Technical Memorandum

2005 Ipswich River Watershed Periphyton Study

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Worcester, MA

February 2010

CN: 228.7

Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at several stations in the Ipswich River Watershed during the summer of 2005. Samples were collected at one Ipswich River and two tributary sites for the identification of periphyton, described here as including the attached microscopic and macroscopic algae. Periphyton sampling was limited to sites chosen for macroinvertebrate/habitat investigations.

Objectives of the periphyton sampling were to provide additional information for use assessment by adding another biological community to the macroinvertebrate and habitat information, and to examine temporal changes in the amount and type of algae present in the assemblage. The periphyton assessment provides supportive information to aid in determining if the designated uses, as described in the Surface Water Quality Standards (MassDEP 2006), are being supported, threatened or lost in particular segments. Periphyton data can be used to evaluate two designated uses, Aquatic Life and Aesthetics.

Aquatic life evaluations determine if suitable habitat is available for "sustaining a native, naturally diverse, community of aquatic flora and fauna." Natural diversity and the presence of native species may not be sustained when there are dense growths of a monoculture of a particular alga. This alteration of the community structure may indicate that the aquatic life use support is lost or threatened. Loss of parts of the food web - vital for aquatic life use support - may result from this alteration. In addition, the die-off and decomposition of large amounts of biomass from macroalgae can fill in the interstitial sites in the substrate and destroy this habitat for the benthic invertebrates further compromising aquatic life.

The algal data are also used to determine if the aesthetic quality of the waterbody has been impacted. Floating rafts of previously attached benthic algal mats can make a waterbody visually unappealing, as can large areas of the bottom substrates covered with long streamers of algae that can discourage waders and hinder fishermen by making the substrata slippery for walking. Fishermen can also snag their fishing lines on the filamentous algae. A determination of whether or not the aesthetic quality of a waterbody is compromised by algal growth can be made by measuring the percent macroalgal cover in a particular habitat (e.g. riffles or pool). Forty percent or greater coverage by filamentous green algae is typically considered a nuisance level of algae (Biggs 1996, Barbour et al. 1999).

Periphyton sampling is typically done on first, second or third order streams and rivers that are small, shallow, and often fast-moving. At each of the stations an estimate of the percent cover of the periphyton and benthic algae is made and samples are collected for algal identification. Periphyton samples are typically scrapes of one type of substrata in the riffle zone. The algal scrapes are used in the qualitative microscopic examination to determine the presence and relative abundance of the phyla that contributes the most to the biomass in the riffle or pool habitats.

Materials and Methods

Periphyton Identifications and Relative Abundance

Three sites were sampled for periphyton from the Ipswich River and tributaries. Periphyton samples were gathered along with the macroinvertebrate samples and habitat information using methods described in Barbour et al. (1999). Sampling was performed by the macroinvertebrate sampling crew and consisted of randomly scraping rocks and cobble substrates, typically within the riffle area, but other habitats were occasionally sampled. Material was removed with a knife

or by hand from rock substrata and then added to labeled glass vials containing sample water. Table 1 contains descriptions of the station locations where periphyton was collected. The samples were transported to the laboratory at MassDEP-Worcester in one-liter plastic jars containing stream water to keep them cool. Once at the laboratory, they were refrigerated until identifications were completed. Samples held longer than one week were preserved using M^3 with a dose rate of 2 ml of preservative per 100 ml of sample (Reinke 1984).

Vials were shaken before subsampling. Filamentous algae were removed first, identified separately, and then the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications. (References used for the taxonomic identifications are listed at the end of this memorandum). Slides were typically examined under 200x power. A scheme developed by Bahls (1993) was employed to determining periphyton abundance on a microscope slide at 200x power as follows:

R (rare)	fewer than one cell per field of view at 200x, on the average;
C (common)	at least one, but fewer than five cells per field of view;
VC (very common)	between 5 and 25 cells per field;
A (abundant)	more than 25 cells per field, but countable;
VA (very abundant)	number of cells per field too numerous to count.

A visual determination was also made of whether or not the algal covering was composed of micro or macroalgae, in particular, the green filamentous algae. The microalgae typically appear as a thin film, often green or blue-green, or as a brown floc. Macroalgal (green filamentous algae) that covers greater than 40% of the substrata in the riffle/run is considered to be indicative of organic enrichment (Barbour et al. 1999) and may indicate that the aesthetic quality of the stream is compromised.

Results

The stations included in the periphyton sampling, as well as their canopy cover and percent algal cover, are presented in Table 1. Table 2 lists the periphyton taxa obtained from the sampling sites along with their relative abundance.

Table 1. 2005 Ipswich River Watershed Periphyton Study. Canopy cover (%) and within-reach algal cover (%)

Station No.	Station Description	Canopy cover (%)	Within- reach algal cover (%)
IP06	Ipswich River, downstream from Main Street, Middleton	30	60
FB00	Fish Brook, upstream from Middletown Road, Boxford	60	5
MB02A	Martins Brook, downstream from Park St, North Reading	60	60

Observations

The Ipswich River main stem sampling location at IP06 exhibited reddish-brown-colored water and a partial canopy cover of approximately 30%. A thin green film of algae on the rocks was found in the pooled areas. The one algae sample indicated little algae present except for a few

diatoms (*Synedra* sp. and *Fragilaria* sp.) and unidentified cyanobacteria (Table 2). While algae were not abundant, mosses covered most substrates.

Mosses were also prevalent in the reach at MB02A (Martins Brook). The water exhibited no odors or oils, was slightly turbid and light yellow in color. Field notes indicate that 80% of the benthos within the reach were covered by sand and only 5% by cobble, the preferred substrate for periphyton since it is large enough not to be easily moved or buried during spates. Therefore, despite the presence of "green" filamentous algal growth on approximately 60% of the cobble, only a small fraction of the total stream bed was actually covered by algae. The only alga in the sample was described as *Stigonema* sp., a blue-green filamentous form which forms short, wooly-type growths. This would not be considered a nuisance alga.

At FB00 (Fish Brook), mosses again were the dominant aquatic vegetation, as 100% coverage was indicated on the field sheets. The water was not turbid, but was colored. Algal cover within the reach was only 5% and was described as green balls on the rocks in the run/pooled reach. This was an unidentified blue-green filamentous form.

None of the stations sampled exhibited nuisance levels of macroalgae, but large amounts of moss covered the substrata at all three sites. The colored water from organic acids found at each location may contribute to reduced algal populations even in areas with open canopy since the light spectrum available to the algae is altered by these substances.

The lack of Bacillariophyceae (diatoms) - often found in areas of low light intensity - and Chlorophyceae (green algae) species - often found in well-lit, nutrient-rich waters - cannot be explained from the results of this investigation. Closed-canopy sites may lack sufficient light or substrates may be unsuitable for the growth of green algae. Scarce nutrients or lack of accrual time for the algal community to recover from scouring caused by heavy rains may also leave the algal community with few species and little biomass present**.**

Table 2. 2005 Ipswich River Watershed Periphyton Study. Relative abundance of periphyton taxa

Station	Date	Class	Genus	Abundance
IP06	27-July	Bacillariophyceae	*Fragilaria* sp.	R
		Bacillariophyceae	*Synedra* sp.	R
		Bacillariophyceae	Unidentified Pinnate diatoms	R
		Chlorophyceae	*Closterium* sp.	R
		Cyanophyceae	Unidentified Blue-green prostrate colony	R
FB00	28-July	Chlorophyceae	*Schroederia* sp.	R
		Cyanophyceae	Unidentified filamentous	VA
MB02A	27-July	Cyanophyceae	*Stigonema* sp.?	C

References Cited

Bahls, L. L. 1993. *Periphyton Bioassessment Methods for Montana Streams.* Water Quality Bureau, Dept. of Health and Environmental Sciences. Helena, Montana.

Barbour, M., Gerritsen, J, Snyder, B. D. and J. B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish*, 2nd edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Biggs, B. J. F. 1996. *Patterns of benthic algae in streams*. IN: Algal Ecology: Freshwater Benthic Ecosystems. R. J. Stevenson, M. Bothwell, and R. L. Lowe. Pp 31-55. Academic Press, San Diego, California.

MassDEP. 2006. *Massachusetts Surface Water Quality Standards (Revision of 314 CMR 4.00, effective December 29, 2006)*. Massachusetts Department of Environmental Protection, Boston, MA.

Reinke, D. C.1984. *Algal Identification Workshop*. Kansas Biological Survey. Manhattan, Kansas.

Commonly Used Taxonomic Keys

Cronberg, G. and H. Annadotter. 2006. *Manual on Aquatic Cyanobacteria: A Photo Guide and a Synopsis of Their Toxicology.* Intergovernmental Oceanographic Commission of UNESCO, International Society for the Study of Harmful Algae. 106 p.

Prescott, G. W. 1982. *Algae of the Western Great Lakes Area*. Otto Koeltz Science Publishers. Koenigstein/West Germany. 977 p.

Smith, G. M. 1950. *The Fresh-water Algae of the United States*. 2nd edition McGraw Hill Publishers. New York. 719 p.

Prescott, G. W. 1982. *How to Know the Freshwater Algae*. Wm C. Brown. New York. 293 p.

VanLandingham, S. L. 1982. *Guide to the Identification, Environmental Requirements and Pollution Tolerance of Freshwater Blue-green Algae (Cyanophyta).* Environmental Monitoring and Support Laboratory. U.S. Environmental Protection Agency. Cincinnati.

Wehr, J. D. and R. G. Sheath. 2003. *Freshwater Algae of North America: Ecology and Classification*. J. H. Thorp, editor. Academic Press, Inc. 917 p.

Whitford, L. A. and G. J. Schumacher. 1984. *A Manual of Fresh-Water Algae*. Sparks Press. Raleigh. 337 p.