

Comparing Odonate Biodiversity, Water Quality and Vegetation of Natural, Man-Made and Modified Ponds at Brookhaven National Laboratory

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Abstract

Odonates are the group of insects known as dragonflies and damselflies. In recent years, these insects have become the focus of interest for environmentalists looking for bioindicator species. Looking at biodiversity across several pond sites at Brookhaven Lab, it may be possible to identify an indicator species or an assemblage of species. There is also an ongoing search for the threatened damselfly species, *Enallagma recurvatum*, *E. minisculum* and *E. pictum*. Three ponds were chosen, one each to represent a natural, man made and man modified pond. Data on odonate species, water quality, weather and vegetation were acquired between July 10 and July 30, 2009. Odonate species data is presented for 2 previously unvisited pond sites. Using modified Shannon, Simpson biodiversity indices and Jaccard's index, statistical analysis of biodiversity was attempted (small sample size presents an issue). A comparison of water quality and vegetation of the ponds is presented.

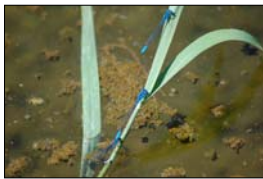


Figure 1: Azure Bluets at P-16

Introduction

Odonates are the group of insects known as dragonflies and damselflies. In recent years, these insects have become the focus of interest for environmentalists looking for a bioindicator species and "flagship" organism to promote the stewardship and management of wetlands. The Odonates are beautiful, charismatic creatures that are a pleasure to watch, collect and identify.

This research builds upon previous work. Several studies have been done over the last 6 years at BNL to study the diversity and species richness of Odonates at vernal ponds and wetlands within the Brookhaven site. Studies have been done to catalog the species found here, to correlate their emergence with temperature, precipitation and other weather parameters. Species data is presented for 2 previously unstudied pond sites. Also statistical analysis of biodiversity as well as correlations between water quality and vegetation of the ponds is described.



Figure 2: Water sampling with a YSI multimeter probe to test temperature, dissolved oxygen, percent free oxygen, and salinity.

Methods and Materials

Several instruments were used during the research on Odonates. In order to collect specimens for identification, 15 inch insect nets, and butterfly habitats were used. We collected data for each site between 9 and 11 AM every other day starting July 13 and ending July 27, 2009. A Nikon SLR camera was used to take photos of specimens for identification purposes. A Kestrel portable weather station was used to acquire weather data (air temperature, wind speed, relative humidity, dewpoint) and a YSI probe was used for water quality (water temperature, salinity, dissolved oxygen and percent oxygen). A Vernier turbidity probe was used in the field for turbidity. HACH kits were used to test water samples for nitrates, phosphates and total suspended solids in the lab. Organisms were identified to species level with field guides. There were some instances where it was necessary to collect specimens and identify them in the lab using a dissecting microscope and classification key (Common vs. Sweetflag Spreadwing, immature bluets and forktails).

Results

Results on weather, water quality and Odonate diversity are summarized in Tables 1 through 3. Pond 7 continues to have the highest species richness as described in past research (Table 3). Distribution of species is varied and some species are only found at one location. Water quality and vegetation are assumed to play a role in species distribution. Table 2 shows that DO levels are generally low, but P-16, treated water, has a higher DO.

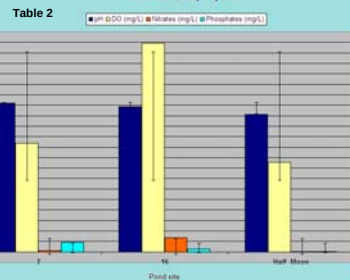
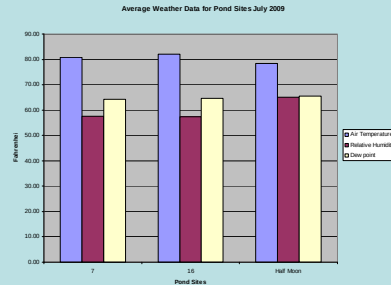


Table 3

Damselfly Species List for Ponds		
Common Name	Scientific Name	Pond # found
Variable Dancer	<i>Argia fumipennis violacea</i>	Pond 7
Azure Bluet	<i>Enallagma aspersum</i>	
Familiar Bluet	<i>Enallagma civile</i>	
Skimming Bluet	<i>Enallagma geminatum</i>	
Rambur's Forktail	<i>Ischnura ramburi</i>	
Eastern Forktail	<i>Ischnura verticalis</i>	Pond 16
Common Spreadwing	<i>Lestes disjunctus disjunctus</i>	
Azure Bluet	<i>Enallagma aspersum</i>	
Citrine Forktail	<i>Ischnura hastata</i>	
Fragile Forktail	<i>Ischnura posita</i>	
Eastern Forktail	<i>Ischnura verticalis</i>	Half Moon
Sweetflag Spreadwing	<i>Lestes forcipatus</i>	
Citrine Forktail	<i>Ischnura hastata</i>	
Fragile Forktail	<i>Ischnura posita</i>	
Furtive Forktail	<i>Ischnura prognata</i>	
Eastern Forktail	<i>Ischnura verticalis</i>	Pond 7
Common Spreadwing	<i>Lestes disjunctus disjunctus</i>	

Pond Sites



Figure 3: Half-Moon: natural pond



Figure 4: P7: man-modified pond



Figure 5: P16: man made treatment water basin

Discussion

Weather data was fairly consistent at sites for each day and the month as a whole. July became increasingly humid toward the end of the month (Table 1). As relative humidity increased and cloudy skies prevailed we observed fewer Odonates at all sites. Sunny, warm days after 9AM (when temperatures began to rise) were the best times for observing Odonates.

Half Moon pond consistently had lower temperatures than the other sites. This is attributed to the dense canopy around the site. This made it difficult to get a direct sunlight air temperature. Also, clouds were often present during our observing times at Half Moon. Pond 7 and 16 on the other hand, had little canopy surrounding them and clear sky temperatures were made.

Using the YSI probe we found that P16 had a water temperature roughly 10 degrees cooler than the other sites. The lower temperature is attributed to the water treatment process of the water discharged into the pond site. There were less species at this site, possibly attributable to water temperature.

The Azure Bluet (*Enallagma aspersum*) was the most abundant species observed at P-16 with minimal observations of *Ischnura* and *Lestes* species. Half Moon pond probably has more species than observed since observations were limited to the one roadside opening of the pond. The rest of the pond's perimeter was surrounded with dense underbrush and pine tree canopy. Pond 7 continues to have the most species diversity as presented in past research. There did not appear to be one dominant species over another, all were represented fairly equally. The Familiar Bluet and Variable Dancer were only observed at this pond. It is assumed that vegetation played a role more than water quality or weather since vegetation was more variable than water and weather quality. In conclusion, vegetation appears to play a role in Odonate distribution as does weather and water quality. Continued research may lead to identification of a bioindicator species or species complex for the wetlands of Brookhaven National Laboratory.



Figure 6: Common spreadwing at P7



Figure 7: Variable Dancer at P7



Figure 8: Eastern Forktail at Half Moon Pond

Applications for the Classroom

- Students can collect species data on plants, insects, birds in their own backyards, neighborhoods to analyze biodiversity.
- Students can perform water quality testing and work with local water authority to assess various local sites.
- Students can develop a digital field guide from photos of specimens.
- Students learning environmental research techniques can design their own experiments to study populations for genetic variation.
- Students can collect weather data to analyze changes in local climate, compare to region, global climates.
- Students can identify bioindicator species based on environmental quality monitoring of local areas.

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