

The Use Of Mark-recapture to Estimate a Population of Cherry-faced Meadowhawk (*Sympetrum internum*) at a Vernal Pool on Brookhaven National Laboratory

Diana Rodriquez¹ and Timothy Green²

¹ Suffolk County Community College, Brentwood, NY 11717, ² Brookhaven National Laboratory, Upton, NY 11973

Abstract

Dragonflies are insects of the order Odonata, suborder Anisoptera. Of the 3000 species known world wide, more than 100 species occur in the state of New York and 32 have been identified at Brookhaven National Laboratory. Odonates play a role in maintaining the delicate ecosystem of vernal pools and other bodies of water such as marshes, streams, and wetlands. 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 specific species populations. Using a simple form of Mark-Recapture, the Odonates are caught in nets, and marks are drawn on their wings with non water-soluble markers. During a course of ten weeks, the method of Mark-Recapture was employed and perfected, considering there has been no previously documented use of it on Odonates there was a necessity to perfect the method to optimize results. Once perfected the system was used during the final four weeks, concentrating on one species, the Cherry-Faced Meadowhawk (*Sympetrum internum*) at one pond. Using the Mark-Recapture method we have found that the method can be successfully employed on Odonates with positive results. A total of 168 Cherry-faced Meadowhawks were captured with 32 individuals recaptured at least once. Using the program NOREMARK, two population estimates were generated, one estimate using the numbers of captured and recaptured Cherry-faced Meadowhawks, and one that also added a variable to account for emigration and immigration. The program estimated about 300 Cherry-faced Meadowhawks inhabit pond 7, without including emigration and immigration. Including the variable for immigration and emigration, the program estimated the population to be over 500 Cherry-faced Meadowhawks inhabiting pond 7. The method of Mark-Recapture has proven useful in the study of Odonates and may be used for future population estimates of other Odonate species. This research is part of an ongoing project that was started in 2003 to observe the Odonate populations of the Brookhaven National Laboratory and will be continued until an accurate account of species is created. Additionally, three new species of Odonates, not previously documented, were added to the list of those found at Brookhaven National Laboratory.



Cherry-faced Meadowhawk (*Sympetrum internum*)

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 32 identified species of dragonflies onsite at BNL. The purpose of this project is to try to identify new species, observe life span and attain an estimate of species population for at least one species. 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. This study specifically looked at the development of a suitable marking system and conducted a proof-of-concept technique using off the shelf software to estimate the population of the Cherry-faced Meadowhawk (*Sympetrum internum*) at one pond on the BNL campus.

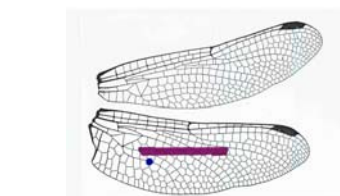


Figure 1. Wing marking pattern. Magenta line indicates pond, dot indicates specific individual (2nd captured).



Cherry-Faced Meadowhawk (*Sympetrum internum*) in Obelisk position

Materials and Methods

To collect the dragonflies, 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 their wings to denote the pond they were found inhabiting and distinguishing marks to note individuals of a species. Once all the data on marked individuals was recorded, the program called NOREMARK was used to calculate population estimates with and without variable's for Odonates that were marked and unmarked, and those that immigrate and emigrate.

The marks drawn on the Odonates wings distinguish one individual from another of one species, as well as denoting the pond they were found inhabiting. Each time a dragonfly is caught an additional mark is placed on the wing to note its recapture which in turn will allow us to observe a lifespan by observing the time between initial capture and final recapture, keeping in mind that the final recapture may not necessarily reflect the exact life span, but a rough estimate. The first six weeks of the ten week study was spent observing the entire dragonfly population at multiple vernal pools. Once the method of Mark-Recapture was proven to be useful in monitoring individuals of multiple species, the remaining four weeks was used to concentrate on one species at one pond in order to develop population and survival estimates.

The marking system employed involves a base color that represents the pond in which the dragonfly was found inhabiting, and an additional color to distinguish one individual from another. The color magenta was used solely for pond 7 and was placed on the right hind wing. Blue was used for the additional markings, and was utilized at every pond. In some cases, green was also used in addition to the blue marking because of the multitude of specimens and need for variation in markings. So every dragonfly caught at pond 7 would have, at minimum, one magenta line. In addition to the magenta line, each individual would have a unique magenta or blue marking which would be placed either on the right hind wing or the right forewing. Multiple series of dots and lines were used. The first individual of all species captured would get a single magenta line on their hind wing. The second would get the magenta line plus a single blue dot right next to the magenta line (See figure 1). This series of markings went up to one magenta line and six blue dots, which would make seven individuals of the same species. The eighth individual would receive two horizontal parallel magenta lines, and there after up until the eleventh another series of dots was placed ranging from one to three. For the Cherry-faced Meadowhawks, after the eleventh dragonfly was marked, vertical blue lines were placed between the two magenta lines in a series up to six. Once that series was complete, multiple combinations of horizontal blue and magenta lines were placed with additional dots of either blue or magenta (See figure 2). After 33 markings on the right hind wing, the right forewing was used for marking in addition to having at least the single magenta line on the hind wing (See figure 3). One hundred and sixty-eight Cherry-faced Meadowhawks were captured so in order to keep from repeating a marking, the English alphabet was used twice, once with all capital letters in blue below the magenta line, and once with lowercase letters above the magenta line. Additionally, eighteen characters from the Japanese alphabet, Katakana, were used in marking the Cherry-faced Meadowhawks. However, the marks could be repeated for the opposite sex, so a male and female Cherry-faced Meadowhawk could have the exact same marking, but two males or two females could not.

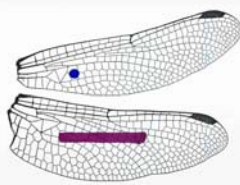


Figure 3. Wing marking pattern. Line indicates pond, as numbers captured increased dot pattern moved to forewing, spot indicates 54th captured individual.

Results

During the summer of 2006, a total of 3 ponds were visited on site at BNL. The Ponds visited were pond 7, pond 13 and the 9 o'clock pond. Over the three years of odonate research at BNL, 35 species have been found out of 56 recorded in Suffolk County, which includes the Common Baskettail (*Epitheca cynosura*), Martha's Pennant (*Celithemis martha*) and the Frosted Whiteface (*Leucorhinia intacta*) which were found for the first time this year at BNL. The Frosted Whiteface being documented for the first time on Long Island. It has been established that mark-recapture can be successfully employed on Odonates with plausible results. Through the use of the program NOREMARK, population estimates have been calculated for the Cherry-faced Meadowhawks at pond 7 as being between 300 and 600 individuals.

Discussion

The purpose of the 2006 Summer Odonate research was to first test if the method of mark-recapture could be successfully employed and yield plausible results. To test the mark-recapture method three ponds were visited on a semi-regular basis and specimens of various species were captured, marked, and released. Frequent visits to the ponds yielded recaptures of some of the marked species, which proved that the method of mark-recapture could be employed with results. Once assured of the usefulness of mark-recapture, only one pond was visited, pond 7, and one species, the Cherry-faced Meadowhawk (*Sympetrum internum*), was concentrated on to calculate a population estimate. A total of one hundred and sixty-eight Cherry-faced Meadowhawks were captured with thirty-two individuals recaptured at least once. This data was entered into the NOREMARK program and two estimates of the Cherry-faced Meadowhawk population were computed. One estimate computed the population using only the numbers of marked and recaptured individuals, and the other estimate included a variable to account for individuals, marked and unmarked, which may have immigrated or emigrated. The estimates computed were approximately 350 Cherry-faced Meadowhawks inhabiting pond 7, without the variables, and over 500 with the variables for marked and unmarked immigration and emigration. Although these estimates have a difference of over 150, both appear to be accurate. The estimate of 350 Cherry-faced Meadowhawks only calculates those that were marked and those seen but unmarked. It must be taken into consideration that there were Cherry-faced Meadowhawks that were never captured or seen, and that there may, and most likely, were dragonflies on the opposite side of the pond being surveyed. The estimate which included the variables for migrating, immigrating, and unseen Cherry-faced Meadowhawks, presumably, appears to be more accurate. Three data entries were made with these variable and yielded population estimates of 516, 609, and 602. Although the gap between the two lowest estimates is 86, these estimates were calculated with 165, 166, and 173 known dragonflies alive. Averaging the three estimates would yield a population estimate of 575 Cherry-faced Meadowhawks.

For future studies it would be recommended to either have a rough estimate of the population of specimens being researched or to project a high number to allow for the development of an easily utilized marking system. This was the first documented use of mark-recapture on odonates, so there was no information available on the type of marking system that could be used. Consideration should also be taken on whether or not it would be desirable to use gender specific markings. Gender specific markings may require physical recapture to identify the sex, where non gender specific markings would allow you the ability to visibly note a sighting of a marked individual. Also, the use of a recapture mark, may allow for easy noting of recapture where no recapture mark would require proper note taking and reliance on memory, but would allow identification by sight without the need to physically capture the animal.



Figure 2. Cherry-faced Meadowhawk (*Sympetrum internum*) with marking on right hind wing. Markings indicate the individual as the 18th captured in this study.

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Citations

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