Chemical and Physical Characteristics of the Sediment in the Pine Barrens of Central Suffolk County, N.Y.

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Introduction

In 1995, New York State created a 52,000 acre Pine Barren Preservation Area in central Suffolk County, N.Y. Relatively few comprehensive sediment studies have been carried out in this area. The purpose of this study is to compare the chemical and physical characteristics of the various forest communities within the Core Preservation Area.

Forest Types

The vegetational communities composing the Long Island pine barrens are dominated by pitch pine (*Pinus rigida*) with oak (*Quercus spp*.) as an associated species, oak dominated areas that have pine as the associated species, and the Dwarf Pine Plains. The origin of these communities is the subject of considerable debate. Patterson et. al (1988) considers the pine barrens to require periodic fire to maintain the forest composition. In the case of the dwarf pines Olsvig (1979) notes that this community requires a burn regime of approximately every ten years to maintain the integrity of this community. Thompson (1995), however, has shown no correlation between dwarf pine age and fire frequency.

In addition, Motzkin (1996), and Black and Pavacic (1997), believe that the non-dwarf forest types are the result of land clearing, etc. during the post-Colonial and later periods. Naidu et al. (1997) have demonstrated that the effects of severe clearing in the pine barrens favors the pine rather than the scrub oak (*Quercus ilicifolia*).

Study Sites

In order to determine if there was a difference between the sediments in pine-oak, oak-pine, pine, and dwarf pine woodlands, three sites were established for this study (Figure 1).

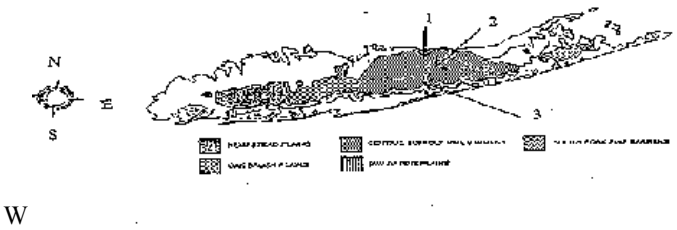


Figure 1. Central Suffolk County Pine Barrens Core Preservation Area.

The first site was The New York State Department of Environmental Conservation's Rocky Point Natural Resources Management Area which covers 6,400 acres. The vegetational community studied at Rocky Point was a largely undisturbed oak-pine woodland and a pine forest. The second site was at Brookhaven National Laboratory which covers 5,263 acres. The vegetational communities studied here were an undisturbed oak-pine forest and a pine-oak forest. The third study site was located in Westhampton Beach at the New York State Air National Guard Facility. There were a variety of woodland types found here, including an undisturbed oak-pine forest, a pine-oak forest, and the Dwarf Pine Plains. The Dwarf Pine Plains cover 2,400 acres.

Data and Interpretations

Physical Characteristics

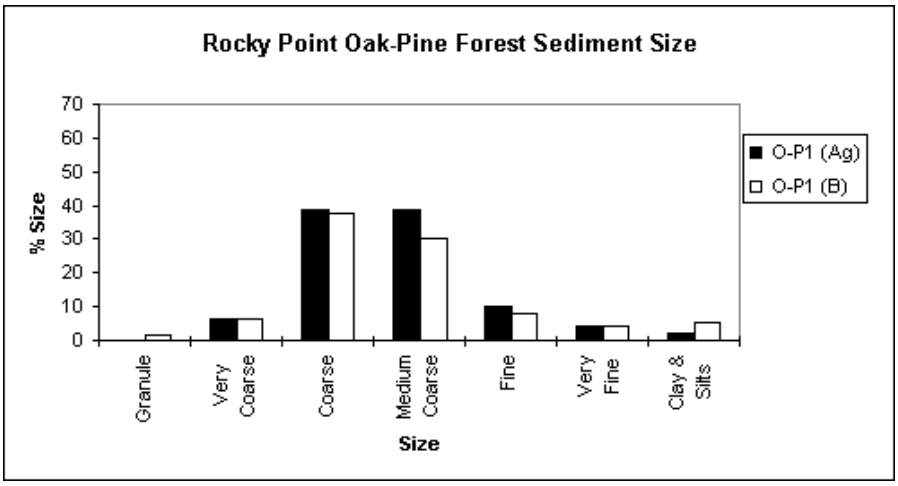
Sediment samples were obtained either by the use of a soil borer or trenching. Trenching enabled a more comprehensive view of the subsurface sediments to $\pm$ 1m, while the soil borer obtained discrete samples of the subsoils to $\pm$ 0.25m. The sediments at these depths are those that are thought to directly influence the present day forest type. Sediment size was determined by sieving which divided each sample into granules, very coarse, coarse, medium coarse, fine, and very fine sand as well as clay and silt.

All sediments sampled had three distinct soil horizons. The O horizon, which is the organic layer composed of leaf litter and organic matter, is the uppermost horizon. The second is the A horizon, while the third horizon is the B horizon, which consists of iron stained sediments.

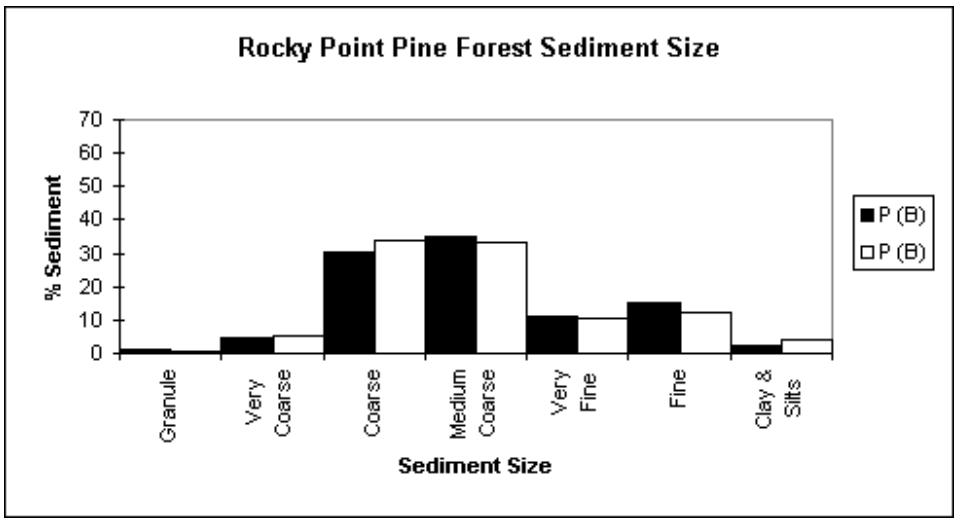
It is to be noted that the generalized soil profiles show the A horizon to consist of a brown subsoil consistently overlying a gray layer. In this study, however, the gray layer consistently overlaid the brown. Thus, it was necessary to subdivide the A horizon in this study into an Ag (g = gray) upper A horizon and an Ab (b = brown) underlying horizon. Table I illustrates the forest type and size of the sediments in the study sites.

Table I

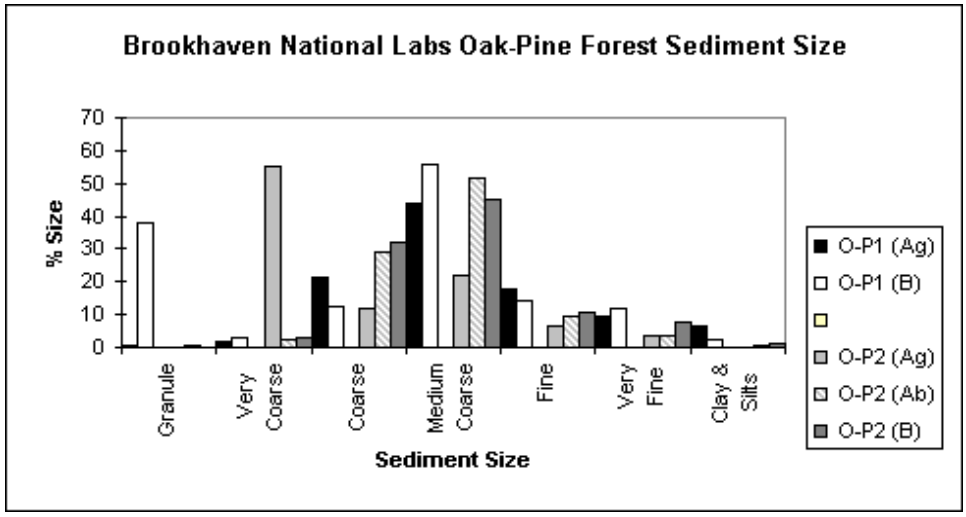
Rocky Point - Site 1 (O-P1)		
Oak - Pine Forest		
Species		Species %
Pine	*(Pinus spp.)*	7.50%
Oak	*(Quercus spp.)*	92.50%



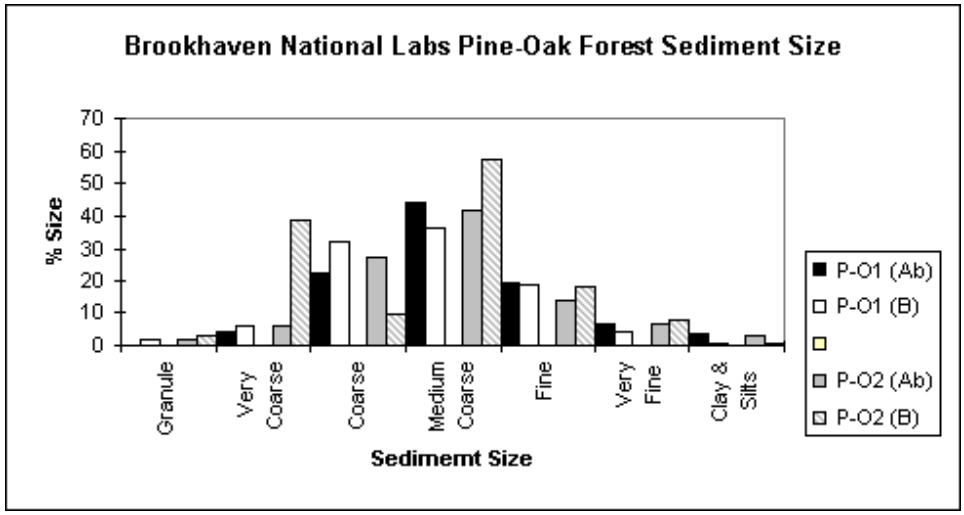
Rocky Point - Site 1 (P)		
Pine Forest		
Species		Species %
Pine	*(Pinus spp.)*	100%



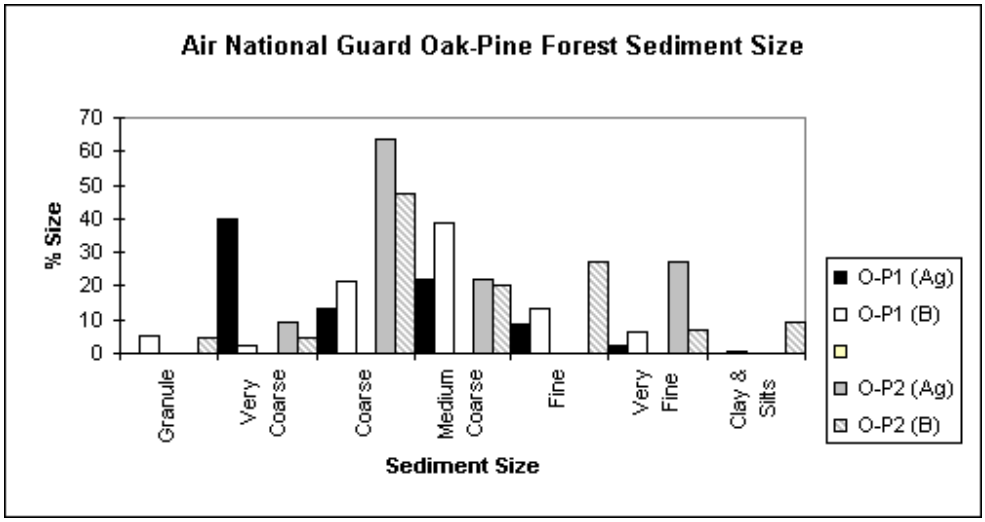
Brookhaven National Labs - Site 2 (O-P)		
Oak - Pine Forest		
Species		Species %
Pine	*(Pinus spp.)*	24.60%
Oak	*(Quercus spp.)*	75.40%



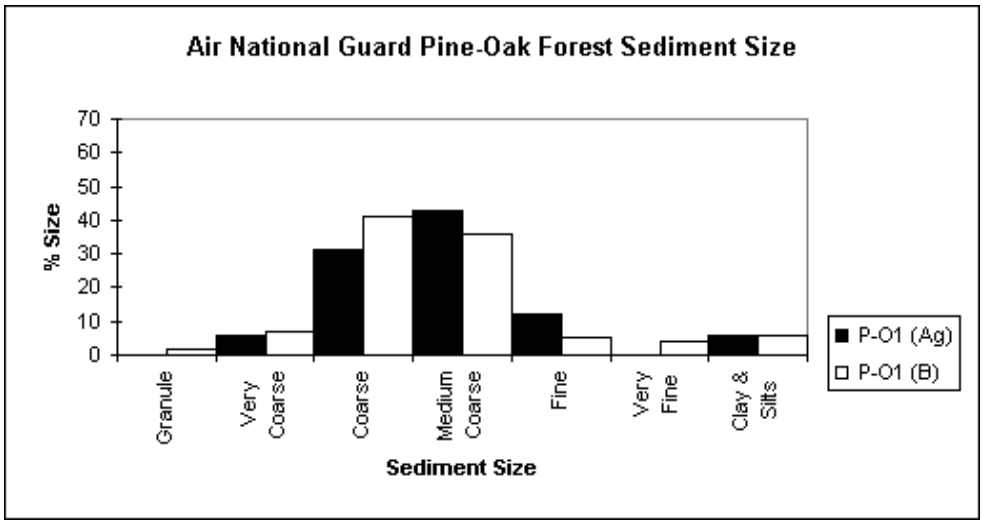
Brookhaven National Labs - Site 2 (P-O)		
Pine - Oak Forest		
Species		Species %
Pine	*(Pinus spp.)*	63%
Oak	*(Quercus spp.)*	37%



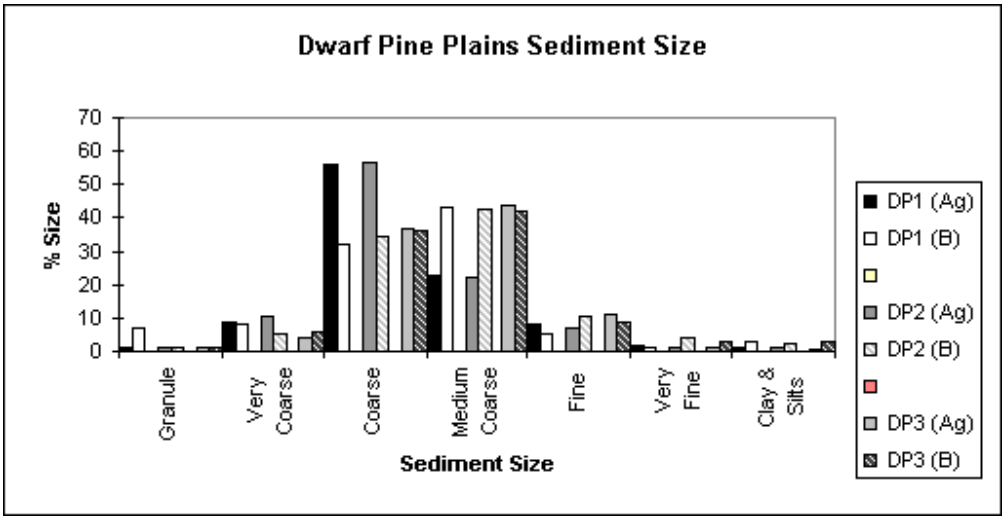
Air National Guard - Site 3 (O-P)		
Oak - Pine Forest		
Species	*(Pinus spp.)*	Species %
Pine	*(Quercus spp.)*	26%
Oak		74%



Air National Guard - Site 3 (P-O)		
Pine - Oak		
Species		Species %
Pine	*(Pinus spp.)*	72%
Oak	*(Quercus spp.)*	28%



Dwarf Pine Plains - Site 3 (DP)		
Species		Species %
Pine	*(Pinus spp.)*	100%



This data clearly indicates, that throughout the pine barrens the sediment is primarily medium to coarse in size. Thus, there is little correlation between the sediment size and specific forest type in the pine barrens. These sediments are well drained and have little capacity to hold water.

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Chemical Characteristics

A total of four chemical parameters: ammonia, nitrate, nitrite, and phosphorus were determined using methods based on the Mehlich I Extraction Method which measures soil nutrients that would be available for plants to use. These methods are commonly used by the U.S. Forest Service and other governmental agencies (Hill,1997).

Figures 2-4 illustrate the average sediment chemistry of all of the various forest types considered in this study.

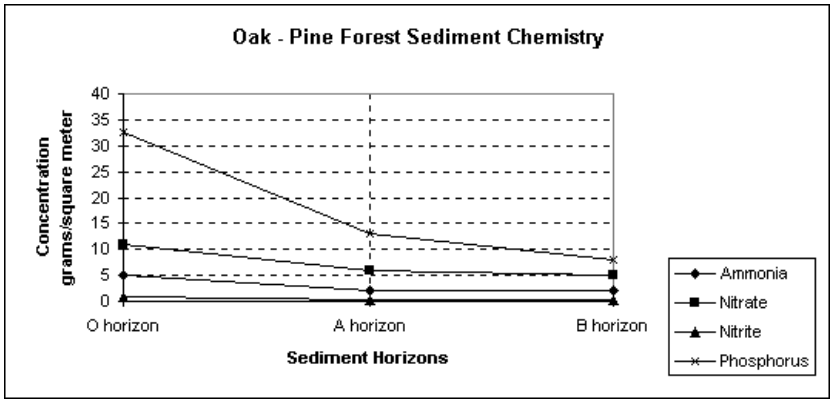

Figure 2.

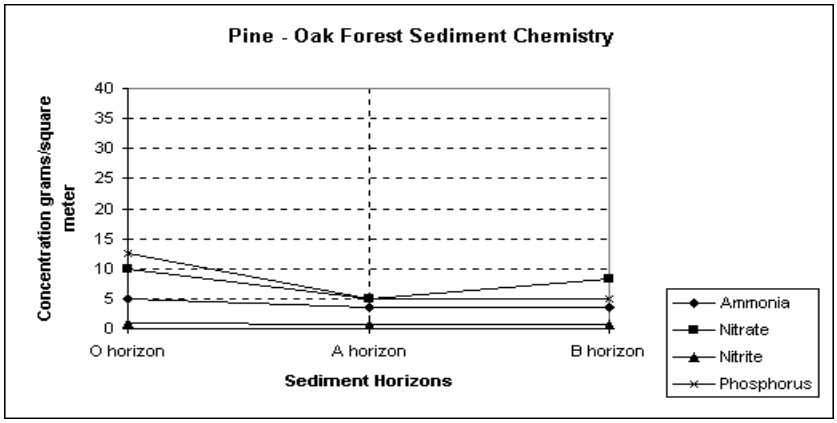

Figure 3.

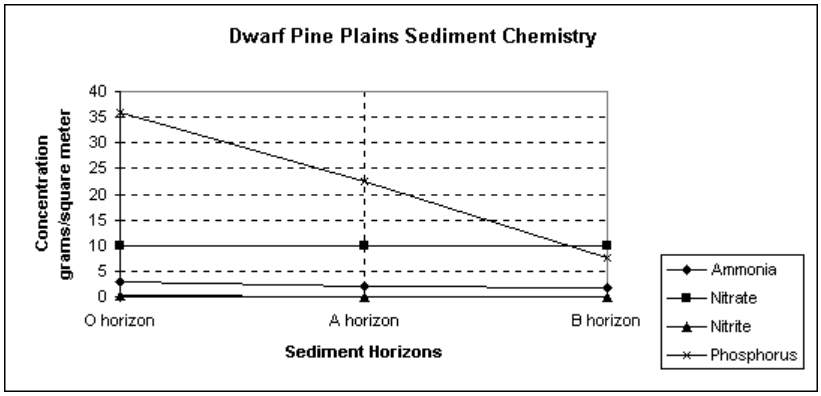

Figure 4.

The chemical characteristics of all the sites were remarkably similar (Figures 2-4). While the O horizon shows the highest concentration of actual and potential nutrients for plant use, these materials are not available since they are present in the leaf litter and not in the

root zone. The nutrients present in the A and B horizon are consistently low in all study areas. Table II summarizes all of the data discussed in this paper.

TABLE II Forest Type and Sediments Characteristics for the Long Island			
Communities			
	Oak-Pine	Pine-Oak	Dwarf Pines
No. of stands sampled	5	3	3
Percent Pine (%)	22	67	100
Percent Oak (%)	78	33	0
Soil texture of the			
A horizon			
Coarse sand (%)	35.54	26.8	49.9
Medium sand (%)	35.68	43	29.76
Fine sand (%)	9.82	14.9	8.6
Silt and clay (%)	2	4.16	1
Soil texture of the			
B horizon			
Coarse sand (%)	30.14	27.56	34.1
Medium sand (%)	29.02	43.3	42.43
Fine sand (%)	14.72	8.9	8.16
Silt and clay (%)	3.58	2.48	2.83
Soil nutrients (ppm			
in the O horizon)*			
Ammonia	5	5	3
Nitrate	11	10	10
Nitrite	1	1	0.3
Phosphorus	32.5	12.5	35.83
Soil nutrients (ppm			
in the A horizon)*			
Ammonia	2	3.6	2
Nitrate	6	5	10
Nitrite	0.4	0.6	0
Phosphorus	13	5	22.5
Soil nutrients (ppm			
in the B horizon)*			
Ammonia	2	3.6	1.66
Nitrate	5	8.3	10
Nitrite	0.4	0.6	0
Phosphorus	8	5	7.5
* Units in this table are in ppm for consistency with Olsvig(1979).			

In addition to the above analysis, the Ag horizon was subjected to high temperatures to determine if the gray color of the sediment was due to merely a surface coating or was

the actual color of the sediment. Thus, the Ag sediments were dried, weighed and heated to 700^{O} C for three hours after which they were re-weighed. Table III gives the results. It can be concluded that the gray color was a surface coating presumably due to organic compounds adhering to the sediment. Since this organic material was only removed by extreme temperatures it is not available for the use of plants.

Table III

Pre-Heating			**After Heating**		
Sample	Weight	Color	Weight	Color	% weight change
DPN	10.45	gray	10.17	white	2.67
DPS	4.19	gray	4.16	white	0.7
DPC	6.33	gray	6.31	white	0.4
BNL PO1	1.64	gray	1.56	white	5

Summary

This data indicates that the specific vegetational communities are not dependent on the physical and chemical characteristics of the sediment. Therefore, the sediment is not the controlling factor in determining forest type in any of the sites studied.

The chemical and physical characteristics of the sediment do not appear to account for the dwarf growth form. This dwarf growth form may be the result of genetic differences, other biotic interactions, and/or abiotic factors such as wind pruning. Since no normal sized pines occupy the Dwarf Pine Plains nor are dwarf pines found in normal size pine communities, genetic differences between the two populations do not seem to be a factor. Thus, it appears that the dwarf growth form may be due to either wind pruning, frost pockets, and/or competition. Interspecific competition with the faster growing scrub oak could cause the contorted shape of the dwarf pines. Qualitative examination of the area show the pine seedlings growing towards the light. This may lead to a contorted form as they mature due to shading by the scrub oak.

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