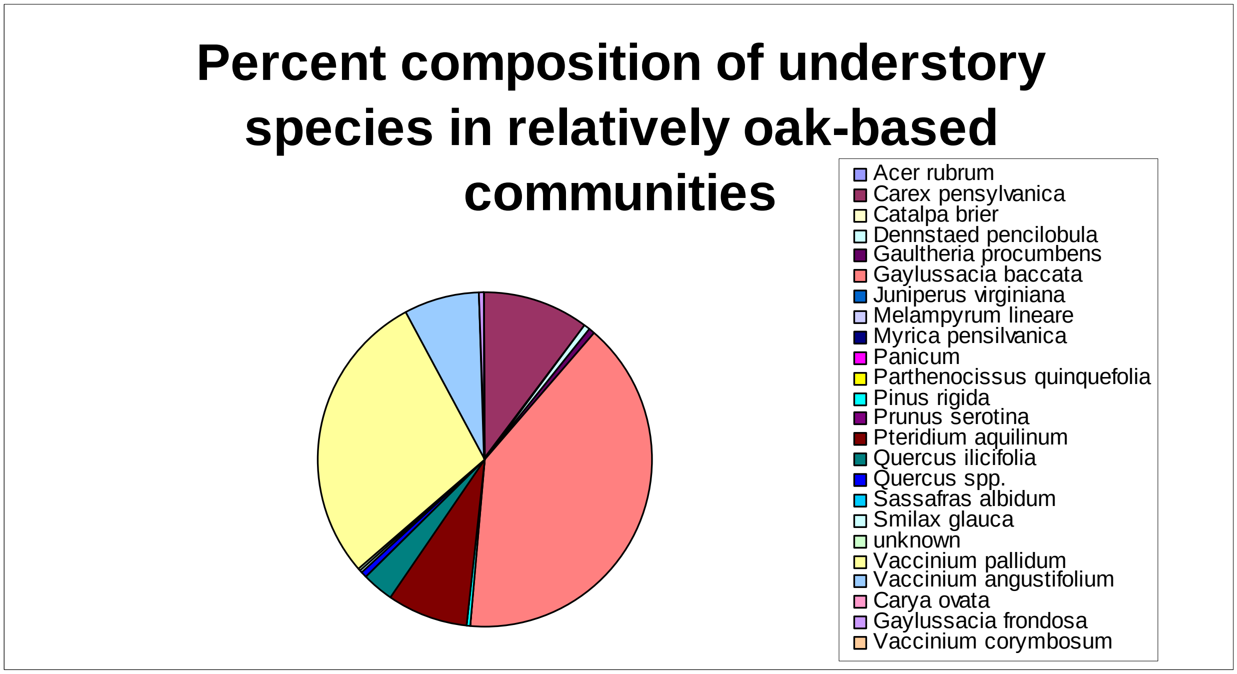

Figure II: The relative percent of the under-story vegetation within oak (non-exclusively pitch pine) communities comprised by each encountered species is shown.