Assessing Benthic Macroinvertebrate Sampling Procedures for the Development of the Freshwater Wetland Health Monitoring Protocols of Long Island's Central Pine Barrens

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ABSTRACT

While wetlands, among the most productive ecosystems in the world, are often called nurseries of life, little is known about the current health status of Long Island's freshwater wetlands. Such vital systems should be individually monitored over a period of time to determine the overall health of the wetlands. However, before gathering data in the field, it is necessary to assess and choose methods that will obtain the most representative results. Appropriately designed protocols will achieve the goals of establishing baseline data of the current wetland health and provide land managers with the data they require to make management decisions regarding to optimize the health of the wetlands under their control. Monitoring methods need to be consistent, informative, efficient and replicable in order to be comparable to future data.. Benthic macroinvertebrates are crucial indicators of wetland health, since the number and type of species present yield significant information regarding water quality. Due to their limited migration patterns, these organisms allow researchers to determine the sustainability of a wetland. In this research, appropriate procedures for sampling these organisms were reviewed and assessed using protocols developed by other states, such as Ohio and Florida. These protocols were adjusted to accommodate the wetlands of Long Island's Central Pine Barrens. Invertebrates were acquired using a d-frame dip net to jab and sweep various targeted wetland habitats. Invertebrates were then randomly chosen from an observation tray and identified in the field, or preserved for laboratory identification using a dissecting microscope. Several protocols called for a sampling total of 100 organisms, this task, however, consumed time that could have been allotted to other aspects of the protocol. Therefore, the benthic macroinvertebrates encountered were noted as present, thus providing a list of organisms that existed in the wetland at a given time. When this list is compared to data collected during the revisit of a site, the absence of a formerly present organism provides information about the current state of the wetland and how it has changed. Despite a low amount of diversity while sampling, there was a plethora of adult Odonates in the wetland. This occurrence would support the existence of a substantial supply of microorganisms, such as algae and periphyton. It was concluded that simply monitoring benthic macroinvertebrates in the water of the wetlands may not be an informative way of monitoring the aquatic organisms. Therefore, for the freshwater wetlands protocol of Long Island's Central Pine Barrens, further analysis should delve into a smaller scale of aquatic biota assemblages.

Dr. Timothy Green and Sarah Miloski observing benthic macroinvertebrates.

INTRODUCTION

The Long Island Central Pine Barren region, an area of over 100,000 acres, boasts more than 400 protected wetlands, yet very little research has been done to determine their current health status. These wetlands are home to various state threatened and endangered species of plants, fish, and wildlife. Such vital and sensitive systems should be individually monitored over a period of time to determine the overall health of the wetlands and to have baseline data for future comparison. Appropriately designed protocols will achieve the goals of establishing baseline data of the current wetland health and provide land managers with the data they require to make management decisions to optimize the health of the wetlands under their control. Methods need to be consistent, informative, efficient and replicable in order to be comparable to future data.

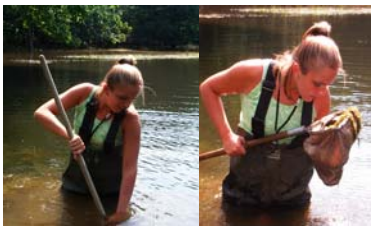
The Foundation for Ecological Research in the Northeast (FERN), a not-for-profit organization, is currently fostering a step by step monitoring protocol specifically designed for the freshwater wetlands of the Central Pine Barrens of Long Island. This project rectifies the lack of baseline data regarding the current state of the freshwater wetlands in the Central Pine Barrens. The data attained by using the protocols for monitoring will be utilized to compare the health of the wetland to future biomonitoring data [1].

An essential aspect of wetland systems are benthic macroinvertebrate assemblages. Since many benthic macroinvertebrates have limited migration patterns and a certain level of tolerance to pollution, they are valuable in assessing site-specific impacts. Also, this group of organisms is composed of species that represent an extensive range of trophic levels, serving as a food source to other wetland organisms, such as amphibians and fish. So any changes in populations can be detected through monitoring and possible effects of alterations can be foreseen. Since benthic macroinvertebrates are to be sampled in addition to the monitoring of other aspects of the wetland, such as water quality and vegetation, field time was a constraining factor and had to be taken into consideration when the protocols were prepared. With this limitation in mind, the sampling of benthic macroinvertebrates had to be informative, replicable, efficient and representative of the wetland as a whole. The resulting data provided a list on what assemblages of benthic macroinvertebrates were present at that given time. When this list is compared to data collected during the revisit of a site, the absence of a formerly present organism provides information about the current state of the wetland and how it has changed. This information will aid land owners in making management decisions and show the results of management practices tried after the baseline data was collected.

MATERIALS AND METHODS

Assessing benthic macroinvertebrate protocols involved the review of protocols developed by other states and made available by the EPA [4-8]. The methods used in these protocols were altered to accommodate the specific requirements of wetlands within the Central Pine Barrens by evaluating them in the field and assessing how favorable the methods were to the goals of the protocol.

To sample for invertebrates as a rapid bioassessment, one meter sweeps were taken using a d-frame dip net with US 30mm mesh in various substrates, including open water, vegetation, soft substrate and submerged macrophyte. Sweeps taken in each habitat were counted and recorded on data forms. After sweeping in a habitat, contents were emptied in a 20cm x 30cm gridded pan of 5cm squares. Debris was rinsed and organisms attached to the debris were taken off. While noting the time expended, it was attempted to count 100 specimens by randomly choosing grids and removing the organisms in the chosen grid with forceps. Specimens were identified to Order in the field to assess biodiversity and presence was recorded. After counting, organisms were released. The methods were discussed among the sampling crew in terms of adjustments that were necessary to make this section of the protocol simple and time efficient, while achieving the most useful and accurate data.



Sarah Miloski sweeping macroinvertebrates with a dipnet and then observing the collected content.

Emily Efstration and Sarah Miloski viewing collected organisms in a gridded tray.

RESULTS

Table 1 depicts relevant case studies by state, their sampling window, frequency, and methods. Each wetland monitoring program varied by state depending on needs, location, purposes, etc. To apply these methods and alter them to the wetlands of interest for the Long Island protocol, an outing was necessary to survey the benthic macroinvertebrates at hand. Table 2 and 3 below are from sampling a Coastal Plain Pond on 20 July 2007. As demonstrated below in Table 2 and Table 3, there were a considerably greater number of organisms in the more vegetated habitat, with essentially the same kinds of organisms as compared to the open water. The vegetated edge sample contained 2 mayfly nymphs (Order: Ephemeroptera) that the open water sample lacked.

Table 1. EPA case studies for macroinvertebrate sampling.

State	Time of Year Sampled	Number of Visits Per Pond	Method
Florida	n/a	1	20 sweeps per wetland. Number of sweeps proportional to percent of total wetland
Michigan	Various	Many	D-frame dip nets - late July-August, and 2-3 wks after snow melt, during high-water, and just before wetlands dry up, if perm. in midsummer and fall
Minnesota	June- early July	1	D-frame dip nets; bottle trap activity trap (funnel trap)
Montana	April-September	1	D-nets
Ohio	Early, middle and late Spring	3	Funnel Traps, Dip Nets, Hester-Dendy Artificial Sampler
Vermont	April, May, June	2	Funnel Traps, D-Nets, Qualitative Search

Table 2. Macroinvertebrates sampled in an open water habitat.

Habitat: Open water		Sweeps:	5
Common Name	**Class**	**Order**	**Total**
Aquatic worm	Oligochaetae		1
Midge larvae	Insecta	Diptera	11
Mosquito larvae	Insecta	Diptera	1
Water boatman	Insecta	Hemiptera	1
Total Individuals Collected: 14			

Table 3. Macroinvertebrates sampled in a vegetated edge habitat.

Habitat: Vegetated Edge		Sweeps:	5
Common Name	**Class**	**Order**	**Total**
Aquatic worm	Oligochaetae		35
Blackfly larvae	Insecta	Diptera	1
Mayfly nymph	Insecta	Ephemeroptera	4
Midge larvae	Insecta	Diptera	10
Mosquito larvae	Insecta	Diptera	24
Total Individuals Collected: 74			

DISCUSSION AND CONCLUSION

With the dynamics of wetland systems in mind, combined with the aforementioned case studies, benthic macroinvertebrates sampling should be part of the protocols for every season in the freshwater wetlands of the Long Island Central Pine Barrens. However, collection methods for each season will differ. Hester-Dendy activity traps will be deployed late Spring and collected mid-Summer. Summer is the season of high plant productivity and limited light availability, so during this time period, it is recommended that a d-frame dip net be used. Each season will have leaf litter bags implemented at the beginning, and checked the start of the following season. This would give way to an idea of what macroinvertebrates were present in that season with out physically sampling every day. For future monitoring, the leaf litter bags should be deployed and retrieved the same period of time as the last monitoring for the best accuracy and comparability. The same goes for d-frame sampling. Environmental conditions may affect what organisms are active within the water when sampling is taken place, and therefore the sample may be compromised due to poor conditions. So, for future monitoring, the sampling dates should be close and the weather conditions should be similar to build a more comparable collection of data.

Interesting enough, all ponds visited had a large population of adult dragonflies (Suborder: Anisoptera) and adult damselflies (Suborder: Zygoptera). For a population of this size to exist, an adequate supply of algae and periphyton should also be present. Therefore, there is a need to extend the wetland invertebrate monitoring protocols to monitor algae and periphyton presence. Although there does not seem to be a great deal of diversity on the benthic macroinvertebrate scale, there can be significant biodiversity on a smaller scale. If unmonitored, these assemblages could potentially have an undetected impact on the wetland [9].

In conclusion, utilizing other protocols enabled the development of a protocol specifically designed for the wetland monitoring of Long Island's Central Pine Barrens. Field assessments allowed for the necessary adjustments to make monitoring the benthic macroinvertebrate population time efficient, replicable and comparable to future data. This assessment also forced the monitoring protocols to include a section that delves into smaller scaled organisms, such as algae and periphyton to achieve a better idea of the aquatic fauna within the wetland.

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