THE DISTRIBUTION OF SOIL TEXTURES IN A SAMPLE PORTION OF FOX ISLAND COUNTY PARK IN ALLEN COUNTY FORT WAYNE, IN.

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Introduction

Soil is the top layer of the earth's surface, composed of rock and mineral particles mixed with animal and vegetable matter (Barnhart 1986). Soil contains mineral particles of sand, silt and clay, and the more stable part of the decomposing organic matter, called humus (Barnhart 1986, Kellogg 2001). The organic content of soil is widely variable, ranging from zero in some desert soils to almost 100% in peats (Elements of an Ecosystem 1999).

There are five primary influences on soil formation: parent material, climate, topography and relief, biological activity, and time (Elements of an Ecosystem 1999, Kellogg 2001, Chernicoff and Whitney 2007). Parent material is the rock or sediment from which soil develops; certain materials weather faster and produce more soil than others (Chernicoff and Whitney 2007). A difference in climate means a difference in the amount of water and the average temperature of an area, which also influences the rate of chemical weathering. Without water, little chemical weathering occurs, thus little soil develops. Soil formation is most rapid in warm, moist climates and slowest in cold, dry climates. Mountainous climates modify the rainfall by allowing rapid runoff on steep slopes or ponding in low places (Kellogg 2001). In places where the soil is kept so moist by a combination of rainfall and relief that waterlogging prevents decomposition of organic matter as it forms, peat accumulates.

Climate also controls the rate of chemical weathering of the parent material indirectly by influencing the amount of biological activity in an area, which in turn affects the rate of dissolution of the parent material (Chernicoff and Whitney 2007). Without biological activity, little chemical weathering occurs, because bacteria produce chemical acids which promote chemical weathering, and plants produce hydrogen plus, which also promotes chemical weathering.

Time is another factor in soil formation. The more time that elapses, more soil is allowed to form (Chernicoff and Whitney 2007).

The amount of precipitation along the forest edge may vary in comparison to the interior of the forest (Ranney 1977). Rains that are influenced by the wind increase the amount of precipitation along the edge. Forest edges will often act as a barrier for snow, thereby accumulating snow in greater quantities. These increases in precipitation along the forest edge might have had an influence on soil formation, and might have had an influence on biological activity, which in turn influenced soil formation.

A soil profile is a vertical cross-section from ground level to the bedrock on which the soil sits (Elements of an Ecosystemn 1999) and is made up of various soil horizons or layers of soil that run parallel to the surface (Buol et al. 1973). The following properties help describe soil horizons: color, texture, consistence, structure, boundary characteristics, and horizon continuity.

Soil texture is defined as the relative proportions of the various soil separates—the size groupings of soil particles—in a soil material (Buol et al. 1973). The three main separates are sand, clay, and silt. The soil separates are not subject to ready change, and thus the size of the separates (the texture) is a basic property of the soil. Texture will affect processes operating within the soil, and will affect chemical exchange because surface area per unit volume increases greatly as particle size decreases (Gerrard 2000). All these size groups less than 2mm in diameter are collectively called separates, more specifically, those below 0.02 mm in diameter are called clay (Kellogg 2001). The physical and chemical reactions in soil largely take place on the surface areas of individual grains, so in this sense, clay is relatively the most important texture because it has the least diameter and will therefore have a greater amount of surface area possible in any given amount of soil.

Soil types are determined dependent on the country in which the study is taking place (Pitty 1978). The soil textural triangle used in the USA (Figure 1) determines the type of soil based on the percentage of sand, clay, and silt present. The process of separating the soil into these parts is called mechanical analysis (Brady 1974). Sand is the largest group of particles considered as soil material and divided into subdivisions called coarse, medium, and fine (Hillel 1982). Clay particles are characteristically platelike or needlelike in shape, and silt consists of particles intermediate between sand and clay. In mechanical analysis the soil is sieved and divided by size (millimeters), determining in turn what percent is silt, clay, and sand (Figure 2) (Brady 1974).

In Indiana there are 357 different soil types (Lindsey et al 1965). Fox Island is predominately Oak-Hickory (Schutt 1997) and as such tends to have one or a combination of these soil types: silt loam, loam, fine sandy loam, sandy loam, gravelly loam, loamy fine sand, and fine sand (Lindsey et al. 1965). The word “loam” denotes only the size distribution for the particles and not at all the percentage of organic matter or fertility (Kellogg 2001). Coarser soils have lower capacity to retain organic plant nutrients, gases, and water, which are essential for plants. Soils with higher clay content tend to retain these substances (Columbia Encyclopedia 2000).

According to the soil survey of Allen County, Indiana, the upland portion of the sample plot in Fox Island County Park (Figure 3) is labeled as a Plainfield series (PIP), which are usually well drained, coarse-textured, and composed of a 26 inch layer of fine sand with an underlying material of silty clay loam (1969). The lower portion of the sample plot (Figure 3) is

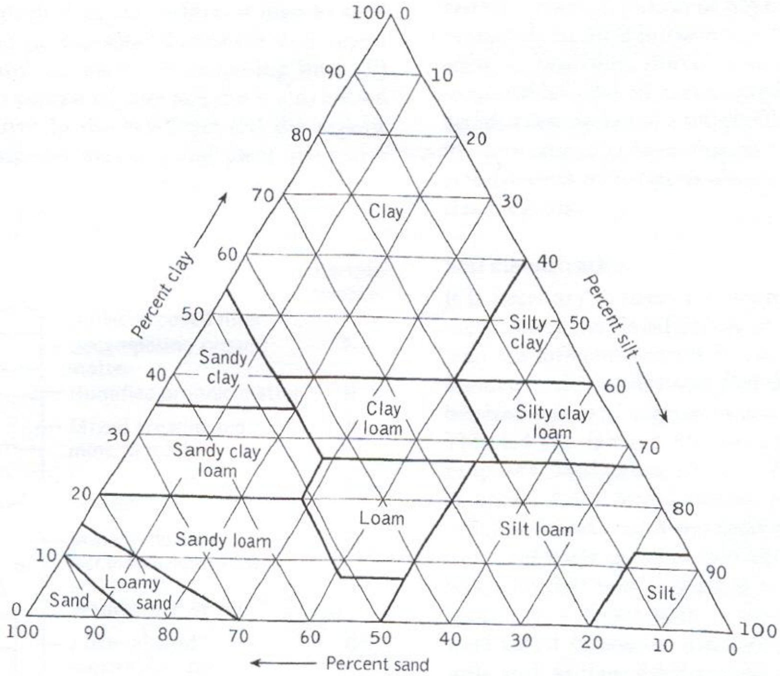

Figure 1—This figure determines the soil type of a sample portion of soil based on its percentage of silt, clay, and sand (Brady 1974).

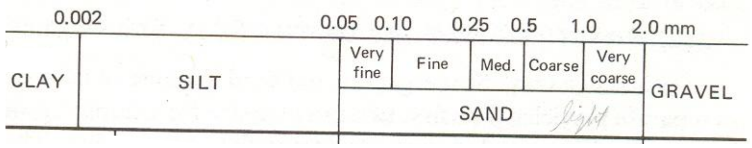

Figure 2—This figure shows the size measurements in millimeters for clay, silt, and sand for a portion sample of soil (Brady 1974).

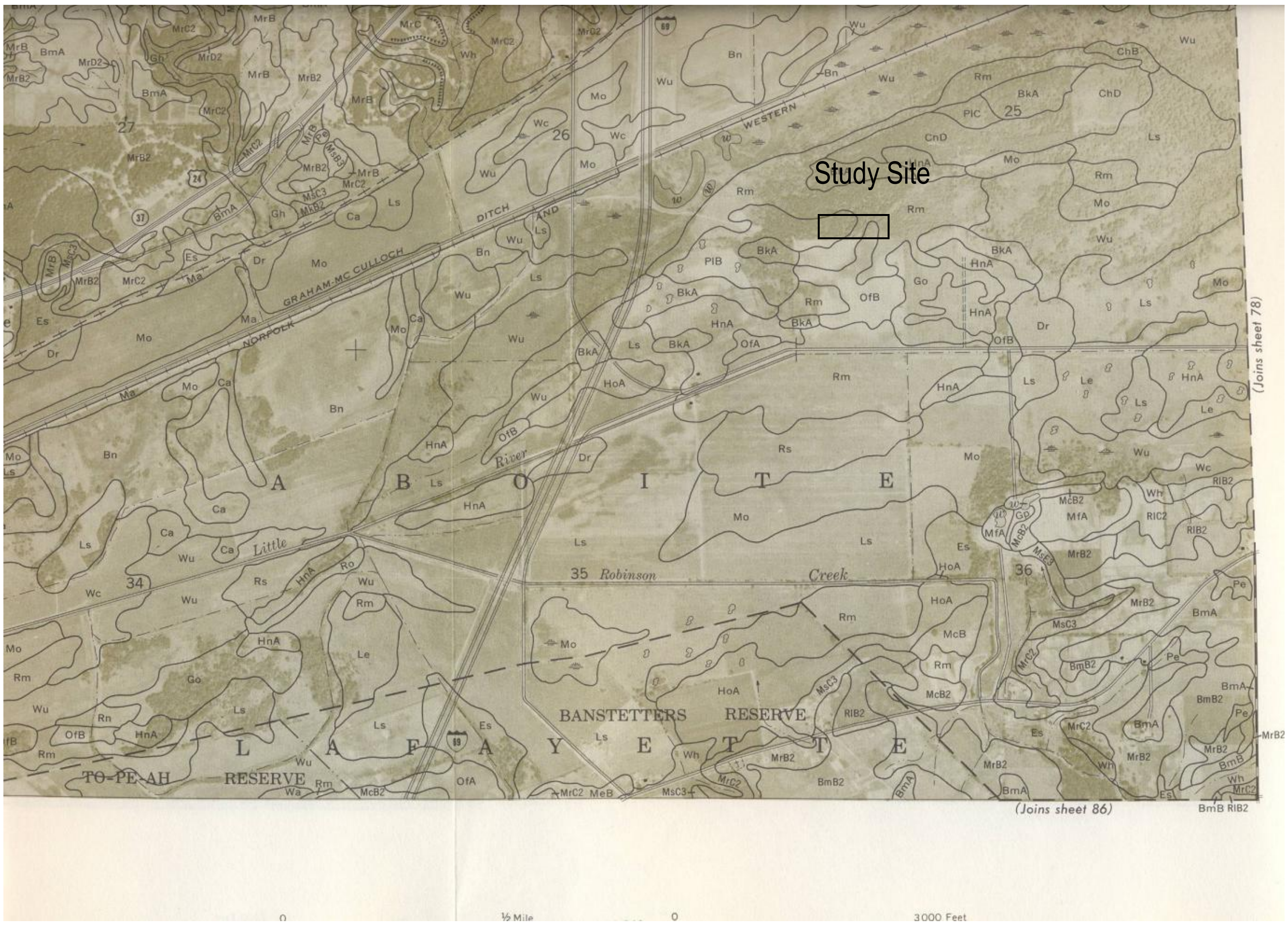

Figure 3—This map shows the soil types of the approximate location of the sample portion of Fox Island County Park, Fort Wayne, IN from aerial photos taken of the area (Soil Survey 1969).

labeled a Rensselaer series (Rm), which is usually poorly drained, with a 14 inch layer of silty clay loam, and an underlying material of loamy fine sand. Fox Island County Park, Fort Wayne, IN was formed by the Wisconsin Glacier forming sand dunes throughout the park, also influencing the park's soil type (Ridenour 1988).

The purpose of this paper is to document soil texture in the study site in Fox Island County Park, in Allen County, IN. In doing so, we will be evaluating how the edge effect and elevation affect soil texture.

Methods Section

Our study site in Fox Island County Park was 240m from west to east by 50m meters from north to south, (see Figures 4). Our study site was located on an edge of the forest and then proceeded from the uplands in the west to the lowlands (wetland) in the east. There is a south-facing forest edge, located adjacent to a field, on our sample site. This provides a gradient of upland to wetland from west to east and a gradient along depth of the edge effect. The study site was divided into 10m by 10m quadrats. These were marked off with orange construction flags at each corner. We collected three samples from each quadrat with a soil corer. The soil corer was pushed into the soil to collect each sample.

Each soil sample was left in plastic bags in the lab until fully dry. Each sample was sifted. The layers of the sieve's mesh were, in decreasing order, 2.000mm, 1.000mm, 0.500mm, 0.250mm, 0.125mm, 0.063mm, with a sixth and last layer to collect the particles less than 0.063mm in diameter. The part of each sample that was greater than 2.000mm in diameter was discarded because it was not considered soil. We weighed each part of the sample separately.

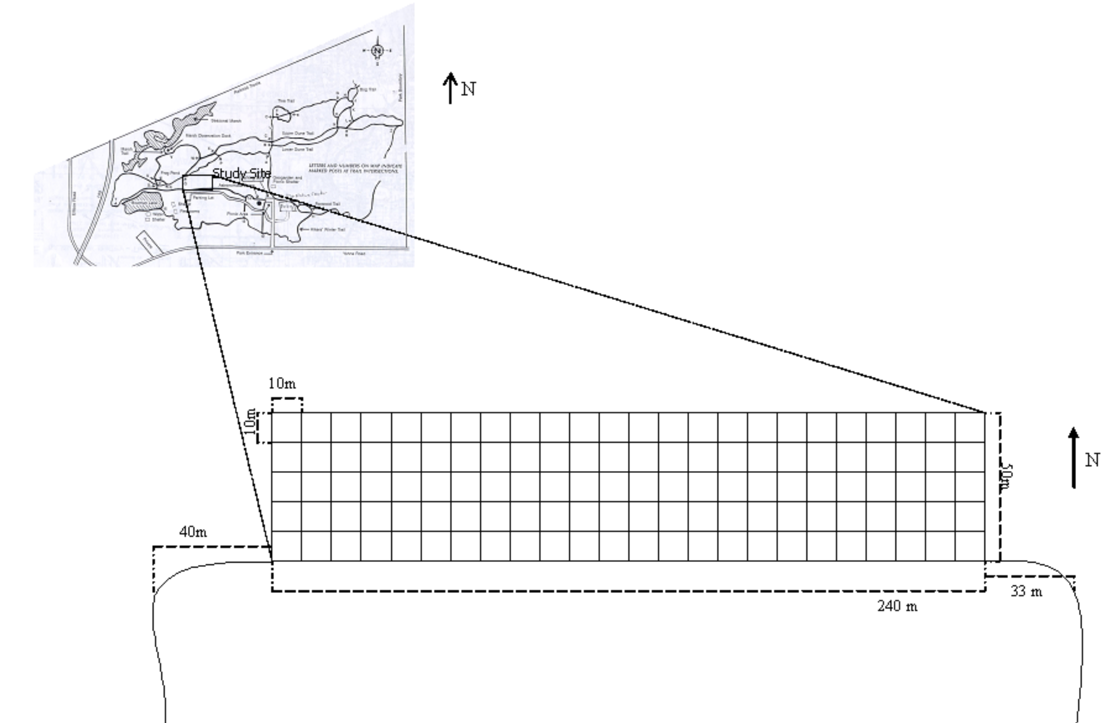

Figure 4—Map of Fox Island and aproximate location of sample site, taken from Fox Island County Park and Nature Preserve park map. This map displays the aproximated location of the sample site and the edge of the forest found along the southern border of the site, and the layout of study site of Fox Island, with 120 quadrats total, each 10 meters by 10 meters. 40 meters on the west side and 33 meters on the east side were not included in the sample site so as to ensure a true edge.

The data was entered into Excel. We input the weight of the parts of the sample from each sieve and multiplied it by the mean size of the mesh of that sieve; that equaled the average particle size for that sample. Afterwards, we created a PivotTable, which we used to create a 3-D graph. We utilized statistical analyses, using the program *Analysis It* to do a two-way ANOVA test for plot and depth's effect on soil texture distribution, and a 1-way ANOVA test for plot's effect on soil texture distribution. Our hypotheses are as follows: H_1: Plot does affect soil texture distribution. H_o: Plot does not affect soil texture distribution. H_1: Depth does affect soil texture distribution. H_o: Depth does not affect soil texture distribution.

Results

The two-way ANOVA statistical analysis yielded the following results. The plot P value for average soil particle weight is 0.0074, and because 0.0074 is less than 0.05, we reject our null hypothesis (Table 1). Therefore, plot does make a significant difference in the average soil particle weight for the Fox Island County Park study site. The average soil particle weight significantly decreased with plot from the dry highlands to the lower wetlands (Figure 6). The depth P value for average soil particle weight is 0.7060, thus 0.7060 is not less than 0.05 (Table 1). Therefore, we reject the alternative hypothesis that plot does make a significant difference in the average soil particle weight. The average soil particle weight did not significantly increase or decrease with relation to depth (Figure 5).

The one-way ANOVA statistical analysis yielded the following results. The plot P value for average soil particle weight is 0.0058, and because 0.0058 is less than 0.05, we reject our null hypothesis (Table 2). This also supports that plot does make a significant difference in the

Table 1—This table shows the 2-way ANOVA statistical analysis for effect of plot and depth for the average soil particle size.

Source of variation	SSq	DF	MSq	F	p
Plot (m)	2.062	23	0.090	2.09	0.0074
Depth (m)	0.093	4	0.023	0.54	0.7060
Within cells	3.954	92	0.043		
Total	6.109	119			

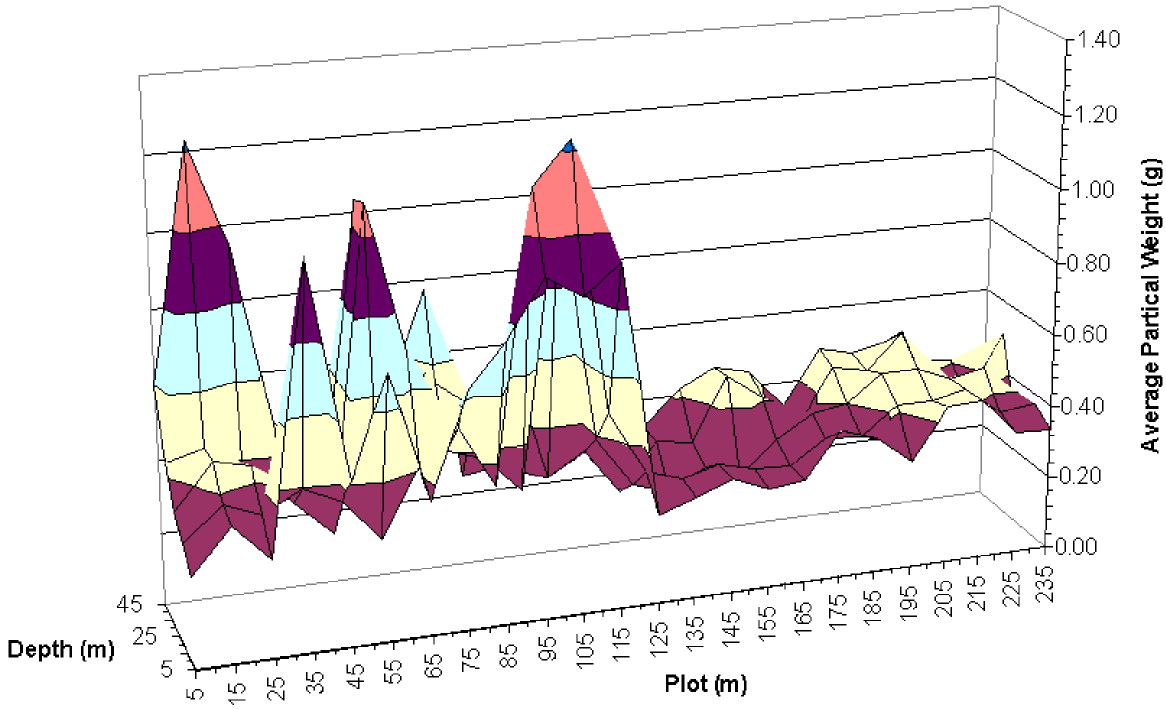

Figure 5—This graph shows the average particle weight for the quadrats of each plot and depth for sample 1.

Table 2—This table shows the 1-way ANOVA statistical analysis of plot for the average soil particle size.

Source of variation	SSq	DF	MSq	F	p
Edge (m)	2.062	23	0.090	2.13	0.0058
Within cells	4.047	96	0.042		
Total	6.109	119			

average soil particle weight for the Fox Island County Park study site. The average soil particle weight significantly decreased with plot from the dry highlands to the lower wetlands (Figure 5).

Discussion

Plot significantly affected average soil particle weight, but depth did not have a significant effect upon average soil particle weight. Thus, the edge effect did not have a significant effect upon average soil particle weight, but the topography did have a significant effect.

The soil survey labels the upland portion of the study site as a Plainfield series (PIP) and the lowland portion of the study site as a Rensselaer series (Rm). Although our study did not classify the soil series within our study site, the analyses show a significant difference in average soil particle weight and thus soil texture.

We found no significant difference in average soil particle weight with respect to depth. Thus, there is no support that changes in precipitation, snow accumulation, and sunlight penetration (such as would occur due to the edge effect) have any relationship to average soil particle weight and thus soil texture. However, we found that topography does have an effect on average soil particle weight, specifically with regard to lowland topography. Thus, precipitation does affect average soil particle weight but not as a result of the edge effect.

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