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2006 Westfield River Periphyton Community Assessment

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Introduction

Biological sampling was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at four tributary and four mainstem stations in the Westfield River Watershed during the summer of 2006 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 aquatic life 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 important components of the food web – that are 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 render 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 substrate 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 contribute 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 if uses of the river (Aquatic Life Support and Aesthetics) are lost or threatened because of excessive algal growth.

Materials and Methods

Periphyton Identifications and Relative Abundance

Periphyton samples were gathered, along with macroinvertebrate samples and habitat information, from eight sites on the Westfield River and selected tributaries (Table 1) 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 determine 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. Macroalgae (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.

Table 1*. List of biomonitoring stations sampled during the 2006 Westfield River watershed survey, including station and unique identification numbers, drainage areas, sampling site descriptions, sampling dates, % canopy cover and % algal cover within reach.

Station ID	Unique ID	Drainage Area (mi^2)	Sampling Site Description	Sampling Date	% Canopy Cover	% Algal Cover Within Reach
MEDB01	B0578	4.16	Meadow Brook, ~75 meters upstream of the confluence with the Westfield River, Cummington, MA	6-Sept-2006	35	90
WRDS04	B0577	1.49	Wards Stream, upstream at Harvey Road, Worthington, MA	6-Sept-2006	65	10
WBWR01	B0576	50.5	West Branch Westfield River, ~50 meters upstream from Middlefield Road, Chester, MA	6-Sept-2006	0	55
WB01	B0175	94.5	West Branch Westfield River, ~920 meters upstream/Northwest from Route 112, Huntington, MA	5-Sept-2006	10	Not recorded
WR02	B0177	321	Westfield River, ~590 meters downstream/South from confluence with West Branch Westfield River, adjacent to Roadside Park, Huntington, MA	5-Sept-2006	0	80
LR02C	B0475	54	Little River, ~275 meters downstream from Cook Brook, Westfield, MA	5-Sept-2006	50	90
PNDB00.1	B0575	8.77	Pond Brook, upstream at Union Street, Westfield, MA	5-Sept-2006	80	Not recorded
WR07	B0182	452	Westfield River, ~725 meters downstream/East of confluence with Little River, Westfield, MA	5-Sept-2006	20	80

* adapted from: MassDEP 2012.

Results

Periphyton was examined from eight stations in the Westfield River watershed including four mainstem and four tributary stations. Their locations are described in Table 1 as well as % canopy cover and % algal cover in the reach. A taxonomic list of the periphyton collected, along with their relative abundance, can be found in Appendix A.

Tributary stations had the higher percentages of % canopy cover which ranged from 35 to 80 % compared to the wider mainstem stations where the range was 0 to 20 %. Canopy cover has a direct effect on the amount of light available for photosynthesis as well as on in-stream temperatures which can also affect algal growth. Optimum canopy cover is considered to be between 0 to 50 % or what is described as open to partially open (Table 2).

Table 2: Descriptive terms for % canopy cover

% Canopy cover	Description
0-25	Open
26-50	Partially open
51-75	Partially closed
76-100	Closed

The % algal cover and community assemblages are affected by the % canopy cover as well as other factors such as nutrient levels, velocity and the abundance of available grazers. Typically, as canopy cover increases the algal cover decreases. At the locations sampled the correlation value was r^2 =-0.38 percent between algal cover and % canopy cover (i.e., as canopy cover increased algal cover decreased.)

Tributary Stations

Field notes indicate that at station MEDB01, Meadow Brook in Cummington, landuse on one side of the stream is primarily a cow field while the other is residential. Canopy cover in this small stream (width 4 m) was 35%. The riffle in 2006 was described (MassDEP 2012) as being 90% covered by a thin film of green algae (Appendix A). The one sample collected here for algal identifications and relative abundance indicated cyanobacteria and diatoms present. As shown in Appendix A, the algae identified for this location had few cells present in this sample. It may be that the algal sample was not collected at the best location for a qualitative assessment. The filamentous cyanobacteria *Lyngbya* sp. may have been a major constituent of the green film on the rocks although the counts don't verify this. The field sheets indicate that mosses covered ~ 15 % of the reach.

Wards Stream (WRDS04) in Worthington had a partially closed canopy (65%) Surrounding landuse was estimated to be 40% forest, 50% residential and 10% road crossings. The sample was a composite from run and riffles within the reach. The algae sampled were dominated by diatoms, with several genera listed, but all were listed as rare on the slide (Appendix A).

Little River (LR02C) had a partially open canopy at ~ 50% canopy cover. The surrounding landuse was 100 % forest. The algae in the sample were diverse with several diatoms as well as the cyanobacteria *Planktothrix* sp. (formerly *Oscillatoria* sp.) (Suda et al. 2002) which was very abundant in this sample. It likely contributed to the 'green film' observed on the surfaces.

Pond Brook (PNDB00.1) in Westfield had a closed canopy (80%). Field sheets from 2006 describe the surrounding landuse as 70% commercial and 10 % agriculture. The % algal cover was not recorded for this station, however, the green filamentous *Cladophora* sp. was very abundant in the sample collected. *Cladophora* is often found in areas with elevated N and P as well as available sunlight (Borchardt 1996). There are no indications that nuisance amounts of *Cladophora* sp. were present and, instead, may have occurred as isolated clumps of algae.

Westfield River Stations

West Branch Westfield River (WBWR01) had surrounding land use of 95% forest, but with its' 30 meter width still had an open canopy. Algal cover within the reach (55%) was composed of several diatom genera including *Gomphonema* sp. and *Synedra* sp., but the taxa most abundant in the sample were the green filamentous *Oedogonium* sp. and *Rhizoclonium* sp. (Appendix A). *Oedogonium* sp. is often found in areas of elevated nutrients (Biggs 1996, Borchardt 1996)

West Branch Westfield River (WB01) had an estimated stream width of 35 m and an open canopy (~10 % canopy cover). The algal sample was described as a thin green film on rocks in both the pool and the riffle. The diatoms *Synedra* and *Navicula* were the most abundant taxa present, but the green algae *Spirogyra* and *Rhizoclonium* were also common.

Farther downstream the mainstem Westfield River (WR02) also had an open canopy (Table 1) and approximately 80 % of the substrates were covered by algae. The green filamentous algae *Oedogonium* sp. was very abundant in the slide examined.

Farther downstream still, at station WR07 in Westfield, the Westfield River also exhibited an open canopy and 80 % algal cover (of both macro and micro algae) in the reach. The site was located approximately 350 m downstream from the Westfield Wastewater Treatment Plant discharge pipe. Another potential source of nutrients was the agricultural land which represented 40 % of the surrounding landuse. The remainder of the surrounding landuse was forested. Algal cover was described as being composed of a thin green film that was likely composed of the many diatoms found in the sample in very abundant amounts including *Fragilaria* sp., *Melosira* sp. and *Synedra* sp. The green filamentous alga *Oedogonium* sp. was also found in very abundant amounts in this composite sample (Appendix A).

Observations

The qualitative sampling employed here can only provide a partial indication of the community changes that occur in the algal community from the tributary headwaters down to the lower mainstem reaches. Headwater streams often are dominated by diatoms, in part because those streams typically lack inorganic nutrients, are of higher gradient and are often shaded, thus not affording the conditions favorable for the growth of the green filamentous algae. This pattern was evident at Meadow Brook and Wards Stream. The sample collected from the Little River - located in the lower portion of the Westfield River watershed - was primarily composed of diatoms, but also contained some cyanobacteria. It was at the lower Westfield River stations, WR02 and WR07, and, surprisingly, at the upper of the two sampling sites on the West Branch of the Westfield River (WBWR01) where the green filamentous algae were dominant.. The green filamentous alga, *Cladophora* sp., was present in the sample collected from the Pond Brook tributary, but there is no indication that it covered large areas of the substrates.

More quantitative work with the diatoms, including speciation, would provide a great deal more information about environmental conditions in these streams and rivers.

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Appendix A: Westfield River Periphyton 2006

Station #	Unique ID	Station Description	Date	Class	Genera	Relative Abundance
MeDB01	B0578	Meadow Brook, ~75 meters upstream of the confluence with the Westfield River, Cummington, MA	6-Sep	Bacillariophyceae	*Navicula*	Rare
				Bacillariophyceae	pennate diatoms	Rare
				Cyanophyceae	*Lyngbya*	Common
WRDS-04	B0577	Wards Stream, upstream at Harvey Road, Worthington, MA	6-Sep	Bacillariophyceae	*Cocconeis*	Rare
				Bacillariophyceae	*Melosira*	Rare
				Bacillariophyceae	*Synedra*	Rare
				Bacillariophyceae	*Tabellaria*	Rare
				Bacillariophyceae	*ui pennate*	Rare
				Chlorophyceae	*Microspora*	Rare
LR02C	B0475	Little River, ~275 meters downstream from Cook Brook, Westfield, MA	5-Sep	Bacillariophyceae	*Cymbella*	Rare
				Bacillariophyceae	*Fragilaria*	Rare
				Bacillariophyceae	*Navicula*	Rare
				Bacillariophyceae	*Synedra*	Rare
				Bacillariophyceae	*Tabellaria*	Rare
				Chlorophyceae	*Arthrodesmus*	Rare
				Chlorophyceae	*Oedogonium*	Rare
				Cyanophyceae	*Planktothrix*	Very abundant
				Cyanophyceae	*coccoid b/g cells*	Rare
PNDB00.1	B0575	Pond Brook, upstream at Union Street, Westfield, MA	5-Sep	Chlorophyceae	*Cladophora*	Very abundant
WR07	B0182	Westfield River, ~725 meters downstream/East of confluence with Little River, Westfield, MA	5-Sep	Bacillariophyceae	*Cymbella*	Common
				Bacillariophyceae	*Fragilaria*	Very abundant
				Bacillariophyceae	*Melosira*	Very abundant
				Bacillariophyceae	*Navicula*	Common
				Bacillariophyceae	*Synedra*	Very abundant
				Chlorophyceae	*Oedogonium*	Very abundant
				Chlorophyceae	*Spirogyra*	Rare
WBWR01	B0576	West Branch Westfield River, ~50 meters upstream from Middlefield Road, Chester, MA	6-Sep	Bacillariophyceae	*Fragilaria*	Common
				Bacillariophyceae	*Gomphonema*	Common
				Bacillariophyceae	*Synedra*	Common
				Chlorophyceae	*Bulbochaete*	Rare
				Chlorophyceae	*Oedogonium*	Very abundant
				Chlorophyceae	*Rhizoclonium*	Very abundant
				Chlorophyceae	*Spirogyra*	Rare
				Cyanophyceae	*Planktothrix articulata*	Rare
WB01	B0175	West Branch Westfield River, ~920 meters upstream/Northwest from Route 112, Huntington, MA	5-Sep	Bacillariophyceae	*Cymbella*	Rare
				Bacillariophyceae	*Fragilaria*	Rare
				Bacillariophyceae	*Gomphonema*	Rare
				Bacillariophyceae	*Navicula*	Very abundant
				Bacillariophyceae	*Synedra*	Very abundant
				Bacillariophyceae	*Tabellaria*	Rare
				Chlorophyceae	*Closterium*	Rare
				Chlorophyceae	*Oedogonium*	Rare
				Chlorophyceae	*Rhizoclonium*	Common
				Chlorophyceae	*Spirogyra*	Common
WR02	B0177	Westfield River, ~590 meters downstream/South from confluence with West Branch Westfield River, adjacent to Roadside Park, Huntington, MA	5-Sep	Bacillariophyceae	*Cymbella*	Rare
				Bacillariophyceae	*Synedra*	Common
				Chlorophyceae	*Oedogonium*	Very abundant