

### **Strait Creek (STRA)**

A slightly impaired biological community existed at Strait Creek near Nelson, Pa., after being nonimpaired in fiscal year 2001 and moderately impaired in fiscal year 2002. Also, the most abundant taxon changed from *Paraleptophlebia*, to *Psephenus*, to *Amphinemura*. This heavy dominance of *Amphinemura* also resulted in a low percent dominant taxon metric score. Large amounts of algae were noted in the stream, and the rocks were very slippery. The physical habitat was designated excellent, despite evidence of past channelization. All field chemistry parameters were within normal limits, although dissolved oxygen (7.82 mg/l) was the lowest value of all Group 3 streams (Table A3).

### **White Branch Cowanesque River (WBCO)**

White Branch Cowanesque River near North Fork, Pa., continues to degrade in biological quality. In May 2003, this site was designated severely impaired with the worst metric scores in taxonomic richness (7), Hilsenhoff Biotic Index (6.0), EPT Index (2), and percent Ephemeroptera (0 percent). This site had been nonimpaired in May 2000 with a number of pollution intolerant taxa, and then it degraded to moderately impaired during May 2001 and May 2002. The sample was dominated by the pollution tolerant taxa Chironomidae, comprising 79.7 percent of the sample. The habitat was partially supporting due to low scores in sediment deposition, embeddedness, and riparian vegetative zone width. Cows had direct access to the stream in a pasture upstream of the sampling site. Field chemistry measurements were within acceptable ranges.

### **White Hollow (WHIT)**

White Hollow near Wellsburg, N.Y., was designated as the reference site for Group 3 streams in fiscal year 2003 due to the best combination of biological, water quality, and habitat data. This site had the best Hilsenhoff Biotic Index (1.1) and percent Chironomidae (3.2 percent). Macroinvertebrate taxa with a low Hilsenhoff tolerance value included *Prosimulium*, *Hexatoma*, *Ameletus*, *Ephemerella*, *Epeorus*,

*Suwallia*, *Sweltsa*, *Leuctra*, *Amphinemura*, *Ostrocerca*, *Isoperla*, *Yugus*, *Diplectrona*, *Wormaldia*, and *Neophylax*. The physical habitat was excellent with good stream cover and ample woody debris from a largely coniferous forest. All water chemistry parameters were normal.

## **MANAGEMENT IMPLICATIONS**

Long-term studies of this nature are critical to establish water quality trends and understand biological conditions. To effectively manage the resources, officials and local interest groups must have a true picture of ecological dynamics and possible problem areas, which can only be obtained through long-term studies such as this one.

Several management implications can be extracted from the chemical water quality, macroinvertebrate community, and physical habitat data collected from sampling areas. A Pearson Product Moment Correlation was performed for each reference category for average WQI score, RBP III score, and physical habitat score. Statistically significant relationships ( $p < 0.05$ ) observed among the chemical characteristics, the biological communities, and physical habitats of the interstate streams are described below. These observations, although based on a small sample size, are presented as possible subject areas for future research and as issues to be considered by aquatic resource managers, local interest groups, elected officials, and other policy-makers.

### **New York – Pennsylvania Sites**

The 13 sites in this reference category have shown and continue to show a large degree of variability in water quality; however, they do not vary much in biological or habitat condition. The biological conditions overall are nonimpaired or only slightly impaired and habitat degradation at numerous sites continues to be due to dredging in the stream and the unstable nature of these glacial streams. Fiscal year 2003 sampling was conducted during drought conditions for part of the year, and channel flow conditions were very low during that time. These low flows may have

contributed to higher concentrations of water chemistry parameters and less streambank erosion. There was no significant correlation between RBP III score and WQI score, and no significant correlation between RBP III score and habitat; however, the RBP III scores were not normally distributed.

### **Pennsylvania – Maryland Sites**

There were no significant correlations between RBP III score and water chemistry, RBP III score and habitat, and habitat and water chemistry between the nine Pennsylvania-Maryland border sites. Habitat conditions were not normally distributed. In fiscal years 2001 and 1999, there was a significant ( $p < 0.05$ ) negative correlation between biological score and WQI, and in fiscal year 1999 there also was a significant negative correlation between RBP III score and the water chemistry score. Since a high WQI score denotes poor water quality, this indicates that those sites with degraded water quality also had degraded biological communities in fiscal years 2001 and 1999.

The area surrounding the Pennsylvania-Maryland border sites was largely agricultural. Intensive agricultural activities without proper BMPs often result in streambank erosion and sedimentation, contributing to poor instream habitat quality and to nutrient enrichment. Nutrient enrichment encourages excessive plant growth, which can depress dissolved oxygen levels during plant decomposition. Erosion also may contribute metals that were present in the soil to the stream water.

### **River Sites**

For the eight river sites, there was a positive significant correlation between RBP III scores and habitat; however, habitat scores were not normally distributed. There were no other significant correlations in these data sets. In fiscal years 2000 and 2001, there was a significant positive correlation between physical habitat and RBP III scores, indicating that better physical habitats supported better macroinvertebrate communities. Also, during fiscal year 1999, a negative correlation existed between WQI score and

biological score, indicating sites with degraded water quality also had degraded biological communities.

### **Group 3 Streams**

Only physical habitat and biological scores were considered in the correlation analysis of Group 3 streams, as extensive water quality information was not collected during this sampling season. There was a significant ( $p < 0.05$ ) positive correlation between physical habitat and biological community for the Group 3 sites; however, the populations were not normally distributed. The Group 3 streams were located on the New York-Pennsylvania border, so many of them were glacial streams that were dredged for gravel. These disturbances in habitat may have attributed to degradation in the biological community. Conversely, many of the Group 3 streams were small order streams that were largely forested. These protective habitat conditions may have attributed to nonimpaired biological conditions.

### **Future Study**

Future study and remediation efforts should focus on those streams that had severely or moderately impaired macroinvertebrate communities or exceeded water quality standards. DRYB, WBCO, and SCTT 3.0 were the only sites to have severely impaired macroinvertebrate communities. Moderately impaired biological conditions were found at Biscuit Hollow, Denton Creek, Long Arm Creek, and Cowanesque River (COWN 1.0 and COWN 2.2). Additional study of stream water chemistry, biology, and habitat at varying flows may help explain some impairment problems.

Those streams that exceeded water quality standards, Apalachin Creek, Cascade Creek, Cayuta Creek, Little Snake Creek, Troups Creek, Conowingo Creek, Deer Creek, Ebaughs Creek, Chemung River, Cowanesque River, and the Susquehanna River (10.0, 289.1, 340.0, 365.0), should be monitored for future violations. Furthermore, the source of these pollutants should be identified. State water quality standards vary across state lines, and problems may arise when

the source of these pollutants is located in an adjacent state.

## CONCLUSIONS

Seventeen (33.3 percent) of the 51 interstate macroinvertebrate sampling sites contained nonimpaired biological communities. Biological conditions at another 26 sites (51 percent) were slightly impaired, while five sites (9.8 percent) were moderately impaired. Three sites (5.9 percent), Dry Brook, White Branch Cowanesque River, and Scott Creek were designated severely impaired. Two sites (SUSQ 10.0 and CASC 1.6) were not sampled using RBP III techniques and, thus, were not averaged into the final scores. Thirty-three sites (64.7 percent) had excellent habitats. Eleven sites (21.6 percent) had supporting habitats, and five sites (9.8 percent) had partially supporting habitats. Two sites (3.9 percent) had nonsupporting habitat ratings.

Overall, interstate streams seemed to achieve their designated uses, and only 41 observations (3.5 percent) of water chemistry parameters exceeded state standards. Total iron exceeded standards most frequently with 12 violations (30 percent). Total and dissolved iron appears to be naturally high in some of these watersheds. Tioga River is the only stream that has documented abandoned mine discharge indicated by high metals and high acidity. Elevated aluminum and depressed alkalinity may be due to acid precipitation especially in the New York-Pennsylvania border streams. Total dissolved solids, nitrate plus nitrite, and dissolved oxygen are all indicators of organic pollution.

Of the New York-Pennsylvania border streams, the biological community of 10 (76.9 percent) of these streams was nonimpaired, and three sites (23.1 percent) were slightly impaired. Eight sites had excellent habitats (61.5 percent), four sites (30.8 percent) had supporting habitat, and one site (7.8 percent) had partially supporting habitat. High metal concentrations, particularly total iron, appeared to be the largest source of water quality degradation in this region. The parameters that exceeded New York and Pennsylvania state standards were iron,

aluminum, dissolved oxygen, total dissolved solids, total chlorine, pH, and alkalinity. Iron standards were exceeded at Apalachin Creek, Cascade Creek, Little Snake Creek, and Troups Creek. Aluminum standards were exceeded at Cayuta and Troups Creeks. Dissolved oxygen standards were exceeded at Apalachin Creek. Total dissolved solids were exceeded at Cascade Creek, total chlorine was exceeded at Cayuta Creek, pH was exceeded at Troups Creek, and Cascade Creek and Little Snake Creek exceeded alkalinity standards. In fiscal year 2003, improved biological conditions were seen at many of the New York-Pennsylvania streams in particular, Bentley Creek, Cayuta Creek, Choconut Creek, Seeley Creek, South Creek, Trowbridge Creek, Troups Creek, and Wappasening Creek. Higher numbers of taxa were observed at many sites, which may be due to the increase to 200-count subsamples. Sediment deposition also was noted at numerous streams, which was due to reductions in flow. Cascade Creek, Holden Creek, and North Fork Cowanesque River are often dry during the July and August sampling of Group 1 and 2 streams, so it is recommended that they be sampled with the Group 3 streams in May.

Nonimpaired biological conditions existed at two (22.2 percent) of the nine Pennsylvania-Maryland interstate streams. Five sites (55.5 percent) were slightly impaired, and one (11.1 percent) each were moderately and severely impaired. Six (66.7 percent) of the Pennsylvania-Maryland border sites had excellent habitats, and one each (11.1 percent) had supporting, partially supporting and nonsupporting habitats. Biological conditions at Pennsylvania-Maryland sites appeared to be remaining the same or decreasing slightly during fiscal year 2003. The only sites that exceeded Pennsylvania and Maryland water quality standards were CNWG 4.4 for dissolved solids and nitrite plus nitrate, EBAU 1.5 for total chlorine, and DEER 44.2 for alkalinity. Only total chlorine exceeded Maryland standards for this group of streams; however, Maryland does not have standards for metals as New York does, and New York, Pennsylvania, and Maryland have yet to develop aquatic life standards for organics and nutrients. The Pennsylvania-Maryland border streams are located in a heavily agricultural