

sites for Hilsenhoff Biotic Index (5.67) and percent Ephemeroptera (1.37 percent) metrics. The sample was dominated by the pollution tolerant taxa Chironomidae (62) comprising 42.5 percent of the sample. The habitat was partially supporting due to low scores in sediment deposition, embeddedness, and instream cover. The stream discharge was high at the time of sampling, and the water was turbid. Cows had direct access to the stream in a pasture upstream of the sampling site. Also, there were silt fences located on the right bank of the stream suggesting that work was being done near the sampling site. Despite these disturbances, field chemistry measurements were within acceptable ranges. In fact, dissolved oxygen was the highest value (12.59 mg/l) of any of the Group 3 streams, which would not be expected since this site was downstream of a dam; however, the stream was at high flow due to recent rains (Table A3).

White Hollow (WHIT)

White Hollow near Wellsburg, N.Y., was designated as the reference site for Group 3 streams in fiscal year 2002. This site had the highest number of taxa (23) and number of EPT (16), and also had the best scores in percent dominant taxa (14.17 percent) and Shannon-Weaver Diversity Index (2.70). Macroinvertebrate taxa with a Hilsenhoff tolerance value of three or less included *Prosimulium*, *Antocha*, *Dicranota*, *Hexatoma*, *Ameletus*, *Ephemerella*, *Epeorus*, *Haploperla*, *Sweltsa*, *Leuctra*, *Amphinemura*, *Ostrocerca* (Plecoptera: Nemouridae), *Isoperla*, *Yugus* (Plecoptera: Perlodidae), *Diplectrona*, *Wormaldia*, and *Rhyacophila*. The physical habitat was designated excellent with good stream cover 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 nine sites in this reference category have shown and continue to show a large degree of variability in water quality. There was no significant correlation between RBP III score and water chemistry (WQI score), and no significant correlation between RBP III score and habitat. In fiscal year 1999 and fiscal year 2000, a significant ($p < 0.05$) positive correlation between RBP III score and habitat score existed; however, that correlation was not observed in the data for fiscal year 2001 or fiscal year 2002. The habitat in the New York-Pennsylvania border streams often is noted to be unstable due to the glacial history of these streams and the practice of dredging for gravel in streams.

Pennsylvania – Maryland Sites

There was no significant correlation between RBP III score and water chemistry, and no significant correlation between RBP III score and habitat between the eight Pennsylvania-Maryland border sites. In fiscal year 2001, there was a significant ($p < 0.05$) negative correlation between biological score and WQI. There were no significant correlations noted during fiscal year 2000; however, during the 1999 fiscal year, a significant negative correlation also existed

between the 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 year 2001 and fiscal year 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. Additionally, nutrient enrichment encourages excessive plant growth, which can depress dissolved oxygen levels during plant decomposition.

River Sites

For the nine river sites, there was no significant correlation between RBP III scores and water chemistry, and no significant correlation between RBP III scores and habitat. In fiscal year 2001, there was a significant positive correlation between physical habitat and RBP III scores, indicating that better physical habitats supported better macroinvertebrate communities. There also was a significant positive correlation between physical habitat and RBP III scores in fiscal year 2000. 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 ($p < 0.05$) correlation between physical habitat and biological community for the Group 3 sites. 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, increasing trends, or exceeded water quality standards. DRYB and PRIN were the only sites to have severely impaired macroinvertebrate communities. Moderately impaired biological conditions were found at Denton Creek, Smith Creek, Strait Creek, White Branch Cowanesque River, Seeley Creek, Wappasening Creek, and Cowanesque River (COWN 1.0 and COWN 2.2).

Increasing trends were noted at sites on Cayuta Creek (chloride), Chemung River (chloride and solids), Conowingo Creek (chloride and nitrogen), Cowanesque River (chloride, solids, and manganese), Deer Creek (chloride, solids, nitrogen, sulfate, and WQI), Ebaughs Creek (chloride, sulfate, and WQI), Octoraro Creek (chloride and solids), Scott Creek (aluminum), Susquehanna River (chloride and solids), Tioga River (aluminum), and Troups Creek (chloride, solids, phosphorus, and WQI). These sites should be investigated to determine the source of these parameters, particularly chloride. Chloride trends were increasing at numerous sites, and no decreasing trends for this parameter were found. Efforts should be made to determine why chloride trends are increasing.

Those streams that exceeded water quality standards, Apalachin Creek, Cascade Creek, Little Snake Creek, Troups Creek, Falling Branch Deer Creek, Cowanesque River, Tioga River, and the Susquehanna River, 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

Fourteen (29.8 percent) of the 47 interstate macroinvertebrate sampling sites contained