

## MACROINVERTEBRATE RESULTS

Macroinvertebrate communities are an excellent indicator of water quality conditions because they have limited mobility, relatively long residence times, and show varying degrees of sensitivity to pollutants. AMD can cause a reduction in diversity, abundance, and changes in community structure, both taxonomically and functionally (Simpson et al., 1985). Mayflies (Ephemeroptera)

are one of the most sensitive groups of aquatic insects to low pH and AMD pollution. Mayflies that normally live in neutral waters experience a greater loss of sodium in their blood when exposed to low pH than do the acid-tolerant stoneflies *Leuctra* and *Amphinemura*, whose sodium uptake is only slightly reduced by low pH (Earle and Callaghan, 1998; Kimmel, 1999). Low pH also tends to eliminate scraper and grazer taxa that feed on algae, leaving AMD macroinvertebrate communities dominated

by collectors, shredders, and predators. Therefore, the fauna of AMD-impaired streams are typically characterized by few or no mayfly genera, few scrapers, low taxa richness, and a dominance of *Leuctra* and *Amphinemura*. A community loss index was calculated for each site to estimate the loss of taxa at sites with AMD impairment (Figures 4 and 5). The higher the community loss index, the more taxa were absent compared to the reference site.

Figure 4. Community Loss Index Results for Drury Run Watershed (The higher the value, the more taxa were absent from the site compared to the reference site.)

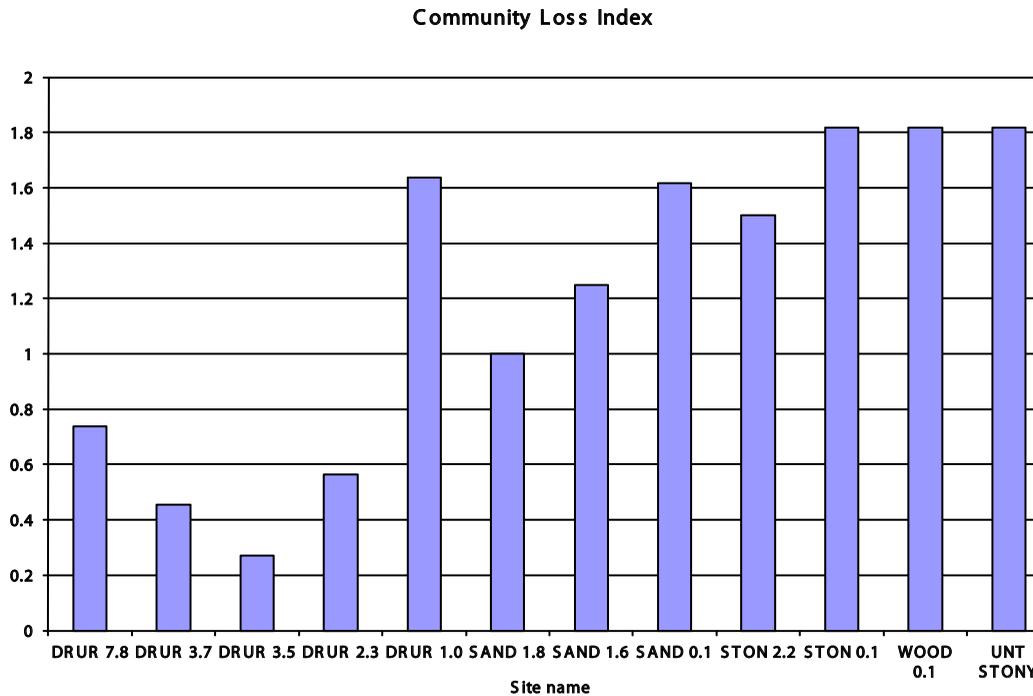
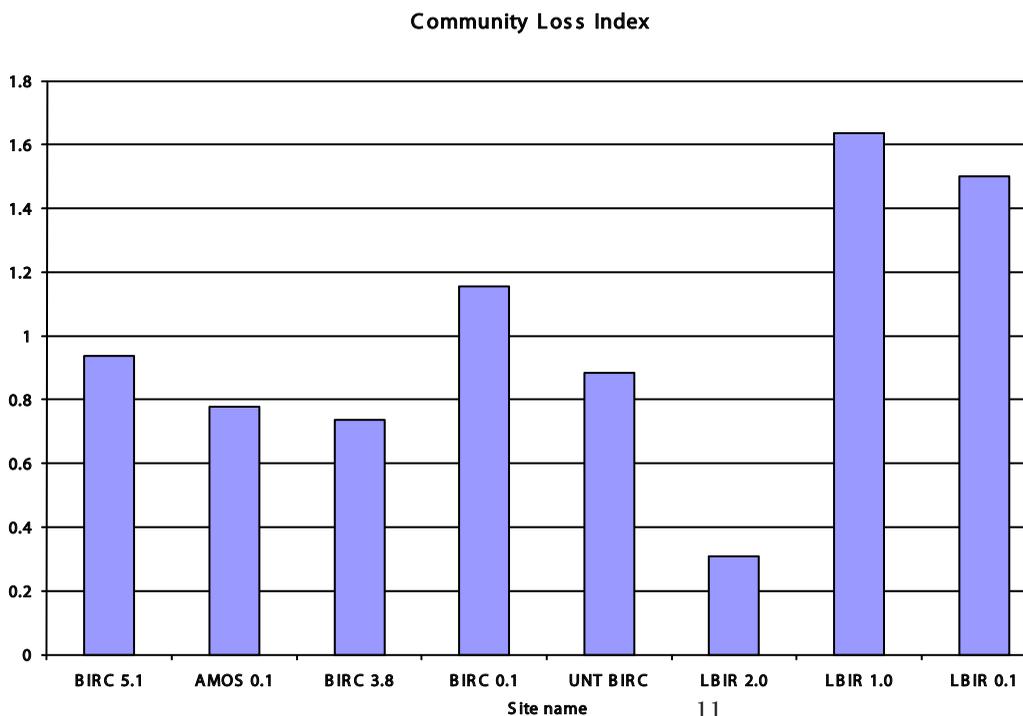


Figure 5. Community Loss Index Results for Birch Island Run Watershed (The higher the value, the more taxa were absent from the site compared to the reference site.)



*Insects of the order Ephemeroptera are commonly known as Upwinged Flies or Mayflies. Mayflies are one of the most sensitive orders to AMD conditions.*

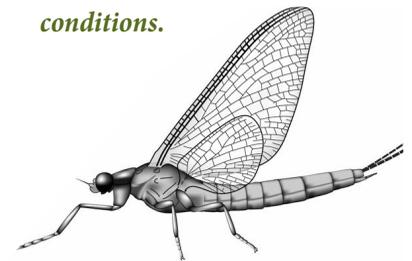


Image Credit: R.W. Holzenthal

## DRURY RUN

In Drury Run, there were a wide variety of biological conditions. Because Drury Run originates in the Tamarack Swamp, the most upstream sampling location contained some obvious remnants of that environment such as tannins in the water, high iron concentrations, and sandy substrate despite the presence of a defined channel. The macroinvertebrate community at this location (DRUR 7.8) was slightly impaired, but the driving factor was likely habitat conditions as there was no evidence of acidic conditions or other AMD impairment. The next two downstream sites on Drury Run had nonimpaired biological communities, with one of the sites (DRUR 6.5) scoring as 85 percent of the best sites of similar drainage area in the entire West Branch Susquehanna Subbasin (Buda, 2010). Both of these sites had more than 40 percent mayfly taxa, high EPT, high species diversity, high evenness, and high taxa richness. Both of these sites were located above the AMD-impacted tributaries.

Downstream of Sandy Run, the first AMD-impacted tributary to enter Drury Run, the macroinvertebrate community continues to rank in the nonimpaired category but there are marked changes, specifically the sharp decline in percentage of mayfly taxa. Below Sandy Run, the biological community was less diverse, had a lower evenness that was dominated by acid tolerant stoneflies *Leuctra* and *Amphinemura* and was comprised of only 10 percent mayflies.

***“...the greatest community loss occurred in the AMD-impacted tributaries and at the mouth of Drury Run (DRUR 1.0), downstream of all the AMD influence.”***

Farther down on Drury Run (DRUR 2.3), downstream of two other AMD inputs, Woodley Draft and Whiskey Run, macroinvertebrate communities were still ranked as nonimpaired. However, the evidence of AMD impacts are more obvious as mayfly taxa made up only 2 percent of the community, which was once again dominated by *Leuctra* and *Amphinemura*. Finally, at the mouth of Drury Run, downstream of all polluted tributaries, the cumulative effect of the impaired water quality was very evident. At this location, only 11 taxa were collected and there were fewer than 200 individuals in the whole sample. Species diversity was very low and mayflies made up less than 1 percent of the sample.

As expected, the sampled tributaries of Drury Run, which are all known to have some level of AMD impairment, had poor macroinvertebrate communities in general. The upstream sampling site on Sandy Run, above the AMD discharge, had the best macroinvertebrate community of all the tributary sites, and it was the only tributary site to have any mayfly taxa at all. The remaining six tributary sites all were devoid of mayfly populations, were dominated by *Leuctra* and *Amphinemura*, and had taxa

richness ranging from 11-16. This was not unexpected based on the quality of the water. Stony Run is the most heavily impacted tributary, and its macroinvertebrate communities reflected that as tributaries had pH ranging from 4-5. Figure 4 shows the community loss index value for each stream sampling location compared to DRUR 6.5, which had the best macroinvertebrate community scores in the watershed. It is easy to see that the greatest community loss occurred in the AMD-impacted tributaries and at the mouth of Drury Run (DRUR 1.0), downstream of all the AMD influence.

## BIRCH ISLAND RUN

The upper reaches of Birch Island Run are naturally acidic, with pH values in the 5.5 - 6.0 range. No other water quality parameter indicates any AMD impacts, but the macroinvertebrate community shows some similar characteristics because of the acidic nature of the water. BIRC 5.1, AMOS 0.1, and BIRC 3.8 all ranked as slightly impaired with a community composition that included very few mayfly taxa, a low similarity to reference conditions, and low species diversity. At BIRC 1.0, which is directly above the confluence with Little Birch Island Run, macroinvertebrate conditions were also ranked as slightly impaired; however, at this site, 20 percent of the sample were mayflies. There was a high level of evenness and increased taxa richness. Overall, this site compared favorably (75 percent) to the best sites of similar drainage size in the entire West Branch Susquehanna River Watershed (Buda, 2010). However, the conditions one mile downstream at the mouth of Birch Island Run were far different after the addition of AMD-impacted waters from Little Birch Island Run. BIRC 0.1 was rated as moderately impaired with lower taxonomic richness than the headwaters: no mayfly genera, low diversity, and 80 percent of the sample was comprised of acid-tolerant stoneflies.

Little Birch Island Run itself has a similar pattern of a nonimpaired macroinvertebrate community quickly shifting to an impaired community as polluted waters make their way into the stream. LBIR 2.0 was nonimpaired and, despite its low number of mayflies, this site had the highest taxa richness of the whole watershed, high EPT, and high species diversity. One mile downstream and below one AMD outflow, only half the number of taxa were found, the community was again dominated by acid tolerant stoneflies, and no mayflies at all were collected. At the mouth of Little Birch Island, one more mile downstream and incorporating further AMD issues, the macroinvertebrate community had the lowest taxa richness in the whole watershed, no mayfly taxa, the lowest EPT score, and was dominated by two taxa. Both LBIR 1.0 and LBIR 0.1 scored as moderately impaired. Figure 5 shows the Community Loss Index values for Birch Island Run. The higher the value, the more taxa were absent when compared to BIRC 1.0, which was used as the reference site for the Birch Island Run Watershed.

## FISH

Fish sampling was conducted in both Drury Run and Birch Island Run in June 2010. Sampling results reflected water quality and were indicative of natural conditions as well as AMD-impacted ones. Cooper and Wagner (1973) studied the distribution of fish in Pennsylvania streams affected by AMD and found that fish species were severely impacted at pH 4.5 - 5.5. They found that a pH of 4.5 and total acidity of 15 mg/L accounted for a complete loss of fish in 90 percent of streams studied. While some fish species, such as brook trout, *Salvelinus fontinalis*, are very tolerant of low pH, the addition of metals decreases that tolerance (Earle and Callaghan, 1998).

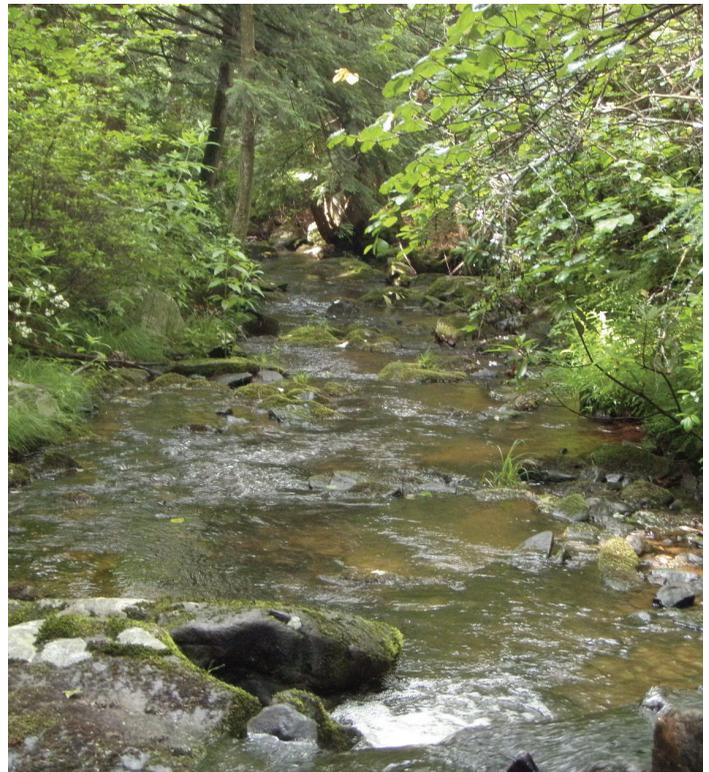
### DRURY RUN

In the upper nonimpaired reaches of Drury Run, fish communities were most diverse and can be considered typical for small headwater streams in this region. At the most upstream site, three species were collected: creek chub (*Semolilus atromaculatus*), eastern blacknose dace (*Rhinichthys atratulus*), and brook trout. Directly upstream and downstream of Sandy Run, four species were collected: sculpin (*Cottus spp.*), brook trout, brown trout (*Salmo trutta*), and eastern blacknose dace. However, fewer numbers of these species were collected below the input of Sandy Run. Downstream of Woodley Draft and Whiskey Run, only brook trout were collected, and downstream of Stony Run, no fish were present due to the severely degraded water quality conditions.

On Sandy Run above the AMD discharge, the water quality was suitable to support brook trout despite a low pH and low buffering capacity. However, in the reach below the discharge, no fish were collected. The poor water quality coming from the discharge isolates the brook trout population above it. At the mouth of Sandy Run, four brook trout were captured, but they likely came up from Drury Run and only use Sandy Run when conditions are favorable. Stony Run supports no fish at all.



**While some fish species, such as brook trout (pictured above), are very tolerant of low pH, the addition of metals decreases that tolerance (Earle and Callaghan, 1998).**



**The natural buffering capacity of Drury Run (above) and Birch Island Run is quite low, which amplifies the impact of the AMD on the health of both streams.**

Brook trout was the dominant species in the Drury Run Watershed, and they ranged in size from 2 inches to 7 inches in length. Of the five brown trout that were collected, two were more than 9 inches long.

### BIRCH ISLAND RUN

The fish community in the Birch Island Run Watershed was made up by almost entirely brook trout, except for the eight sculpins collected on the lower mainstem of Birch Island Run. One smallmouth bass was caught at the mouth of Birch Island Run but was likely a non-resident that used Birch Island Run marginally as a source of food. The upper sites on Birch Island Run had naturally low pH, which excluded the viability of most fish species other than brook trout. However, at BIRC 1.0, directly above the confluence with Little Birch Island, the pH was high enough and the alkalinity had improved enough to also support a population of sculpins. Little Birch Island only supports brook trout and the numbers were fairly high despite the poor water quality, as brook trout can tolerate low pH, low alkalinity, and high metal concentrations. More than 120 brook trout were collected at the eight stream locations sampled in the Birch Island Run Watershed and ranged from two to eleven inches in length.

Improving water quality conditions in Birch Island Run and Drury Run would certainly improve the brook trout fishery and would allow more connectivity with the West Branch Susquehanna River.