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SOUTH SHORE COASTAL WATERSHEDS
2006 PERIPHYTON BIOASSESSMENT

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Introduction

Biological assessment was performed by personnel from the Massachusetts Department of Environmental Protection (MassDEP) at several stations in the South Shore coastal watersheds during the summer of 2006. Samples were collected from sediments and hard bottom substrates for the identification of periphyton, the attached microscopic algae and macroscopic algae (primarily filamentous types). 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

Benthic algal samples were gathered by the macroinvertebrate sampling crew from six sites (Table 1) using methods described in Barbour et al (1999). Canopy cover was obtained by standing midstream and estimating the percent of the sky that was obscured by vegetation or other obstructions. Periphyton sampling 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. 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 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 sampling locations and provided some insight into what could be influencing algal growth at each site. This information is included in Table 1. Table 2 presents the information from the algae sampling including taxonomic identifications. 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.

The closed canopy found at most of the stations included in the South Shore coastal survey likely contributed to the low amounts of algae found (Table 1). Only JR102 on the Jones River in Kingston, had an open canopy, although it, too, had little algal cover. Field notes suggested that the water column was moderately turbid, and that the bottom substrates were covered with rooted submergent macrophytes which occupied sites where algae might otherwise have attached.

The highest amount of estimated algal cover for the stations sampled (20%) was found at the South River in Marshfield. Substrates were good for algal attachment with approximately 55% cobble in the reach (field notes). The filamentous green *Microspora* sp. was dominant and formed long, cottony streamers (field notes). Aquatic vegetation was also prevalent at this site and covered 70% of surfaces. Taxa found included *Callitriche* sp., *Sparganium* sp., *Myriophyllum* sp. and *Potamogeton* sp. (field notes).

Table 1. List of biomonitoring stations sampled during the 2006 South Shore coastal watersheds survey, including station and unique identification numbers, sampling site descriptions, sampling dates, % canopy cover and % algal cover within reach.

Station ID	Unique ID	Sampling Site Description	Sampling Date	% canopy cover	% algal cover within reach
SR102	B0598	South River 100 m downstream from Main St., Marshfield	July 26	70	20
FS102	B0591	French Stream upstream from Summer St, Rockland	July 26	99	<5
IM101	B0596	Iron Mine Brook ~ 100 m downstream from Broadway, Hanover	July 26	98	15
ER015	B0588	Eel River ~ 100 m upstream from Russell Millpond, Plymouth	July 27	95	<2
ER07	B0590	Unnamed tributary through Forge Pond, ~ 500 m upstream from Forge Pond, Plymouth	July 27	100	10
JR102	B0593	Jones River ~150 m downstream from Elm St.@ USGS Gage, Kingston	July 27	15	5

Station FS102 on French Stream, Rockland exhibited a closed canopy (99%) and little algal biomass, so no algal samples were collected. Substrate availability also limited algal growth with only 20% cobble estimated in the reach (field notes). Aquatic vegetation was limited to moss covering approximately 5% of the surfaces.

Station IM101 at Iron Mine Brook, Hanover also had a closed canopy and algae were sparse (15% cover). No aquatic vegetation was listed in the field notes as occurring in this stream. Cobble substrates comprised approximately 80% of the reach. These stabile substrates offered very good conditions for attached algal growth; however, the 98% canopy cover offered little light (Table 1) and likely affected the algal population. Algal samples were not collected at this station.

The Eel River-station ER015 in Plymouth had a closed canopy (Table 1) and little algae present. Approximately 10% of the benthos was covered by moss (field notes).

At Station ER07 - unnamed tributary approximately 500 meters upstream from Forge Pond, Plymouth - the canopy cover was estimated at 100%. Despite limited light availability, approximately 10% of the substrates were covered with filamentous cyanobacteria *Lyngbya* sp., as well as unidentified diatoms. Aquatic vegetation, composed of S*parganium* sp., *Myriophyllum* sp. and *Callitriche* sp., covered ~50% of the substrates.

The canopy at station JR102 on the Jones River was more open (table 1) than other stations in the South Coastal basin (15%), but algal cover remained low at ~5%. Substrates were 99% covered by aquatic vegetation, primarily *Ceratophyllum demersum* and *Phalaris arundinacea*. The latter species served as a substrate for the growth of filamentous *Microspora* sp. and *Ulothrix zonata*.

Overall algal growth was limited in the stations sampled in the South Coastal watersheds. Light limitations, resulting from closed canopies, is likely a major contributor to this sparse algal growth. Conversely, the substrates (cobble) offered good attachment sites for diatoms and green algae although the algae did not proliferate at these sites.

Table 2: South Coastal Basin Periphyton Bioassessment: Stations and Algal Identificatons

Station ID	Unique ID	Sampling Site Description	Sampling Date	Class	Genus
SR102	B0598	South River 100 m downstream from Main St., Marshfield	July 26	Chlorophyceae	*Chaetophora elegans* *Microspora* sp. *Ulothrix* sp.
FS102	B0591	French Stream upstream from Summer St, Rockland	July 26	No identifications	
IM101	B0596	Iron Mine Brook ~ 100 m downstream from Broadway, Hanover	July 26	No identifications	
ER015	B0588	Eel River ~ 100 m upstream from Russell Millpond, Plymouth	July 27		sponge spicules
ER07	B0590	Unnamed tributary through Forge Pond, ~ 500 m upstream from Forge Pond, Plymouth	July 27	Cyanophyceae Bacillariophyceae	*Lyngbya* sp. Unidentified diatoms
JR102	B0593	Jones River ~150 m downstream from Elm St.@ USGS Gage, Kingston	July 27	Chlorophyceae Chlorophyceae	*Microspora* sp. *Ulothrix zonata*

References Cited

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.

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. *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.

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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.