A SAMPLING DEVICE FOR THE FAUNA OF STORM WATER CATCH BASINS

MARI BUTLER
Endicott College
Beverly, MA 01915

RICHARD CASAGRANDE AND ROGER LEBRUN
University of Rhode Island, Plant Sciences Department
Kingston, RI 02188

HOWARD GINSBERG
USGS Patuxent Wildlife Research Center
Kingston, RI 02881

ALAN GETTMAN
Rhode Island Department of Environmental Management, Mosquito Abatement Office
Kingston, RI 02881

Abstract: Storm water drainage catch basins provide habitat to a variety of different aquatic organisms including arthropods, molluscs and annelid worms. Arthropods such as mosquitoes are known to use these environments as larval habitat. Because of health concerns, catch basins are often targeted for mosquito control exposing all inhabitants to pesticides such as methoprene or BTI. In this paper we describe a sampler that we used to evaluate catch basin communities in southern Rhode Island over a six month period. We also examine its efficacy and consistency. We found that the sampler effectively estimated organism abundances.

INTRODUCTION

Storm water drainage catch basins can provide habitat for a variety of invertebrates. In particular, they are known to provide habitat for Culex species (Covell et al. 1971, Gerry et al. 1989, Ishii et al. 1989, Kikuchi 1992, Knepper et al. 1992, McCarry 1996, Munstermann et al. 1977, and Siegal et al. 1997) and Aedes species (Covell et al. 1971, Gerry et al. 1989, Ishii et al. 1989) necessitating their treatment with larvicides. Because of the difficulty in gaining access to these environments, little is known about the other organisms that share these environments with mosquito larvae (Ishii et al. 1989, Kikuchi 1992). After measuring methoprene concentrations at out flow areas and in catch basins, highest levels (~.5ppb) were confined to treated catch basins leading us to focus our efforts there (Butler, doctoral dissertation, 2005). We conducted a quantitative survey of non-target organisms routinely exposed to mosquito larvicides such as methoprene or *Bacillus* spp. by monitoring organisms inhabiting 30 catch basins in southern Rhode Island during the active season of 2002 using a custom made sampler. We also monitored water characteristics during this six-month period. The efficacy of our catch basin sampling device was determined in a laboratory study. In this paper we describe a device used to sample the fauna of storm water catch basins and present results on the efficacy and consistency of samples taken with this device.

MATERIALS AND METHODS

Thirty catch basins from two sites in Narragansett, Rhode Island, were sampled six times between May 10 and November 7, 2002. For details on sampling regime see Butler et al., (2007, In Press). A custom-made catch-basin sampler (Figure 1) capable of sampling the water column from the surface to the bottom of the catch basin was used. The sampler was designed and constructed by Dr. Richard Casagrande.

It consisted of a Plexiglas tube 15.24 cm diameter and 85 cm tall, opened at the bottom and sealed at the top except for a small hole the size of a standard boat plug. Two poles were attached on opposite sides to extend the reach of the two people lowering the sampler. The catch basin cover was removed, and the sampler was lowered vertically to the bottom with the hole on top of the sampler left open. Once the sampler was resting on the bottom, the boat plug was inserted into the hole using another custom-designed pole. The sampler, containing a known volume of water [Area of sampler (m2) x depth of water (m)] that spanned from the air/water interface to the water/sediment interface, was lifted until the bottom of the sampler was just below the surface of the water. At this point, a 164-ì m sieve attached to another pole was held under the sampler and all were slowly lifted above the surface of the water. As water drained out of the sampler and through the sieve, particles greater than 164 ì m were captured and rinsed into a sampling jar.

Accuracy of the sampler was tested by comparing estimates of the numbers of organisms in a test catch basin in the lab using the sampler with the estimates taken using an independent pipetting technique. This was conducted at the end of a laboratory study where catch basins in the lab had been stocked with organisms from local catch basins. Approximately five weeks earlier debris had been collected and spread evenly throughout ten artificial 72-liter cement catch basins constructed in the laboratory. The artificial catch basins were filled to 72 liters with tap water. At the end of each of two trials, a sample was taken from each of the ten catch basins using the catch basin sampler as part of a separate study. After these samples were taken and preserved, the contents of the entire catch basin simulations were pumped through the 164 ì m sieve and preserved. Two of these total catch basin samples were compared to two samples taken by the catch basin sampler to test the accuracy of the catch basin sampler. Because of the difficulty in separating organisms from detritus and the enormous numbers of organisms, these total samples were subsampled for enumeration using a 10-ml Stemple pipette. Total samples were combined into a 2000-ml beaker filled with water, agitated using aeration, and gently mixed with a stirring rod. Three 10-ml aliquots were removed and counted from the first sample (CBS 4) and 15 10-ml aliquots were removed and counted from the second sample (CBS 8). A Contingency Table calculating "G" was used to measure if proportions of organisms found in different taxonomic groups varied between the sampling device and the total sample (Sokal et al., 1969). This test is similar to a chi-square test, but has the advantage of allowing for individual comparisons to be made between subsets of variables. In addition, consistency of the sampler was tested by taking four samples from another test catch basin and then plotting them for comparison (Figure 1).

Figure 1. Catch Basin Sampling Device.

RESULTS AND DISCUSSION

A comparison of invertebrate abundances was made using contingency tables (Table 1 and 2). This test showed that there was no significant difference in the proportions of organisms collected by the sampling device compared to subsampling the total sample with the Stemple pipette ($G<7.1$, $p>0.06$). In addition, we extrapolated the abundances to estimate the total number of organisms found in the catch basin. These numbers are shown in Table 3. Both methods appear to sample the same organisms at the same order of magnitude.

Table 1. Numbers of organisms from CBS 4

	Sampling Device	**Sum of 3 10-ml aliquots taken from total***
Copepods	1396	309
Acari	16	7
Other Aquatic Organisms	5	4

* ($G = 4.8811$, $df = 2$, $p = 0.0871$)

Samples collected by the catch-basin sampler were fairly consistent in taxa abundances (Figure 2). The four samples show similar trends in abundances of

Table 2. Numbers of organisms from CBS 8

	Sampling Device	**Sum of 3 10-ml aliquots taken from total***
Copepods	815	956
Acari	9	25
Oligochaete Worms	4	8
Other Aquatic Organisms	4	9

* (G = 7.1, df = 3, p = 0.0688)

the eight different organisms that were caught in the sample. Oligochaete worms are not shown on this graph since they were often broken into pieces making it difficult to accurately compare their numbers on the same scale as the other organisms. However, they appeared to be most abundant by volume. Copepods were the most abundant by number in two samples while collembola were the most abundant in the other two samples. Mites and mosquitoes followed closely in numbers. The organisms found in these test catch basins did not include all organisms we encountered in the field, but representatives from the three phyla (Annelida, Mollusca, and Arthropoda) were included in this test, and appear to be sampled at comparable levels. Field samples were more diverse containing taxa such as Annelids including Oligochaeta (segmented worms) and Hirudinea (leeches); Molluscs such as gastropods (snails) and bivalves (clams); and Arthropods predominantly crustaceans (Ostracods, Amphipods, Isopoda, and Copepoda), insects (Diptera, Coleoptera and Collembola) and Arachnida (water mites and soil mites).

The patchy distribution of these organisms can lead to some variation in the samples. However, the catch basins sampler provided a reasonable estimate of invertebrate abundance. There was concern over how the escape response displayed by some of the surface dwellers such as mosquitoes might affect our estimates. Removing the catch basin cover often caused the surface dwellers to dive for cover. We found that waiting a few minutes and then quickly lowering the sampler to the bottom effectively captured organisms ranging from surface dwellers to bottom dwellers. Prior to this study, there have been very few studies trying to estimate abundances of organisms that live in catch basins due to the difficulty in working in this environment. Because this environment is so difficult to quantitatively sample, there was not a great deal of quantitative data available for comparison. However, Syrphidae (hover

Table 3. Data from both sampling methods extrapolated to total catch basin abundance.

	Extrapolated from Stemple Pipette Counts	**Extrapolated from r catch basin sample**
Copepods	16,480	18,909
Mites (soil mites and water mites combined)	373	217
Collembola	53	0
Oligochaete Worms	53	41
Other	53	13

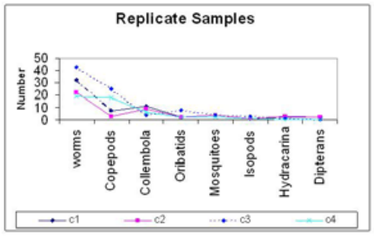

Figure 2. Replicate samples taken in laboratory catch basin using catch basin sampler. C1-C4 designate each of the different samples.

flies), *Assellus hilgendorforii* (isopods), *Cleon dipterum* (mayfly), Chironomidae (midges), and *Hermetia illucens* (black soldier flies) have been observed living in catch basins in Japan (Kikuchi 1992), and Ishii et al. (1989) found Culicidae (mosquitoes), Chironomidae (midges) and Psychodidae (moth flies) in the catch basins they studied. Many of the organisms that we found were from the same families as those found in the studies mentioned above.

This sampler was used to assess patterns in the catch basin fauna of southern Rhode Island. Butler et al. (2007) reported that a large portion of catch basin communities are populated by organisms such as copepods and amphipods, and numerous other crustaceans and insects that are washed or rinsed passively into the system. These organisms tended to increase in abundance from May through September. During this same time period, total suspended solids in the water as well as carbon and nitrogen gradually increased. Mosquitoes and other Diptera, on the other hand, were an exception to this rule since they actively search out sites in which to lay their eggs. They peaked in abundance early in July, a month before the other organisms. A similar pattern of inhabitant arrivals has also been described in temporary woodland pools (Wiggins et al. 1980). We speculate that some of these organisms such as the amphipods (Schwartz, 1992) and copepods (Marten, 1994) Macrocyclops albidus and Paracyclops poppei might also be of interest in mosquito control.

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AERIAL FIELD TRIALS OF AQUABAC® (400G)

GLENN A. LEVINSON
Middlesex County Mosquito Extermination Commission
Edison, NJ 08837

The Middlesex County Mosquito Extermination Commission currently uses temephos (Abate® 5-BG, Clarke Mosquito Control, Roselle, IL) in its aerial larval control program. Preliminary aerial field trials of Bacillus thuringiensis var. israelensis (Aquabac® 400G, Becker Microbial Products, Inc., Coral Springs, FL) mosquito larvicide pellets were carried out in September, 2006 to evaluate its efficacy in controlling both woodland pool and salt marsh mosquitoes. The purpose of the study was to investigate the feasibility of integrating a biolarvicide into the aerial larval control operations to achieve greater environmental sensitivity without reducing current efficacy standards and to determine an effective application rate that is within the helicopter payload capacity. Two separate trials at three locations each were conducted. Aquabac® was applied at rates of approximately 2 and 4 lbs/acre, respectively. Pre and post treatment larval densities of both woodland pool and salt marsh mosquitoes were assessed. Aquabac® provided 80-100% control of woodland pool mosquitoes in about 72 hours when applied at approximately 2 lbs/acre. The higher rate of 4 lbs/acre resulted in 80-100% control of salt marsh mosquitoes within 24 hours of the aerial application, and fell within the upper range of our helicopter payload capacity. In addition, the rapid larval mortality (< 24 h) simplified quality assurance procedures. More extensive evaluation of the biolarvicide is planned for the following mosquito season. These preliminary results indicate that Aquabac® 400G warrants consideration as a component of the Commission's aerial larval control program.