# Assessment of Benthic Macroinvertebrate Communities in Coastal New England Streams

Prepared for the Maine Department of Marine Resources

## Introduction

Lotic Inc. was retained by the Maine Department of Marine Resources (DMR) to sort, identify and analyze benthic macroinvertebrate samples from tidally influenced streams along the coast of New England. These samples were collected with rock baskets, using Maine Department of Environmental Protection (DEP) protocols. Sorting and Identification were performed by Lotic.

The Maine DEP will use a computer model and best professional judgment to determine a water classification based on the macroinvertebrate communities. An official classification can only be provided by DEP personnel. For the purposes of this report, Lotic has provided an estimate of the DEP water classification, based on a number of macroinvertebrate metrics. Lotic has been estimating DEP classification results with > 90% accuracy for over 10 years.

## Maine DEP Classification

Maine statute M.R.S.A. 38, Chapter 465 establishes a four category water classification system. Within each water class, an aquatic life standard is described in narrative form. The narrative aquatic life standards for the four water classes are as follows:

| Class | Biological Standard |
|---|---|
| AA | Aquatic life as naturally occurs. |
| A | Aquatic life as naturally occurs. |
| B | Water quality sufficient to support all indigenous aquatic species. Only non-detrimental changes in the resident biological community are allowed. |
| C | Water quality sufficient to support all indigenous fish species. Changes to aquatic life may occur but structure and function of the resident biological community must be maintained. |

The communities referred to in the statutes are the benthic macroinvertebrate communities residing within the designated stream or river reach of unimpeded free-flowing waters.

The intended use of the aquatic life standard in the water classification system is to perform community analysis evaluations of benthic samples collected in a standardized fashion by comparing each community to baseline communities in each water quality class. The results of the comparison demonstrate which community type the collected sample most resembles, and thereby determine a water class. If the collected benthic community does not resemble any of the biological standard communities, the water class determination, by default, is classified "non-attainment."

In preparation for the aquatic life standards, MEDEP biological personnel reviewed eight years of macroinvertebrate data from collections made throughout the state. From these data, MEDEP established

a baseline data set of 145 samples collected by standardized rock basket samplers (introduced substrates) throughout the months of July, August and September during the eight year period.

The MEDEP's data base is comprised of a wide range of water qualities. Many of the collections were made from pristine sites, or sites with little anthropogenic influence. A number of collections in the MEDEP's data base were made from streams or rivers in which the resident biological communities were severely altered from their original state. These sites were used as worst-case scenarios, and were therefore determined to be in "non-attainment" of the aquatic life standards.

MEDEP personnel then rated these sites a priori according to the biological narratives for Class A, B and C, as well as for the category of non-attainment (NA). A minimum of 25 sites were evaluated in each determination category.

**Results**

Table 1 summarizes the metrics used by Lotic and the estimated DEP water classification.

**Table 1. Metric results and estimated Maine DEP Water Quality Classification**

| | Plecoptera Richness | Taxa Ratio (E/T) x P | Indicator Taxa | EPT Richness | Total Richness | Dominant Taxon | Trichoptera Richness | Ephemeroptera Richness | Estimated MEDEP Classification |
|---|---|---|---|---|---|---|---|---|---|
| Westport River | 5 | 2.2 | 2 | 18 | 41 | *Cricotopus bicinctus* 15.5% | 9 | 4 | A/B |
| Dear Meadow Brook | 3 | 1.5 | 0 | 15 | 28 | *Ephemerella* 24.4% | 8 | 4 | B |
| Mast Landing* | 3 | 1.5 | 0 | 12 | 36 | *Orthocladius* 79.0% | 6 | 3 | B |
| East Bay | 0 | 0 | 0 | 7 | 21 | *Stenacron* 17.0% | 3 | 4 | C |
| Jones River* | 2 | 1.2 | 0 | 10 | 39 | *Cricotopus* 25.0% | 5 | 3 | B/C |
| Mill River | 1 | 0.5 | 1 | 7 | 30 | *Nais* 57.9% | 4 | 2 | C |
| Wewentic River | 3 | 6 | 1 | 6 | 22 | *Tvetenia vitracies* 57.0% | 1 | 2 | C |
| Crane River | 0 | 0 | 0 | 4 | 27 | *Gammarus* 35.0% | 4 | 0 | NA |
| Fore River* | 1 | 1 | 0 | 3 | 15 | *Nais* 86.0% | 1 | 1 | NA |
| Long Creek* | 0 | 0 | 0 | 2 | 9 | *Gammarus* 36.0% | 2 | 0 | NA |
| North River* | 0 | 0 | 0 | 2 | 23 | *Cricotopus bicinctus* 42.4% | 2 | 0 | NA |
| Oyster River* | 0 | 0 | 0 | 0 | 8 | *Orthocladius* 54.4% | 0 | 0 | NA |
| Sougas River | 0 | 0 | 0 | 3 | 34 | *Gammarus* 48.0% | 3 | 0 | NA |
| Squamscott River | 0 | 0 | 0 | 4 | 16 | *Gammarus* 43.0% | 4 | 0 | NA |
| Tannery Brook | 0 | 0 | 0 | 3 | 18 | *Rheotanytarsus* 37.0% | 3 | 0 | NA |
| Winnicut River* | 0 | 0 | 0 | 3 | 16 | *Orthocladius* 68.0% | 2 | 1 | NA |

*Samples with marine organisms

**Metric Definitions**

**EPT Richness** The orders Ephemeroptera, Plectoptera and Trichoptera (mayflies, stoneflies and caddisflies, respectively) are generally considered to be indicators of good water quality. The richness (number of taxa) usually increases with an increase in water quality and habitat, although type of habitat is also important.

EPT richness is also noted for each individual group. Plecoptera are particularly sensitive to low levels of dissolved oxygen, and react negatively to increasing amounts of organic material. Ephemeroptera and Trichoptera are somewhat less sensitive to organic pollution, but are good indicators of the variability of habitat. Both orders are found in a variety of habitats (e.g. riffles, pools, sediment, rocky substrate, etc.) and will increase in richness as habitat variability within the stream increases.

**Taxa Ratio** The taxa ratio is a measure of the Ephemeroptera/Trichoptera ratio, and its relationship with the plecoptera richness. The taxa ratio will increase with increasing water and habitat quality.

**Indicator Taxa** The Maine DEP publishes a list of macroinvertebrate taxa that are considered to be indicators of good water quality. This list is based on several years of data, and includes taxa that are only found in Class A or Class B waters, based on DEP's model.

**Total Richness** The total richness usually increases with water and habitat quality. However, some Class B sites will have higher richness, due to a positive response to organic pollution. Severe pollution will usually result in a much lower richness value.

**Dominant Taxon** Two variables are considered with this metric. As water and habitat quality increase, the percentage of the dominant taxon will usually decrease, and is more likely to be an EPT taxon. Samples from very poor water will often have a Dipteran or non-insect as the dominant Taxon.

**Analysis**

There is a direct correlation between EPT richness, total richness, and the estimated water classifications. EPT richness, and Plecoptera richness in particular, are important to DEP's determinations, and the presence of these taxa are important in the estimates of the first 7 sites in Table 1.

The sites that are estimated to be NA are more problematic. The lower numbers of EPT taxa could indicate water quality problems, but could also indicate an influx of salt water at the sample site during high tide. Ephemeroptera and Plecoptera taxa in general are more sensitive to salt than the other taxa found in these samples, especially Diptera.

The dominant taxon metric supports the conclusion that the benthic communities are affected by incoming tides. Four of the 9 sites estimated to be NA are dominated by *Gammarus sp.*, a genus of amphipod that is commonly found in marine, estuarine and freshwater habitats. Four are dominated by Chironomidae, a common Dipteran family that is primarily freshwater, but is also found in estuaries and tide pools. Five of the NA sites also had exclusively marine or estuarine organisms: *Rhithropanopeus sp.*, *Edotea sp.*, *Idotea sp.*, *Corophium sp.*, and *Pontopereia sp.*

When taken in the context of habitat type and location, it is our conclusion that these are normal benthic communities.