

The Use Of Mark-Recapture To Estimate Odonate Populations At Vernal Pools At  
Brookhaven National Laboratory

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## **Abstract**

The Use Of Mark-Recapture To Estimate Odonate Populations At Vernal Pools At Brookhaven National Laboratory. DIANNA RODRIGUEZ (SUNY Old Westbury, Old Westbury NY), TIMOTHY GREEN (Brookhaven National Laboratory, Upton NY)

Dragonflies are insects of the order Odonata, suborder Anisoptera. In the state of New York there are 60 known, documented species of odonates of the 3000 species known worldwide. Odonates are important because they play a role in maintaining the delicate ecosystems of vernal pools and other bodies of water such as marshes, streams, and wetlands. Monitoring and tracking odonates can present much difficulty due to their numerous population, migration, extraordinary flight speed, and relatively short life span. The use of a tracking system is needed in order to keep accounts of odonate species populations that are being monitored and observed. With the use of a very simple form of the mark-recapture method, odonates are caught using nets and numbers are drawn on their wings then released. The study was conducted for ten weeks; the first three weeks was spent observing all odonate species at four ponds. However, due to a very low population, one of the ponds was eliminated from the study leaving only the remaining three ponds to be studied for the entire ten-week period. As well as employing the mark-recapture method, surveys were conducted at each of the three ponds once a week at the same time each week. These surveys provide an account of all species visibly present and their apparent abundance. From the use of mark-recapture, 525 dragonflies were captured and marked with 18 dragonflies recaptured at least once. The study was actually conducted for eight and a half weeks with the remaining week and a half used to generate the population estimates and attempt to verify their validity. Once all data was collected the program Noremark was used to make population estimates. Two population estimates

were generated for each pond, the program including a variable to account for emigration and immigration. The program estimated about 629 dragonflies inhabiting pond 7, 2,700 dragonflies inhabiting 9 O'clock pond, and inconclusive results for Meadow Marsh. The surveys have shown that there are at least ten common species amongst all three ponds, and the most abundant species at the ponds have changed in the past eight and a half weeks. It has also been noted that several species, such as the Widow Skimmer (*Libellula luctuosa*) and the Calico Pennant (*Celithemis elisa*), have a greater presence at the ponds in comparison to previous studies and observations of the ponds. It has also been observed that a species, the Band-Winged Meadowhawk (*Sympetrum semicinctum*), which has not been previously documented as part of Brookhaven National Labs Odonate population, has gained a significant abundance during weeks five through eight. These studies are indicators of pond health and speciation, and have thus far shown that the ponds at Brookhaven Lab are clean and habitable because of the great abundance of these sensitive insects. This research is part of an ongoing project that was started in 2003 to observe the Odonate populations of the Brookhaven National Laboratory campus and will be continued until an accurate account of species is created. Future studies may include the effects of hydroperiod on Odonate populations and abundance.

## **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 identify new species, and attain population estimates of the species inhabiting the ponds at Brookhaven National Labs. 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 be able to estimate the health of a population within a given area. Tracking and monitoring Odonates can be extremely difficult due to their relatively short lifespan, numerous populations, and extraordinary flight speed. To observe and monitor Odonates, the use of a tracking system is needed to keep accounts of individual species populations. In 2006, a study was conducted to see if the use of mark-recapture could be successfully employed on dragonflies to attain population estimates. Proven applicable to dragonflies, the marking system was refined and employed once again for this study. This study was conducted to observe all odonate species and their populations at three ponds on the BNL campus.

## **Methods and Material**

A 15-inch diameter net was used to catch the specimens while in flight or perched on vegetation. Waders were worn to wade through ponds and flooded areas around the ponds. A magnetic board was used to hold down individual dragonflies by pinning down their wings with a magnet. Non-water-soluble markers were used to mark the dragonfly's right hind wing with distinguishing marks in a color to denote the pond they were found inhabiting. Once a dragonfly was caught with the net it was removed, by hand, by pinching its wings together. The marks were either drawn on it while in the hand, or while they were held down on the magnetic board. Once marked, the dragonfly was promptly released. Each additional recapture was noted but no additional marks were drawn onto the wings. The marking system employed involves a base color that represents the pond in which the dragonfly was found inhabiting, and numbers were used as the marks. The same numbers are used for different species and both sexes within a species. The numbers distinguish one individual dragonfly of a species from another as well as provide the amount of a species of dragonfly captured. The colors of the marks are pond indicators, so all the odonates of one specific pond have the same color marking. This can be useful in migratory species; we will be able to see if a dragonfly migrates to another pond. Once a dragonfly is caught and marked it is immediately released for future recapture. The color magenta was used solely for pond 7. Blue was used solely for the pond called Meadow Marsh. And green was used for the pond called 9 O'clock pond. Therefore, every dragonfly caught at pond 7 would have a magenta number on their right hindwing, at Meadow Marsh they would have a blue number on their hindwing, and at the 9 O'clock pond they would have a green number on their right

hindwing. The first individual of each sex of all species captured would get a number one on their hind wing. The second would get the number two and so on. Once all the data on marked individuals was recorded, the program called NOREMARK was used to calculate population estimates with variable's for Odonates that were marked and unmarked, and those that immigrate and emigrate.

## **Results**

During the summer of 2007, a total of 3 ponds were visited on site at BNL. The Ponds visited were pond 7, Meadow Marsh and the 9 o'clock pond. Over the four years of odonate research at BNL, 35 species have been found out of 56 recorded in Suffolk County, which includes the Band-winged Meadowhawk (*Sympetrum semicinctum*) that was found for the first time this year at BNL. Through the use of the program NOREMARK, estimates were generated for the odonate populations of the three ponds Meadow Marsh, 9 O'clock Pond, and Pond 7. For pond 7, the population estimates the program generated were 517 and 732, which average to about 629. For 9 O'clock Pond the estimates the program generated were 3,050 and 2,348 which average to about 2,700 dragonflies inhabiting the area. For Meadow Marsh the results were inconclusive. The program generated averages of 274,102, and 372,067. Both of which were completely implausible and must be revisited. The surveys have shown that there are at least ten common species amongst all three ponds, and the most abundant species at the ponds have changed in the past eight and a half weeks. At two ponds, pond 7 and 9 O'clock pond, the most abundant species was the Common Whitetail (*Libellula lydia*) during the first five weeks. Now, however, at pond 7 there are two more species with nearly the

same abundance as the Common Whitetail, the Black Saddlebag (*Tamea lacerata*) and the Widow Skimmer (*Libellula luctuosa*). At 9 O'clock Pond, the most abundant dragonflies are now the Calico Pennants (*Celithemis elisa*), and the Carolina Saddlebags (*Tamea carolina*); the Common Whitetails no longer have much of a presence at this pond. At the third pond, called Meadow Marsh, the most abundant dragonfly is still the Spangled Skimmer (*Libellula cyanea*). It has also been noted that several species, such as the Widow Skimmer (*Libellula luctuosa*) and the Calico Pennant (*Celithemis elisa*), have a greater presence at the ponds in comparison to previous studies and observations of the ponds. It has also been observed that a species, the Band-Winged Meadowhawk (*Sympetrum semicinctum*), which has not been previously documented as part of Brookhaven National Labs Odonate population, has gained a significant abundance during weeks five through eight.

### **Discussion**

The estimates computed for Pond 7 were 517 and 732, which give an average of 629 dragonflies. The averaged estimate of 629 dragonflies appears to be low. Though there have been no previous studies on total dragonfly a population at pond 7, a study was conducted in 2006 estimating the population of the Cherry-faced Meadowhawks (*Sympetrum internum*). Those estimates yielded populations between 300 and 600. In comparison to the estimates for total dragonfly population, it would support the idea of a larger average population. Such a low estimated average for total dragonflies captured may be due to the low rate of recapture. For the study on the Cherry-faced Meadowhawks, about 150 were captured with 33 recaptured at least once. For the total



population study, 178 were captured with only 14 recaptured. Also, the Cherry-faced Meadowhawk study was conducted over four weeks, compared to total dragonfly population, which was conducted over eight and a half weeks. So the factor of time may also play a role in the estimates because the program, NOREMARK, generates the estimates using the number of pond visits in the equation. It must also be noted that during most visits to Pond 7, at maximum, only about one third of the dragonflies seen were actually capture; on some occasions less were capture, and even less often were more than one third of the dragonflies seen captured. Further studies of the pond would probably yield more accurate results. The estimates computed for 9 O'clock Pond were 3,050 and 2,348 which give an average of 2,700 dragonflies. Unfortunately, this was the first time estimates have been generated for dragonfly population at the 9 O'clock pond so there is no data to directly make comparisons with. However, using the estimates from pond 7 as an indirect comparison, an estimated population average of 2,700 dragonflies appears to be a plausible. Though again, this estimate may also be lower than the actual average. Comparing pond size alone, 9 O'clock pond is at minimum three times the size of pond 7, and has a visually larger population of dragonflies. There were also sixty more dragonflies captured at 9 O'clock pond than at pond 7; 9 O'clock pond also had fewer recaptures, only 4. It must also be noted that during most visits to 9 O'clock pond, at maximum, maybe one fifth of the dragonflies seen were captured due to the largeness of the pond. As for Meadow Marsh, the program NOREMARK generated estimates of 274,102 and 372,067. These estimates are completely implausible and inaccurate. Judging by pond size alone, there should be an estimate similar, if not slightly smaller, than pond 7. Visually, fewer dragonflies were present at Meadow Marsh than at either

pond 7 or 9 O'clock pond. These estimates may have been generated so inaccurately by the program because of fewer visitations to the ponds, fewer dragonflies captured, 111, or because, unlike the other two ponds, there were no recaptures of any of the marked dragonflies. This was due to the lack of accessibility to the ponds edges; most of the ponds perimeter is blocked by the aquatic plant known as Cattail (*Typha latifolia*), which made it difficult to successfully swing a net and capture a dragonfly. There have been no previous studies of dragonfly populations at Meadow Marsh to make any further data comparisons with. Further studies of the pond would probably yield more accurate results.

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