DISCUSSION

Water Quality

A comparison of water quality data from the present large river assessment project (September 2002) to water quality samples collected for the most recent (July 2001) interstate streams report (LeFevre and Sitlinger, 2003) indicates that water quality conditions for the Susquehanna River between Windsor, N.Y., and Sayre, Pa., are stable and generally within limits, although temperatures were greater than 25 degrees Celsius in the July samples. One parameter of interest is total organic carbon (TOC). TOC concentrations doubled between SUSQ 5 and SUSQ 6, which is located downstream of the wastewater treatment plant in Binghamton. Overall, from the data analysis, it appears that the Susquehanna River, in the stretch encompassed by this study, contains fairly good water quality, with a few nutrient parameters that are slightly elevated.

Macroinvertebrate Communities

A storm that quadrupled base flows just prior to the start of this study precluded sample collection completely at two sites and greatly reduced the number of samples collected at all other sites, except SUSQ 1 and SUSQ 2. Out of a total of 180 potential samples (3 HD samples, 5 RBP samples, 5 RS samples, and 5 VBS samples at each of the 10 sampling sites), only 84 samples were collected (see Appendix B). Thus, a detailed statistical analysis was not possible. However, several inferences can be drawn from the existing data.

- A 200-organism subsample was used for assessments in this study. However, in six of the 20 HD samples and 8 of the 17 VBS samples, less than 200 organisms total were collected. In comparison, only 3 (one due to subsampling error) out of 31 total RS samples and 2 (one due to subsampling error) out of 15 RBP samples contained less than 200 organisms. It appears that HD and VBS samplers are less effective in collecting larger numbers of benthic macroinvertebrates.
- The rock substrate basket samplers consistently scored higher for taxa richness, EPT Index, and Shannon-Wiener Diversity Index than all other samplers.
- In comparing the three types of data analysis (Table 10), the IBI assessment type tended to assess more sites as nonimpaired than did the other two types of analyses (reference site and reference condition). This may be due to using only three assessment designations (nonimpaired, partially impaired, and severely impaired) rather than four (nonimpaired, slightly impaired, moderately impaired, and severely impaired), as in the reference site and reference condition analyses. These later assessment types were very similar in their assessment categorizations (see Table 10).
- At several sites, the biological assessment of the river varied depending upon location of the sampler. For example, at the same station, the left side of the river had a nonimpaired designation while the right side had a slightly impaired designation. This result was expected as the microhabitats do vary across the width of the river. However, at only one site (SUSQ 6), for one sampler type (RS), did an assessment vary from nonimpaired to severely impaired. This site appears to be an anomaly as it is almost completely (>90 percent) dominated by Chironomidae. The sampler also was located downstream of the wastewater treatment plant discharge from Binghamton.
- The biological communities found during the current pilot study were similar to those assessed during the most recent interstate streams survey (LeFevre and Sitlinger, 2003). In both surveys, staff used the Susquehanna River at Windsor, N.Y., as a reference site as it contained the best available biological and physical habitat conditions. The Susquehanna River at Sayre, Pa., was assessed as nonimpaired in the interstate streams survey while it appeared to be slightly to

moderately impaired in the current survey. However, this may be due to high flows, which precluded a complete sampling effort at the site.

Physical Habitat

All stations in this study had either excellent (comparable to reference) or supporting habitat, even though conditions throughout the river were dissimilar. Some parameters used in the habitat form are not applicable to the large river setting. For example, vegetative protective cover, channel flow status, and riparian vegetative zone width may have little bearing on samplers located in the middle of a river that, in some areas, is a mile wide. The habitat directly adjacent to the samplers and the type of substrate on which the sampler is located may have more impact on the benthic macroinvertebrate community composition and will be addressed in future studies.

Comparison of Sampler Types

One of the main goals of this project was to assess different types of samplers for their ability to collect macroinvertebrates from the large rivers of the Susquehanna basin. Four different samplers were used in this study: vacuum benthic samplers; rock baskets; multi-plate samplers; and kick screens. Each of the sampler types has advantages and disadvantages. These are detailed below.

Vacuum benthic sampler

One of the advantages associated with a vacuum benthic sampler is that it collects organisms from a discrete area and can be quantified. Additionally, it gives a point-in-time collection that does not require a colonization period and can be used on a variety of substrates. However, it does have several limitations, as indicated below.

- The wires that connect to the pump must be above the water. Thus, it has depth limitations of approximately three feet.
- The sampler must be used in conjunction with a SCUBA diver and a boat.
- Staff had a difficult time controlling the sampler when velocities increased. The high stovepipe design made the sampler difficult to control.
- The sampler did not collect larger numbers of macroinvertebrates reliably.
- The sampler costs approximately $300 to produce and is difficult to maintain.

Rock baskets

An advantage associated with rock substrate basket samplers is the ability to use them in any water depth and any flow regime. Additionally, since this type of sampler uses natural river rocks and pebbles, artificial substrate is not an issue for colonization of organisms. Rock baskets also are very economical to produce, costing about $2 per basket, and can be used from year to year. However, there are some disadvantages with this type of sampler as well.

- Theft and/or displacement sometimes occur when using rock baskets.
- Rock baskets require a six-week colonization period, thus creating an extra trip to the sampling sites.
- In deeper water, a SCUBA diver is recommended to collect the rock baskets without greatly disturbing the contents of the sampler.

Multiplate samplers

Like the rock baskets, a major advantage of using multiplate samplers is the ability to use them in any water depth and flow regime. Additionally, since the total sample area encompassed in the sampler can be calculated, the sample can be quantified. Multiplate samplers are very economical to produce as well, costing approximately $2 per sampler. Disadvantages are the same as those of rock baskets, above. Additional disadvantages are:

- Multiplate samplers use artificial substrates, in this case hardboard, which may not reflect the substrate preferences of macroinvertebrates.

- Multiplate samplers are inconsistent in collecting larger numbers of organisms to allow a 200-organism subsample.

RBP kick screens

An advantage of using kick screens is ease of use. SRBC staff has been using traditional RBP methods since 1992 in the subbasin survey and interstate streams projects, and are, thus, very familiar with the process and have a database on which to build. Additionally, kick nets are economical, costing approximately $100 and can be used for several years before replacing. Another advantage is that a kick net sample does not require colonization time and provides a point-in-time sample. Several disadvantages are discussed below.

- There are depth limitations with the kick nets. The top of the net is approximately three feet high and cannot be used in depths exceeding the top of the net. Thus, most samples must be taken near the shore, in riffle areas, or adjacent to islands.
- Velocity can be an issue with kick nets as they are difficult to control during higher flows.

FUTURE DIRECTIONS

Based on lessons learned from the pilot project, SRBC staff has determined that for future river assessment projects, a combination of rock baskets and RBP methods will be used. Rock baskets will be used as they are effective in sampling deeper waters and produce consistent results. RBP methods also will be used as a comparison to the subbasin survey and interstate stream projects. The vacuum benthic sampler method will not be used in the free-flowing river, as it is difficult to control and inconsistent in collecting larger numbers of macroinvertebrates needed for bioassessment. Multiplate samplers will not be used as they also collect large numbers of macroinvertebrates inconsistently.

In summer 2004, SRBC staff will be sampling a larger portion of the mainstem Susquehanna River and its large tributaries: West Branch Susquehanna; Chemung; and Juniata Rivers. Twenty sites on the mainstem Susquehanna River from Sidney, N.Y., to Marietta, Pa., and one site at the mouth of each of the larger tributaries will be sampled using the methods described above. Staff also will be considering different ways to assess habitat in conjunction with the sampling effort. Additionally, SRBC is interested in determining a sampling protocol for the reservoir system, which encompasses the final 45 miles of the river.