

Table 10. Summary of F test Results for Each Metric

Metric	F value	P (one-tail)	F critical value
Number of Individuals	1.811	8.370E-04	1.364
Taxa Richness	1.551	0.0100	1.364
Hilsenhoff Biotic Index	2.801	3.235E-08	1.364
Percent Ephemeroptera	2.951	7.104E-09	1.364
Percent Dominant Taxa	1.246	0.122	1.364
EPT Taxa	1.253	0.116	1.364
Percent Chironomidae	0.615	0.006	0.7294
Shannon-Wiener Diversity Index	1.175	0.195	1.364

Table 11. Summary of Two-tailed t test Results for Each Metric

Metric	t stat	P (two-tail)	t critical value
Number of Individuals	-2.729	0.007	1.971
Taxa Richness	-4.978	1.277E-06	1.971
Hilsenhoff Biotic Index	-5.309	2.634E-07	1.971
Percent Ephemeroptera	9.168	3.137E-17	1.971
Percent Dominant Taxa	2.581	0.0105	1.972
EPT Taxa	-1.467	0.144	1.972
Percent Chironomidae	0.972	0.332	1.971
Shannon-Wiener Diversity Index	-4.633	6.355E-06	1.971

DISCUSSION

Water Quality

A comparison of water quality from the present large river assessment project (August – October 2005) to water quality samples collected for the most recent interstate streams (Steffy and Sitlinger, 2006), Upper Susquehanna Subbasin Survey (Stoe, 1999), Middle Susquehanna Subbasin Survey (LeFevre, 2002), West Branch Subbasin Survey (LeFevre, 2003), Juniata River Subbasin Survey (LeFevre, 2005), and Lower Susquehanna Subbasin Survey (LeFevre, 2006) indicates that water quality conditions on the Susquehanna River between Sidney, N.Y., and Marietta, Pa., and at the mouths of its major tributaries, are stable and generally below limits, although temperatures were greater than 25 degrees Celsius in most of the August samples and aluminum exceeded levels of concern in all samples. From the data analysis, it appears that the Susquehanna River, in the stretch encompassed by this study, contains fairly good water quality, with some slightly elevated parameters.

Macroinvertebrate Communities

Upper Susquehanna River and the Chemung River

The section of the Susquehanna River from the headwaters at Cooperstown, N.Y., to the confluence with the Chemung River at Sayre, Pa., is in the Upper Susquehanna Subbasin. This survey included seven stations on the mainstem Susquehanna River from Sidney, N.Y., to Sayre, Pa. The river in this part of the Susquehanna basin flows through mostly agricultural and forested land with some small communities and one larger population center, Binghamton, N.Y. Overall, the sites at Sidney (SUSQ 394) and Windsor (SUSQ 365), N.Y., exhibited high taxa richness, EPT Index, and diversity. At Sidney,

two of the kick net samples and one of the rock basket samples indicated nonimpaired conditions at the site, while at Windsor, one of the kick net samples and two of the rock basket samples were nonimpaired. The station at Great Bend (SUSQ 356), Pa., where the Susquehanna River enters Pennsylvania briefly before flowing back into New York State, also had good biological conditions, with two rock basket samples designated nonimpaired. This site also had the highest number of taxa (28) of any river station. One kick net sample at Kirkwood (SUSQ 344), N.Y., was nonimpaired.

However, downstream of Binghamton, N.Y., conditions degraded slightly. At Apalachin (SUSQ 327), N.Y., six of the samples were rated as moderately impaired, with one sample designated severely impaired. This was the only severely impaired sample in the entire survey. Three of the rock basket samplers could not be found, possibly due to human interference, as the station was located just upstream of a fishing and boating access point. At Barton (SUSQ 312), N.Y., six stations were designated slightly impaired, with the remaining four moderately impaired. Overall, the number of EPT taxa was depressed at these two stations. The river seemed to improve as it reached Waverly (SUSQ 300), N.Y., as it contained seven slightly impaired samples and two moderately impaired samples. One sampler could not be found.

The Chemung River empties into the Susquehanna at Athens, Pa. At this point, the Chemung is nearly a third of the size of the Susquehanna. Staff sampled the Chemung River at Athens (CHEM 3), Pa., and found relatively good biological conditions. One sample was designated nonimpaired, with six slightly impaired, and three moderately impaired. One of the rock basket samplers appeared to have been disturbed.

Middle Susquehanna River and the West Branch Susquehanna River

The section of the Susquehanna River from the confluence with the Chemung River at Sayre, Pa., to the confluence with the West Branch Susquehanna River at Sunbury, Pa., is termed the Middle Susquehanna River. During this survey, 10 stations were sampled on the mainstem Susquehanna in this section of the river, in addition to a site on the West Branch Susquehanna at Lewisburg, Pa. This stretch of the river is very diverse with sections located in agricultural land, some sections flowing through forested hills, and some portions draining urban settings, particularly the Wilkes-Barre/Scranton, Pa. area. A large portion of this section of the watershed was heavily mined in the past.

Six samples at Towanda (SUSQ 271), Pa., were designated slightly impaired, with one of the rock basket samples designated moderately impaired. Staff could not find two of the rock baskets at SUSQ 271, one was not collected as it was entirely out-of-water, and another was approximately 50 percent out of water. At Wyalusing (SUSQ 256), Pa., three samples were designated slightly impaired, while four of them were rated moderately impaired. Staff could not find two of the samplers, while one was entirely out of water, and another had been disturbed as it was discovered at a significant distance from where it had been placed. At Meshoppen (SUSQ 234), Pa., three samples were designated slightly impaired, while six samples were rated moderately impaired. One of the rock baskets could not be found. The station at Tunkhannock (SUSQ 219), Pa., had eight slightly impaired samples and one moderately impaired sample. One of the rock baskets could not be found and another appeared to have been disturbed as it contained only 100 macroinvertebrates. At West Falls (SUSQ 207), Pa., eight samples were rated slightly impaired, while one rock basket sample was designated moderately impaired. One rock basket had been disturbed as it was found on the bank of the river. Six samples were rated slightly impaired at Wilkes-Barre (SUSQ 192), Pa., while one sample was designated moderately impaired. Three of the rock baskets were entirely out of water at the time of collection and were not included in the survey. At Shickshinny (SUSQ 174), Pa., one sample was designated slightly impaired, while the remaining nine samples were rated moderately impaired. Most of the rock basket samples at this station were impacted by low water levels; four of them contained fewer than 200 individual organisms for

analysis. The station at Berwick (SUSQ 157), Pa., contained four slightly impaired samples and six moderately impaired samples. At Bloomsburg (SUSQ 149), Pa., six of the samples were designated slightly impaired, with four moderately impaired samples. Two of the rock basket samplers had been disturbed, with one having fewer than 200 organisms in the sample. The station on the Susquehanna River near Danville (SUSQ 138), Pa., had one nonimpaired sample, four slightly impaired samples, and five moderately impaired samples. Two of the rock basket samplers had been cut loose from their anchors prior to collection.

Staff collected a sample near the mouth of the West Branch Susquehanna River at Lewisburg (WBSR 8), Pa. Three of the samples were designated nonimpaired, with very high taxa richness and a large number of EPT taxa. Five of the samples were rated slightly impaired, and one sample was designated moderately impaired.

Lower Susquehanna River and the Juniata River

The portion of the watershed from the confluence of the mainstem with the West Branch Susquehanna River at Sunbury, Pa., to the outlet of the Susquehanna River at Havre de Grace, Md., is termed the Lower Susquehanna River Subbasin. Staff sampled five stations on the mainstem Susquehanna River and one station on the Juniata River during this survey. This subbasin has extensive agricultural land uses and is the most populated with several large population centers, including Harrisburg, York, and Lancaster, Pa. The final 45 miles of river are ensconced in a series of reservoirs formed by hydroelectric dams and could not be sampled using the current protocols.

Staff sampled the biological conditions of the river downstream of Sunbury (SUSQ 122), Pa. One of the samples was designated slightly impaired, while five of the samples were rated moderately impaired. Four of the rock baskets could not be found, and the remaining one contained fewer than 200 organisms. At McKees Half Falls (SUSQ 106), Pa., seven of the samples were designated slightly impaired, with two samples rated moderately impaired. One rock basket could not be found. The river seemed to improve slightly at Halifax (SUSQ 94), Pa., with one sample rated nonimpaired, eight samples designated slightly impaired, and one sample rated moderately impaired. At Fort Hunter (SUSQ 77), Pa., seven samples were rated slightly impaired and three samples were rated moderately impaired. One of the rock basket samplers had been disturbed and was mostly out of water. Two of the rock baskets had fewer than 200 organisms. At Marietta (SUSQ 45), Pa., eight of the samples were rated slightly impaired, while one of the samples was designated moderately impaired. One of the samplers had been disturbed and was out of water.

A station was located near the mouth of the Juniata River near Duncannon (JUNR 2), Pa. Three of the samples were designated nonimpaired, with a large number of EPT taxa. Five of the samples were rated slightly impaired, and one sample was designated moderately impaired. One of the rock basket samplers could not be found.

Differences Between Sampler Types

In an ongoing effort to improve and expand SRBC's river assessment project, staff performed *t* tests to determine if the mean of each metric was significantly different ($p=0.05$) between the rock basket samplers and the traditional RBP methods. It was determined that the number of EPT taxa ($p=0.144$) and percent Chironomidae ($p=0.332$) metrics were significantly different between the two sampler types. The kick net samplers collected more EPT taxa while collecting a lesser percentage of Chironomidae.

Overall, both sampling methods worked well during the current survey. One hundred two rock basket samplers were retrieved out of a possible total of 125 (82 percent recovery), while staff was able to collect all 125 kick net samples. Water levels remained relatively low throughout this survey and, in some cases, negatively affected the rock basket samplers as areas which had been inundated during sampler placement were dry or nearly so during collection. Additionally, in some cases, the rock basket samplers had been displaced or entirely moved from their original location, presumably by human intervention. Conversely, at some stations, kick net samples were difficult to obtain due to the velocity and/or depth of the river.

Future Directions

SRBC will continue to sample the large rivers of the Susquehanna River Basin as flow conditions permit. During 2003, 2004, and 2006, river flows were too high to safely and effectively sample the river. Staff will continue to evaluate the current sampling protocol, including comparing data collected during the current survey to past biological surveys of the Susquehanna River and evaluating USEPA's large river protocols. Additionally, staff will be considering different ways to assess habitat in conjunction with the sampling effort and will work toward securing funding to determine a sampling protocol for the reservoir system that encompasses the final 45 miles of the river.