Differential Responses to Sediment Transport by Two Different *Hydropsyche* Populations

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Abstract

Behavioral responses of *Hydopsyche morosa* were examined when the insects were subjected to three sizes of sediment resulting in 100% embeddedness. Two populations of insects were collected; one from Trout Creek, a stream rich in sediment, and one from Tenderfoot Creek, a stream with little sediment. When buried, the insects either drifted or remained buried but alive. Drift predominated among Tenderfoot Creek insects, while Trout Creek insects experienced a decreasing amount of drift with increasing sediment size.

Introduction

Fine sediment deposits constitute a primary hazard to the biological integrity of stream ecosystems (Cordone and Kelly 1961, Waters 1995). Accumulation of deposited sediment can lead to a number of primary and secondary effects on aquatic organisms including interference with food gathering and respiration, resource depletion, smothering of surfaces, and sedimentation of interstitial spaces (Culp et al. 1986, Edwards 1969, Graham 1990, Jones 1949, Nuttal and Bielby 1973, Resh and Rosenberg 1984).

This study seeks to examine the differential behavioral responses of *Hydropsyche morosa* (Trichoptera: Hydropsychidae) to

induced sediment loads resulting in 100% imbeddedness. The basis for comparison of behavioral responses will result from collections of *Hydropsyche morosa* larva from two different stream populations.

Tenderfoot Creek in Gogebic County Michigan has a primarily rocky bed with low sediment content, while Trout Creek in Vilas County Wisconsin has a sandy bed and much higher sediment content. This study was preformed by first collecting *Hydropsyche morosa* from both sites and then subjecting the larva to a large single sediment addition under controlled conditions in an attempt to ascertain any differential behavioral responses between the two populations.

The objective of this study was to determine the effects of different sediment particle size on the behavioral responses of two populations of *H. morosa*.

Materials and Methods

Experimental procedure

Instar V of *Hydropsyche morosa* larvae were collected from Tenderfoot Creek in Gogebic County Michigan and Trout Creek in Vilas County Wisconsin. Tenderfoot creek has an almost exclusively rocky bottom with little sediment while Trout Creek is rich in both coarse and fine sediment. Experiments were conducted

in chambers as described by Runde (1999). Two to five individuals were placed in each chamber ensuring that at least one individual would construct a net. After 24 hours the position of all nets were mapped. Only larvae that constructed nets were included in the analysis. Retreats were constructed of particles slightly larger than 2mm in diameter. Following the mapping, single 50g sediment loads were added to each chamber, burring the retreats and nets. Three sizes of sediment were used: 250-500μm, 500-1000μm, and 1000-2000μm. After 24 hours, the status of the larvae was checked and they were categorized into one of the following outcomes: drift-alive, drift-dead, buried-alive, and buried-dead. Buried-alive behavior consisted of using the anal claws to maintain contact with a buried retreat while extending the head and thorax into the overlying water column. Drift behavior consisted of leaving the retreat altogether and drifting downstream attempting to acquire a new retreat location. Drift and buried-alive behaviors for each replicate were calculated as the proportion of organisms exhibiting the behavior.

Sand used in the experiment was collected from Juday Creek in St. Joseph County Indiana and separated into size classes using sieves with 250, 500, 1000 and 2000μm mesh. Velocity was held constant for all experiments at 20-25 cm/sec. Temperatures were maintained at 17±1°C in a 12:12 photoperiod.

Sediment was added in a single 50g load, equivalent to a loading rate of 16220 g/m2. Sediment addition resulted in a 1 cm layer along the bottom of the chamber.

Statistical analysis

Since the controls for this experiment did not vary, all statistical analysis compare populations within the experimental group only. Percent cumulative drift across particle size classes was analyzed using two-way ANOVAs. SigmaStat (v 2, SPSS, Chicago, IL) was used for all tests.

Results

When exposed to a single 50g sediment addition, *H. morosa* either emerged from their retreats and drifted or remained in their retreats (Figure 1). Percent drift was then analyzed for the three particle sizes for insects from both locations. *H. morosa* from Tenderfoot Creek did not exhibit any changes in drift percentage with changing sediment particle size.

A decrease in drift was observed for *H. morosa* from Trout Creek with increasing particle size ( ).

Insects from Tenderfoot Creek experienced higher drift percentages relative to those of insects from Trout Creek for both the 501-1000µm and 1001-2000µm particle size experiments ( ).

Discussion

The results show that *H. morosa* collected from Tenderfoot Creek have an unchanging incidence of drift with changing particle size. The drift response for these insects occurred at a high rate for all experimental trials (Figure 1).

The drift response for individuals collected from Trout Creek did change with differing particle size. Drift percentages were similarly high to those of Tenderfoot Creek insects in the 251-500μm sediment size experiment. However, drift percentages progressively lowered for this population in the 501-1000μm and 1001-2000μm sediment size experiments.

Runde (1999) observed a similar decrease in drift with increasing particle sediment size. He suggests that the drift of buried *Hydropsyche* may be induced by a lack of oxygen. Factors that may lower oxygen levels in the interstitial spaces include the depth of burial, composition of the sediment (including sediment size), and water velocity (Runde 1999). In this experiment, both water velocity and depth of burial were held relatively constant while only the sediment type was changed. Observed decreases in drift among the Trout Creek populations with increasing particle size were similar to the results of Runde. Although these two experiments were completed using different

species of *Hydropsyche*, the results both show a relative decrease in drift from the 251-500μm sediment size to the 1001-2000μm size and from the 5001-1000μm sediment size to the 1001-2000μm size.

The observed decrease in drift among the Trout Creek population in this experiment may have been due to an adaptive response resulting from regular sediment exposure. A repeatedly buried insect Trout Creek would have to adapt to frequent burials in order to survive. This study suggests that the conditioning or desensitization in response to sediment stimuli seem to only be present in those insects that are regularly exposed to sediment.