A Comparison of the Chemistry of Soil Surrounding Natural and Anthropogenic

Ponds at

Brookhaven National Laboratory

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Abstract

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Brookhaven National Laboratory (BNL) is located in the Long Island Pine Barrens, an
area formed through decomposition and reworking of glacial materials. BNL has many
wetland structures including vernal ponds, recharge basins, and streams. Some of these
serve as breeding grounds for tiger salamanders (*Ambystoma tigrinum*), a species listed as
endangered by the New York Natural Heritage Program.   Anthropogenic habitats need
to possess suitable characteristics with respect to soil and water chemistry in order to
serve as successful breeding habitat for tiger salamanders. Soil is an important factor in
controlling vegetation and water chemistry. In this study five ponds were selected for a
study of soil chemistry: two natural and three anthropogenic. Nine soil samples were
collected from each pond, eight around the perimeter and one from the pond bottom.
Global Positioning System (GPS) was used to locate the sample points and ArcGIS was
used to map the ponds and sample points. Soil samples were tested for pH, nitrate
nitrogen, phosphorus, potassium, aluminum, ferric iron, magnesium, sulfate, calcium, and
chloride using LaMotte Combination Soil and LaMotte Soil Micronutrient Kits.   Soil
moisture content was also determined. Soil color, texture, structure, consistency, and
mottling were also observed and recorded. Five of the nine soil samples from each pond
were digested using the EPA method 3050B for Acid Digestion of sediment, sludge, and

soil and then tested for copper, iron, zinc, magnesium, cadmium, aluminum and lead

using the ICP-AES.   Soil pH was acidic throughout, ranging from 4.0 to 6.5. Nutrient

levels were low and consistent across pond types. Soil chemistry did not differentiate

between the two types of ponds. This information will serve as baseline data for BNL's

natural resource manager and enable BNL to optimize the management of amphibian and

reptile habitats.

Introduction

The soils of Long Island Pine Barren (LIPB) were developed by deposited and reworking of several advances of Pleistocene glacial ice [1]. The soil is made-up of 80-96% sand, excessively drained, nutrient poor, and acidic [2]. The vegetation types that forms LIPB is determine or influenced by its soil's profile [3]. Only vegetation that are able to withstand the harsh conditions of droughty soil, low nutrient levels and acidity is able to persist. Many of the plants produce waxes, resins, or volatile oils that reduce the amount of water loss as well as insect herbivory. These adaptations of wax production have allowed vegetation to exist in pine barren soil also increasing the potential of fire [4]. LIPB are dominated by more then 60% of canopy cover tress that consist of pitch pine oak and one or more oak species (Qurcus coccinea, Q. alba, Q. velutina). LIPB also contain a rare species of pitch pine called dwarf pitch pine. The shrubs and herb levels are dominated by ericaceous plants such as huckleberry (Gaylussacia baccata), bearberry Arctostaphylos uva-uri), blueberry (Vaccinium pallidum) and wintergreen (Gaulthera procumbens) [2]. These types of vegetation are disappearing rapidly.

Land clearance, development, and fire suppression are destroying LIPB natural habitats that are used by rare species [1]. Brookhaven National Laboratory (BNL), an advocate for preserving the natural beauty of LIPB, is located in the Long Island Pine Barrens. BNL has many wetland structures including vernal ponds, recharge basins, and streams. Vernal ponds are circler depressions that are nutrient- poor, acidic, ground water fed, and seasonally fluctuating wetlands; often enclosed by a canopy of trees and carpeted will leaf litter [4]. Some of these serve as breeding grounds for tiger salamanders (*Ambystoma tigrinum*), an endangered species listed by the New York Natural Heritage

Program. Vernal ponds, because of their seasonally fluctuation are fish free habitat eliminating the main source of predation of the breeding salamanders adult's eggs and larvae [4]. Tiger Salamander have been known to breed at sixty-one sites within Long Island pine Barren.

To reduce the risk killing off rare species from Long Island Pine Barren anthropogenic habitats are being introduces.   The main goal of introducing anthropogenic habitats is to reduce the loss of ecological function by providing habitats that are functionally equivalent to natural habitats [5] To categorize an anthropogenic habitat as flourishing its ecological function, characteristics that classify a habitat hydrologic (e.g., soil), biochemical (e.g., water chemistry) and habitat (e.g., vegetation) [6], it must be compared to the ecological functions of a successful natural habitat [5]. Comparing the soil chemistry of natural and anthropogenic habitats will provide information needed for the measurement of ecological functions of anthropogenic habitats. It will provide as baseline data for BNL's natural resource manager and enable BNL to optimize the management of amphibian and reptile habitats

Materials and Methods

In this study five ponds within Brookhaven National Laboratory were selected for study of soil chemistry: two natural Brookhaven Pond six (BP6), Brookhaven Pond nine (BP9) and three anthropogenic Brookhaven Pond thirteen (BP13), Brookhaven Pond Seven (BP7), and Brookhaven Pond Meadow (BPM). Nine soil samples were collected from each pond; one from the center of the pond and eight from around the pond two meters from the shoreline. The center of the pond was found using Global Positioning

System (GPS). The other eight samples were collected at each cardinal point (N, S, E, W) and the midpoint between each of them (NE, NW, SE, SW) Soil temperature, texture, structure, consistency, and litter depth was recorded at each sample location. Soil temperature was determined using a thermometer. A soil textural triangle was used to classify the texture class of the soil. Litter depth was measure using miller meters.

To determine soil moisture 10g from each sample each sample was placed a pre-weighed container and placed in a 65°C drying oven for 48 hours. The rest of the soil was air dried for 24 hours. Soil color, both wet and dry, was observed and recorded using Munsell Soil Color Charts.

Each soil sample was tested for ph, nitrate nitrogen, potassium, phosphorus, magnesium, calcium, chloride, ferric iron sulfate, and aluminum using a LaMotte Combination Soil and LaMotte Soil Micronutrient Kit.

Five grams of air-dried soil from the north, south, east, west and center samples was digested using the EPA method 3050B for Acid Digestion of sediment, sludge, and soil and then tested for copper, iron, zinc, magnesium, cadmium, aluminum, calcium and lead using the ICP-AES.

DISCUSSION AND CONCLUSION

The landscape of the three-anthropogenic ponds was contrast to the two natural ponds. The soils around the anthropogenic ponds were covered with twelve inches or less of grass it lack plants and trees. The soils around the natural ponds was covered with lot of trees mostly species of oak (Qurcus coccinea) and plants mostly blueberry (Vaccinium pallidum) and more leaf littler then anthropogenic.   The ph values for the natural pond soil samples are slightly more acidic with a range of 4.8 to 5.5 when compared to anthropogenic soil samples with a rang of 5.9 to 6.5

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