2003 Blackstone River Water Quality Survey
Results of Periphyton Sampling

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Introduction

During the summer of 2003, personnel of the MassDEP's Division of Watershed Management (DWM) conducted a biomonitoring survey of the Blackstone River. 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 and algal type and abundance were recorded.

Periphyton sampling and analysis was limited to two sites that were also chosen for macroinvertebrate/habitat investigations (reported separately). The stations are listed in the table below and are described in further detail in Fiorentino (2006). The two segments represented by these stations were listed in Category 5 (the "303d List of Impaired Waters") of Massachusetts' 2004 Integrated List of Waters (MassDEP 2005) as needing investigation to determine the cause of toxicity, as well as the calculation of Total Maximum Daily Loads (TMDLs) for the control of nutrients, organic enrichment/ low dissolved oxygen and metals (Fiorentino 2006). The Blackstone River at BLK02 receives treated effluent from the Upper Blackstone Water Pollution Abatement District (UBWPAD) WWTP, and discharges from this facility as well as POTWs in Millbury, Grafton, Northbridge, Uxbridge, Douglas and Upton all occur to the Blackstone River, or tributary streams, upstream from BLK12A.

List of biomonitoring stations sampled for periphyton on September 15, 2003 as part of the Blackstone River Basin survey, including station identification number, mile point and site description.

Station ID	River Mile	Site Description
BLK02	46.0	Blackstone River at Old McCracken Road, below UBWPAD, Millbury, MA
BLK12A	24.5	Blackstone River 30 m upstream from Central Street, Millville, MA

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.

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. Vital links in the food web, crucial to sustaining aquatic life, may be lost as a result of 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 invertebrate community, thus compromising aquatic life use support.

The algal data are also used to determine if aesthetics have been impaired. Floating rafts of previously attached benthic algal mats can render a waterbody visually unappealing. Long streamers of filamentous algae attached to the bottom substrates also discourage swimmers and

hinder fishermen by making the substrata slippery for walking. Fishermen can also snag their fishing lines on the filamentous algae. Observations made by wading in the stream and viewing the periphyton on rocks or cobbles provide evidence for determining if nuisance algal growth is present. As part of the habitat assessment, a visual evaluation is made to determine if the algal covering is 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. The macroalgal filaments are usually representatives of the Chlorophyceae (the green algae) and are typically 2-3 cm or longer. If 40% or more of the riffle/run substrata is covered by macroalgae the aesthetics of the stream may be threatened and organic enrichment indicated (Barbour et al. 1999). Thus, to gain information on the likely impacts that algal growth is having on the benthic community, estimates are made of the areal coverage of the micro or macroalgae on the substrates within the sampling reach (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 is made and samples are collected for algal identification. Periphyton samples are typically scrapes collected from 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. The estimate of percent cover of the filamentous algae (macroalgae) is used in conjunction with the microscopic examination to determine whether excessive algal growth may be threatening the uses of the river (Aquatic Life Support and Aesthetics).

Methods

Periphyton samples were obtained 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 scraping randomly gathered rocks and cobbles from the riffle area or, occasionally, other habitats. Material was removed with a knife or by hand from rock substrata and then added to labeled glass vials containing sample water. The samples were transported to the lab at MassDEP-Worcester in one-liter plastic jars containing stream water to keep them cool.

Once at the lab, the vials were refrigerated until identifications were completed. Samples held longer than a 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 to get uniform samples before subsampling. Filamentous algae were removed first and identified separately before the remainder of the sample was examined. An Olympus BH2 compound microscope with Nomarski optics was used for the taxonomic identifications. Ten fields were typically examined on each slide at a power of 200x. References used for the taxonomic identifications are listed at the end of this memorandum.

A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme developed by Bahls (1993) for determining abundance on a slide is 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.

Results and Discussion

A taxonomic list and relative abundance of the algae identified from the periphyton community at each sampling location is presented in the appendix.

Station BLK02 had very little canopy cover (<5%), but the bottom substrates were primarily covered by aquatic macrophytes (*Potamogeton crispus*, *Ceratophyllum* sp. and *Elodea* sp.) and mosses; approximately 90% of the bottom was covered. The green (Chlorophyceae) alga, *Rhizoclonium* sp. was dominant and was found both tangled in the moss and as a drift alga loosely covering the surface of substrata in the riffle. Also abundant was another Chlorophyceae - Ulothrix sp. The luxuriant algal and aquatic plant growth was indicative of an abundant supply of plant nutrients.

A 50% enclosed canopy at BLK12A resulted in less available light than at BLK02, yet algae covered approximately 70% of the suitable substrates. Periphyton at BLK12A was dominated by diatoms, primarily the centric diatom *Melosira* sp. along with the pennate diatoms *Synedra* sp. and *Navicula* sp. The chain-like growth form of diatoms, such as *Melosira,* is easily broken up and they, along with the other diatoms, are described as a "brown floc" covering the surfaces of rocks, debris and other available habitat. *Oscillatoria* sp., a member of the cyanobacteria, may have contributed to what was described on the field sheets as a "green film".

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Appendix: 2003 Blackstone River Periphyton - Algal Taxonomic Identifications and Abundance Data *All samples collected on September 15, 2003*					
Station	**Location**	**Habitat**	**Class**	**Genera**	**Relative Abundance***
BLK02 *Sample 1*	Blackstone River, at Old McCracken Road, below UBWPAD, Millbury, MA	Filaments on moss	Chlorophyceae	*Rhizoclonium*	VA
			Chlorophyceae	*Ulothrix*	VA
BLK02 *Sample 2*		Floc on substrates	Chlorophyceae	*Rhizoclonium*	VA
			Chlorophyceae	*Ulothrix*	VA
			Amorphous matter		VA
			Pollen		VA
BLK12A *Sample 1*	Blackstone River, 30 m upstream from Central St., Millville, MA	algal mat in marginal pool	Bacillariophyceae	*Cymbella*	R
			Bacillariophyceae	*Fragilaria*	R
			Bacillariophyceae	*Gyrosigma*	R
			Bacillariophyceae	*Melosira*	VC
			Bacillariophyceae	*Navicula*	A
			Bacillariophyceae	*Stauroneis*	R
			Bacillariophyceae	*Synedra*	VC
			Bacillariophyceae	ui pennate diatoms	A
			Chlorophyceae	*Chlamydomonas*	R
			Chlorophyceae	*Scenedesmus*	R
			Chlorophyceae	ui *Ulothrix*-type chloroplast	C
			Cyanophyceae	*Lyngbya*	C
			Cyanophyceae	*Oscillatoria*	A
			Cyanophyceae	*Phormidium*	R
BLK12A *Sample 2*		Riffle, rock	Bacillariophyceae	*Melosira*	R
			Bacillariophyceae	ui pennate diatoms	R

* R (rare)
C (common)
VC (very common)
A (abundant)
VA (very abundant**)**