The Use of Visual Surveys To Determine Odonate Species and Abundance at Vernal Pools At Brookhaven National Lab

Dianna Rodriguez

Office of Science, Science Undergraduate Laboratory Internship (SULI)

SUNY Old Westbury

Brookhaven National Laboratory

Brookhaven, New York

August 10, 2007

Prepared in partial fulfillment of the requirements of the Office of Science, Department of Energy's Science Undergraduate Laboratory Internship under the direction of Timothy Green in the Environmental Sciences department at Brookhaven National Laboratory.

Participant:_____

Signature

Research Advisor:_____

Signature

Table of Contents

Abstract

The Use of Visual Surveys To Determine Odonate Species and Abundance at Vernal Pools At Brookhaven National Lab. DIANNA RODRIGUEZ (SUNY Old Westbury, Old Westbury NY) TIMOTHY GREEN (Brookhaven National Laboratory, Upton NY).

Dragonflies and damselflies are insects of the order Odonata, suborders *Anisoptera* and *Zygoptera*, respectively. In the state of New York there are over 170 known, documented species of odonates of the over 5000 species known worldwide. Odonates play an important role in maintaining the delicate ecosystems of vernal pools and other bodies of water such as marshes, streams, and wetlands. Determining the species present and their abundance at a site can be difficult due to their incredible flight speed, their temperamental habits, and the surrounding weather conditions. Visual surveys are the simplest way to document the species and their abundance. Specific ponds onsite at Brookhaven National Laboratory (BNL) were each surveyed once every five to nine days at the same designated time. The survey was conducted for a full hour and the odonates present were marked as being present at intervals of ten minutes using a number system that denotes a range of 1 to 5, 6 to 20, 21 to 100, or 100 + individuals. The study was conducted for ten weeks. The surveys have shown the strong presence of some odonates while others have very weak presence or none at all. The surveys have also shown that at certain ponds overall species abundance was declining at an alarming rate unrelated to flight season; hydroperiod may have had a significant effect on certain Odonate species.

Through these surveys we have added to the New York Odonate Atlas, an existing study that is identifying all odonates of New York by identifying all Odonates present at BNL.

Introduction

Odonates are predacious flying insects that inhabit bodies of water such as vernal pools, ponds, lakes, and streams. Within the order Odonata there are two sub-orders, Anisoptera (dragonflies), and Zygoptera (Damselflies). Odonates are physically characterized by a head with 2 compound eyes and three small "simple" eyes, a thorax with six bristly legs and two pairs of membranous wings, and a long brightly colored abdomen consisting of 10 segments. Since 2003 research has been conducted at Brookhaven National Laboratory (BNL) to identify the species inhabiting the ponds and Peconic River onsite. Currently there are approximately 36 identified species of dragonflies onsite at BNL. The purpose of this project is to try to determine Odonate presence and abundance at ponds onsite at BNL. Since Odonates play a role in maintaining the delicate ecosystem of vernal pools and other bodies of water such as marshes, streams, and wetlands it is desirable to determine their abundance. Tracking and monitoring Odonates can be extremely difficult due to their relatively short lifespan, numerous populations, and extraordinary flight speed. To observe Odonates, visual surveys were conducted to determine what species are present at ponds, their abundance, and how that abundance changes over the course of a few weeks. This study was conducted to observe all Odonate species and their populations at four ponds on the BNL campus.

Methods and Material

To do the surveys, the protocol created by Jason T. Bried from the Nature Conservancy in Albany NY, was followed. Figure 1 shows an example of the survey used to record the data. The protocol stated that each site would be visited for one full hour, and each species of Odonates be marked at ten minute intervals through the use of a stop watch. If a species could not be identified in flight, a 15-inch diameter net was used to capture the odonates, which were then examined in hand. To keep consistency with Odonates surveyed, times were set for each pond; species abundance varies with time of day and lack of consistency would yield inaccurate abundances that could be lower than actual abundance. Two ponds were visited in one day. Pond 7 was visited at around 10:40 am, and pond 10, which was visited the same day as pond 7, was visited at around 1:17 pm. Ponds 1 and 2 were visited on the same day, at about 12:20pm and 1:30pm, respectively. The ponds were visited once every five to nine days. For each survey, the temperature, cloud cover and other weather conditions such as wind speed and humidity were recorded. To perform the survey, a stop watch was set for one hour, and the surveyor would walk around the edge of the pond and record what species were seen, their sex, any breeding stage, and newly emerged Odonates, tenerals, or their shed exuviae. The species abundance was recorded using a number system to denote a range. The number system used was 1= 1 to 5, 2= 6 to 20, 3 = 21 to 100, and 4 = 100 + individuals. Ponds 7 and 10 were surveyed for nine weeks, and ponds 1 and 2 for only 7 weeks due to problems initially locating them.

Results

During the summer of 2008, a total of four ponds were visited at Brookhaven National Laboratory (BNL). The ponds visited were Pond 7, Pond 10, Pond 1, and Pond 2. Over the past five years of Odonate research at BNL, 36 species have been found out of the 56 recorded in Suffolk County. Through the use of the visual surveys, Odonate abundances were recorded, noting population fluctuations that may have been affected by hydroperiode and flight season. For Pond 10, most species did not show significant changes in abundance. Only one species at Pond 10, *Tramea lacerata,* held the same abundance of 2 throughout the 8 weeks of surveys. None of the species abundance at Pond 10 seems to have been affected by hydroperiod, however flight season shows that the late appearance of *Lestes disjunctus, Celethemis elisa, Libellula incesta,* and *Celithemis eponina* could indicate effects on emergence. Table 1 shows the species and their abundance for pond 10. Pond 7 had dried up completely during the fifth week of surveys. For most species at Pond 7 a decline in abundance can be noted when the pond was drying up. Once Pond 7 refilled the following week, species abundance were either the same or higher than before the pond dried up. Two species, *Anax longipes* and *Leuchorrhinia intacta,* had appeared once before the pond dried up and did not return after the pond refilled. One species, *Sympetrum internum,* had appeared the sixth week of surveys. Hydroperiode may have caused its late emergence and very small abundance. Table 2 shows species and abundance for Pond 7. Pond 1 had most species abundance gradually increase then decrease. Only one species, *Sympetrum internum,* held a steady abundance of 2 throughout the six weeks the pond was surveyed. Most species abundance gradually increased, peaked, and then decreased. Table 4 shows species and abundance

for Pond 1. Pond 2, like Pond 1, had species abundance that gradually increased then decreased, but had no steady abundances for any species. Table 3 shows species and abundance for Pond 2. For both Pond 1 and Pond 2, there were five species that did not emerge until their third week of surveys, which would have been the fifth week of the summer research; this could also support the theory that hydroperiod may have affected their emergence.

Discussion

The purpose of the Summer 2008 Odonate research, was to determine species of Odonates and their abundance at ponds onsite at Brookhaven National Laboratory (BNL). To determine the species and their abundance at a pond, visual surveys were conducted for one-hour periods during a specific time of day for each pond. The surveys provide a range for abundance that compensates for Odonates that may not have been seen. Generally, most Odonates flight seasons begin from March to June, and end between August and October. Most of the Odonates observed had flight seasons starting in either May or April, with five species flight season starting in June and one Odonates flight season starting in July. Table 5 shows all observed species flight seasons. For Pond 10, two species, *Lestes disjunctus disjunctus* and *Celithemis elisa,* have flight seasons starting in June and March, respectively. Both of these dragonflies did not appear until the second week of July. Up until the second week of July the ponds were all drying up severely. Also, during the last week of July, two species, *Libellula incesta* and *Sympetrum internum,* flight seasons both starting in June, were first sighted. One species, *Celithemis eponina,* flight season starting in June, was sighted the first week of August. All five of

these Odonates were sighted after the beginning of their flight season, which could indicate that the dry weather and rapid drying up of Pond 10, could have lead to a late emergence, especially since they retained an abundance for the remaining weeks after they were first sighted. Pond 1 and Pond 2, both were visited starting in July instead of June due to discrepancies with locating them. Pond 1 had fairly stable abundances that slowly increased, peaked, and then slowly decreased. As like Pond 10, there were a three species, *Lestes disjunctus disjunctus, Sympetrum internum,* and *Libellula pulchella*, which were not sighted unlit after the second week of July. There was also two species, *Libellula deplanata* and *Ischnura verticalis*, which was not present until the third week of July. Flight seasons for these Odonates were March and June. So again the idea of hydroperiode could have affected emergence. Pond 2 had eighteen species sighted. Only seven out of the eighteen species sighted were sighted during the entire six weeks of surveys. Two species, *Libellula pulchella* and *Libellula luctuosa,* were seen only the first week. One specie, *Anax longipes*, was seen only the first two weeks of surveys and three species, *Tramea lacerata, Erithemis simplicicollis,* and *Ischnura verticalis* were sighted intermittently, varying from week to week. And again, as in Pond 10 and Pond 1, there were three species, *Enallagma civile, Sympetrum internum,* and *Libellula deplanata*, that were not sighted until the second week of July, and two, *Lestes disjunctus disjunctus* and *Ischnura hastata*, weren't sighted until the third week of July; *Sympetrum internum,* and *Lestes disjunctus disjunctus* being a common late emergent Odonate for Pond 10, Pond 1, and Pond 2. The theory of hydroperiod affecting Odonate emergence is plausible for these three ponds, however, there has not been any previous studies on Odonate populations and abundance for those ponds so future studies on populations would need

to be conducted to be able to determine if hydroperiod has had any affects on any specie of Odonate. Pond 7 however, has had two previous years of Odonate population analysis performed. Pond 7 had twenty Odonates sighted, with twelve being sighted the first week, five more being sighted the second week , two Odonates not being sighted until the first week of July, *Anax longipes* and *Pantala flavescens*, and one, *Sympetrum internum*, not being sighted until the third week of July. Pond 7 dried up completely the second week of July and was revived the third week. With the ponds revival, the Odonates returned and many with increased populations indicating that the pond drying up did not destroy the populations. *Sympetrum internum's* late emergence helps support the theory of hydroperiod affecting Odonate abundance. In the summer of 2006, Odonate populations were calculated for Pond 7. The presence of *Sympetrum internum* was so great starting the last week of June, that they were the main focal point of the research with a population range of 300 to 800. The summer of 2007, Odonate populations were calculated for Pond 7, with *Sympetrum internum* having a very strong presence again by the end of June and similar population ranges. This summer however, the presence of *Sympetrum internum* is nearly nonexistent; their abundance of two one week only because exactly 6 were seen that day. Through these surveys the change in Odonate abundance was observed and through these observations, it has been theorized that although on existing populations hydroperiod may not necessarily affect Odonate populations, there may be a significant effect on populations of Odonates that have later flight seasons and therefore emerge from the water in later months. It must also be mentioned that throughout all these surveys there were almost no tenerals observed. There were no dragonfly tenerals observed at all at any of the four ponds and only about

a dozen damselfly tenerals were observed. Throughout the entire study only 5 exuviae were seen, all being observed at Pond 10. This lack of tenerals may also support the theory of late emerging Odonates being affected by hydroperiod. Tenerals emerge from the water when ready for the adult stage of life. However, with the ponds drying up the tenerals may not have been able to emerge from the water before the ponds dried up. Hydroperiod may have a serious effect on Odonate larvae. Future studies of Odonates and the effect of hydroperiod would need to be conducted in order to understand such drastic changes, and late emergence.

Table 1: Pond 7 Species

Species	7-Jun	24-Jun	30-Jun	8-Jul	15-Jul	25-Jul	30-Jul	7-Aug
Libellula lydia	2	3	2	2	N/A	3	2	2
Libellula pulchella	2	2	2	1	N/A	2	2	2
Anax junius	1	1	1	N/A	N/A	2	1	1
Arigompus villosipes	2	1	1	1	N/A	1	N/A	N/A
Tramea lacerata	2	2	1	1	N/A	2	2	1
Tramea carolina	1	1	1	N/A	N/A	1	2	2
Libellula luctuosa	1	1	1	1	N/A	1	N/A	N/A
Pachydiplax longipennis	1	1	1	N/A	N/A	1	3	2
Enallagma aspersum	3	4	2	2	N/A	2	3	2
Ischnura verticalis	3	3	2	1	N/A	1	2	2
Argia fumipennis	2	1	2	N/A	N/A	1	1	2
Lestes disjunctys disjunctus	1	2	2	1	N/A	4	3	2
Erythemis simplicicollis	N/A	1	1	1	N/A	1	2	N/A
Enallagma civile	N/A	2	1	1	N/A	2	3	2
Perithemis tenera	N/A	1	N/A	N/A	N/A	1	1	N/A
Leucorrhinia intacta	N/A	1	N/A	N/A	N/A	N/A	N/A	N/A
Celithemis elisa	N/A	1	N/A	N/A	N/A	1	1	1
Anax logipes	N/A	N/A	N/A	1	N/A	N/A	N/A	N/A
Pantala flavescens	N/A	N/A	N/A	1	N/A	1	N/A	1
Sympetrum internum	N/A	N/A	N/A	N/A	N/A	2	1	N/A

Table 2: Pond 10 Species

Species	17-Jun	24-Jun	30-Jun	8-Jul	15-Jul	21-Jul	28-Jul	4-Aug
Libellula lydia	3	3	2	2	2	2	2	2
Libellula pulchella	2	2	1	1	2	2	1	2
Anax junius	2	1	1	1	1	1	1	1
Arigompus villosipes	1	1	N/A	N/A	1	1	N/A	N/A
Tramea lacerata	2	2	2	2	2	2	2	2
Tramea carolina	1	2	1	1	N/A	N/A	2	2
Enallagma civile	3	4	3	3	3	2	3	2
Pachydiplax longipennis	2	1	1	1	1	2	2	1
Enallagma aspersum	4	4	3	4	4	3	4	3
Ischnura verticalis	1	N/A	1	2	2	2	3	3
Erythemis simplicicollis	1	N/A	N/A	2	2	2	2	2
Pantala flavescens	2	N/A	1	N/A	N/A	1	2	2
Anax logipes	1	1	1	1	1	N/A	1	
Argia fumipennis	N/A	1	N/A	1	1	N/A	N/A	1
Libellula luctuosa	N/A	1	2	1	2	1	1	1
Lestes disjunctys disjunctus	N/A	N/A	N/A	N/A	2	1	2	2
Celithemis elisa	N/A	N/A	N/A	N/A	1	N/A	2	1
Sympetrum internum	N/A	N/A	N/A	N/A	N/A	N/A	1	1
Libellula incesta	N/A	N/A	N/A	N/A	N/A	N/A	2	1
Celithemis eponina	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1

Table 3: Pond 2

Species	1-Jul	9-Jul	16-Jul	25-Jul	20-Jul	8-Aug
Libellula lydia	2	2	2	3	2	1
Libellula pulchalla	1	N/A	N/A	N/A	N/A	N/A
Anax junius	1	2	1	1	1	1
Anax longipes	1	1	N/A	N/A	N/A	N/A
Pachydiplax longipennis	2	2	3	2	2	2
Tramea Carolina	1	1	2	1	1	1
Tramea lacerata	1	1	N/A	1	N/A	N/A
Libellula luctuosa	1	N/A	N/A	N/A	N/A	N/A
Erythemis syplicicollis	1	1	N/A	N/A	1	2
Enallagma aspersum	4	3	4	4	4	4
Ischnura verticalis	2		2	1	2	2
Libellula incesta	2	2	2	3	2	2
Perithemis tenera	1	1	1	2	1	1
Enallagma civile	N/A	N/A	2	1		2
Sympetrum internum	N/A	N/A	1	2	1	2
Libellula deplanata	N/A	N/A	2	N/A	N/A	1
Lestes disjunctus disjunctus	N/A	N/A	N/A	3	1	1
Ishnura hastata	N/A	N/A	N/A	2	N/A	2

Table 4: Pond 1

Species	2-Jul	9-Jul	16-Jul	25-Jul	30-Jul	7-Aug
Libellula lydia	2	2	2	3	2	2
Perithemis tenera	2	2	2	2	1	1
Anax junius	1	1	2	2	1	1
Tramea lacerata	2	2	1	2	N/A	N/A
Tramea carolina	2	2	2	2	1	1
Pachydiplax longipennis	2	2	3	3	3	2
Enallagma aspersum	3	3	4	4	4	3
Libellula incesta	2	2	3	3	2	2
Libellula pulchella	N/A	N/A	1	N/A	N/A	N/A
Lestes disjunctys disjunctus	N/A	N/A	2	4	2	2
Sympetrum internum	N/A	N/A	2	2	2	2
Libellula deplanata	N/A	N/A	N/A	2	N/A	N/A
Ischnura verticalis	N/A	N/A	N/A	N/A	1	N/A

Figure 1: Sample Survey

Date: **Start Time:** **Cloud Cover:**

Site: **End Time:** **Other Weather Data:**

	Time Marker									**Notes:**
	0-10	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**				

Keys:
Breeding: G = guarding, C = copulation wheels, T = tenerals, O = oviposition, E = exuviae
Abundance: 1 = 1-5; 2 = 6-20; 3 = 21-100; 4 = 100+ individuals

Acknowledgements

I would like to take this opportunity to thank the U.S. Department of Energy for the opportunity to participate in the Science Undergraduate Laboratory Internship (SULI) program. I would also like to thank my mentor Timothy Green for all his time, help and support. And I would also like to thank my fellow interns and friends for making my research this summer fun and memorable

Bibliography

Lam, Ed, Damselflies of the Northeast Forest Hills, NY. : Biodiversity Books, 2004

Needham, James G. and Westfall Jr., Minter J., and May, Michael L. Dragonflies of North America Gainesville, Fl.:Scientific Publishers, Inc. Revised 2000

Nikula, Blair and Loose, Jennifer L. and Burne, Matthew R., A Field Guide to the Dragonflies and Damselflies of Massachusetts Westborough, Ma.:Massachusetts Division of Fisheries and Wildlife, 2003