Technical Memorandum

2005 Millers River Watershed Periphyton Sampling Results

Joan Beskenis, PhD.

Massachusetts Department of Environmental Protection
Division of Watershed Management
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Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at two stations on the Otter River in the Millers River Watershed during the summer of 2005. Samples were collected for the identification of periphyton, described here as including the attached microscopic and macroscopic algae. Estimates were made of the percent algal cover within the riffle of the sampling reach. Algal type and abundance were also recorded. Periphyton sampling was limited to sites chosen for macroinvertebrate/habitat investigations.

Objectives of the periphyton sampling were to provide additional information for 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 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, which is 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 detrital material and exudates 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).

Materials and Methods

Periphyton Identifications and Relative Abundance

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, added to labeled glass vials containing sample water, and transported to the laboratory at MassDEP-Worcester in one-liter plastic jars containing stream water to keep them cool. Once at the laboratory, samples were refrigerated until taxonomic 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:

Rare – Fewer than one cell per field of view at 200x, on the average;
Common – At least one, but fewer than five cells per field of view;
Very common – Between 5 and 25 cells per field;
Abundant – More than 25 cells per field, but countable;
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 Otter River 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. Relative abundance provides an indication of the dominant alga within the sample.

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

Station No.	Station Description	Canopy cover (%)	Within-reach algal cover (%)
BO221	Otter River –approximately 570 meters upstream/southeast from Route 202, Templeton (upstream of Templeton WWTP discharge)	0	5
OTSE	Otter River, upstream from Main St, Templeton	30	5

Table 2. 2005 Millers River Watershed Periphyton Sampling. Relative abundance of periphyton taxa

Station	Date	Class	Genus	Abundance
BO221	13-Sept	Bacillariophyceae	*Melosira varians*	VA
		Chlorophyceae	*Spirogyra* sp.	VA
		Bacillariophyceae	ui diatom chain	VA
		Bacillariophyceae	ui pennate diatoms	VA
OTSE	14-Sept	Bacillariophyceae	*Fragilaria* sp.	A
		Bacillariophyceae	*Melosira* sp.	VA
		Chlorophyceae	*Ulothrix zonata*	VA
		Xanthophyceae	*Vaucheria* sp.	VA

Observations

At station BO221, filamentous green algae (*Spirogyra* sp.) (Table 2) were visible on rocks covering an area of 5% of the reach (Table 1). Diatoms, particularly *Melosira varians*, were also found at this location. With 0% canopy cover, sunlight was not a limiting factor affecting the growth of attached algae. The field sheets do indicate that the water was tea-colored, which would reduce the light that reached the benthos and may have had some effect on algal growth. The watershed is 50% forested and 50 % industrial. Obvious sources of nonpoint source pollution were also noted along the reach, including adjacent impervious surfaces from parking lots and abandoned factories. Only a cursory interpretation of stream conditions can be made based on algal coverage and morphological types of algae (e.g., long filaments or biofilms) observed on a single sampling date. Nonetheless, nutrients contributed by the sources identified above do not appear to have resulted in excess algal growth.

At station OTSE, the filamentous algae *Vaucheria* sp. and *Ulothrix* sp. were found within a mat (or biofilm) in the run. Although algae covered only 5% of the reach at this site, both of these genera can produce prolific amounts of biomass under ideal growing conditions such as cooler water temperature and elevated nutrients (Biggs 1996). On the sampling date, however, mosses, rather than algae, covered approximately 90% of the river bottom.

References

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.