

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)

Abstract

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, temperamental habits, and weather conditions. Visual surveys are the simplest way to document species and their abundance. Specific ponds onsite at Brookhaven National Laboratory (BNL) were surveyed once every five to nine days, at the same designated time, each survey. The survey was conducted for a full hour and the odonates present were marked as being present at intervals of ten minutes. Their abundance is marked 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 is 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 NY Odonate Atlas, an existing study that is identifying all odonates of the State by identifying all Odonates present at Brookhaven National Lab.

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 are 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.



Figure 1: Common Green Damselflies in tandem while female oviposits eggs into water

Materials and Methods

To do the surveys, the protocol created by Jason T. Bried from the Nature Conservancy in Albany, NY, was followed. Figure 3 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, teneral, 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.

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

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

Species	2-Jul	9-Jul	16-Jul	25-Jul	30-Jul	7-Aug
<i>Libellula lydia</i>	2	2	2	3	2	2
<i>Libellula pulchella</i>	2	2	2	2	1	1
<i>Anax junius</i>	1	1	2	2	1	1
<i>Tramea lacerata</i>	2	2	1	2	N/A	N/A
<i>Tramea carolina</i>	2	2	2	2	1	1
<i>Pachydiplax longipennis</i>	2	2	3	3	3	2
<i>Enallagma asperum</i>	3	3	4	4	4	3
<i>Libellula incesta</i>	2	2	3	3	2	2
<i>Libellula pulchella</i>	N/A	N/A	1	N/A	N/A	N/A
<i>Lestes disjunctus disjunctus</i>	N/A	N/A	2	4	2	2
<i>Symptetrum internum</i>	N/A	N/A	2	2	2	2
<i>Libellula deplanata</i>	N/A	N/A	N/A	2	N/A	N/A
<i>Ischnura verticalis</i>	N/A	N/A	N/A	N/A	1	N/A

Species	1-Jul	9-Jul	16-Jul	25-Jul	20-Jul	8-Aug
<i>Libellula lydia</i>	2	2	2	3	2	1
<i>Libellula pulchella</i>	1	N/A	N/A	N/A	N/A	N/A
<i>Anax junius</i>	1	2	1	1	1	1
<i>Anax longipes</i>	1	1	N/A	N/A	N/A	N/A
<i>Pachydiplax longipennis</i>	2	2	3	2	2	2
<i>Tramea Carolina</i>	1	1	2	1	1	1
<i>Tramea lacerata</i>	1	1	N/A	1	N/A	N/A
<i>Libellula luctuosa</i>	1	N/A	N/A	N/A	N/A	N/A
<i>Enallagma simplicicollis</i>	1	1	N/A	N/A	1	2
<i>Enallagma asperum</i>	4	3	4	4	4	4
<i>Ischnura verticalis</i>	2	2	2	1	2	2
<i>Libellula incesta</i>	2	2	2	3	2	2
<i>Perithemis tenera</i>	1	1	1	2	1	1
<i>Erythemis simplicicollis</i>	1	1	N/A	N/A	1	2
<i>Symptetrum internum</i>	N/A	N/A	1	2	1	2
<i>Libellula deplanata</i>	N/A	N/A	2	N/A	N/A	1
<i>Lestes disjunctus disjunctus</i>	N/A	N/A	N/A	3	1	1
<i>Ischnura hastata</i>	N/A	N/A	N/A	2	N/A	2

Date:	Start Time:	Cloud Cover:
Site:	End Time:	Other Weather Notes (temp, wind, h)
Species*	Time marker (minutes)	Sex
	0-10 10-20 20-30 30-40 40-50 50-60	Breeding
		Abundance
		Notes
Do you think any species were missing from this survey?		
How many?		
Which species (if possible)?		
* Circle any uncertain (<100% certainty) species identifications		
Breeding: G = guarding, C = copulation wheels, T = teneral, O = oviposition, E = exuviae		
Abundance: 1=1-5, 2=6-20, 3=21-100, 4=100+ individuals		

Figure 2: Sample Survey with keys

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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 hydroperiod 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 seem to have been affected by hydroperiod, however flight season shows that the late appearance of *Lestes disjunctus*, *Celithemis 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 *Leucorrhinia intacta*, had appeared once before the pond dried up and did not return after the pond refilled. One species, *Symptetrum internum*, had appeared the sixth week of surveys. Hydroperiod 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, *Symptetrum internum*, held a steady abundance of 2 throughout the six weeks the pond was surveyed. Most species abundance gradually increased, peaked, 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 which 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 *Symptetrum 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, then slowly decreased. As like Pond 10, there were a two species that were not sighted until after the second week of July. There was also one species that was not present until the third week of July and one that was sighted the fourth week of July. Flight seasons for these Odonates were March and June. So again the idea of hydroperiod could have affected emergence. Pond 2 had eighteen species sighted. Only seven out of the eighteen species sighted were sighted during the six weeks of surveys. Two species, *Libellula pulchella* and *Libellula luctuosa*, were seen only the first week. Two other species, *Anax longipes* and *Tramea lacerata*, were seen the first two weeks of surveys and three species, *Tramea lacerata*, *Erythemis 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 that were not sighted until the second week of July, and two the third week of July; *Symptetrum 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. 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, *Symptetrum 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. *Symptetrum 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 *Symptetrum 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 *Symptetrum internum* having a very strong presence again by the end of June and similar population ranges. This summer however, the presence of *Symptetrum 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 which have later flight seasons and therefore emerge from the water in later months. 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 5: Odonate Flight Seasons

Species	Flight Season
<i>Libellula lydia</i>	May to September
<i>Libellula pulchella</i>	May to September
<i>Anax junius</i>	April to October
<i>Argemom villosipes</i>	May to August
<i>Tramea lacerata</i>	May to October
<i>Tramea carolina</i>	May to August
<i>Libellula luctuosa</i>	April to October
<i>Pachydiplax longipennis</i>	June to September
<i>Libellula incesta</i>	June to September
<i>Libellula deplanata</i>	March to July
<i>Celithemis eponina</i>	June to August
<i>Erythemis simplicicollis</i>	May to October
<i>Perithemis tenera</i>	June to September
<i>Leucorrhinia intacta</i>	April to September
<i>Celithemis elisa</i>	March to October
<i>Anax logipes</i>	May to September
<i>Pantala flavescens</i>	July to September
<i>Symptetrum internum</i>	June to October
<i>Enallagma asperum</i>	May to October
<i>Enallagma civile</i>	May to October
<i>Ischnura verticalis</i>	April to November
<i>Lestes disjunctus</i>	June to October
<i>Argia fumipennis</i>	June to October

Citations

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