Macroinvertebrate Collection Protocol

Quittapahilla Watershed Monitoring Program

October 2020

Background

Benthic macroinvertebrates are small animals living among the sediments and stones on the bottom of streams, rivers, and lakes. They are animals without backbones (invertebrates) and visible to the eye without magnification (macro). Insects comprise an important component of these organisms and include mayflies, stoneflies, caddisflies, beetles, midges, crane flies, dragonflies, and others. Other, non-insect, members of the benthic macroinvertebrate community are snails, clams, aquatic worms, and crayfish. These organisms are extremely important in the food chain for fish and other aquatic animals. Also, they are important players in the processing and cycling of nutrients in aquatic systems (adapted from West Virginia Department of Environmental Protection, 2018).

Benthic macroinvertebrates have been used for many years to assess water quality (see for example, Bartsch, 1948; Tarzwell and Gaufin, 1953). Currently, they are used throughout the world in water-quality assessments. They are used effectively as environmental indicators of biological integrity, to describe water quality conditions or health of aquatic ecosystems, and to identify causes of impairment. Benthic macroinvertebrate communities are known to respond to a wide array of environmental stressors, and in different ways. This response will often make it possible to determine the type of stress that has affected the community. Many macroinvertebrate taxa have relatively long-life cycles and are relatively stationary. The invertebrates living in a stream have been subjected to the water-quality conditions where they reside for their entire life span. Thus, community structure of the macroinvertebrate community is a function of past water quality conditions.

The Quittapahilla Watershed Macroinvertebrate Monitoring Program

Multiple protocols for collecting benthic macroinvertebrate samples have been proposed and are used today. The most commonly used protocols are variations of the U.S. Environmental Protection Agency's "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" (Barbour et al., 1999). Indeed, the Pennsylvania Department of Environmental Protection uses a modified form of the USEPA bioassessment protocol for their standard collection methodology (Chalfant and Shull, 2017). And, that methodology is the template for the methodology adapted to the Quittapahilla Creek Watershed.

Sampling Sites

The monitoring program for the Quittapahilla Creek Watershed includes four sites on streams tributary to the Quittapahilla Creek and two sites on the mainstem of the Quittapahilla Creek (Table 1).

Table 1. -- Monitoring stations planned for the Quittapahilla Creek Watershed.

Station name	Station number	Drainage area (mi^2)
Mainstem stations		
Quittapahilla Creek at Garfield Street	Q1	32.7
Quittapahilla Creek at Palmyra-Bellegrove Road	Q2	73.4
Tributary stations		
Snitz Creek at Dairy Road	S1	12.4
Beck Creek at Bricker Lane	BK1	7.9
Bachman Run at Louser Road	BM1	7.3
Killinger Creek at Killinger Road	K1	10.8

These stations will also be locations for periodic water-quality sampling (approximately 6 times per year), continuous streamflow recordings, annual habitat evaluations, and annual geomorphic evaluations. All these activities will be coordinated under the Quittapahilla Watershed Monitoring Program. The macroinvertebrate sampling will be conducted one time each year for as long as the Quittapahilla Watershed Monitoring Program is viable, hopefully, for a decade or more.

Collection Procedures

First, a reach of stream is identified where the collection will be made. This stream reach should be near a water-quality monitoring station, with no intervening tributaries or other inputs between the sampling reach and the water-quality monitoring station. Each sampling reach should be approximately 100 meters long and should include a representative variety of riffle-run habitats.

Within the sampling reach, six locations are selected to collect sub-samples. These locations should include a mix of microhabitats present including slow-flowing shallow riffles and fast-flowing deeper riffles. At each of the six sub-sampling locations, a D-frame net having a mesh size of 500 microns is used to collect a kick sample of the benthic–dwelling organisms. The net is placed on the bottom of the stream and the bottom of the stream immediately upstream from the net is disturbed by shuffling, kicking, or scraping the bottom. The bottom disturbance

should cover an area of approximately 1 m^2 to a depth of 10 cm as the substrate allows. The disturbance should continue for 60 seconds. As the stream bottom is disturbed, the bottom debris and the bottom-dwelling organisms are swept into the net by the flow of the water. The first sub-sample should be collected from the downstream-most location, working upstream so as to avoid disturbance of the sub-sampling locations.

Following each sub-sample collection, the net is examined and all visible macroinvertebrates are picked from the net and placed into a jar containning70% ethanol. Woody debris and aquatic plants that wash into the net are also checked for macroinvertebrates and those organisms are collected as well. Organisms from all six sub-samples are composited into one jar of ethanol. Additional jars may be used if needed to contain the sample. Each jar is labeled with collection date, time, sampling-site number and the names of the people in the collecting party. The jar with the preserved organisms is then sent to the laboratory for organism identifications.

Replicate samples are suggested for 10 percent of the sampling effort.

Macroinvertebrate Identifications

Identification of the macroinvertebrates will be done in the laboratory, under a dissecting microscope. The macroinvertebrate key, Freshwater Macroinvertebrates of Northeastern North America (Peckarsky et al., 1990), will be used for the identifications. Identifications will be taken to the genus level, if possible.

Data Analysis and Reporting

The macroinvertebrate data will be transferred to a spreadsheet for analysis. Each individual taxon will be classified by feeding group, class, and tolerance level. Several commonly-used metrics will be used to evaluate the data. These metrics and the method for calculating each are listed in Table 2.

Table 2. – Biological indices planned for evaluating macroinvertebrates collected from the Quittapahilla Creek Watershed.

Index name	Equation for calculating the index
Family Biotic Index	Σ (ni x ti) / N
Biotic Index (BI)	Σ (ni x ai) / N
Evenness	H’ / H’ max
Species Abundance	(# of individuals of species A) / (total # of individuals)
Simpson’s Dominance	Σ ni(ni-1) / N(N-1)
Simpson’s Density	1- Simpson’s Dominance
Shannon-Weiner Index	- Σ (pi x ln pi)
Coefficient of Community	(2Sab)/ (Sa + Sb)

Other indices may be used as well, particularly those described by Chalfant and Shull (2017). These various indices will be compared from one year to the next to determine the health of the community and whether the macroinvertebrate community is changing and if so, at which sampling locations. Annually, a report of findings will be prepared. This report will be posted on the Quittapahilla Watershed Association web page under the Monitoring tab.

Personnel

Dr. Rebecca Urban and her students at Lebanon Valley College (LVC) will be in charge of the macroinvertebrate monitoring. The students involved may be members of the ???ecology??? class at LVC or may be students conducting special projects or senior projects.

References

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