Technical Memorandum

2005 Shawsheen River Watershed Periphyton Sampling Results

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Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at several stations in the Shawsheen River Basin during the summer of 2005. Samples were collected from three main stem Shawsheen stations 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 Shawsheen 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.

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

Station No.	Station Description	Canopy cover (%)	Within- reach algal cover (%)
SR01	Shawsheen River, ~190m downstream from Mill Street, Tewksbury	80	<5, (20%Aquatic vegetation)
SH00	Shawsheen River, Rtes. 4/225, Bedford	90	5
SH09	Shawsheen River, downstream from Central Street, Andover	0	40

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

Station	Date	Habitat	Class	Genus	Abundance
SR01	27-Jul	riffle/mat	Bacillariophyceae	*Tabellaria* sp.	A
			Cyanophyceae	*Planktothrix* sp.	VA
SH00	26-Jul	riffle/mat	Cyanophyceae	*Stigonema* sp.	VA
SH09	27-Jul	pool	Bacillariophyceae	*Melosira* sp.	VA
			Chlorophyceae	*Rhizoclonium* sp.	R
SH09	27-Jul	riffle/mat	Bacillariophyceae	*Fragilaria* sp.	A
			Bacillariophyceae	*Melosira* sp.	A
			Cyanophyceae	*Lyngbya* sp.	A
			Cyanophyceae	ui filamentous	A

Observations

There was little algae present (<5 %) within the sampling reach at SR01 in Tewksbury. The surrounding forested land use resulted in a closed canopy that may have affected algal growth.

In contrast, SH00 had a 100% commercial surrounding land use and a closed canopy that limited light penetration to the substrates. The filamentous cyanobacteria –*Stigonema* sp. was present in small patches that covered <5% of the sample reach. Aquatic vegetation (i.e., macrophyton) was not prevalent with <5 % of the reach covered with moss.

At SH09 two habitats were sampled at the same station: a pool area and the riffle that had mat like material attached to the cobble. The 0% canopy cover contributed to the 40% algal cover some of which was growing on the aquatic vegetation that covered 30% of the substrates.

Unlike algae in lakes and ponds whose growth is primarily a response to light and nutrients, periphyton (attached microorganisms) have physical constraints such as substrate type, temperature and velocity in addition to light and nutrients. Loss of periphyton populations can also result from grazing or scouring. (Biggs 1996). Because of the natural variability inherent in periphyton populations, single observations of relative periphyton abundance and species composition are of limited value when assessing the general condition and use support of waterbodies. Given the limited information available from these Shawsheen River stations, 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 the sampling date.

As described in the Introduction, aesthetics do not seem to be impaired by algal growth at these Shawsheen River stations. Aquatic life is not threatened because large amounts of biomass apparently are not accumulating, given the low production observed on the sampling dates.

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