Technical Memorandum CN: 232.6

FARMINGTON RIVER WATERSHED

2006 Periphyton Bioassessment

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April 2015

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Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at several stations in the Farmington River basin during the summer of 2006. 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 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 *Massachusetts Surface Water Quality Standards* (MassDEP 2006), are being supported, threatened or lost in particular segments. Periphyton data can be used to help 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…” (MassDEP 2006). 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 and compromise the aquatic life use support.

The algal data are also used to determine if aesthetics have 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. This profuse growth can discourage waders and hinder fishermen by making the substrata slippery for walking. Fishermen can also snag their fishing lines on the filamentous algae. Nuisance amounts of algae, which can compromise aesthetics, can be determined by estimating the percent macroalgal cover in a particular habitat (e.g. riffles or pool) (Biggs 1996; Barbour et al. 1999). Macroalgal growth is generally considered to be at nuisance levels when the percent cover by filamentous green algae is greater than 40 % (Biggs 1996; Barbour et al. 1999).

Attached algae are typically sampled from first-, second- or third-order streams and rivers that are shallow and often fast-moving. At each of the stations an estimate of the percent cover of both the periphyton – the attached microscopic algae – and the attached, filamentous, macroscopic algae that is seen without a microscope 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 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 the designated uses of the river (i.e., Aquatic Life Support and Aesthetics) are lost or threatened because of excessive algal growth.

Materials and Methods

Periphyton samples were gathered along with the macroinvertebrate samples and habitat information using methods described in Barbour et al (1999) and in the periphyton procedure described in the unpublished protocol (Beskenis 2006). 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 lab at MassDEP-Worcester in one-liter plastic jars containing stream water to keep them cool. Once at the lab, they 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, identified separately and then the remainder of the sample was examined. Samples from sites where the dominant substrate is moss and that include a fragment of moss in the vial are shaken to free diatoms and other benthic and planktonic algae. An Olympus BH2 compound microscope with Nomarski optics was used for the identifications. Appendix A contains the references used for identifications. Slides were typically examined under 200 power. A modified method for periphyton analysis developed by Bahls (1993) was used. The scheme developed by Bahls for determining abundance on a slide is 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 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) that may compromise the aesthetic quality of the stream.

Results

Habitat and watershed information from the macroinvertebrate field sheets were used in describing the locations and provided some insight into what could be influencing algal growth in the area. This information is included in Table 1. Table 2 presents the information from the algae sampling including taxonomic identifications and relative densities. Remarks follow for each station based on the information included in tables 1 and 2, particularly with regard to algal growth and issues pertaining to the presence/absence and abundance of the taxa present.

TB00 at Thomas Brook, Otis exhibited a closed canopy (95%) (Table 1) and low percent algal cover. Mosses covered ~20 % of the reach. The algae present in the riffle were both green filamentous forms: *Spirogyra* and *Oedogonium* (Table 2). Both of these genera can proliferate when occurring in low velocity waters with abundant sunlight and nutrients (Biggs 1996).

Canopy cover at FR01B (West Branch Farmington River, Otis) was low (5%) which likely contributed to ~40% algal coverage within the reach. Two filamentous green macroalgae, *Oedogonium* and an unidentified taxon, predominated the sample. In enriched streams, characterized by low-velocity runs, *Oedogonium* biomass can accrue to levels that impair the aesthetic quality and aquatic life use of those water bodies (Biggs 1996).

Station FR03 on the Fall River, a tributary to the West Branch Farmington River, in Otis had a closed canopy, yet ~20 % of the stream bottom was covered by periphyton (microscopic attached algae). The periphyton community was dominated by the diatom *Melosira* (Table 2). The majority of the substrates (75%) were covered by aquatic mosses which typically thrive in locations receiving low ambient light.

Table 1. List of biomonitoring stations sampled during the 2006 Farmington River Watershed survey, including station numbers, sampling site descriptions, sampling dates, % canopy cover and % algal cover within reach.

Station ID	Sampling Site Description	Sampling Date	% canopy cover	% algal cover within reach
TB00	Thomas Brook upstream from Rte 8, Otis, MA	August 16	95	5
FR01B	West Branch Farmington River downstream from MassDPW yard on Route 8, Otis, MA - approx 500 m downstr/south from confluence with unnamed tributary	August 16	5	40
FR03	Fall River ~ 100 m upstream from Reservoir Road, Otis, MA	August 16	90	20
FR05B	West Branch Farmington River upstream from Clark Road - upstream USGS gage, Sandisfield, MA	August 15	20	40
FR06B	Clam River ~ 25 m upstream/northwest from South Beech Plain Road, Sandisfield, MA	August 16	20	40
FR08	Sandy Brook upstream from State Line Hill Road, Norfolk, CT	August 15	80	<5
FR09	Hubbard Brook upstream from West Hartland Road, Granville, MA	August 15	40	30

The canopy at Station FR05B (West Branch Farmington River, Sandisfield) was primarily open and the green macroalgae *Oedogonium* and *Spirogyra* were dominant in the riffle. Macroalgal cover of the substrates within the reach was estimated at 40%. This could be considered a ‘nuisance amount’ of attached algae, but it is a borderline value and should not be considered impairment without determining the frequency and duration of these conditions.

An abundance of the filamentous green algae *Rhizoclonium* and *Spirogyra* was present in the sample collected from Station FR06B on the Clam River, Sandisfield. These genera are considered potential ‘nuisance’ forms since they can grow in long streamers and attain elevated amounts of biomass (Biggs 1996). Algal cover was estimated to be 40%; however, more information would need to be gathered before making any determination of impact. One critical factor is how long these bloom conditions persist since ephemeral blooms would have less of an impact, both visually and on the habitat.

Sandy Brook (FR08) exhibited a closed canopy (80%) which likely helped to suppress algal growth, although scouring at higher flows, a lack of available nutrients and heavy grazing by macroinvertebrates all contribute to low algal densities. The diatom genera *Gomphonema* and *Melosira* created a thin, brown film on the stream substrates (unpublished field sheets).

Approximately 20% of the substrates at FR09 on the Hubbard River in Granville were covered with moss. The green macroalga *Ulothrix* sp. was very abundant in the sample examined, but algal cover within the reach was limited to approximately 30% of the substrates.

Table 2: Farmington River 2006 Periphyton Bioassessment - Class, Genera and Relative Abundance

Station No.	Location	Date	Class	Genera	Relative Abundance[1]
TB00	Thomas Brook, upstream from Rte 8, Otis	16-Aug	Chlorophyceae	*Spirogyra* sp.	A
			Bacillariophyceae	*Synedra* sp.	R
			Chlorophyceae	*Oedogonium* sp.	A
FR01B	W Br Farmington River, upstream from Otis nr Rte 8, Otis	16-Aug	Chlorophyceae	*Oedogonium* sp.	A
			Chlorophyceae	UI green filament	A
			Bacillariophyceae	*Melosira* sp.	C
FR03	Fall River, upstream from Reservoir Rd, Otis	16-Aug	Bacillariophyceae	*Cyclotella* sp.	R
			Bacillariophyceae	*Melosira* sp.	VA
			Bacillariophyceae	*Meridion* sp.	R
			Bacillariophyceae	*Synedra* sp.	R
			Chlorophyceae	*Cladophora* sp.	R
			Cyanophyceae	*Lyngbya* sp.	R
FR05B	West Branch Farmington River upstream from Clark Rd. upstream USGS gage Sandisfield	15-Aug	Chlorophyceae	*Oedogonium* sp.	VA
			Chlorophyceae	*Spirogyra* sp.	A

Table 2 (cont.): Farmington River 2006 Periphyton Bioassessment - Class, Genera and Relative Abundance

Station No.	Location	Date	Class	Genera	Relative Abundance[1]
FR06B	Clam River ~ 25 m upstream/northwest from South Beech Plain Rd Sandisfield	16-Aug	Chlorophyceae	*Spirogyra* sp.	VA
			Chlorophyceae	*Rhizoclonium* sp.	VA
FR08	Sandy Brook, upstream from New Marlborough Rd., Norfolk, CT	16-Aug	Bacillariophyceae	*Gomphonema* sp.	R
			Bacillariophyceae	*Melosira* sp.	R
			Chlorophyceae	UI green film	R
			Chlorophyceae	*Zygnema* sp.	R
			Cyanophyceae	*Lyngbya* sp.	R
FR09	Hubbard Brook, upstream from West Hartman Rd	15-Aug	Chlorophyceae	*Ulothrix* sp.	VA

[1] Relative abundance indicated as follows (see text):

R = Rare
C = Common
VC = Very Common
A = Abundant
VA = Very Abundant

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, Synder, 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.

Beskenis, J. 2006. *Periphyton Procedure 2006*. Massachusetts Dept. Environmental Protection. Worcester. Unpublished manuscript.

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. 1984. Algal Identification Workshop. Kansas Biological Survey, Kansas Dept of Health and Environment. Lawrence, Kansas.

Appendix A

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. *How to Know the Freshwater Algae*. Wm C. Brown. New York. 293 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.

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.