Division of Water Quality
Watershed Assessment Team
December 10, 2006

Memorandum

To: Steve Kroeger
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Through: Susan Gale *SMG*

From: Larry Eaton *LE*

Subject: Hatchers Run-Tar Subbasin 01; WAT Special Study

Background

Aquatic macroinvertebrates were collected, and the riparian condition and aquatic habitat evaluated, at one site along Hatchers (Hachers) Run in Oxford, NC (Figure 1), a tributary to Fishing Creek in the Slate Belt ecoregion, on August 25, 2006. These data were collected as part of an Environmental Protection Agency (Section 319) grant to evaluate possible relationships between riparian condition and aquatic life. The data also complement monitoring currently being conducted by the NC Division of Water Quality (DWQ) supporting the NC Ecosystem Enhancement Program's (EEP) development of a Local Watershed Plan (LWP) for the Fishing Creek and Coon Creek watersheds. Information from the August 25, 2006 collection supplements collections at seven sites in March 2006 by the DWQ's Biological Assessment Unit (BAU). (BAU; memo from Jeff DeBerardinis to Jimmie Overton – July 26, 2006).

Watershed Description

The Hatchers Run catchment above US 15 (lat 36.2746667, long 78.6083333)was largely suburban with some commercial development in the Oxford area. It represented a mix of agricultural land uses along with residential and commercial development. Forested riparian buffers existed along some stream segments. The drainage area at this site was 4.2 square miles. The topographic map of the watershed is depicted in Figure 1.

The upper third of the Hatchers Run catchment drained into Lake Devin, near the Oxford Tobacco Experiment Station. Specific conductance of the water discharged by Lake Devin was about 87 µmhos. Further downstream, at SR 1004, conductivity increased to 284 µmhos as water flowed through a DOT wetland restoration downstream of the bridge. The source of the elevated specific conductance is more likely to be upstream of the wetland possibly where a buffer violation was reported to the DWQ Raleigh Regional Office earlier in 2006.

Methods

The Qual 4 sampling method is used here because of the limited habitat in flowing water. This and other sampling methods are described in detail in the Standard Operating Procedures used by the NC DWQ Biological Assessment Unit (http://h2o.enr.state.nc.us/esb/BAUwww/benthossop.pdf). All organisms from four samples (one kick, one sweep, one leaf-pack, and visuals) are collected and picked in the field. Since Hatchers Run has a watershed area of 4.2 square miles, EPT criteria are used to assign a bioclassification. Criteria for Piedmont streams are used.

The purpose of this collection is to inventory the aquatic fauna to the lowest practical taxonomic level (usually genus or species) and produce an indication of the relative abundance for each taxon. Organisms are classified as Rare (1-2 specimens, denoted by "R" on taxa tables), Common (3-9 specimens, "C"), or Abundant (>10 specimens, "A").

Several data-analysis summaries (metrics) can be produced from benthos samples to detect water quality problems. These metrics are based on the idea that unstressed streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

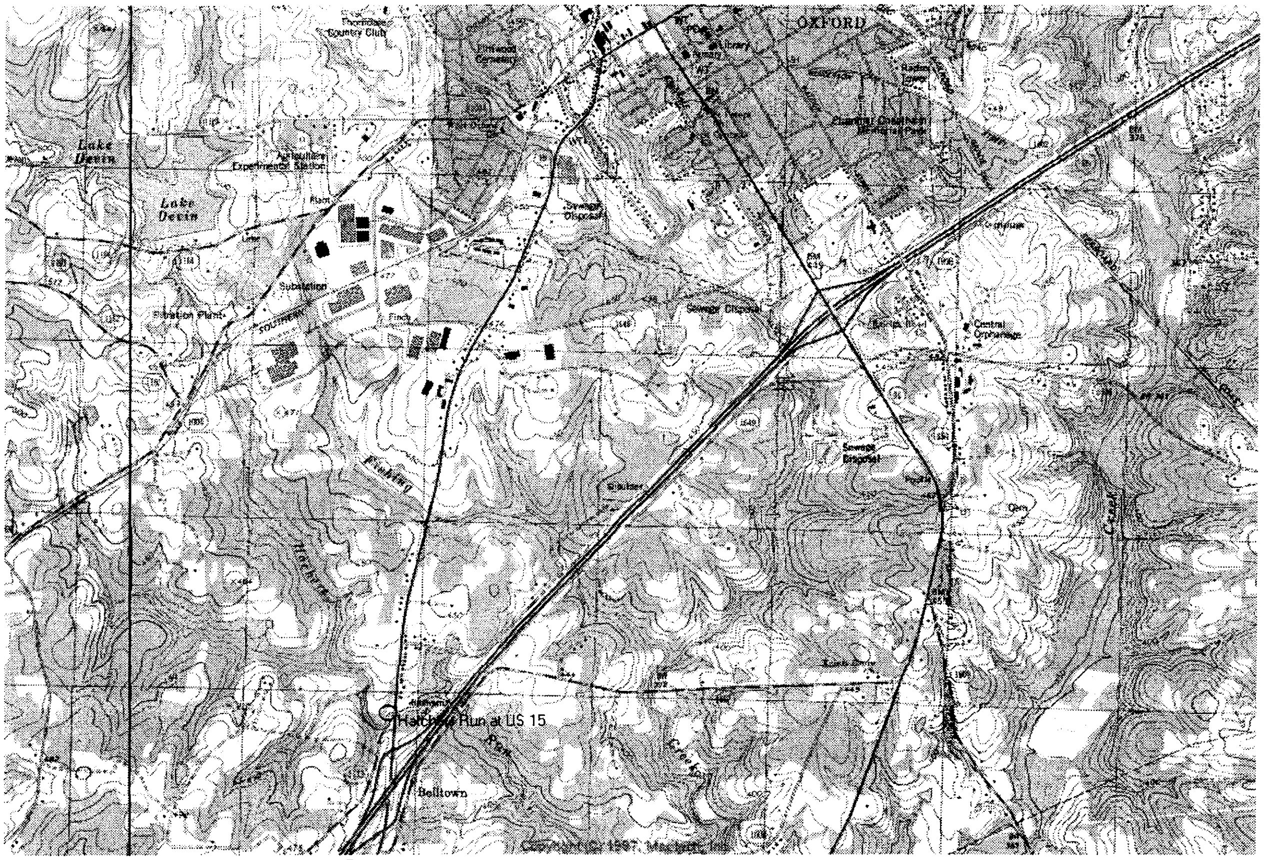

Figure 1. Hatchers Run at US 15.

EPT taxa richness (EPT S) criteria have been developed by DWQ to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect orders that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Also useful for assessing the aquatic community is the North Carolina Biotic Index (NCBI) which is the relative tolerance of the macroinvertebrate community. Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions.

A final assessment of the stream habitat and of the land use within the catchment is also completed. These habitat evaluations assess the quality and quantity of instream habitat, the quality and quantity of the stream's riparian zone, and also evaluate detrimental impacts on stream habitat such as bank erosion and substrate embeddedness. Habitat evaluations result in a score between 1 and 100, with higher values indicating higher quality habitat.

Results

Habitat and Physical Parameters

Substrates within the sampling reach contained two riffles, each containing a small amount of boulder (10%), and a good mix of rubble and a trace of gravel. The remainder of the substrate was sand (Table 1). Very little flow was noted except in shallow parts of the riffle. The habitat score was 78, including optimal shading (10 points out of 10), a wide riparian buffer with only rare breaks (9 points out of 10) and unstable banks (6 points out of 15).

Table 1. Substrate and physical measurements at Hatchers Run

Substrate type	Relative Proportion (%)	Physical Measurements	Results
Boulder	10	Temperature (°C)	24.1
Rubble	30	Dissolved oxygen (mg/L)	6.3
Gravel	Trace	Specific conductance (μmhos)	80.0
Sand	60	pH (s.u.)	6.5
Silt	Trace		

This site on Hatchers Run does not appear to have significant water quality problems. The conductivity is relatively low compared to most of the other sites monitored in support of the LWP that have conductivities in the range of 100-300 μmhos/cm. There was very little flow at this site except within the riffles, which was typical of most of the Fishing Creek watershed sites visited in late August. Nearly half of these sites visited in August, and nearly all sites with little to no flow, had dissolved oxygen readings below 4.0 mg/l. The relatively high DO at Hatchers Run might be, at least in part, from elevated periphyton levels stimulated by excess nutrients from suburban areas.

Benthic Macroinvertebrate Community

Macroinvertebrate Indices

The benthic community at this site consisted of 47 taxa, of which 13 belonged to the intolerant groups of mayflies, stoneflies and caddisflies (EPT). Summaries of the various metrics are provided in Table 2, and the complete taxa list is provided in Appendix A. The bioclassification assigned to this site was Fair, one taxa short of Good-Fair.

Table 2. Summary of benthic macroinvertebrate metrics and bioclassification

Summary Metric	Value
Total Taxa Richness	47
EPT Taxa Richness	13
EPT Abundance	50
Biotic Index	6.7
Bioclassification	Fair[1]

[1] Low or no flows during the spring may have resulted in the Fair bioclassification.

Functional Feeding Group Analysis

A functional feeding group analysis was conducted to determine the relative proportion of the numbers of species in different feeding groups. Species of macroinvertebrates can be classified into different feeding groups, although a significant amount of overlap can occur between groups (e.g. an animal that scrapes algae off a rock can either be a scraper or an herbivore, filter feeders and deposit feeders are subsets of collectors, and when some species of scrapers can't find enough food, they will become deposit feeders). The DWQ Biological Assessment Unit has assigned a feeding group to most species in its database. These groups include predators, scrapers, collectors, deposit feeders, filter feeders, omnivores, and herbivores. This analysis can reveal imbalances between macroinvertebrate feeding groups.

The results depicted in Figure 2 were derived by dividing the total relative abundance (Abundant = 10, Common = 3 and Rare =1) for all species in each functional feeding group by the total abundance for all species found in the sample. Approximately 40% were predators (Figure 2) and about one-sixth were scrapers, which feed on the periphyton on the rocks and logs. Only 10% were filter feeders (Figure 2).

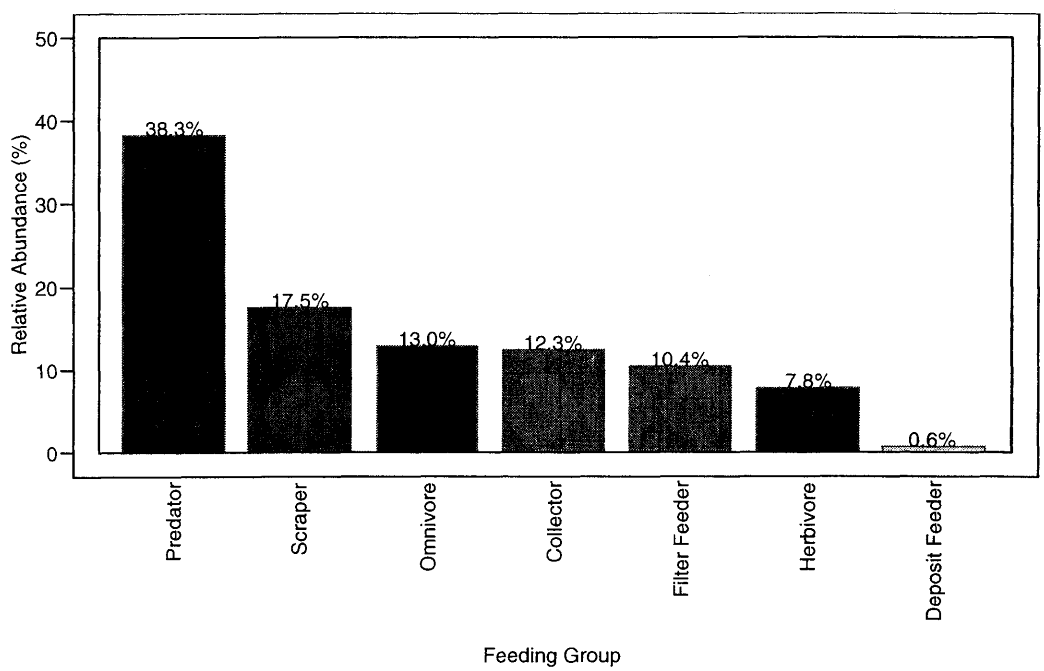

Figure 2. Relative abundance by functional feeding groups.

The functional feeding group analysis depicts an unbalanced community with a predominance of predators, and few filter feeders. Usually, predators form a small (about 10-15%) portion of the community. When predators become the dominant feeding type, they are usually responding to a previous explosion of prey, which are usually reacting to elevated dissolved or particulate nutrient additions. Even though the sampled stream reach was well shaded, 89% of the mayflies were scrapers from the families Heptageniidae (three species) and Baetidae (five species). This may suggest dissolved nutrient additions to the stream that support the periphyton growth upon which these scrapers feed. While it does not take high levels of nutrients to support a large scraper community when a stream receives little shading from its canopy, it usually requires higher levels of nutrients to support a high proportion of scrapers when light to the stream bed is limited by a nearly closed canopy. Excessive algal growth was not noted, however, so at this time any nutrient inputs do not seem to be excessive.

If flow stops in a stream, filter feeders can't get food and they starve. When flow resumes, filter feeders must recruit anew into the stream. The limited number of filter feeders (early instar *Cheumatopsyche* caddisflies and one *Isonychia* mayfly) suggests that flow ceased at this site earlier in the spring and or summer and had recently resumed. A high proportion of predators in a population can often be found in streams that have stopped flowing. Susan Gale (personal communication) observed a lack of flow at this site in late April/May, which may account for the lack of filter feeding taxa such as *Hydropsyche/Symphitopsyche* caddisflies and blackflies (*Simulium*), which were frequently found by BAU during March collections in the Fishing Creek watershed. This lack of flow could also be responsible for the relatively high Biotic Index (6.70) at this site. Considering the reduction in filter feeders due to lack of flow, it is likely that Hatchers Run may improve its rating to Good-Fair if sampled during times when flow is present.

Conclusions

The two major factors that appear to be affecting the aquatic macroinvertebrate community at Hatchers Run are: 1) periodic lack of flow and 2) nutrient inputs. The bioclassification for this site was Fair but shy of a Good-Fair bioclassification resulting from the absence of one EPT taxon likely due to flow cessation earlier in the year. Low flow or cessation of flow earlier in the year greatly impacted taxa dependent on flow for survival (filter feeders). It is likely this site is capable of supporting one to three more filter feeding EPT taxa (e.g. *Hydropsyche* spp) under higher flow conditions. The high proportion of grazers at this site (ca. 33%) may be due to high densities of periphyton, whose growth is stimulated by nutrients.

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Appendix A. List of taxa by functional feeding group. The numbers in parenthesis (x, y) represent the number of species (x) and the total relative abundance(RA) for each group (y). Numeric values assigned to RA classes are: Rare (R) =1, Common (C) = 3, and Abundant (A) = 10. The total abundance for all groups is 154.

Feeding Group	Order	RA	Feeding Group	Order	RA
Collector (5, 9)			Predator (cont).		
Hyalella azteca	Crustacea	C	*Conchapelopia gp*	Diptera (Chironomidae)	C
Corynoneura sp	Diptera (Chironomidae)	R	*Natarsia sp*	Diptera (Chironomidae)	R
Polypedilum illinoense	Diptera (Chironomidae)	C	*Nilotanypus sp*	Diptera (Chironomidae)	R
Anepholes sp	Diptera (misc)	R	*Hexatoma sp*	Diptera (misc)	C
Paracloeodes sp	Ephemeroptera	R	*Palpomyia/Bezzia gp*	Diptera (misc)	R
			Corydalus cornutus	Megaloptera	R
Deposit Feeder (1,1)			*Nigronia fasciatus*	Megaloptera	R
Lumbriculidae	Oligochaeta	R	*Argia sp*	Odonata	R
			Basiaeshna janta	Odonata	C
Filter Feeder (6, 26)			*Boyeria vinosa*	Odonata	C
Microtendipes pedellus gp	Diptera (Chironomidae)	R	*Calopteryx sp*	Odonata	A
Rheotanytarsus sp	Diptera (Chironomidae)	R	*Dromogomphus*	Odonata	R
Isonychia sp	Ephemeroptera	R	*Helobdella triserialis*	Other	R
Sphaerium sp	Mollusca	A	*Hydracarina*	Other	C
Cheumatopsyche sp	Trichoptera	A	*Prostoma graecens*	Other	R
Chimarra sp	Trichoptera	C	*Rhagovelia sp*	Other	A
Herbivore (3, 12)			Scraper (11, 37)		
Scirtes sp (larvae)	Coleoptera	R	*Dubiraphia sp*	Coleoptera	R
Dugesia tigrinus	Other	R	*Baetis flavistriga*	Ephemeroptera	C
Triaenodes abus	Trichoptera	A	*Baetis intercalaris*	Ephemeroptera	R
			Baetis propinquus	Ephemeroptera	C
Omnivore (1, 10)			*Centroptilum sp*	Ephemeroptera	C
Cambarus bartoni	Crustacea	A	*Stenacron interpuctatum*	Ephemeroptera	A
			Stenonema femoratum	Ephemeroptera	R
Predator (20, 59)			*Stenonema modestum*	Ephemeroptera	A
Helichus sp	Coleoptera	A	*Ferrissia sp*	Mollusca	C
Laccophilis sp	Coleoptera	R	*Micromenetus dilatus*	Mollusca	R
Neoporus sp	Coleoptera	R	*Neophylax ornatus*	Trichoptera	R
Ablabesmyia mallochi	Diptera (Chironomidae)	C			