



River Watch Program

The Lackawanna River Corridor Association (LRCA) initiated the program in 1989 to identify and address water quality problems. Patterned after the Vermont River Watch Network, the Lackawanna River Watch program was designed to involve residents of the watershed in monitoring the biological, physical and chemical conditions of the Lackawanna River and its tributaries. With this program, the LRCA hopes to promote awareness and involvement of the public in river stewardship, and thereby a greater sense of community ownership of this valuable resource.

In 1989, area high school and university students began monitoring basic water quality parameters and aquatic life at eight sites. By 1991, local citizens began visiting additional sites and expanding activities of the River Watch program to include monitoring leaking sewer lines, erosion, sedimentation, and riverside dumping. During 1992-93, an additional project, carried out cooperatively with Pennsylvania Gas & Water Company, involved collecting water samples near sewer treatment plant outfalls for bacteriological testing.

A major aspect of the River Watch monitoring program has been to collect benthic macroinvertebrates from the River. Benthic macroinvertebrates include the insects, crayfish, worms, clams, snails, and other invertebrates that spend at least part of their lives on the stream bottom, and are large enough to see with the naked eye. The types and numbers of macroinvertebrates found in a particular portion of a river are a consequence of the water quality conditions that occur there. Some kinds of macroinvertebrates can only survive in water that is virtually free of pollution, and will disappear if water becomes contaminated, for example by chemicals, or increased sediment loads or nutrients, or lower dissolved oxygen levels. Others are more tolerant of pollution and occur more typically in water that is somewhat contaminated. Yet others may be very tolerant of polluted conditions and dominate waters that are highly contaminated. These differences in pollution-tolerance make benthic macroinvertebrates excellent indicators of the water quality conditions where they live. Collecting these organisms repeatedly in an area over a long period of time can, therefore, provide an idea of whether and how conditions may be changing, and whether new water quality problems are arising.

There are a variety of pollution sources to the Lackawanna River that impact the macroinvertebrate community. Four major sources are inputs from combined sewer-storm water overflows (CSO), sewage treatment plant (STP) outfalls, mine drainage, and erosion and sedimentation (E&S) from construction sites, roadways and abandoned coalmine lands. In many municipalities along the river and its major tributaries, runoff

from rain events or snow melt drains directly into sewer lines, the main trunks of which run alongside the streams. When the sewage-storm water mixture exceeds the capacity of the sewer line, CSO regulators are designed to open and allow the mixture to flow directly into the river or tributary. There are approximately 140 of these overflow outlets along the River. Water discharged into the river from CSOs contains not only sewage but many other materials picked up by storm water in its rush downhill. These include trash, sediment and de-icing material from roads, dumped or spilled chemicals from homes and businesses, oil leaked from cars, and other materials.

The six major STPs along the Lackawanna River are additional pollution sources. The effluent from an STP may contain high concentrations of nutrients such as nitrates and phosphates which promote the growth of algae, and a high capacity to consume dissolved oxygen (known as biochemical oxygen demand or BOD) which reduces its availability to aquatic plants and animals. STP effluent can contain other pollutants as well, including metals from the treatment process itself.

Metals and other chemical pollutants are discharged into the river from the surface openings of flooded mine tunnels, which tend to be located right along the riverbanks. Some of the largest mine discharges, particularly in the lower reaches of the Lackawanna River, dump millions of gallons into the river daily. Water from mine discharges generally has high concentrations of iron and sulfur compounds, very low concentrations of dissolved oxygen, and low (acidic) pH.

In addition to CSOs, STPs and mine drainage openings as point sources of pollution, there are many non-point pollution sources, including sediment and leached materials from abandoned mine lands, culm piles and construction sites, and trash dumped in or along the river. Pollutants from all of these sources alter water quality from its natural state, and affect the types of macroinvertebrates that can live under these altered conditions.

METHODS

Study sites on the Lackawanna River range from a site in Forest City (just downstream of the Stillwater Dam) 36.7 miles upstream of the confluence with the Susquehanna River (River Mile 36.7 = RM 36.7) to the furthest downstream site in Old Forge (RM 3.5). Sites are often located near tributary streams, AMD and STP outfalls, or major CSOs. Not every site is sampled each year; volunteer turnover and changes in program results in some sites dropping out or new ones being added.

SAMPLING

Typically, a site is sampled three to four times a year between May and October. Macroinvertebrates are collected with rectangular frame nets (opening of 46 cm wide by 22 cm high, 0.5 mm mesh) in a riffle area at each site. The bottom edge of the net is placed against the bottom of the stream and all rocks in an area as wide as the net and approximately 0.5 meters upstream are rubbed under water. The dislodged macroinvertebrates and organic material are carried by the River's current into the net. The sampled area is also kicked, to insure that all macroinvertebrates have been

collected from that area before the net is removed from the water. The same procedure is then repeated in one or two other areas of the riffle. Contents of the net are put in a half-gallon plastic container for transport back to the laboratory. Some samples are transported back to the lab alive; others have 75-80% ethanol added to them to preserve the organisms until they can be sorted.

LABORATORY ANALYSIS

At the University of Scranton laboratory, each sample is washed in a 0.5 mm sieve and placed into a shallow sorting tray. From 1991 to 1995, all of the macroinvertebrates were picked from each sample, which often involved hundreds of organisms. Since 1996, we have used the Environmental Protection Agency's Rapid Bioassessment Protocol and randomly pick out the first 100 macroinvertebrates from each sample. All macroinvertebrate samples are stored in 75% ethanol and retained for reference.

During sorting, the macroinvertebrates in each sample are separated by taxonomic order. Initial identifications are made to the level of order or, in some cases, family using general macroinvertebrate guides. Organisms of a particular order or family that are distinctly different are further separated and recorded as separate taxa. For example, when all mayflies (Order *Ephemeroptera*) have been separated from a sample and there are four distinctly different types of mayflies, we record separate counts for each of the four taxa under the *Ephemeroptera*. All identifications and counts are later checked for accuracy by aquatic biologists.

DATA ANALYSIS

We present an analysis of the macroinvertebrate collections in terms of two mutually exclusive groups: "EPT taxa" and "non-EPT taxa." Taken together, these two groups represent all of the macroinvertebrate organisms collected at a site. The acronym EPT is derived from the first letters of three invertebrate orders, the *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies) and *Trichoptera* (caddisflies). These three orders comprise organisms that are especially good indicators of water quality, and hence their presence and numbers provide a sensitive assay of stream conditions. Mayflies and stoneflies are especially intolerant of pollution, and tend to be the most sensitive taxa to polluted water. While many caddisflies are intolerant, one family – the *Hydropsychidae* – is more tolerant of polluted conditions. Hence, the diversity (number of different taxa) and abundance of EPT macroinvertebrates are widely used as indicators of water quality in streams and rivers. Non-EPT macroinvertebrates include such organisms as aquatic earthworms, snails, clams, leeches, crayfish, and the larvae or adults of insects in the Orders *Megaloptera* (hellgramites and dobsonflies), *Coleoptera* (beetles) and *Diptera* (craneflies, blackflies and midges).

We calculate the mean number of taxa in each order, the mean number of total taxa, and the mean number of EPT taxa for each sampling period we consider. We also compute the relative frequency of each order at each site as the percentage of samples taken at the site in which at least one organism in the order occurs. Finally, for each site, we compute the percentage of all individual organisms comprised by EPT organisms, for each sampling period.