The Relationship of Soil and Water Chemistry to the Preservation of Salamander Habitats in the Long Island Pine Barrens

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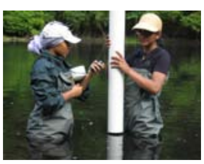
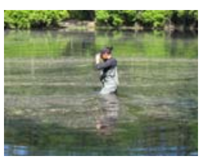
Abstract

The Eastern Tiger Salamander has been listed as an endangered species on Long Island in New York since 1983. Many salamanders are threatened by habitat loss and water pollution. The purpose of this study was to develop an understanding of the chemical and biological factors that affect salamander population and distribution, identify possible threats to viability, and contribute to the development of a management plan to protect this species. Field studies and analysis activities included soil and water measurements important to the ecological functioning of coastal ponds in the Long Island Pine Barrens—Peconic River Complex. Soil and water samples were collected and analyzed in four natural ponds using colorimetric and spectroscopic methods. Metals in the samples were further analyzed using an inductively coupled plasma–atomic emission spectrometer (ICP). Tiger salamanders appeared to thrive in areas with low concentrations of pollutants and moderate levels of natural factors such as dissolved oxygen. The presence of tannin—lignin and the amount of suspended solids had an affect on salamander populations. This showed that salamanders prefer oxygen-rich environments that contain relatively low amounts of decaying matter. According to our research, longer hydroperiods are preferred by the species. This work was completed as a small portion of the implemented Wildlife Management Plan being conducted by the Environmental and Waste Management Services Division at Brookhaven National Laboratory. The soil and water chemistry of ponds with and without tiger salamanders were analyzed in order to further investigate the decline of the species and to better understand ways in which to preserve their habitats.



Taking core sample at Pond 1



Assessing Pond 2

Using YSI Water Quality Meter at Pond 13a

Vegetation surrounding Pond 3

Assessing Pond 17b

Background

The size of the woodlands and wetlands required for terrestrial salamander habitats are becoming reduced and the chemistry of the soils and water are being altered due to the effects of water level fluctuations, pollution, the introduction of predatory fish and combinations of other related factors. Though tiger salamanders spend much of their time on land, most begin migrating to breeding ponds as early as January or as late as April. During this time of year, the females will begin to submerge their egg masses approximately one foot below the surface of the pond. Around June and July, larval salamanders will emerge and begin transformation in the drying ponds. High larval mortality will occur if the ponds dry up too quickly. This study was done during the larval period of the salamanders. Egg masses were observed in Ponds 1 and 2.

Tiger salamanders spend a large portion of their life cycle out of the water, beneath the surface in burrows. As a result, the chemical makeup and porosity of the soil are crucial to the salamander's existence. The soils of the Long Island Pine Barrens are mostly sandy and well drained making it desirable for the largest of the six mole salamanders found in New York State.

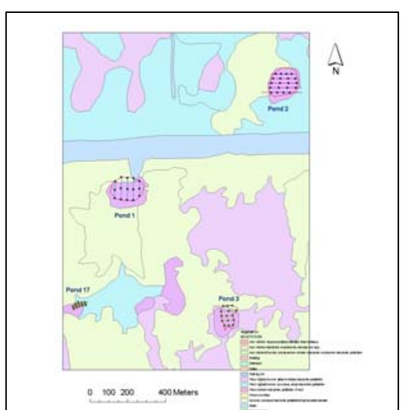
As more research is conducted, it is crucial to build a management plan that encompasses all aspects of the tiger salamander's life cycle. After having conducted this research, we realize that biological factors associated with salamanders are only a part of the solution. Water and soil interactions in and around the vernal ponds are equally critical to salamander habitat preservation and deserve equal concern.

Methods

Site selection
Four ponds were selected on the north end of Brookhaven National Laboratory, 1, 2, 3, and 17b. Ponds 1 and 2, known tiger salamander ponds, were compared to ponds 3 and 17b, non-salamander ponds. In addition, pond 13a was used as a comparison because of recorded tiger salamander abundance.

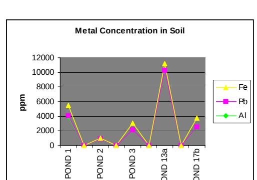
Water Testing
After the ponds were marked and mapped, 15 equidistant points within the ponds were located using a GPS unit for sampling. Twenty points were selected for pond 2. Water depth was measured at each point where approximately 250ml of water was collected. Then, using a calibrated YSI water quality meter, the temperature (^{o}C), pH, dissolved oxygen (mg/L), turbidity (NTU) and conductivity ($\mu s/cm^2$) were measured and digitally recorded. A Hach CEL/890 Advanced Portable Laboratory kit and colorimeter was used to test for nitrate, chlorine, sulfate, phosphorous, tannin-lignin, suspended solids and molybdenum. An Inductively Coupled Plasma—Atomic Emission Spectrometer (ICP—AES) tested for copper, iron, zinc, aluminum and lead. Calcium and magnesium were also tested in order to later determine water hardness.

Soil Testing
Eight sites were marked using GPS at equal distances around the perimeter of each pond, in addition to one point from the middle (n=9 from each pond). The soil temperature, a general description of the vegetation surrounding each point, and litter depth were recorded. A Guelph permeameter was used to measure soil porosity at each point. A core sample was taken at the northeast corner of each pond using a soil auger. Once dry, the soil moisture was calculated and soil color was determined using a Munsell color chart. The soil was then tested for pH, nitrate, phosphorous, potassium, aluminum, chloride, ferric iron, sulfate and magnesium using a LaMotte Combination Soil and a LaMotte Soil Micronutrients Kit. The percentage of organic matter in the soil was measured using a wet oxidation method with hydrogen peroxide. Soil samples were digested using EPA method 3050B for acid digestion of sediments, sludge, and soils, and tested using the ICP—AES for copper, iron, zinc, magnesium, cadmium, aluminum and lead. Vegetation samples were taken from inside each pond and identified.

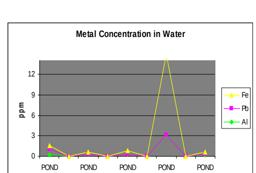


Sample Collection

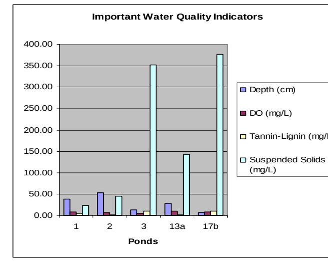
Results



Of all the metals tested in the water and soil, only Al, Pb and Fe were found in high concentrations. Concentrations were higher in the soil than the water.

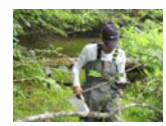


Concentrations of lead in the soil and water were higher than expected.



Testing and analyzing water samples

Collecting water samples



Locating points using GPS units

Preparing samples for the ICP-AES

Conclusions

Pond 1 was most like pond 13a, the comparison pond, because it contained similar amounts of dissolved oxygen, temperature, conductivity, phosphorous, iron and a higher pH than pond 2 or the non-salamander ponds 3 and 17a. Ponds with salamanders had greater hydroperiods, dissolved oxygen levels, and molybdenum levels. Higher molybdenum levels could be a result of ponds 1 and 2 closer location to the dirt road. Ponds without salamanders had significantly higher turbidity, tannin/lignin, suspended solids, calcium, and total hardness.

Salamanders can tolerate a wide range of environmental conditions as long as a combination of desirable levels of pH, dissolved oxygen, and hydroperiod are present. Even though pond 17b had several variables in common with pond 13a, it is possible that salamanders were not found in ponds 17b or 3 because the combination of desirable conditions was not present.

In this study, natural pollution was more significant than man-induced pollution. There were high levels of iron in the soil of salamander ponds. Iron could help increase the amount of vegetation, such as rice cutgrass, which seems to be preferred by tiger salamander for egg attachment. The higher levels of lead found in soil could be due to the past addition of tetraethyl lead to gasoline over a period of time.

Our team agrees with the management plan set forth by Brookhaven National Laboratory. Ponds should be monitored on a regular basis and maintenance during migration times should be kept to a minimum. A buffer zone of at least 850 feet should be maintained and one well marked path to each pond should be established to reduce the amount of human disturbance to the ponds.

Inductively Coupled Plasma—Atomic Emission Spectrometer

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