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

nonimpaired biological communities. Biological conditions at another 23 sites (48.9 percent) were slightly impaired, while 8 sites (17 percent) were moderately impaired. Two sites (4.3 percent), Dry Brook and Prince Hollow Run, were designated severely impaired. Six sites (SUSQ 10.0, SCTT 3.0, CASC 1.6, LSNK 7.6, NFCR 7.6, and TROW 1.6) were not sampled using RBP III techniques and, thus, were not averaged into the final scores. Twenty-eight sites (59.6 percent) had excellent habitats. Fourteen sites (29.8 percent) had supporting habitats, and five sites (10.6 percent) had partially supporting habitats. No sites had a nonsupporting habitat rating.

Overall, interstate streams seemed to achieve their designated uses, and only 25 observations (0.90 percent) of water chemistry parameters exceeded state standards. Total iron exceeded standards most frequently with nine violations (36 percent). Total iron, dissolved iron, total aluminum, alkalinity, and pH, which all exceeded New York or Pennsylvania standards, are indicators of abandoned mine drainage pollution.

Of the New York-Pennsylvania border streams, the biological community of one (11.1 percent) of these streams was nonimpaired. Six sites (66.7 percent) in the New York-Pennsylvania reference category were slightly impaired, and two streams (22.2 percent) were moderately impaired. Seven sites had excellent habitats (77.8 percent) and two sites (22.2 percent) had supporting habitats. 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, and alkalinity. Iron standards were exceeded at Apalachin Creek, Cascade Creek, and Little Snake Creek. Aluminum and dissolved oxygen standards were exceeded at Troups Creek, and Cascade Creek and Little Snake Creek exceeded alkalinity standards. Rechannelization of the streambed and removal of instream habitat may have resulted in poor conditions for macroinvertebrate colonization in several streams, including Bentley Creek and Seeley Creek. Wappasening Creek and Choconut Creek have shown a decreasing biological condition over the past three or four years. The impairment at WAPP 2.6 may be due to high levels of nutrients such as nitrogen, nitrate, and nitrite, which are shown to exceed the 90th percentile. Choconut Creek may have been impaired by the drought during the past couple years, since it did receive moderate ratings in velocity/depth regime and channel flow status. The impairment at Choconut Creek does not appear to be due to water quality conditions, although it is only sampled once a year, so the water quality is unknown at other times of the year. Consideration should be given to changing these streams to Group 1 status so they can be more closely monitored for water quality impairment.

Nonimpaired biological conditions existed at five (62.5 percent) of the eight Pennsylvania-Maryland interstate streams. The remaining three sites (37.5 percent) were slightly impaired. Five (62.5 percent) of the Pennsylvania-Maryland border sites had excellent habitats, two sites (25 percent) had supporting habitats, and one (12.5 percent) had partially supporting habitat. Some improvements were seen in some aspects of water quality or biological condition of many of the Pennsylvania-Maryland streams, particularly Conowingo Creek, Deer Creek, Ebaughs Creek, Falling Branch Deer Creek, and Scott Creek. The only parameter that exceeded Pennsylvania and Maryland water quality standards was alkalinity, at Falling Branch Deer Creek. The Pennsylvania-Maryland border streams are located in a heavily agricultural region, and many of the parameters that exceeded the 90th percentile at these sites were nutrients. Also, streambank erosion and sedimentation were a problem in the instream habitat for this region.

River sites consisted of nine stations located on the Susquehanna River, Chemung River, Cowanesque River, and Tioga River. One station (SUSQ 10.0) is never sampled for macroinvertebrates due to a lack of riffle habitat at the site. The biological communities of four sites (44.4 percent) were nonimpaired, three sites (33.3 percent) were slightly impaired, and two sites (22.2 percent) were moderately impaired. Six of the sites (66.7 percent) had excellent habitats, and three sites (33.3 percent) had

supporting habitat. Water quality parameters that exceeded state standards were pH, dissolved oxygen, total iron, and total aluminum. Standards were exceeded at COWN 5.0, COWN 2.2, COWN 1.0, SUSQ 365.0, SUSQ 340.0, and TIOG 10.8. Sites that had exceeded state standards in fiscal year 2001, but did not exceed standards in fiscal year 2002, were CHEM 12.0, SUSQ 289.1, SUSQ 44.5, and SUSQ 10.0. Those sites that exceeded standards in fiscal year 2002, that had not exceeded standards in fiscal year 2001, were only SUSQ 365.0 and TIOG 10.8. The effects of the Cowanesque Reservoir were evident through comparison of COWN 5.0, COWN 2.2, and COWN 1.0. The water chemistry changed from upstream of the reservoir (COWN 5.0) to downstream of the reservoir (COWN 2.2) with dissolved oxygen, total iron, and total aluminum values exceeding the state standards and numerous parameters exceeding the 90th percentile at COWN 2.2. Furthermore, the macroinvertebrate community lost seven pollution intolerant taxa from upstream to downstream of the reservoir. Some recovery of the river was evident further downstream of the reservoir at COWN 1.0 with the reappearance of pollution intolerant taxa and the improvement in water chemistry.

Of the 21 Group 3 sites, four stations (19 percent) were designated nonimpaired. Eleven sites (52.4 percent) had slightly impaired biological communities, while four stations (19 percent) had moderately impaired conditions. Two (9.5 percent) of the sites were severely impaired. Ten (47.6 percent) of the 21 stations sampled had excellent habitat conditions, seven (33.3 percent) had supporting habitats, and four sites (19 percent) had partially supporting habitats. There was a significant positive correlation between physical habitat and biological score during this sampling season, suggesting that biological condition depended on the quality of habitat in these small, low order streams.

The Seasonal Kendall nonparametric test for trends was applied to observed concentration and flow-adjusted concentration. Trends were detected ($p<0.10$) for several parameters at individual stations. For each parameter, an overall weighted value was calculated to indicate the strength of the trend in the Susquehanna River Basin over the period 1986 through 2001. The only overall increasing trend was in concentrations of total chlorides. This could be the result of applying salt to remove ice from roads or from the use of chlorine in wastewater and water treatment plants. No overall trends in either unadjusted or flow-adjusted concentrations were evident in total suspended solids, total sulfate, total aluminum, and WQI. All other parameters showed a decreasing trend in either unadjusted or flow-adjusted concentrations. These decreasing trends suggest an improvement in water quality. Total phosphorus showed a particularly strong decreasing trend in both unadjusted and flow-adjusted concentrations. Other strong trends included unadjusted concentrations of total ammonia and total iron.

The current and historical data contained in this report provide a database that enables SRBC staff and others to better manage water quality, water quantity, and biological resources of interstate streams in the Susquehanna River Basin. The data can be used by SRBC's member states and local interest groups to gain a better understanding of water quality in upstream and downstream areas outside of their jurisdiction. Information in this report can also serve as a starting point for more detailed assessments and remediation efforts that may be planned on these streams.

Table 55. Summary of Overall Direction of Trends

Parameter	Detected Trends				Overall Direction of Concentration Trend	Overall Direction of Flow-Adjusted Concentration Trend
	Concentration		Flow-Adjusted Concentration			
	+	-	+	-		
Total Suspended Solids	7	1	3	0	None	None
Total Ammonia	0	13	0	11	Decreasing	Decreasing
Total Nitrogen	2	9	1	9	None	Decreasing
Total Phosphorus	0	13	1	13	Decreasing	Decreasing
Total Chloride	13	0	10	0	Increasing	Increasing
Total Sulfate	2	5	2	7	None	None
Total Iron	0	12	0	11	Decreasing	Decreasing
Total Aluminum	1	5	1	5	None	None
Total Manganese	1	11	0	10	Decreasing	Decreasing
Water Quality Index	1	0	3	0	None	None