Understory Vegetation Analysis in the Proposed Long Island Solar Farm of Pine Barrens Forest, NY

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Abstract

The Conservation of renewable energy is a critical demand for the protection of the environment. In order to encourage energy efficiency through innovation of technologies, BP Solar has proposed the installation of the Long Island Solar Farm (LISF) on 200 acres of the Long Island Pine Barrens Forest (LIPBF) at Brookhaven National Laboratory. We conducted baseline observations of the pH and distribution of vegetation species within the area. A total of 12, 25m long transects, each consisting of 6 quadrats (1m²) were laid through the vegetation. In addition, 5 control transects were laid in the outer area of the proposed solar farm. The vegetation distribution was identified by taking a tally of each individual species within each plot of a quadrat according to their genus and species. The heights of the species were also measured. The pH was measured by immersing an electrode pH meter into the soil of the fourth plot of each quadrant. The variations in pH range from 3.2 to 5.9. The areas with a higher acidity of 3.2 to 4.8, composed of sandy soil common for the Pine Barrens Forest, were populated with more vegetation. Moreover, the areas with a lower acidity of 5 to 6.8 were covered with a moist, marshy type of soil populated with minimal vegetation. Based on the relationship between diversity in soil and vegetation, we have reason to believe that vegetation is driven by acidic soil. The results indicate among all sites and dominant species in the Long Island Solar Farm (LISF) low bush blueberry (LB) and high bush blueberry (HBB) showed the highest and lowest IVI (125.00 ±50.90 and 70.88±20.95, respectively). Shannon Weiner Index (H) values on plant community diversity ranged from -0.1976 in Control 1 to -2.0849 in transect 12 of site 14. In conclusion, the pH and the vegetation distribution and diversity gives us the necessary baseline information needed to compare with what may return to the LIPBF in the future, after the installation of the solar farm.

Introduction

The Pine Barrens Forest is a distinctive type of forest located in the eastern part of the United States along the Atlantic Coastal Plain. The unique features of the ecology of the LIPBF result in an unusual flora. Pine Barrens occur on nearly level to slightly undulating ground in well-drained coarse-textured moraines [1]. Plant and site productivity are important drivers of the forest understory [2]. The vegetation consist of a variety of shrubs, the most common of which are scrub oak and members of the heath family. The shrub and herb layers are generally dominated by ericaceous plants such as huckleberry (*Gaylussacia baccata*), blueberry (*Vaccinium pallidum*) and wintergreen (*Gaultheria procumbens*) [3]. The dominant specie is the pitch pine, (*Pinus rigida)*. In no other region in North America does the pitch pine cover such an extended area of the country. Natural Pine Barrens acidity is created when decaying vegetation produces an organic acid that washes down through and is absorbed by the sandy soils [4].

Soil pH is a measure of soil acidity or alkalinity [3]. Soil pH is an important factor in the regulation of vegetation changes. Plant uptake has been related to pH-level in numerous experiments [5]. The most important factors controlling vegetation types located in the LIPBF are the soil saturation and soil composition. The LIPBF is composed of deposits of sand, gravel and clay. Sediments in the LIPBF are low in organic matter, coarse, well-drained, droughty, nutrient-poor, sandy soils [6]. Soil pH has shaped the modern vegetation of the LIPBF. These acidic soils are high in iron content but low in calcium, magnesium, and potassium [4]. The survival of vegetation located in the LIPBF requires loamy highly acidic soil conditions with a pH that ranges from 3.6 to 5. These conditions limit the kinds of vegetation that can grow on these soils.

The goal of this research is to establish the baseline observation of the vegetation located in the proposed LISF by applying quantitative and qualitative analysis. The specific objectives are to: (a) collect data based on distribution and diversity of the understory vegetation and (b) analyze data statistically for density, frequency, cover, and IVI to identify the evenness or diversity in LISF. Ultimately, we will compare the vegetation that presently covers the area with what may be there in the future.

Materials and Methods

Line Transects

The data on distribution composition were compiled from samples taken from a total of 17 line transects which included 5 controls (Figure 1). Each transect was 25m in length, laid out in north-south direction across the boundary of the vegetation type.

Quadrats

Six quadrats were laid along each line transect. Each quadrate measured 1m^2 was divided into four plots. All the vegetation in each individual plot was counted and recorded on data sheets.

pH

The pH level was measured using an electrode pH meter tester by Kelway Instruments (Typ-36 TEW).

Vegetation analysis (quantitative and qualitative)

Frequency is the vegetation attribute that describes the probability of finding a species within a particular area (Numbers of plots in which species occur/Total number of plots * 100).

Relative frequency (RF) = Fequency of a species/Total frequency of all species * 100

Density is closely related to abundance but more useful in estimating the importance of species. It is defined as the number of plants of a certain species per unit area (Number of plants of a certain species/Total area sampled * 100)

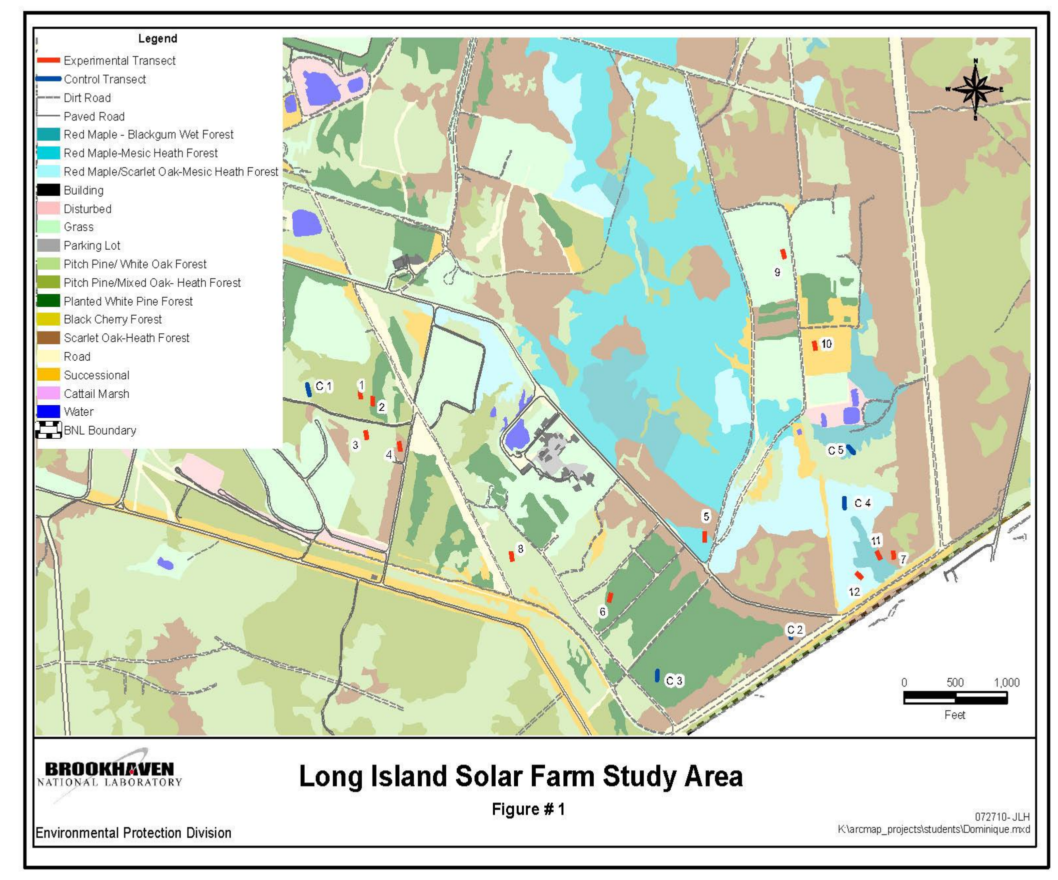
Relative density (RD) = Density of a species/Total area sampled * 100

Cover attributes to the amount of species covering an area in a given unit (Total area covered by a species/Total area sampled * 100)

Relative cover (RC) = Cover for a species/Total cover for all species * 100

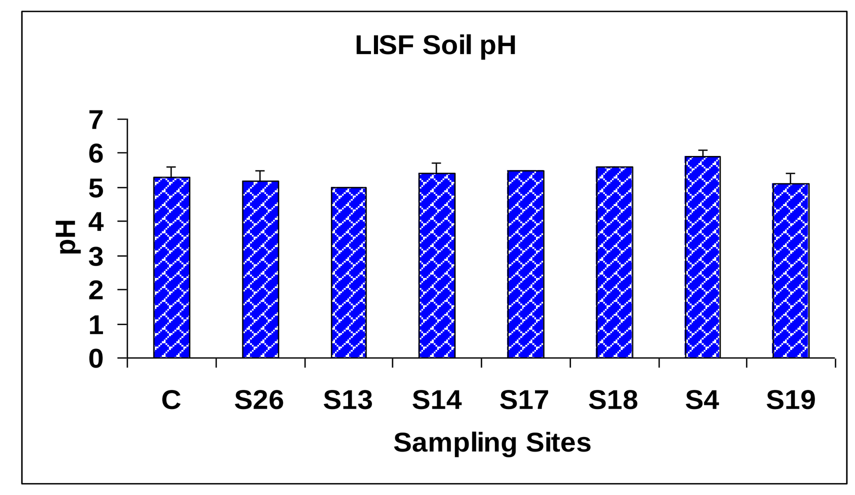
IVI: The important value index represents index member which is the ratio of the value of all species in a given period to the value of all species in the base period (**IVI = RF + RD + RC**)

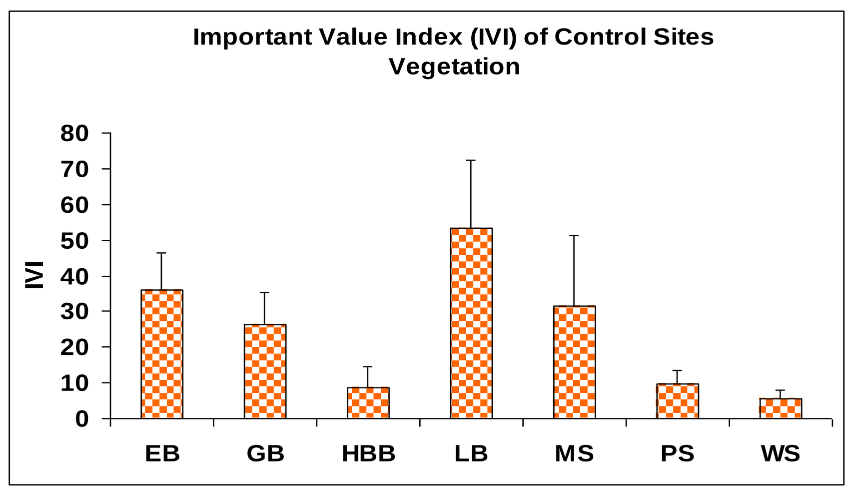
Statistical analysis: Descriptive statistics were computed from individual measurements of each attribute and then averaged by sample and site. The mean, variance, standard deviation, standard error, and cover value were computed for continuous data using Microsoft Excel software.

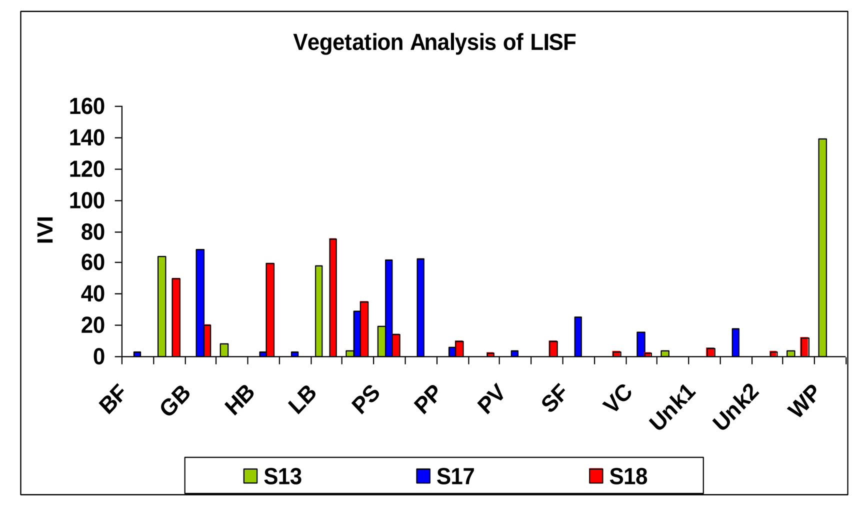


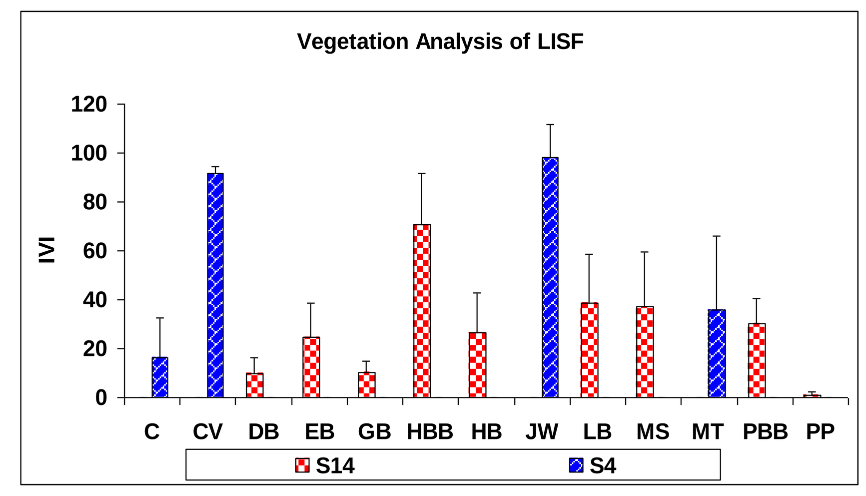
Common Name	Abv.	Genus	Species
Bracken Fern	BF	*Pteridium*	*aquilinum*
Black cherry	BC	Prunus	serotina
Early Lowbush Blueberry	EB	*Vaccinium*	*pallidum*
Greenbrier	GB	*Smilax*	*rotundifolia*
Highbush Blueberry	HBB	*Vaccinium*	*corymbosum*
Huckleberry	HB	*Gaylussacia*	*bacata*
Late Lowbush Blueberry	LB	*Vaccinium*	*angustifolium*
Maple Seedling	MS	*Acer*	*rubrum*
Pine Barren Bellwort	PBB	*Uvularia*	*puberula*
Seedbox	SB	*Ludwiga*	*alemifolia*
Virginia Creeper	VC	*Parthenocissus*	*quinquefolla*

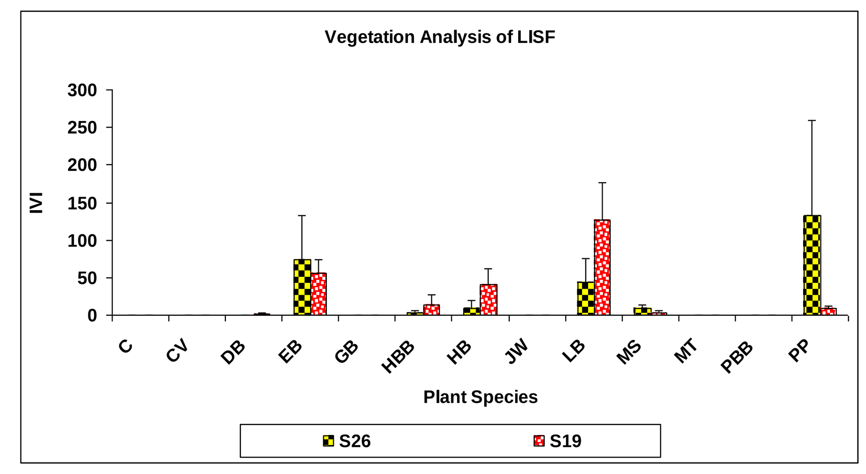
Results and Discussion











Site	LISF Site	H
C1	C1	-1.47
C2	C2	-1.87248
C3	C3	-0.19764
C4	C4	-1.94825
C5	C5	-1.77116
T1	S26	-1.13217
T2	S26	-0.4709
T3	S19	-0.78964
T4	S19	-1.60547
T5	S17	-1.75208
T6	S13	-1.16
T7	S14	-1.70421
T8	S18	-1.85
T9	S4	-1.26296
T10	S4	-1.26213
T11	S14	-1.6068
T12	S14	-2.08499

- Soil pH ranged from 3.2 to 5.9
- Among all sites and dominant species of vegetation in Long Island Solar Farm (LISF) sites, low bush blueberry (LB) and high bush blueberry (HBB) showed the highest and lowest IVI (125.00±50.90 and 70.88±20.95, respectively).
- Shannon Weiner Index (H) values on plant community diversity ranged from -0.1976 in C1 to -2.0849 in T12 of S14

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

- The areas with a higher acidity of 3.2 to 4.8, composed of sandy soil common for the Pine Barrens Forest, were populated with more vegetation. Moreover, the areas with a lower acidity of 5 to 6.8 were covered with a moist, marshy type of soil populated with minimal vegetation. Based on the relationship between diversity in soil and vegetation, we have reason to believe that vegetation is driven by acidic soil

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