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The Effects of Suspended Sediment Upon the Net Maintaining Behavior of the Larval Polycentropodid Caddisfly, *Neureclipsis*

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Introduction

The movement of suspended sediment in streams is thought to be a major disrupter of stream life. There is evidence that sediment transport has caused a change in species diversity and density in lotic benthos. Suspended sediment can be particularly disruptive to filter feeding aquatic insects, namely of the orders Ephemeroptera, Diptera, and Trichoptera.

Previous studies by Runde (1998) have focussed on net spinning species in the family Hydropsychidae of the order Trichoptera. He found that exposure to suspended sediment caused four types of behavior: net cleaning, removal of net attachments, hole cutting, and net removal. Also, the amount of net destruction increased as particle size and load increased. A possible reason for this behavior is to allow an adequate supply of oxygenated water to continuously flow through the net.

Similar studies have not been done on another filter feeding family of Trichopterans, the Polycentropodids. One Polycentropodid genera, *Neureclipsis*, constructs a characteristic silken, trumpet-like net (Wiggins 1998). These nets are not very structurally strong, so they are found only in slower currents. The nets are found on rocks, decaying wood, and tall grasses (Hilsenhoff 1995). These insects feed by capturing zooplankton and insects in their nets. Suspended sediments may hinder their ability to capture food in their nets and to have oxygenated water by clogging the net mesh and forcing the water around the net.

I examined the behavioral responses of *Neureclipsis* sp. to several different suspended sediment types and sizes. There are several possible outcomes to these tests: net cleaning, hole making, taking down the net, drift, and death. This study will concentrate specifically on whether the insects clean and make holes in their nets. There are two main objectives of the investigation: 1) to identify the possible effects suspended sediments may have on stream species, and 2) to compare the behavior of Polycentropodids to Hydropsychids in the presence of suspended sediments. It is believed that increased particle size will increase the net destroying behavior of the larvae.

Materials and Methods

All experiments were performed at the University of Notre Dame Environmental Research Center using larvae of the caddisfly *Neureclipsis*. The larvae were collected from Tenderfoot Creek in Gogebic Co., MI; all larvae collected were of approximately the same size. The experimental mini-streams were constructed according to the protocol of Runde (1998).

Effect of leaf particles: To observe the effects of leaf particles on the behavior of Polycentropodidae, leaf particles less than 64 μm in width were introduced into the mini-streams. Leaves were ground and then separated by size with a sieve to collect particles of the desired size. To each of 5 mini-streams, 0.5 g of leaf particles was added. Five controls to which no sediments were added were also maintained. The nets were observed and mapped after 24 hours.

To find out whether particle size affects the behavioral response of Polycentropodidae, leaf particles of three larger sizes were introduced to the mini-streams. To five mini-streams, 0.5 g of leaf particles in the size range 64-125 μm were added. To five other mini-streams, 0.5 g of leaf particles in the size range 125-250 μm were added, and 0.5 g of leaf particles of size 250-500 μm were added to five mini-streams. Five controls were also used. The nets were observed after 24 hours.

Effect of coal and clay particles: To test the effect clay and coal and their continuous addition to the nets, a long term experiment was performed. For six days, 0.1 g of coal (>250 μm) was added directly into 5 nets via plastic pipette every 24 hours over a six day period. Observations were taken every 24 hours. The same procedure was used to test the effects of clay. The controls used for comparison consisted of five nets to which no coal or coal had been added. These nets were examined after six days.

Results

Effect of leaf particles: No net destructive behavior was observed in the controls. When leaves were applied to the mini-streams, the insects either made holes in their nets or made no changes to their nets. A significant difference was seen in the hole making behavior between insects exposed to leaf particles <64 um in size and those exposed to leaf particles of size 250-500 um (Kruskal-Wallis 1 way RM ANOVA; H_2=9.088, p=.002) (see figure 1). A larger proportion of the insects exposed to the larger particle size made holes in their nets. Other comparisons between insects exposed to the other sizes of leaf particles using the Student-Newman-Keuls method did not show a significant difference in hole making behavior between insects exposed to different leaf particle sizes.

Effect of prolonged exposure to coal and clay: Hole making behavior did change over the treatment time of six days in the case of coal application. Behavior during days 1 and 2 of the treatment differed significantly from the behavior observed in days 4 and 5 (Kruskal-Wallis 1 way RM ANOVA; p=.028). The longer exposure time caused a higher proportion of insects to make holes in their nets (see figure 2). However, there was not a significant difference between the controls and the treated insects.

The repeated application of clay particles did not significantly affect the hole making behavior of the larvae (Friedman 1 way RM ANOVA; chi square=2.0, p=0.0920). This data is not shown.

Figure 1- Proportion of insects making holes as a function of leaf particle size. Leaf particles of sizes <64 um, 64-125 um, 125-250 um, and 250-500 um were added in one load of 0.5 g.

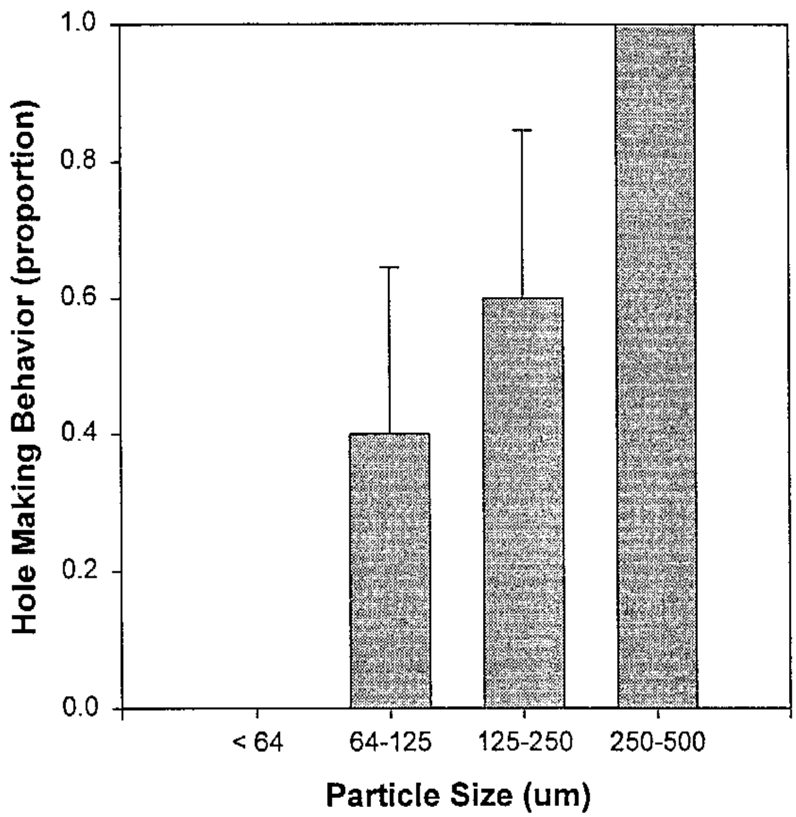
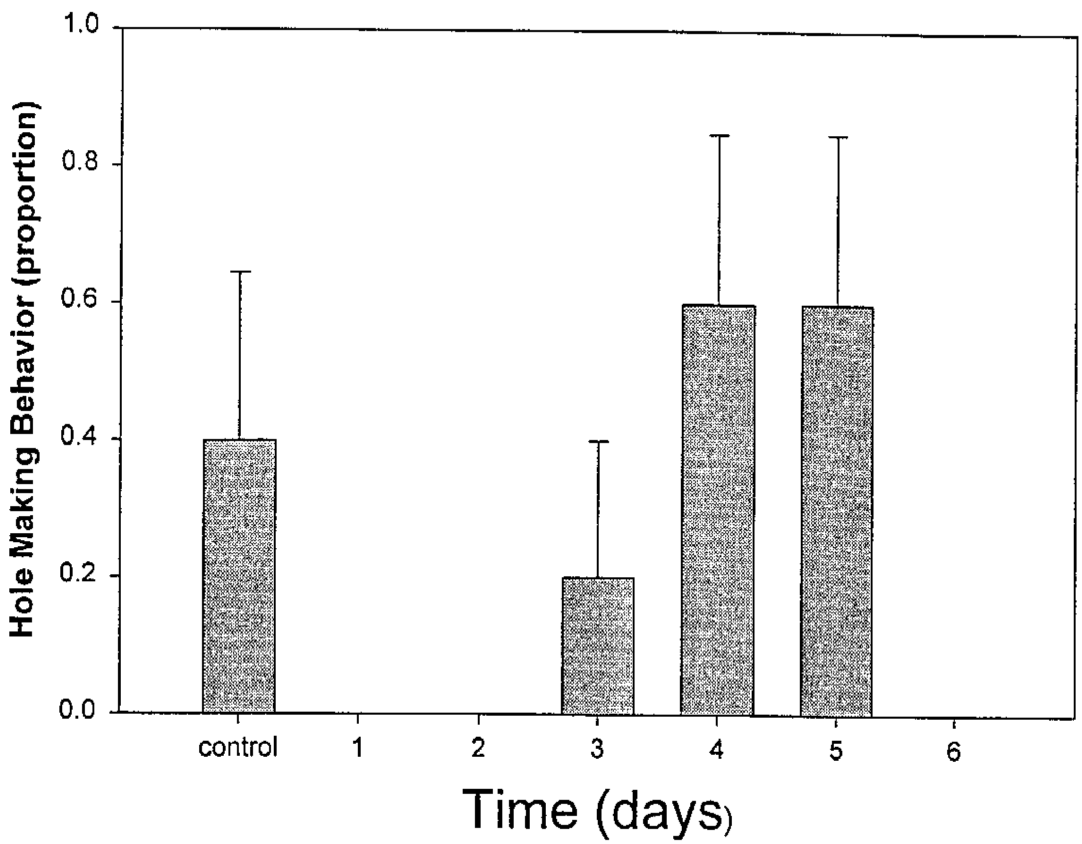


Figure 2- Proportion of insects making holes in nets as a function of time. The load was 0.1 g of leaf particles added once every 24 hours for six days. The controls were insects observed after six days; no particles were added to these controls.



Discussion

Although this study concentrated specifically on the hole-making behavior of *Neureclipsis*, several of the behaviors described by Runde (1998) in Hydropsychids were observed. Namely, the *Neureclipsis* were observed cleaning their nets and taking them down in the presence of suspended sediment. Both of the experiments performed in this study confirm that an increased particle size does increase the incidence of hole making in *Neureclipsis*. The application of leaf particles of greater size increased the number of individuals that made holes in their nets. Also in congruence with the hypothesis that particle size is directly proportional to hole-making incidence is the differential effect of applications of clay and coal. Coal, which is of particle size <64 um, caused the larvae to make holes over time; clay particles, which are approximately 0.3 um in size, did not cause a significant effect on the larvae. It is important to note that their is a significant difference between the effect of coal particles and leaf particles of size <64 um. This difference can be accounted for in the different styles of loading. The coal most likely had the greater effect because it was loaded directly into the mouth of the larval nets; the leaf particles were added to the water without dilution, indirectly to the net. Also, all the leaves were added at the same time, but the coal was added over six days.

Larger particles effectively eliminate the necessary flow of water through the nets of *Neureclipsis*. When the nets are completely clogged interiorly, the insects are not able to obtain oxygen while remaining in their retreats. They must venture to the outside of their nets where the threat of predation is much greater. Instead of doing this, many of these larvae appear to tear holes in their nets to allow adequate water flow for oxygen intake. Another possibility for this behavior is to allow food to flow into the net.

These findings raise an interesting question: How do the larvae know when to cut holes in their nets? They may be signalled by decreased oxygen availability, decreased food availability, or decreased water velocity within the net. Each of these possibilities could be tested by subjecting the larvae to these artificially-induced conditions and observing which condition causes the larvae to make holes at the greatest frequency.

Literature Cited

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Name	**Year**	**Advisor**	**Title**
Brill	1999	Hellenthal	Behavioral Movement of Dragonfly Larvae in the Light vs. the Dark
Buescher	1999	Hellenthal	Microhabitat Preference of Two Common Species of Dragonflies at UNDERC
Evans	1999	Boyd	Arginine Vasotocin (AVT) Influences Aggressive Call Behavior in the Gray Treefrog
Foy	1999	Hellenthal	Microhabitat Effects on the Growth Rates of Odonata Larvae
Giefer	1999	Runde	Differential Responses to Sediment Transport by Two Different *Hydropsyche* Populations
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Lord	1999	Runde	A Population Census of *Esox lucius*
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