Limnological Studies of BNL Ponds

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Introduction

According to the Environmental and Waste Management Service Division, the Brookhaven National Laboratory is located in a section of the Oak/Chestnut forest region of the Coastal Plain of Long Island. Forest types are typically oak-pine or pine-oak. Brookhaven National Laboratory property constitutes roughly five percent of the 100,000 acre Pine Barrens on Long Island**.** Upland soils tend to be very well drained, while depressions form ephemeral coastal plain ponds. Hence, a mosaic of wet and dry areas on site are correlated with variations in topography and depth to the water table. Without fires or other disturbances, vegetation would follow the normal moisture gradient closely. In actuality, vegetation onsite is in various stages of succession, reflecting the history of disturbances to the area, the most important of which are land clearing, fire, local flooding, and draining**.** Over 230 plant species have been identified onsite. Fifteen mammal species endemic to the site include those species common to mixed hardwood forest and open grassland habitats. The goal of this project is to establish baseline water quality information of the ponds on the Brookhaven National Laboratory Site. Vegetation maps of the site will be analyzed to possibly correlate this information with pond data collected. The ponds surveyed in this study are vernal, coastal plain ponds, recharge-basins and wetlands.

Materials and Methods

Water Quality Analysis of the ponds at BNL were conducted by chemical analysis using a water chemistry kit from the LaMotte Company and electronic analysis using a YSI 6820 Multi-Parameter Water Quality Monitor.

Using the LaMotte Water Quality Kit

The LaMotte Water Analysis Kit uses a series of test with colormeteric endpoints that indicate chemical conditions of the water being surveyed. The tests conducted with this kit measured in parts per million (ppm) the concentration of dissolved carbon dioxide, dissolved oxygen, nitrate and phosphate, silica, total hardness, calcium and magnesium. The pH analysis of the water also had a colormetric endpoint but was not measure in ppm, it was matched against the Octet Comparator provided in the kit.

The water quality tests were conducted according to the instructions provided with the LaMotte kit. The tests were conducted in the field at the site of the pond water and in a chemistry laboratory. The samples were collected according to the procedure outline in the kit instructions using sample bottles provided in the kit.

Using The YSI 6820 Multi-Parameter Monitor

The YSI monitor was calibrated prior to its use analyzing pond waters. It was used to measure pH, dissolved oxygen, conductivity, turbidity and temperature. The ponds were surveyed directly at the source using the YSI monitor. Some of the ponds were analyzed prior to the availability of the YSI or were not analyzed by the YSI due to the shallow depth of pond waters

Results

The results of the pond limnology tests at BNL indicate certain trends in pH, dissolved carbon dioxide, and total hardness. Influencing factors on these chemical conditions correlate with water infiltration sources and the flora surrounding and inhabiting the pond locations. Ponds predominately fed by precipitation, within Oak/Pine borders, have pH values ranging from 4.5 to 6.5, carbon dioxide values ≥6ppm, and total hardness values ≤16ppm. Ponds within Oak/Pine borders that tend to be storm/cooling water fed have pH values ranging from 7 to 9, carbon dioxide values ≤6ppm, and total hardness values ≥16ppm. No significant levels of phosphates (≤0.01ppm) were detected in any pond. Low levels of nitrates (≤2.2ppm) were detected at three of the recharge basins.

Measurements involving dissolved oxygen, silica, calcium, and magnesium varied greatly and require further investigation to indicate trends.

Fig. 1 P-A6a Recharge Basin

Fig 2. P-4 Coastal Plain

Fig. 3 P-7 Man-Modified

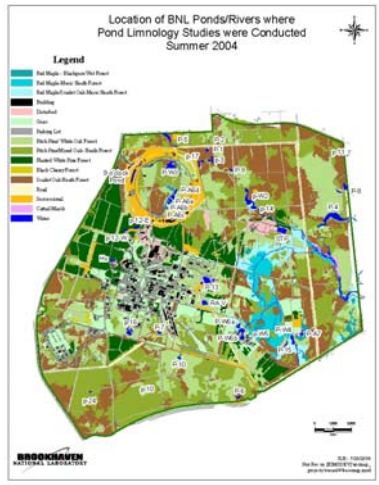

Fig. 4 P-9 Coastal Plain

Fig. 5 P-W3 Coastal Plain

Fig. 6 P-1 Coastal Plain

Fig. 7 P-16 Recharge Basin

Discussion

Oak leaves, pine needles, and natural precipitation possess acidic properties that result in a lower pH in some of the ponds tested. Decaying organic material increases the amount of carbon dioxide released as a result of the decomposition process and consequently lowers the pH value. The transport of water through concrete or metal conduits and water runoff from roadways may be a source of increased hardness values in man-made ponds or recharge basins. Runoff from roadways has a buffering affect in ponds that receive storm water, resulting in a neutral to basic pH. Daily weather conditions, photoperiods, canopy cover, and atmospheric temperatures influence oxygen concentrations. Low levels of nitrate and phosphate values indicate minimal natural or anthropogenic influences such as pesticide use and municipal waste dumping.

This is the first of a three-year project studying water quality, ecosystem monitoring and soil testing. Future studies should reveal additional trends, linkages to natural factors influencing water chemistry and the effects of water chemistry on distribution of biotic assemblages.

Results

Ponds	Date	Pond Types	Water Source	Vegetation Types	pH	DO ppm	CO_2 ppm	Hardness ppm	Ca ppm	Mg ppm	Nitrate ppm	Phosphate ppm	Silica ppm	temp. (DC) (YSI)	Conductivity uS/cm² (YSI)	Turbidity NTU (YSI)	pH (YSI)	DO (YSI)
P-9NW	7/8/2004	Coastal Plain	Storm Water fed/Precipitation	Pitch Pine/Mixed Oak/Blueberry	5	3.2	7	8	8	0	0	0	3	na	na	na	na	na
P-9E	7/8/2004	Coastal Plain	Storm Water fed/Precipitation	Pitch Pine/Mixed Oak/Blueberry	6	5.3	10.5	4	4	0	0	0	3	na	na	na	na	na
P-2S	7/9/2004	Coastal Plain	Precipitation	Pitch Pine/Mixed Oak/Blueberry/Bladderworts	5	8.5	12	8	4	4	0	0	2	na	na	na	na	na
P-2N	7/9/2004	Coastal Plain	Precipitation	Pitch Pine/Mixed Oak/Blueberry/Bladderworts	5	8.2	6	10	4	6	0	0	0.5	na	na	na	na	na
P-1E	7/9/2004	Coastal Plain	Precipitation	Pitch Pine/Mixed Oak/Blueberry/Bladderworts	5	6.4	8	6	8	0	0	0	0	na	na	na	na	na
P-1W	7/9/2004	Coastal Plain	Precipitation	Pitch Pine/Mixed Oak/Blueberry/Bladderworts	5	8.8	6	4	8	0	0	0	0	na	na	na	na	na
P-6	7/12/2004	Coastal Plain	Precipitation	Scarlett Oak/Grasses/Blueberry	5.5	2.4	19	12	9	3	0	0	1	20	38	25.4	5.5	2
P-15	7/12/2004	Coastal Plain	Precipitation	Pinagmites/Scarlett Oak	6	3.4	11	12	6	6	0	0	1	na	na	na	na	na
P-W3	7/13/2004	Coastal Plain	Peconic River/Storm Water fed	Pitch Pine/Mixed Oak/Blueberry/Tupelo	5.5	2.8	13	20	8	12	0	0	1	20	103	11	5.8	2
P-5	7/14/2004	Coastal Plain	Precipitation/Storm Water Fed	Scarlett Oak/Blueberry/Pitch Pine/Lilly Pads	6.5	6.2	6	28	28	0	0	0	1	22	191	9.5	6.4	6.9
P-4 (Zeeks)	7/16/2004	Coastal Plain	Precipitation	Oak/Red Maple/Tupelo/Pine/Lilly Pads	5	3.4	8	8	8	0	0	0	0	22.4	30	22.2	4.8	3.3
P-8 (Andy)	7/16/2004	Coastal Plain	Precipitation	Oak/Maple/Pine/Tupelo/Sphagnum Moss	5	4.1	12	8	8	0	0	0	0	24	38	5.6	4.5	5.8
P-A7	7/12/2004	Man-made	Precipitation	Grasses/Sand	5.5	7.7	3	16	10	6	0	0	1	na	na	na	na	na
P-7	7/16/2004	Man-modified Depression	Storm Water fed	Grasses/Oaks/Maples/Pitch Pine/Smartweed	8	10.8	2	20	20	0	0	0	0.5	26.5	59	10.5	9.1	9
P-10	7/12/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses/Sand	9	9.2	0	42	30	12	2.2	0	4	25	224	12	9.5	11
P-A6d	7/13/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses/Phragmites/Pitch Pine	7	7.6	2	20	16	4	0.9	0	1	20	36	18	6.9	8.5
P-A6a	7/13/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses/Phragmites/Pitch Pine	7.5	7	2	64	36	28	0	0	4	21	166	1.4	7.5	8.1
P-A6b	7/13/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses/Phragmites/Pitch Pine	7.5	5	0	16	20	0	0	0	0.5	21	101	8	9.5	10
P-13 (small)	7/16/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses	6.5	7	3.2	16	8	8	0	0	0.5	29.5	29	22.8	6.7	8.5
P-13 (large)	7/16/2004	Recharge Basin	Cooling Tower/Storm Water	Grasses/Sand	7	7.2	4	24	16	8	0	0	15	n/a	n/a	n/a	n/a	n/a
p-16	7/20/2004	Recharge Basin	Treated Water	Grasses/Sand	7.5	8	3	72	28	44	1.32	0	10	n/a	n/a	n/a	n/a	n/a
p-3	7/14/2004	vernal	Precipitation	Scarlett Oak/Pitch Pines/Sphagnum moss	4.5	9.3	19	2	4	0	0	0	0	21	41	26	4.7	6.8
p-17	7/14/2004	vernal	Precipitation	Scarlett Oak/Pitch Pines/Sphagnum moss	4.5	2.4	38	2	2	0	0	0	5	17	62	38	4.7	4.6
P-W6a	7/20/2004	Wooded Wetland	Landfill Runoff	Red Maple/Scarlett Oaks/Grasses	6.5	3.4	16.5	14	16	0	0	0	3.5	24	70	12	6.5	3.1

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