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Division of Water

Hale Creek

Biological Assessment

2005 Survey

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George E. Pataki, Governor

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HALE CREEK
BIOLOGICAL ASSESSMENT

Mohawk Basin
Fulton County, New York

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Stream: Hale Creek, Fulton County, New York

Reach: Gloversville to Johnstown, New York

Drainage basin: Mohawk River Basin

Background:

The Stream Biomonitoring Unit sampled Hale Creek in Fulton County, New York, on August 3, 2005. The purpose of the sampling was to assess overall water quality and determine if the stream is significantly impacted by any of the active farms located along the creek. Major land-use changes have occurred in this drainage area since the last macroinvertebrate sampling event in 2000. In riffle areas at five sites, a traveling kick sample for macroinvertebrates was taken, using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample from each site. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT richness, and percent model affinity (see Appendices II and III). Expected variability of results is stated in Smith and Bode (2004). Table 2 provides a listing of sampling sites and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by macroinvertebrate data reports, including raw data from each site.

Results and Conclusions:

1. Water quality in Hale Creek was slightly impacted to moderately impacted. Primary causes of impact were nutrient enrichment and siltation.
2. Compared to previous macroinvertebrate sampling, water quality was similar. Hale Creek would be expected to greatly benefit from improvements to agricultural land-uses along the length of the stream.
3. The stream could greatly benefit from Best Management Practices (BMP) being established and maintained at the farms that operate adjacent to the creek. If such BMPs are put into place, a follow-up macroinvertebrate study should be done to monitor water quality.

Discussion:

The headwaters of Hale Creek originate on the east side of Black Street near Skiff's Dairy in Johnstown, New York. It flows west for 7.0 stream miles, before entering Cayadutta Creek at Johnstown. Hale Creek is classified as C(T), which denotes fishing and fish propagation as best uses. The stream is stocked with brown trout each year starting downstream of NYSDEC, Hale Creek Field Station at State Route 29. Native brook trout spawn upstream in the headwaters and immediately downstream from the Hale Creek Field Station, but the 1 to 2 mile section in-between will not support trout spawning anymore, primarily due to degradation from agriculture sources and beaver dams (per Tim Preddice, DFWMR, personal communication).

Hale Creek was previously sampled by the Stream Biomonitoring Unit at a site on North Chase Street in Johnstown (Station 6) in 2000. At that time, water quality was assessed as non-impacted.

In the present sampling, water quality in Hale Creek was assessed as slightly impacted to moderately impacted over the 7-mile reach sampled (Figure 1). Nutrient enrichment, siltation and impoundment effects were indicated to be the primary stressors causing the impact (Table 1).

Moderate impacts were seen downstream from Skiff's Dairy (Station 1), where substantial degradation has been occurring over the past few years (per Tim Preddice, DFWMR, personal communication). Hale Creek has been channelized below Black Street and Skiff's Dairy after much silt, sand and manure from the farm accumulated at the downstream side of the culvert under Black Street. The basin is heavily dominated by agriculture and nutrient enrichment is a concern for the entire watershed. The stream could greatly benefit from Best Management Practices (BMP) being established and maintained at the farms that operate adjacent to the creek. Further land-use degradation may result in an additional decline in Hale Creek's overall water quality.

Literature Cited:

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and A. J. Smith, 2002, Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Technical Report, 115 pages.

Smith, A. J. and R. W. Bode, 2004, Analysis of variability in New York State benthic macroinvertebrate samples. New York State Department of Environmental Conservation, Technical Report, 43 pages.

Overview of Field Data:

On August 3, 2005, Hale Creek at the sites sampled was 1- 4 meters wide, 0.1 - 0.3 meters deep, and had current speeds of 40 - 100 cm/sec in riffles. Dissolved oxygen was 6.5 - 11.1 mg/l, specific conductance was 272 - 403 μ mhos, pH was 7.3 - 8.1 and temperature was 11.6 - 21.0 °C (53 -70 °F). Measurements for each site are found on the Field Data Summary sheets.

Figure 1. Biological Assessment Profile of index values, Hale Creek, 2005. Values are plotted on a normalized scale of water quality. The line connects the mean of four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for a more complete explanation.

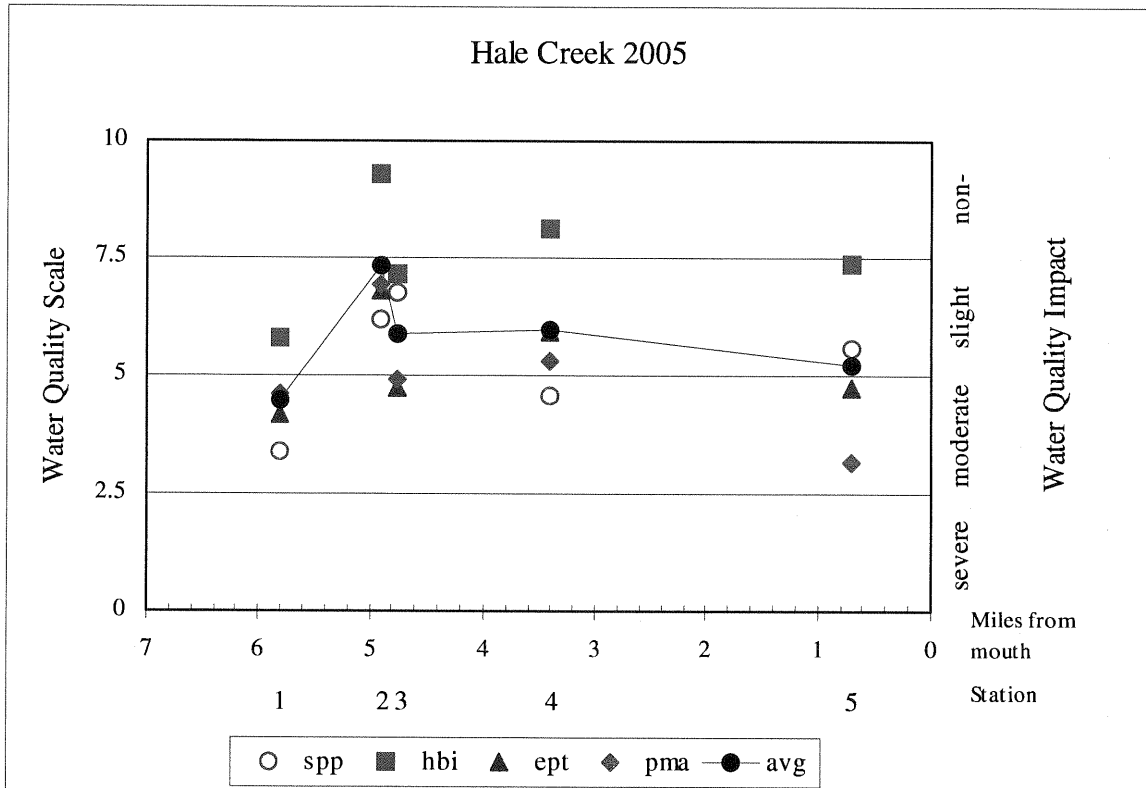


Table 1. Impact Source Determination, Hale Creek, 2005. Numbers represent percent similarity to macroinvertebrate community type models for each impact category. Highest similarities at each station are highlighted. Similarities less than 50 percent are less conclusive. Highest numbers represent probable type of impact. See Appendix X for further explanation.

Community Type	STATION				
	HALE-01	HALE-02	HALE-03	HALE-04	HALE-05
Natural: minimal human impacts	35	54	26	51	49
Nutrient additions; mostly nonpoint, agricultural	60	44	30	45	39
Toxic: industrial, municipal, or urban run-off	45	48	25	33	33
Organic: sewage effluent, animal wastes	58	40	18	22	24
Complex: municipal/industrial	63	32	28	42	33
Siltation	46	49	22	36	32
Impoundment	65	44	22	39	36

STATION COMMUNITY TYPE
 HALE-1 Nutrients, complex*, impoundment
 HALE-2 Natural, siltation
 HALE-3 Nutrients
 HALE-4 Natural
 HALE-5 Natural

* Indications of complex effects are considered spurious; no known Combined Sewer Overflows or other sources are known to exist in the vicinity of Station 1.

Table 2. Station Locations for Hale Creek, Fulton County, NY

<u>STATION</u>	<u>LOCATION</u>
01	Johnstown, New York Below Rte. 29 culvert Latitude/Longitude 43° 02' 03"; 74° 16' 54" 5.8 stream miles above mouth
02	Johnstown, New York 0.25 mile above Hale Creek Field Station Latitude/Longitude 43° 02' 03"; 74° 17' 56" 4.9 stream miles above mouth
03	Johnstown, New York Below Steele Ave. Ext. bridge Latitude/Longitude 43° 02' 02"; 74° 18' 06" 4.75 stream miles above mouth
04	Johnstown, New York 30 m below Hales Mills Rd. culvert Latitude/Longitude 43° 01' 11"; 74° 19' 47" 2.7 stream miles above mouth
05	Johnstown, New York Below East Ave. bridge Latitude/Longitude 43° 00' 36"; 74° 21' 26" 0.7 stream mile above mouth

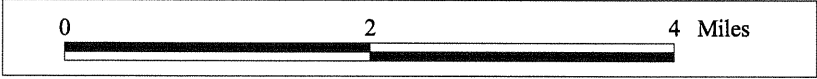
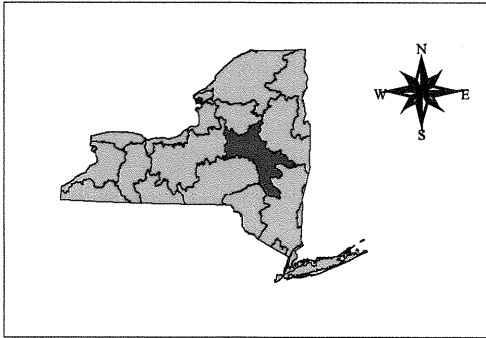
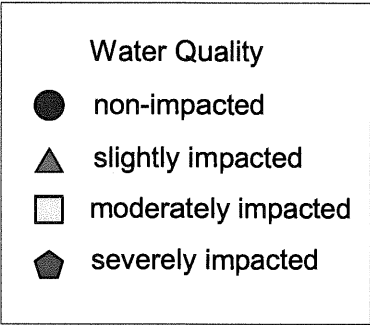
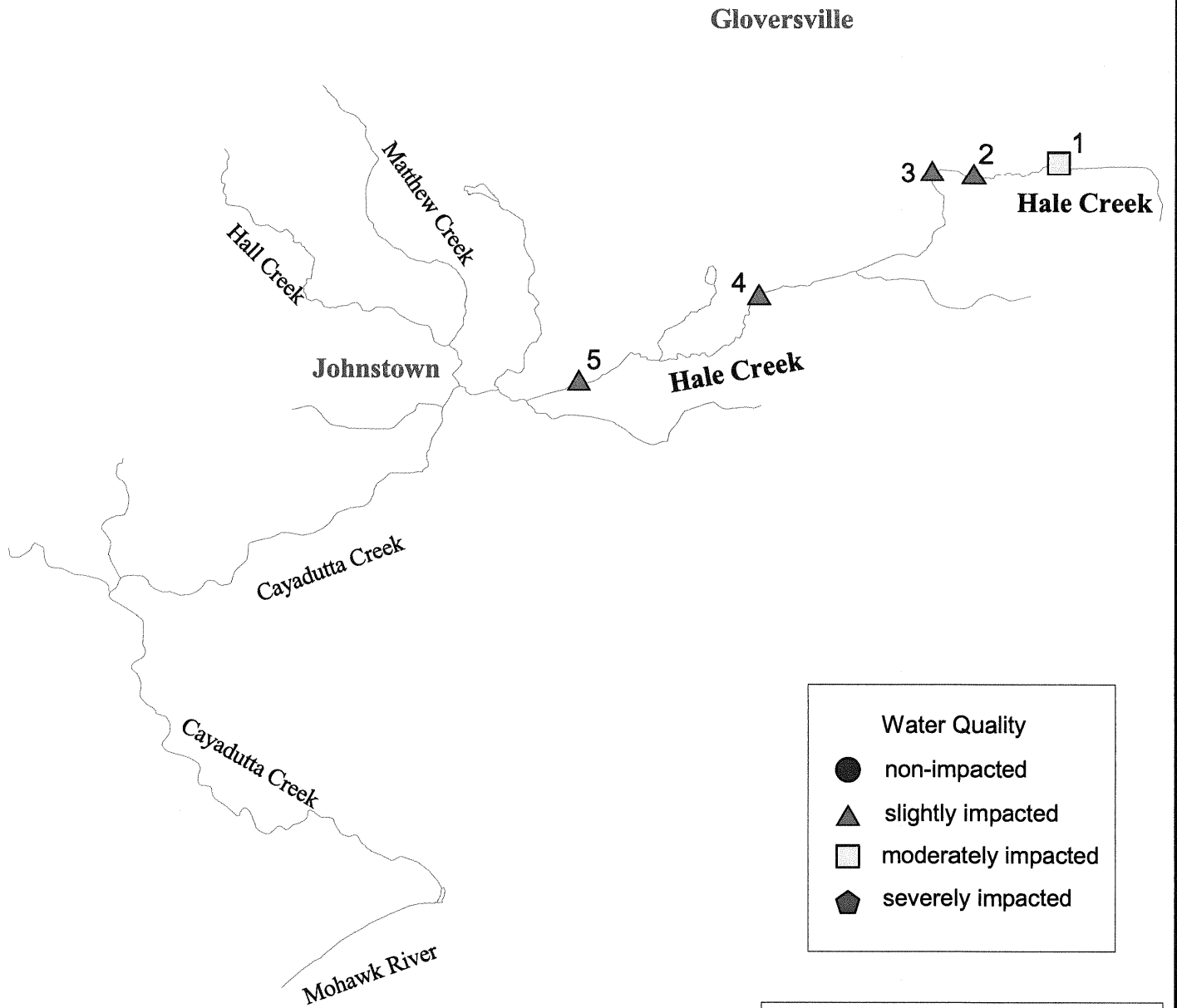


Figure 3a

Site Location Map

Hale Creek

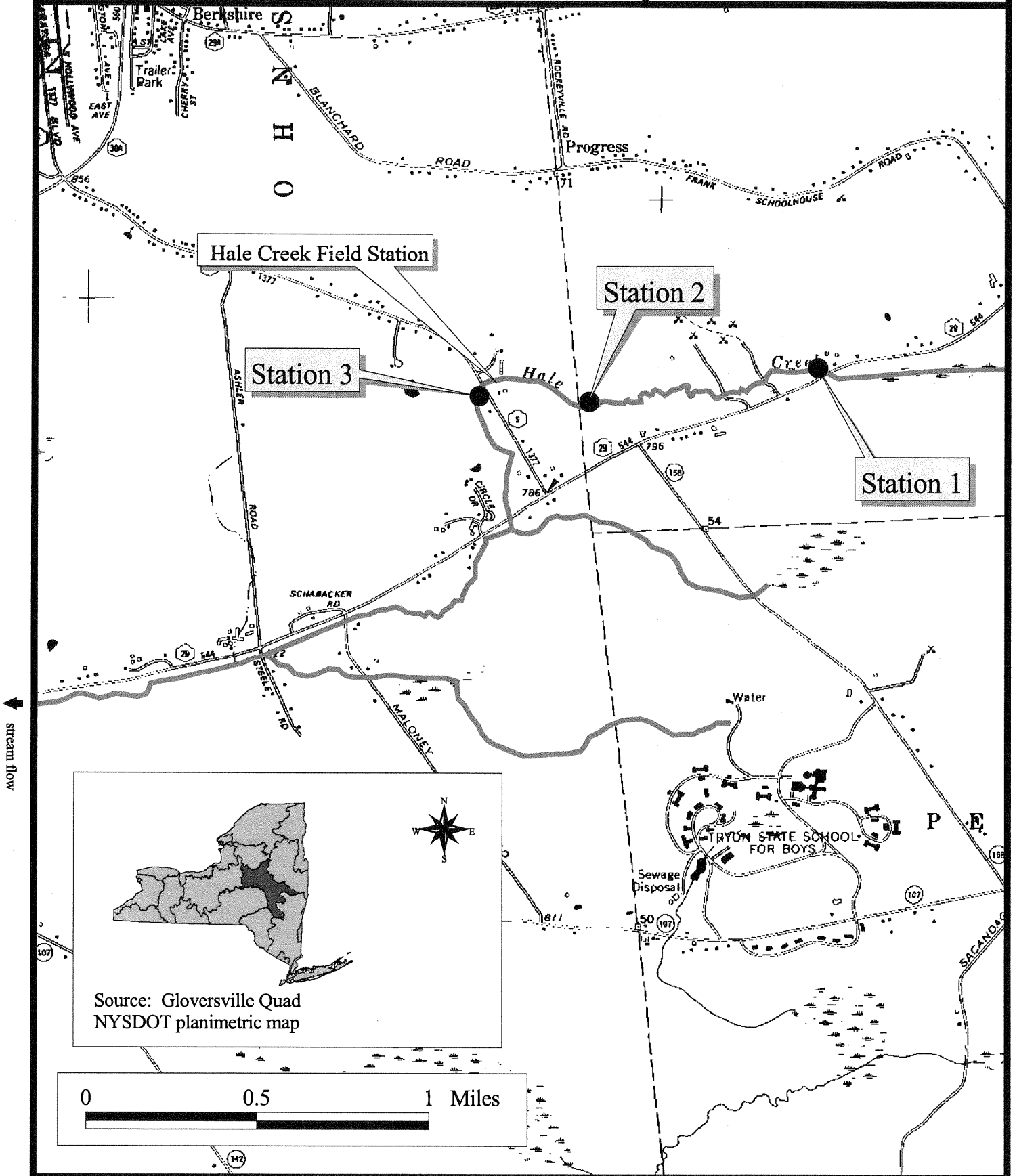


Figure 3b

Site Location Map

Hale Creek

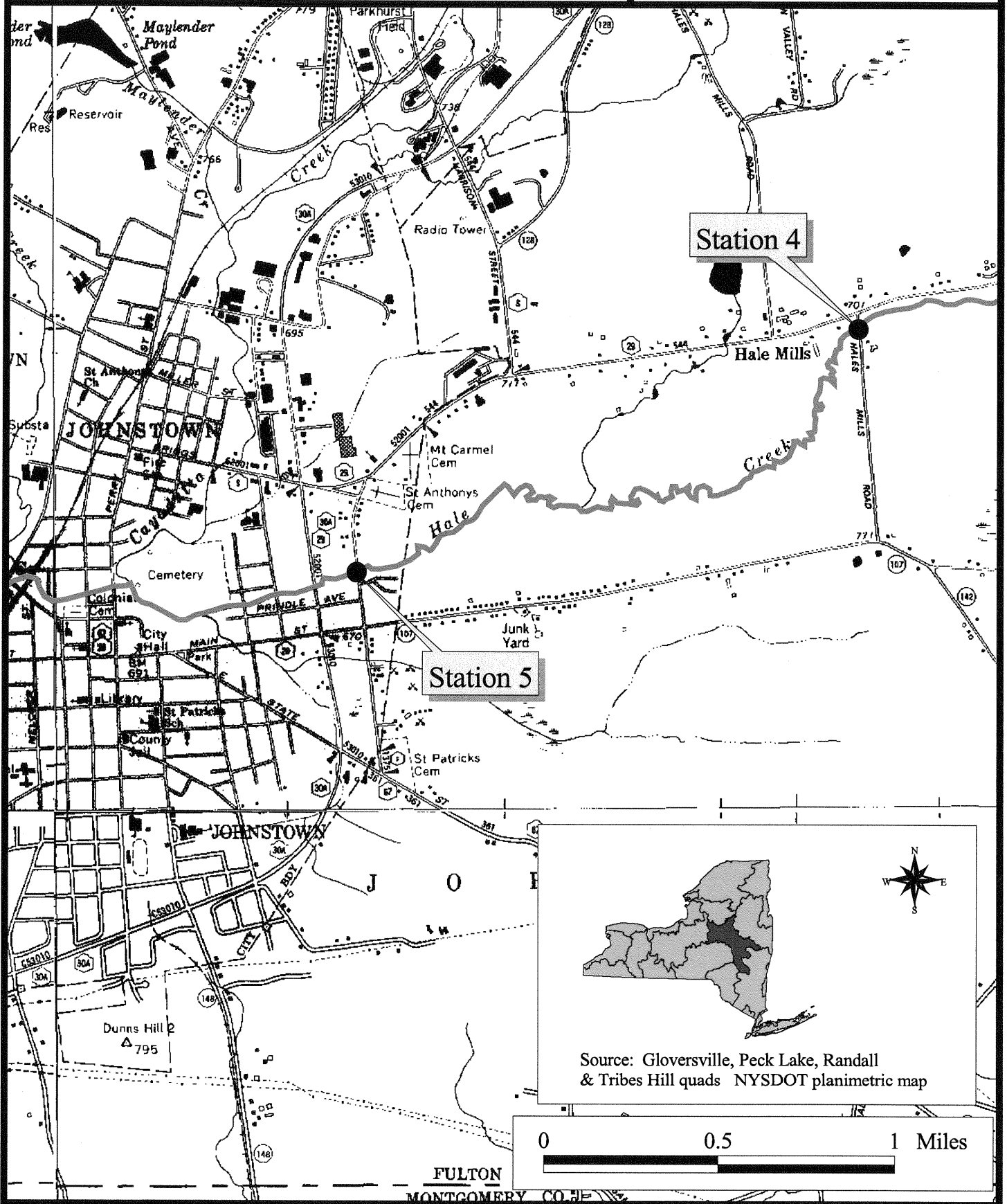


Table 3. Macroinvertebrate Species Collection in Hale Creek, Fulton County, New York, 2005.

PLATYHELMINTHES	Rhyacophilidae
TURBELLARIA	<i>Rhyacophila fuscula</i>
Undetermined Turbellaria	<i>Rhyacophila sp.</i>
ANNELIDA	Hydroptilidae
OLIGOCHAETA	<i>Hydroptila sp.</i>
LUMBRICIDA	Lepidostomatidae
Undetermined Lumbricina	<i>Lepidostoma sp.</i>
MOLLUSCA	DIPTERA
PELECYPODA	Tipulidae
Sphaeriidae	<i>Antocha sp.</i>
Undetermined Sphaeriidae	<i>Dicranota sp.</i>
ARTHROPODA	Undetermined Tipulidae
CRUSTACEA	Ceratopogonidae
AMPHIPODA	Undetermined Ceratopogonidae
Gammaridae	Simuliidae
<i>Gammarus sp.</i>	<i>Simulium aureum</i>
INSECTA	<i>Simulium tuberosum</i>
EPHEMEROPTERA	<i>Simulium sp.</i>
Baetidae	Athericidae
<i>Baetis flavistriga</i>	<i>Atherix sp.</i>
<i>Baetis sp.</i>	Empididae
Heptageniidae	<i>Chelifera sp.</i>
<i>Epeorus (Iron) sp.</i>	<i>Hemerodromia sp.</i>
<i>Heptagenia sp.</i>	Chironomidae
PLECOPTERA	<i>Natarsia baltimorea</i>
Leuctridae	<i>Thienemannimyia gr. spp.</i>
Undetermined Leuctridae	<i>Diamesa sp.</i>
Nemouridae	<i>Pagastia orthogonia</i>
Undetermined Nemouridae	<i>Brillia parva</i>
Perlidae	<i>Cricotopus bicinctus</i>
<i>Agetina sp.</i>	<i>Cricotopus tremulus gr.</i>
Chloroperlidae	<i>Cricotopus vierriensis</i>
Undetermined Chloroperlidae	<i>Eukiefferiella devonica gr.</i>
Perlodidae	<i>Parametriocnemus lundbecki</i>
<i>Isoperla sp.</i>	<i>Tvetenia bavarica gr.</i>
COLEOPTERA	<i>Microtendipes rydalensis gr.</i>
Psephenidae	<i>Polypedilum aviceps</i>
<i>Ectopria nervosa</i>	<i>Polypedilum flavum</i>
Elmidae	<i>Xenochironomus xenolabis</i>
<i>Optioservus fastiditus</i>	<i>Micropsectra polita</i>
<i>Optioservus trivittatus</i>	<i>Tanytarsus glabrescens gr.</i>
<i>Promoresia tardella</i>	
<i>Stenelmis crenata</i>	
TRICHOPTERA	
Philopotamidae	
<i>Chimarra aterrima?</i>	
<i>Dolophilodes sp.</i>	
Hydropsychidae	
<i>Cheumatopsyche sp.</i>	
<i>Hydropsyche betteni</i>	
<i>Hydropsyche slossonae</i>	
<i>Hydropsyche sparna</i>	
<i>Hydropsyche sp.</i>	
<i>Potamyia sp.</i>	

Macroinvertebrate Data Reports: Raw Data

STREAM SITE: Hale Creek HALE-01
 LOCATION: Johnstown, NY Below Rte 29 culvert
 DATE: 03 August 2005
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 organisms

ARTHROPODA

CRUSTACEA

AMPHIPODA Gammaridae *Gammarus sp.* 6

INSECTA

EPHEMEROPTERA Baetidae *Baetis intercalaris* 1

COLEOPTERA Elmidae *Optioservus fastiditus* 1

Stenelmis crenata 5

TRICHOPTERA Hydropsychidae *Cheumatopsyche sp.* 15

Hydropsyche betteni 40

Hydroptilidae *Hydroptila sp.* 1

DIPTERA Simuliidae *Simulium sp.* 6

Chironomidae *Natarsia baltimorea* 1

Thienemannimyia gr. spp. 1

Diamesa sp. 2

Polypedilum aviceps 13

Polypedilum flavum 8

SPECIES RICHNESS: 13 (poor)
 BIOTIC INDEX: 5.85 (good)
 EPT RICHNESS: 4 (poor)
 MODEL AFFINITY: 47 (poor)
 ASSESSMENT: moderately impacted (4.49)

DESCRIPTION: The kick sample was taken 30 m below the SR 29 culvert near Johnstown.

The headwaters site, which is approximately 0.5 mile upstream, was a swamp and could not be adequately sampled. Stream habitat was mostly rubble and gravel, but significant duck weed was present. The macroinvertebrate community was dominated by facultative caddisflies and water quality was assessed as moderately impacted. ISD denoted nutrient enrichment and impoundment effects.

Macroinvertebrate Data Reports: Raw Data, cont'd.

STREAM SITE: Hale Creek HALE-02
 LOCATION: Johnstown, NY 0.25 mile above Hale Creek Field Station
 DATE: 03 August 2005
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 organisms

ANNELIDA			
OLIGOCHAETA			
LUMBRICIDA		Undetermined Lumbricina	4
MOLLUSCA			
PELECYPODA			
VENEROIDEA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA			
	Baetidae	<i>Baetis flavistriga</i>	4
	Heptageniidae	<i>Epeorus (Iron) sp.</i>	21
PLECOPTERA			
	Nemouridae	Undetermined Nemouridae	3
	Chloroperlidae	Undetermined Chloroperlidae	7
	Perlodidae	<i>Isoperla sp.</i>	3
COLEOPTERA	Elmidae	<i>Optioservus fastiditus</i>	1
TRICHOPTERA			
	Philopotamidae	<i>Dolophilodes sp.</i>	8
	Hydropsychidae	<i>Potamyia sp.</i>	26
	Rhyacophilidae	<i>Rhyacophila fuscula</i>	2
		<i>Rhyacophila sp.</i>	4
DIPTERA			
	Tipulidae	<i>Dicranota sp.</i>	1
		Undetermined Tipulidae	1
	Simuliidae	<i>Simulium aureum</i>	2
		<i>Simulium tuberosum</i>	2
	Athericidae	<i>Atherix sp.</i>	1
	Empididae	<i>Chelifera sp.</i>	1
		<i>Hemerodromia sp.</i>	2
	Chironomidae	<i>Pagastia orthogonia</i>	2
		<i>Brillia parva</i>	3
		<i>Micropsectra polita</i>	1

SPECIES RICHNESS: 22 (good)
 BIOTIC INDEX: 2.71 (very good)
 EPT RICHNESS: 9 (good)
 MODEL AFFINITY: 61 (good)
 ASSESSMENT: slightly impacted (7.31)

DESCRIPTION: The kick sample was taken 0.25 mile above the Hale Creek Field Station, upstream of a cleared area where a local horse farm had recently erected a large barn. The substrate was composed of a mixture of gravel and sand. The macroinvertebrate community had improved from Hale-01, being populated with intolerant caddisflies and mayflies, in addition to some stoneflies. ISD denoted natural and siltation effects. Water quality was assessed as slightly impacted.

Macroinvertebrate Data Reports: Raw Data, cont'd.

STREAM SITE: Hale Creek HALE-03
 LOCATION: Johnstown, NY Steele Ave Ext at bridge
 DATE: 03 August 2005
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 organisms

ARTHROPODA

CRUSTACEA

AMPHIPODA Gammaridae *Gammarus sp.* 17

INSECTA

PLECOPTERA Leuctridae Undetermined Leuctridae 3

COLEOPTERA Psephenidae *Ectopria nervosa* 1

Elmidae *Dubiraphia vittata* 1

Optioservus fastiditus 10

Promoresia tardella 5

TRICHOPTERA Hydropsychidae *Cheumatopsyche sp.* 2

Hydropsyche sp. 1

Hydroptilidae *Hydroptila sp.* 2

Lepidostomatidae *Lepidostoma sp.* 1

DIPTERA Tipulidae *Antocha sp.* 1

Undetermined Tipulidae 1

Ceratopogonidae Undetermined Ceratopogonidae 3

Athericidae *Atherix sp.* 1

Empididae *Chelifera sp.* 1

Chironomidae *Thienemannimyia gr. spp.* 12

Diamesa sp. 1

Pagastia orthogonia 11

Cricotopus bicinctus 4

Cricotopus tremulus gr. 1

Tvetenia bavarica gr. 1

Polypedilum aviceps 4

Micropsectra polita 13

Tanytarsus glabrescens gr. 3

SPECIES RICHNESS: 24 (good)
 BIOTIC INDEX: 4.77 (good)
 EPT RICHNESS: 5 (poor)
 MODEL AFFINITY: 49 (poor)
 ASSESSMENT: slightly impacted (5.89)

DESCRIPTION: The kick sample was taken at the bridge on Steele Ave Ext. across the street from the Hale Creek Field Station. The riffle was adequate, but heavy siltation and substantial amounts of filamentous algae covered the substrate, making it difficult to field assess the site. Facultative crustaceans and midges dominated the macroinvertebrate fauna and water quality was assessed as slightly impacted. ISD denoted nutrient enrichment effects.

Macroinvertebrate Data Reports: Raw Data, cont'd.

STREAM SITE: Hale Creek HALE-04
 LOCATION: Johnstown, NY Hales Mills Rd, 30 m below culvert
 DATE: 03 August 2005
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 organisms

PLATYHELMINTHES

TURBELLARIA

Planariidae Undetermined Turbellaria 1

ARTHROPODA

CRUSTACEA

AMPHIPODA Gammaridae *Gammarus sp.* 26

INSECTA

EPHEMEROPTERA Baetidae *Baetis flavistriga* 11

Heptageniidae *Heptagenia sp.* 4

COLEOPTERA Elmidae *Optioservus fastiditus* 24

Promoresia tardella 1

TRICHOPTERA Philopotamidae *Dolophilodes sp.* 15

Hydropsychidae *Cheumatopsyche sp.* 1

Hydropsyche slossonae 5

Hydropsyche sp. 1

Rhyacophilidae *Rhyacophila sp.* 1

DIPTERA Tipulidae *Dicranota sp.* 2

Simuliidae *Simulium tuberosum* 1

Athericidae *Atherix sp.* 1

Chironomidae *Brillia parva* 1

Eukiefferiella devonica gr. 1

Polypedilum aviceps 4

SPECIES RICHNESS: 17 (poor)
 BIOTIC INDEX: 3.89 (very good)
 EPT RICHNESS: 7 (good)
 MODEL AFFINITY: 51 (good)
 ASSESSMENT: slightly impacted (5.98)

DESCRIPTION: The kick sample was taken at Hales Mills Rd, 30 m below the culvert. Macroinvertebrate fauna was diverse, with many species of mayflies, caddisflies, beetles and stoneflies (although no stoneflies were present in the 100-specimen subsample). Some siltation was still present. This site was downstream of a golf course that is located on a hill to the south of the creek. Based on the metrics, water quality was assessed as slightly impacted. ISD indicated highest similarity to natural community models.

Macroinvertebrate Data Reports: Raw Data, cont'd.

STREAM SITE: Hale Creek HALE-05
 LOCATION: Johnstown, NY 10 m below East St. bridge
 DATE: 03 August 2005
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 organisms

ARTHROPODA

CRUSTACEA

AMPHIPODA Gammaridae *Gammarus sp.* 12

INSECTA

PLECOPTERA Perlidae *Agnetina sp.* 1

COLEOPTERA Elmidae *Optioservus fastiditus* 39

Optioservus trivittatus 2

Promoresia tardella 3

Stenelmis crenata 9

MEGALOPTERA Corydalidae *Nigronia serricornis* 6

TRICHOPTERA Philopotamidae *Chimarra aterrima?* 3

Hydropsychidae *Cheumatopsyche sp.* 5

Hydropsyche betteni 8

Hydropsyche sparna 1

DIPTERA Tipulidae *Antocha sp.* 3

Empididae *Hemerodromia sp.* 1

Chironomidae *Cricotopus vierriensis* 1

Parametriocnemus lundbecki 1

Tvetenia bavarica gr. 1

Microtendipes rydalensis gr. 1

Polypedilum aviceps 1

Polypedilum flavum 1

Xenochironomus xenolabis 1

SPECIES RICHNESS: 20 (good)
 BIOTIC INDEX: 4.61 (good)
 EPT RICHNESS: 5 (poor)
 MODEL AFFINITY: 38 (poor)
 ASSESSMENT: slightly impacted (5.21)

DESCRIPTION: This sampling site was 10 m below the East St. bridge, just east of the city of Johnstown. Less than a quarter of a mile upstream, the creek is impounded, but the stream at this site had a good riffle. Biomass at this site was much lower than at HALE-04 and macroinvertebrate fauna were dominated by intolerant beetles and facultative crustaceans. Water quality was assessed as slightly impacted and ISD indicated highest similarity to natural community models.

LABORATORY DATA SUMMARY

STREAM NAME: Hale Creek		DRAINAGE: 12		
DATE SAMPLED: 8/3/2005		COUNTY: Fulton		
SAMPLING METHOD: Travelling Kick				
STATION	01	02	03	04
LOCATION	Gloversville Rte 29 culvert	Gloversville abv. Hale Ck Field Sta.	Gloversville Steele Ave Ext	Johnstown Hales Mills Rd.
DOMINANT SPECIES/% CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Hydropsyche betteni	Potamyia sp.	Gammarus sp.	Gammarus sp.
	40 %	26 %	17 %	26 %
	facultative	intolerant	facultative	facultative
	caddisfly	caddisfly	crustacea	crustacea
2.	Cheumatopsyche sp.	Epeorus (Iron) sp.	Micropsectra polita	Optioservus fastiditus
	15 %	21 %	13 %	24 %
Intolerant = not tolerant of poor water quality	facultative	intolerant	facultative	intolerant
	caddisfly	mayfly	midge	beetle
3.	Polypedilum aviceps	Dolophilodes sp.	Thienemannimyia gr. spp.	Dolophilodes sp.
	13 %	8 %	12 %	15 %
Facultative = occurring over a wide range of water quality	facultative	intolerant	facultative	intolerant
	midge	caddisfly	midge	caddisfly
4.	Polypedilum flavum	Undetermined Chloroperlidae	Pagastia orthogonia	Baetis flavistriga
	8 %	7 %	11 %	11 %
Tolerant = tolerant of poor water quality	facultative	intolerant	intolerant	intolerant
	midge	stonefly	midge	mayfly
5.	Gammarus sp.	Undetermined Lumbricina	Optioservus fastiditus	Hydropsyche slossonae
	6 %	4 %	10 %	5 %
	facultative	facultative	intolerant	facultative
	crustacea	worm	beetle	caddisfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	25.0 (5.0)	6.0 (3.0)	50.0 (9.0)	6.0 (3.0)
Trichoptera (caddisflies)	56.0 (3.0)	40.0 (4.0)	6.0 (4.0)	23.0 (5.0)
Ephemeroptera (mayflies)	1.0 (1.0)	25.0 (2.0)	0.0 (0.0)	15.0 (2.0)
Plecoptera (stoneflies)	0.0 (0.0)	13.0 (3.0)	3.0 (1.0)	0.0 (0.0)
Coleoptera (beetles)	6.0 (2.0)	1.0 (1.0)	17.0 (4.0)	25.0 (2.0)
Oligochaeta (worms)	0.0 (0.0)	4.0 (1.0)	0.0 (0.0)	0.0 (0.0)
Mollusca (clams and snails)	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)	0.0 (0.0)
Crustacea (crayfish, scuds, sowbugs)	6.0 (1.0)	0.0 (0.0)	17.0 (1.0)	26.0 (1.0)
Other insects (odonates, diptera)	6.0 (1.0)	10.0 (7.0)	7.0 (5.0)	4.0 (3.0)
Other (Nemertea, Platyhelminthes)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)
SPECIES RICHNESS	13	22	24	17
BIOTIC INDEX	5.85	2.71	4.77	3.89
EPT RICHNESS	4	9	5	7
PERCENT MODEL AFFINITY	47	61	49	51
FIELD ASSESSMENT	Poor	Good	Good	Very good
OVERALL ASSESSMENT	Moderate	Slight	Slight	Slight

LABORATORY DATA SUMMARY

STREAM NAME: Hale Creek		DRAINAGE: 12	
DATE SAMPLED: 08/03/2005		COUNTY: Fulton	
SAMPLING METHOD: Travelling Kick			
STATION	05		
LOCATION	Johnstown East St bridge		
DOMINANT SPECIES/% CONTRIBUTION/TOLERANCE/COMMON NAME			
	1. Optioservus fastiditus		
	39 %		
	intolerant		
	beetle		
	2. Gammarus sp.		
Intolerant = not tolerant of poor water quality	12 %		
	facultative		
	crustacea		
	3. Stenelmis crenata		
Facultative = occurring over a wide range of water quality	9 %		
	facultative		
	beetle		
	4. Hydropsyche betteni		
Tolerant = tolerant of poor water quality	8 %		
	facultative		
	caddisfly		
	5. Nigronia serricornis		
	6 %		
	intolerant		
	megaloptera		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)			
Chironomidae (midges)	7.0 (7.0)		
Trichoptera (caddisflies)	17.0 (4.0)		
Ephemeroptera (mayflies)	0.0 (0.0)		
Plecoptera (stoneflies)	1.0 (1.0)		
Coleoptera (beetles)	53.0 (4.0)		
Oligochaeta (worms)	0.0 (0.0)		
Mollusca (clams and snails)	0.0 (0.0)		
Crustacea (crayfish, scuds, sowbugs)	12.0 (1.0)		
Other insects (odonates, diptera)	10.0 (3.0)		
Other (Nemertea, Platyhelminthes)	0.0 (0.0)		
SPECIES RICHNESS	20		
BIOTIC INDEX	4.61		
EPT RICHNESS	5		
PERCENT MODEL AFFINITY	38		
FIELD ASSESSMENT	Good		
OVERALL ASSESSMENT	Slight		

FIELD DATA SUMMARY				
STREAM NAME: Hale Creek		DATE SAMPLED: 8/3/2005		
REACH: Gloversville to Johnstown				
FIELD PERSONNEL INVOLVED: Heitzman, Wright, Haugh				
STATION	01	02	03	04
ARRIVAL TIME AT STATION	9:45 AM	11:55 AM	10:20 AM	10:50 AM
LOCATION	Gloversville Rte 29 culvert	Gloversville abv. Hale Ck Field Sta.	Gloversville Steele Ave Ext	Johnstown Hales Mills Rd.
PHYSICAL CHARACTERISTICS				
Width (meters)	1.0	3.0	2.0	3.0
Depth (meters)	0.1	0.1	0.3	0.2
Current speed (cm per sec.)	40	59	71	100
Substrate (%)				
Rock (>25.4 cm, or bedrock)			5	20
Rubble (6.35 – 25.4 cm)	30	20	30	30
Gravel (0.2 – 6.35 cm)	30	30	25	20
Sand (0.06 – 2.0 mm)	20	30	10	10
Silt (0.004 – 0.06 mm)	20	20	30	20
Embeddedness (%)	20	10	30	20
CHEMICAL MEASUREMENTS				
Temperature (° C)	20.7	11.6	13.4	17.8
Specific Conductance (umhos)	403	272	303	345
Dissolved Oxygen (mg/l)	6.5	11.1	10.6	10.7
pH	7.3	7.8	7.8	8.1
BIOLOGICAL ATTRIBUTES				
Canopy (%)	10	100	10	80
Aquatic Vegetation				
algae – suspended	x			
algae – attached, filamentous		x	xxx	x
algae – diatoms	x	x	x	x
macrophytes or moss			x	
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)		x	x	x
Plecoptera (stoneflies)				x
Trichoptera (caddisflies)	x	x	x	x
Coleoptera (beetles)	x			x
Megaloptera (dobsonflies, alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)			x	x
Simuliidae (black flies)		x	x	x
Decapoda (crayfish)				
Gammaridae (scuds)	x	x	x	x
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other				
FAUNAL CONDITION	Poor	Good	Good	Very good

FIELD DATA SUMMARY

STREAM NAME: Hale Creek		DATE SAMPLED: 8/3/2005		
REACH: Gloversville to Johnstown				
FIELD PERSONNEL INVOLVED: Heitzman, Wright, Haugh				
STATION	05			
ARRIVAL TIME AT STATION	11:10 AM			
LOCATION	Johnstown East St bridge			
PHYSICAL CHARACTERISTICS				
Width (meters)	4.0			
Depth (meters)	0.1			
Current speed (cm per sec.)	100			
Substrate (%)				
Rock (>25.4 cm, or bedrock)	20			
Rubble (6.35 – 25.4 cm)	30			
Gravel (0.2 – 6.35 cm)	20			
Sand (0.06 – 2.0 mm)	10			
Silt (0.004 – 0.06 mm)	20			
Embeddedness (%)	5			
CHEMICAL MEASUREMENTS				
Temperature (° C)	21.0			
Specific Conductance (umhos)	361			
Dissolved Oxygen (mg/l)	8.7			
pH	7.6			
BIOLOGICAL ATTRIBUTES				
Canopy (%)	402			
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous	x			
algae – diatoms	x			
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	x			
Plecoptera (stoneflies)	x			
Trichoptera (caddisflies)	x			
Coleoptera (beetles)				
Megaloptera (dobsonflies, alderflies)	x			
Odonata (dragonflies, damselflies)				
Chironomidae (midges)				
Simuliidae (black flies)				
Decapoda (crayfish)	x			
Gammaridae (scuds)	x			
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other				
FAUNAL CONDITION	Good			

Appendix I. Biological Methods for Kick Sampling

A. Rationale: The use of a standardized kick sampling method provides a biological assessment technique that lends itself to rapid assessments of stream water quality.

B. Site Selection: Sampling sites are selected based on these criteria: (1) The sampling location should be a riffle with a substrate of rubble, gravel and sand; depth should be one meter or less, and current speed should be at least 0.4 meter per second. (2) The site should have comparable current speed, substrate type, embeddedness, and canopy cover to both upstream and downstream sites to the degree possible. (3) Sites are chosen to have safe and convenient access.

C. Sampling: Macroinvertebrates are sampled using the standardized traveling kick method. An aquatic net is positioned in the water at arms' length downstream and the stream bottom is disturbed by foot, so that organisms are dislodged and carried into the net. Sampling is continued for a specified time and distance in the stream. Rapid assessment sampling specifies sampling for five minutes over a distance of five meters. The contents of the net are emptied into a pan of stream water. The contents are then examined and major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95 percent ethyl alcohol.

D. Sample Sorting and Subsampling: In the laboratory, the sample is rinsed with tap water in a U.S. No. 40 standard sieve to remove any fine particles left in the residues from field sieving. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula, rinsed with water, and placed in a petri dish. This portion is examined under a dissecting stereomicroscope and 100 organisms are randomly removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. The total number of organisms in the sample is estimated by weighing the residue from the picked subsample and determining its proportion of the total sample weight.

E. Organism Identification: All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species and the total number of individuals in the subsample are recorded on a data sheet. All organisms from the subsample are archived (either slide-mounted or preserved in alcohol). If the results of the identification process are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

Appendix II. Macroinvertebrate Community Parameters

1. Species Richness: The total number of species or taxa found in a sample. For subsamples of 100-organisms each that are taken from kick samples, expected ranges in most New York State streams are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted; less than 11, severely impacted.

2. EPT Richness: The total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organisms subsample. These are considered to be clean-water organisms, and their presence is generally correlated with good water quality (Lenat, 1987). Expected assessment ranges from most New York State streams are: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

3. Hilsenhoff Biotic Index: A measure of the tolerance of organisms in a sample to organic pollution (sewage effluent, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each species by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). For the purpose of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Tolerance values are listed in Hilsenhoff (1987). Additional values are assigned by the NYS Stream Biomonitoring Unit. The most recent values for each species are listed in Quality Assurance document, Bode et al.(1996). Impact ranges are: 0-4.50, non-impacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. Percent Model Affinity: A measure of similarity to a model, non-impacted community based on percent abundance in seven major macroinvertebrate groups (Novak and Bode, 1992). Percent abundances in the model community are: 40% Ephemeroptera; 5% Plecoptera; 10% Trichoptera; 10% Coleoptera; 20% Chironomidae; 5% Oligochaeta; and 10% Other. Impact ranges are: greater than 64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and less than 35, severely impacted.

Bode, R.W., M.A. Novak, L.E. Abele, D.L. Heitzman, and A.J. Smith, 2002, Quality assurance work plan for biological stream monitoring in New York State. NYSDEC Technical Report, 115 pages.

Hilsenhoff, W. L., 1987, An improved biotic index of organic stream pollution. *The Great Lakes Entomologist* 20(1): 31-39.

Lenat, D. R., 1987, Water quality assessment using a new qualitative collection method for freshwater benthic macroinvertebrates. North Carolina Division of Environmental Management Technical Report, 12 pages.

Novak, M.A., and R.W. Bode, 1992, Percent model affinity: a new measure of macroinvertebrate community composition. *J. N. Am. Benthol. Soc.* 11(1): 80-85.

Appendix III. Levels of Water Quality Impact in Streams

The description of overall stream water quality based on biological parameters uses a four-tiered system of classification. Level of impact is assessed for each individual parameter and then combined for all parameters to form a consensus determination. Four parameters are used: species richness, EPT richness, biotic index, and percent model affinity (see Appendix II). The consensus is based on the determination of the majority of the parameters. Since parameters measure different aspects of the macroinvertebrate community, they cannot be expected to always form unanimous assessments. The assessment ranges given for each parameter are based on subsamples of 100 organisms each that are taken from macroinvertebrate riffle kick samples. These assessments also apply to most multiplate samples, with the exception of percent model affinity.

1. *Non-impacted*: Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well represented; EPT richness is greater than 10. The biotic index value is 4.50 or fewer. Percent model affinity is greater than 64. The Nutrient Biotic Index is 5.00 or less. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

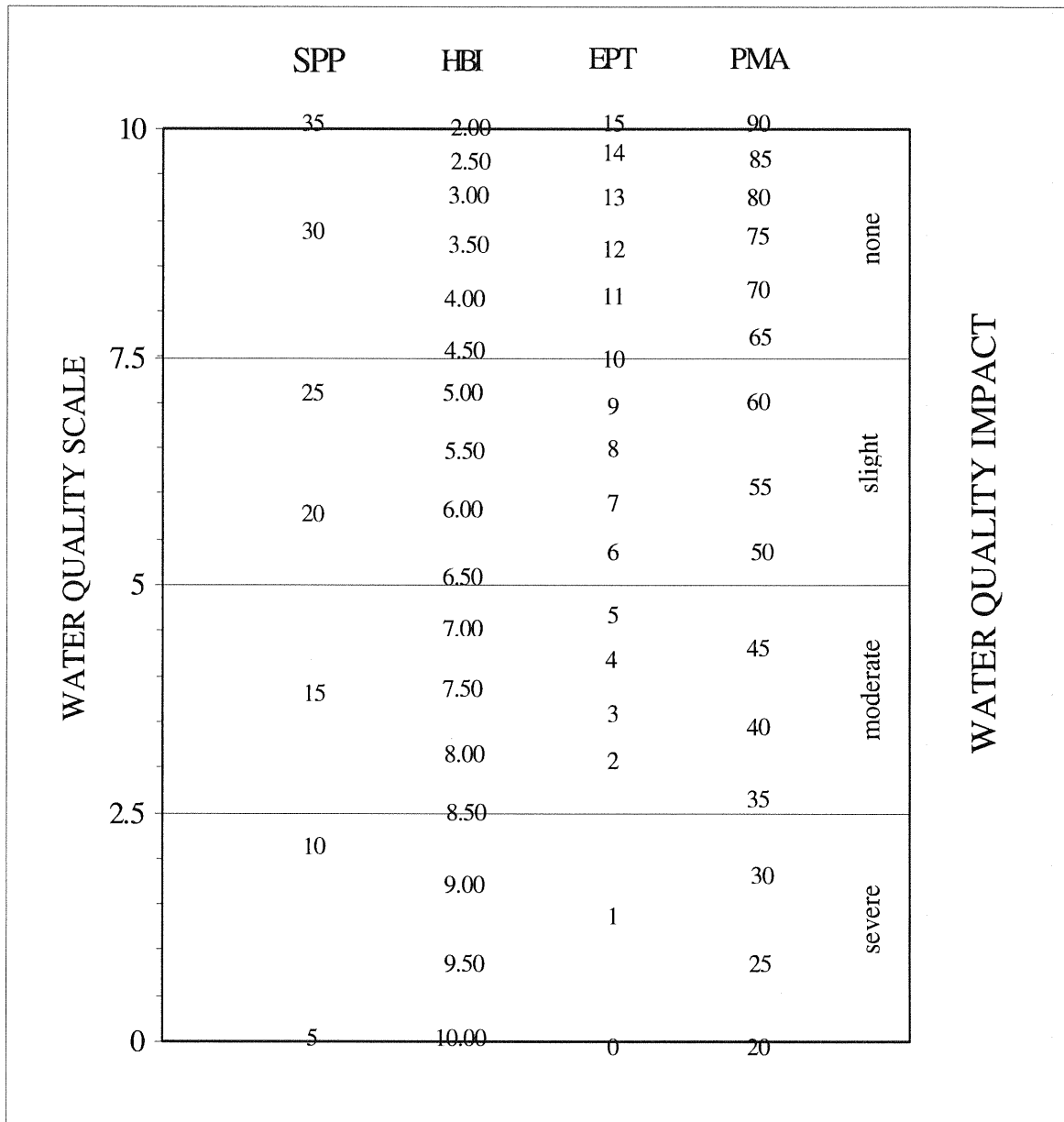
2. *Slightly impacted*: Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness is usually 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. The Nutrient Biotic Index is 5.01-6.00. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

3. *Moderately impacted*: Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness is usually 11-18. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 2-5. The biotic index value is 6.51-8.50. Percent model affinity is 35-49. The Nutrient Biotic Index is 6.01-7.00. Water quality often is limiting to fish propagation, but usually not to fish survival.

4. *Severely impacted*: Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or fewer. Mayflies, stoneflies and caddisflies are rare or absent; EPT richness is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. The Nutrient Biotic Index is greater than 7.00. Dominant species are almost all tolerant, and are usually midges and worms. Often, 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

Appendix IV-A. Biological Assessment Profile: Conversion of Index Values to a Common 10-Scale

The Biological Assessment Profile of index values, developed by Phil O'Brien, Division of Water, NYSDEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale using the formulae in the Quality Assurance document (Bode, et al., 2002), and as shown in the figure below.



Appendix IV-B. Biological Assessment Profile: Plotting Values

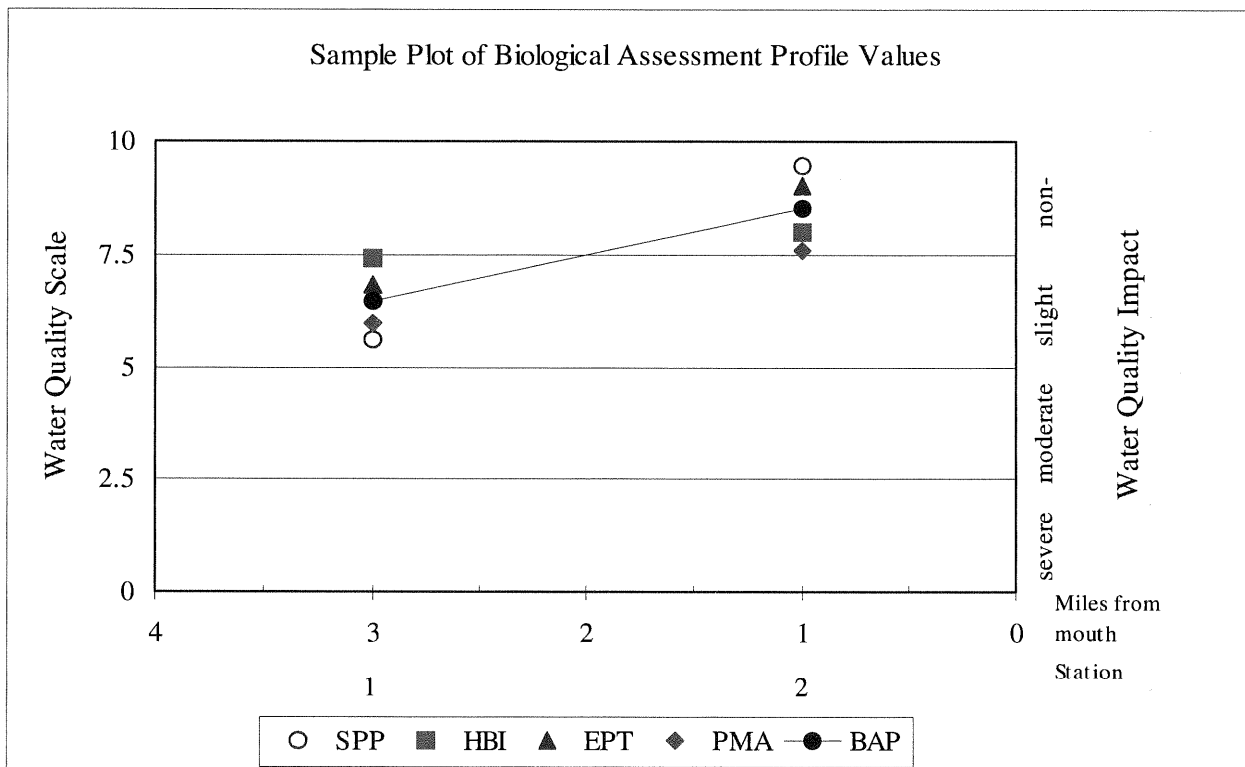
To plot survey data:

1. Position each site on the x-axis according to miles or tenths of a mile upstream of the mouth.
2. Plot the values of the four indices for each site as indicated by the common scale.
3. Calculate the mean of the four values and plot the result. This represents the assessed impact for each site.

Example data:

	Station 1		Station 2	
	metric value	10-scale value	metric value	10-scale value
Species richness	20	5.59	33	9.44
Hilsenhoff biotic index	5	7.4	4	8
EPT richness	9	6.8	13	9
Percent model affinity	55	5.97	65	7.6
Average		6.44 (slight)		8.51 (non-)

Table IV-B. Sample Plot of Biological Assessment Profile values



Appendix V. Water Quality Assessment Criteria

Non-navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	Nutrient Biotic Index*	EPT Value	Percent Model Affinity#	Diversity **
Non-Impacted	>26	0.00-4.50	0.00-5.00	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	5.01-6.00	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	6.51-7.00	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	7.01-10.00	0-1	<35	0.00-2.00

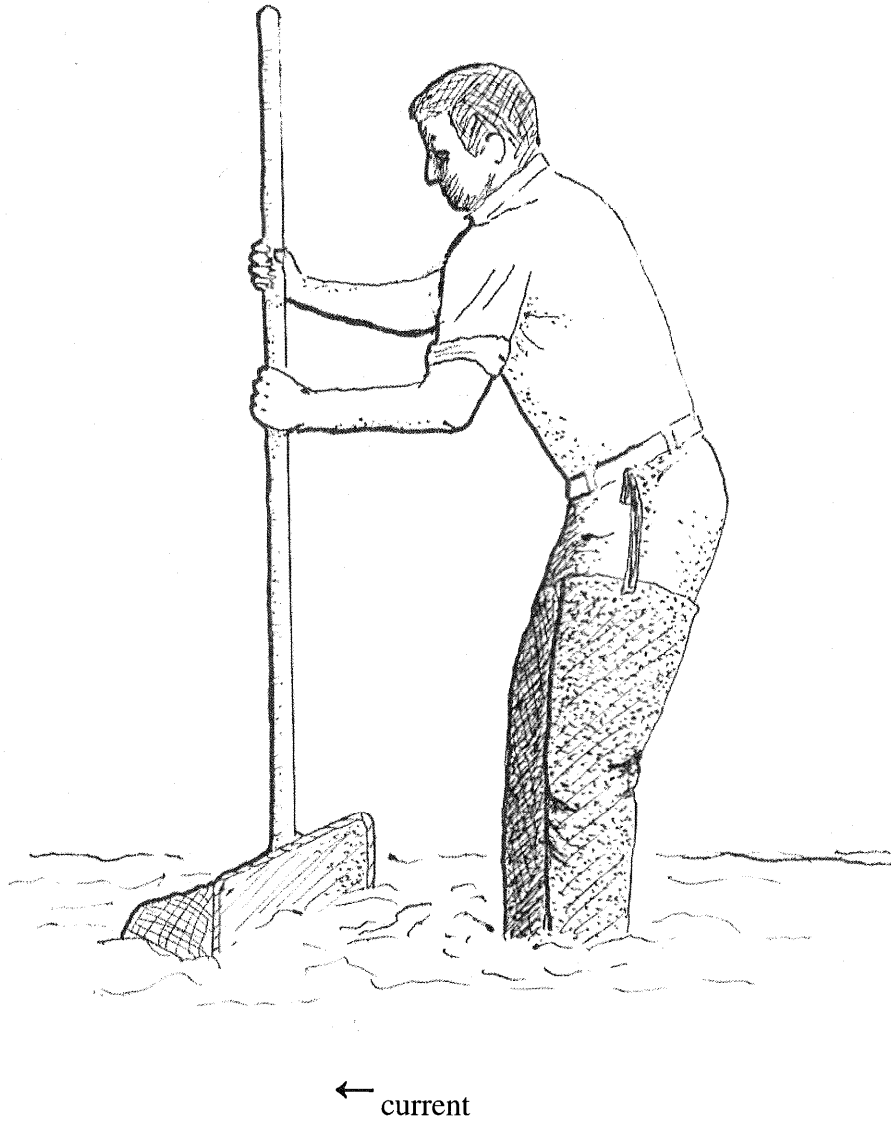
Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.

** Diversity criteria are used for multiplate samples but not for traveling kick samples.

Navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Diversity
Non-Impacted	>21	0.00-7.00	>5	>3.00
Slightly Impacted	17-21	7.01-8.00	4-5	2.51-3.00
Moderately Impacted	12-16	8.01-9.00	2-3	2.01-2.50
Severely Impacted	0-11	9.01-10.00	0-1	0.00-2.00

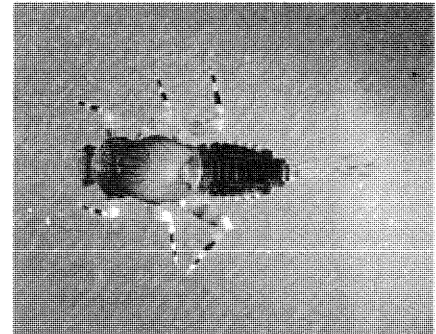
Appendix VI. The Traveling Kick Sample



Rocks and sediment in a riffle are dislodged by foot upstream of a net. Dislodged organisms are carried by the current into the net. Sampling continues for five minutes, as the sampler gradually moves downstream to cover a distance of five meters.

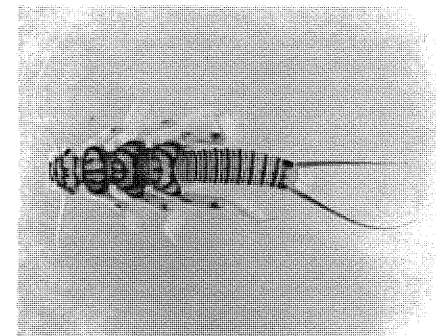
Appendix VII-A. Aquatic Macroinvertebrates that Usually Indicate Good Water Quality

Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.



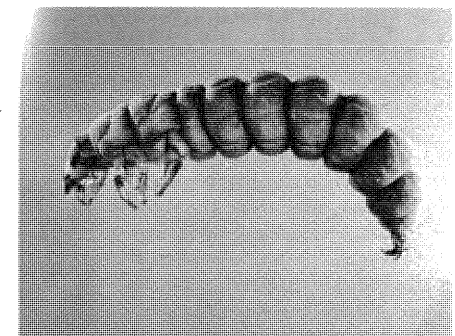
MAYFLIES

Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies, except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained for several months.



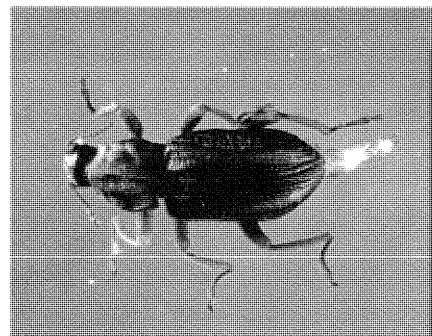
STONEFLIES

Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in nutrient-enriched stream segments.

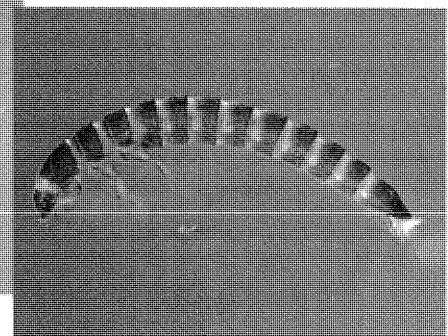


CADDISFLIES

The most common beetles in streams are riffle beetles (adult and larvae pictured) and water pennies (not shown). Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

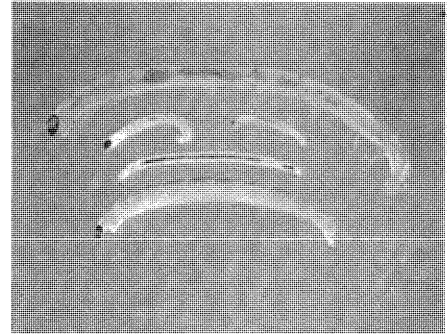


BEEETLES



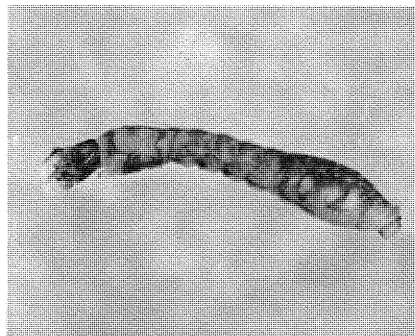
Appendix VII-B. Aquatic Macroinvertebrates that Usually Indicate Poor Water Quality

Midges are the most common aquatic flies. Their larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called “bloodworms” indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.

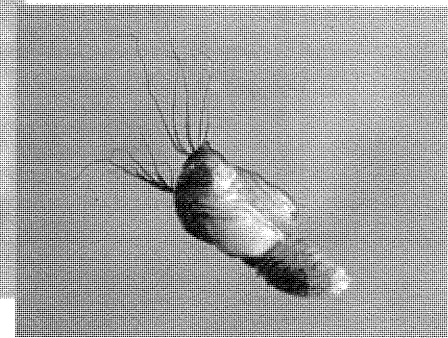


MIDGES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

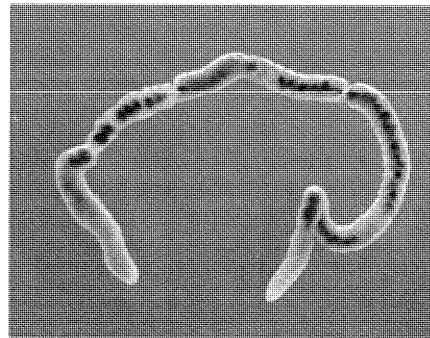


BLACK FLIES

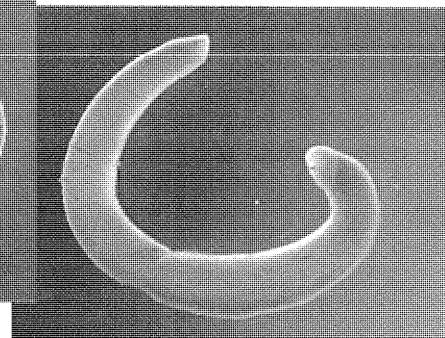


The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution indicators.

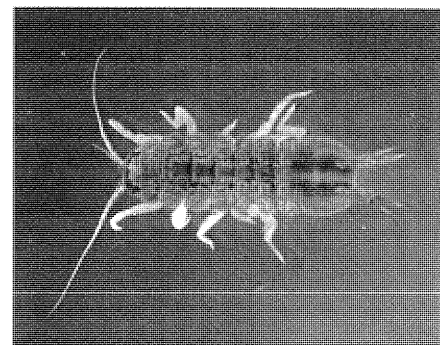
Many leeches are also tolerant of poor water quality.



WORMS



Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. They are classic indicators of sewage pollution, and can also thrive in toxic situations.



SOWBUGS

Digital images by Larry Abele, New York State Department of Environmental Conservation, Stream Biomonitoring Unit.

Appendix VIII. The Rationale of Biological Monitoring

Biological monitoring refers to the use of resident benthic macroinvertebrate communities as indicators of water quality. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit aquatic habitats; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans.

Concept:

Nearly all streams are inhabited by a community of benthic macroinvertebrates. The species comprising the community each occupy a distinct niche defined and limited by a set of environmental requirements. The composition of the macroinvertebrate community is thus determined by many factors, including habitat, food source, flow regime, temperature, and water quality. The community is presumed to be controlled primarily by water quality if the other factors are determined to be constant or optimal. Community components which can change with water quality include species richness, diversity, balance, abundance, and presence/absence of tolerant or intolerant species. Various indices or metrics are used to measure these community changes. Assessments of water quality are based on metric values of the community, compared to expected metric values.

Advantages:

The primary advantages to using macroinvertebrates as water quality indicators are that they:

- are sensitive to environmental impacts
- are less mobile than fish, and thus cannot avoid discharges
- can indicate effects of spills, intermittent discharges, and lapses in treatment
- are indicators of overall, integrated water quality, including synergistic effects
- are abundant in most streams and are relatively easy and inexpensive to sample
- are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
- are vital components of the aquatic ecosystem and important as a food source for fish
- are more readily perceived by the public as tangible indicators of water quality
- can often provide an on-site estimate of water quality
- can often be used to identify specific stresses or sources of impairment
- can be preserved and archived for decades, allowing for direct comparison of specimens
- bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain

Limitations:

Biological monitoring is not intended to replace chemical sampling, toxicity testing, or fish surveys. Each of these measurements provides information not contained in the others. Similarly, assessments based on biological sampling should not be taken as being representative of chemical sampling. Some substances may be present in levels exceeding ambient water quality criteria, yet have no apparent adverse community impact.

Appendix IX. Glossary

anthropogenic: caused by human actions

assessment: a diagnosis or evaluation of water quality

benthos: organisms occurring on or in the bottom substrate of a waterbody

bioaccumulate: accumulate contaminants in the tissues of an organism

biomonitoring: the use of biological indicators to measure water quality

community: a group of populations of organisms interacting in a habitat

drainage basin: an area in which all water drains to a particular waterbody; watershed

EPT richness: the number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) in a sample or subsample

facultative: occurring over a wide range of water quality; neither tolerant nor intolerant of poor water quality

fauna: the animal life of a particular habitat

impact: a change in the physical, chemical, or biological condition of a waterbody

impairment: a detrimental effect caused by an impact

index: a number, metric, or parameter derived from sample data used as a measure of water quality

intolerant: unable to survive poor water quality

longitudinal trends: upstream-downstream changes in water quality in a river or stream

macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats

multiplate: multiple-plate sampler, a type of artificial substrate sampler of aquatic macroinvertebrates

organism: a living individual

PAHs: Polycyclic Aromatic Hydrocarbons, a class of organic compounds that are often toxic or carcinogenic.

rapid bioassessment: a biological diagnosis of water quality using field and laboratory analysis designed to allow assessment of water quality in a short turn-around time; usually involves kick sampling and laboratory subsampling of the sample

riffle: wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids

species richness: the number of macroinvertebrate species in a sample or subsample

station: a sampling site on a waterbody

survey: a set of samplings conducted in succession along a stretch of stream

synergistic effect: an effect produced by the combination of two factors that is greater than the sum of the two factors

tolerant: able to survive poor water quality

Appendix X. Impact Source Determination: Methods and Community Models

Definition: Impact Source Determination (ISD) is the procedure for identifying types of impacts that exert deleterious effects on a waterbody. While the analysis of benthic macroinvertebrate communities has been shown to be an effective means of determining severity of water quality impacts, it has been less effective in determining what kind of pollution is causing the impact. ISD uses community types or models to ascertain the primary factor influencing the fauna.

Development of methods: The method found to be most useful in differentiating impacts in New York State streams was the use of community types based on composition by family and genus. It may be seen as an elaboration of Percent Model Affinity (Novak and Bode, 1992), which is based on class and order. A large database of macroinvertebrate data was required to develop ISD methods. The database included several sites known or presumed to be impacted by specific impact types. The impact types were mostly known by chemical data or land use. These sites were grouped into the following general categories: agricultural nonpoint, toxic-stressed, sewage (domestic municipal), sewage/toxic, siltation, impoundment, and natural. Each group initially contained 20 sites. Cluster analysis was then performed within each group, using percent similarity at the family or genus level. Within each group four clusters were identified. Each cluster was usually composed of 4-5 sites with high biological similarity. From each cluster, a hypothetical model was then formed to represent a model cluster community type; sites within the cluster had at least 50 percent similarity to this model. These community type models formed the basis for ISD (see tables following). The method was tested by calculating percent similarity to all the models and determining which model was the most similar to the test site. Some models were initially adjusted to achieve maximum representation of the impact type. New models are developed when similar communities are recognized from several streams.

Use of the ISD methods: Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural," lacking an impact. In the graphic representation of ISD, only the highest similarity of each source type is identified. If no model exhibits a similarity to the test data of greater than 50 percent, the determination is inconclusive. The determination of impact source type is used in conjunction with assessment of severity of water quality impact to provide an overall assessment of water quality.

Limitations: These methods were developed for data derived from subsamples of 100-organisms each that are taken from traveling kick samples of New York State streams. Application of these methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

ISD MODELS TABLE
NATURAL MACROINVERTEBRATE COMMUNITY TYPE

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Isonychia</u>	5	5	-	5	20	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	10	10	10	10	5	15	40
HEPTAGENIIDAE	5	10	5	20	10	5	5	5	5	10	10	5	5
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	5	-	-	25	5
EPHEMERELLIDAE	5	5	5	10	-	10	10	30	-	5	-	10	5
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
<u>Psephenus</u>	5	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	5	-	20	5	5	-	5	5	5	5	-	-	-
<u>Promoresia</u>	5	-	-	-	-	-	25	-	-	-	-	-	-
<u>Stenelmis</u>	10	5	10	10	5	-	-	-	10	-	-	-	5
PHILOPOTAMIDAE	5	20	5	5	5	5	5	-	5	5	5	5	5
HYDROPSYCHIDAE	10	5	15	15	10	10	5	5	10	15	5	5	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/													
RHYACOPHILIDAE	5	5	-	-	-	20	-	5	5	5	5	5	-
SIMULIIDAE	-	-	-	5	5	-	-	-	-	5	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>													
<u>Orthocladius</u>	5	5	-	10	-	-	5	-	-	5	5	5	-
<u>Eukiefferiella/</u>													
<u>Tvetenia</u>	5	5	10	-	-	5	5	5	-	5	-	5	5
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	5	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	20	-	-	10	20	20	5	-	-
<u>Polypedilum</u> (all others)	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

ISD MODELS TABLE (cont.)
NONPOINT NUTRIENT ENRICHMENT IMPACTED MACROINVERTEBRATE COMMUNITY TYPE

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	5	-	-	5	-	5	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	5	-	-	5	-	5	5	-	-	-
<u>Optioservus</u>	10	-	-	5	-	-	15	5	-	5
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	15	-	10	15	5	25	5	10	5
PHILOPOTAMIDAE	15	5	10	5	-	25	5	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>										
<u>Orthocladius</u>	10	15	10	5	-	-	-	5	5	-
<u>Eukiefferiella/</u>										
<u>Tvetenia</u>	-	15	10	5	-	-	-	-	5	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Microtendipes</u>	-	-	-	-	-	-	-	-	-	20
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	20	10	5	10	5	5
Tanytarsini	10	10	10	5	20	5	5	10	-	10
TOTAL	100	100	100	100	100	100	100	100	100	100

ISD MODELS TABLE (cont.)														
MACROINVERTEBRATE COMMUNITY TYPES														
MUNICIPAL/INDUSTRIAL WASTES IMPACTED									TOXICS IMPACTED					
	A	B	C	D	E	F	G	H	A	B	C	D	E	F
PLATYHELMINTHES	-	40	-	-	-	5	-	-	-	-	-	-	5	-
OLIGOCHAETA	20	20	70	10	-	20	-	-	-	10	20	5	5	15
HIRUDINEA	5	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	5	-	-	-	5	-	-	-	5
SPHAERIIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	10	5	10	10	15	5	-	-	10	10	-	20	10	5
GAMMARIDAE	40	-	-	-	15	-	5	5	5	-	-	-	5	5
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	5	-	-	10	5	-	5	5	10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40	10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20	20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	5	10	20	-	5	10	5	5	15	10	25	10	5	10
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	-	-	-	-	-	-	-	-	20	10	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-	-	5	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	-	-	-	10	20	40	10	5	10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-	-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

ISD MODELS TABLE (cont.)
SEWAGE EFFLUENT, ANIMAL WASTES IMPACTED MACROINVERTEBRATE COMMUNITY TYPE

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-	5	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE	-	-	-	-	-	-	-	-	-	-
Tanypodinae	-	5	-	-	-	-	-	-	5	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	-	10	15	-	-	10	10	-	5	5
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	10	-	-	-	-	-	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	10	-	60
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	60	-	30	10	5	5
Tanytarsini	10	10	10	10	-	-	-	10	40	-
TOTAL	100	100	100	100	100	100	100	100	100	100

ISD MODELS TABLE (cont.)
MACROINVERTEBRATE COMMUNITY TYPES
SILTATION IMPACTED IMPOUNDMENT IMPACTED

	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<u>Optioservus</u>	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	5	10	10	5	20	5	5	10	10	-	5	35	-	5	10
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	30
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	20
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	15
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>															
<u>Orthocladius</u>	25	-	10	5	5	25	5	-	10	-	5	10	-	-	-
<u>Eukiefferiella/</u>															
<u>Tvetenia</u>	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100