New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Birch Creek
Biological Assessment

2004 Survey

New York State
Department of Environmental Conservation

George E. Pataki, *Governor*

BIRCH CREEK

BIOLOGICAL ASSESSMENT

Lower Hudson River Basin
Greene and Ulster Counties, New York

Survey date: June 29, 2004
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CONTENTS

Stream: Birch Creek

Reach: Above and below Pine Hill, Ulster County, New York

NYS Drainage Basin: Lower Hudson River

Background:

The Stream Biomonitoring Unit conducted biological sampling on Birch Creek on June 29, 2004. The purpose of the sampling was to assess general water quality, establish a baseline dataset, and determine any spatial water quality trends. Four traveling kick samples for macroinvertebrates were taken in riftle areas at each of four sites, using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix 1. 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. Macroinvertebrate community parameters used in determination of water quality included species richness, biotic index, EPT value, and Percent Model Affinity (see Appendices II and III). 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 individual site descriptions and raw data from each site.

Water samples were also taken at each site for toxicity testing. Methods are described in Appendix XII and results are given in Table 1.

Assisting in the sampling were Margaret Soulman and Gabe Lewis.

Results and Conclusions:

1. Water quality in Birch Creek was assessed as non-impacted at all sites, indicating very good water quality, based on evaluation of macroinvertebrate community data.

2. Based on toxicity testing, no significant aquatic toxicity was evidenced for any of the sites san1pled, either upstream or downstream of the Pine Hill Sewage Treatment Plant.

3. Exposed clay deposits in the streambank may affect the biota and aesthetics of Birch Creek in the future, as well as that of Esopus Creek.

Discussion

Birch Creek originates on the slopes of Halcott Mountain in the Catskills and flows in a mostly southerly direction, through the Village of Pine Hill before entering Esopus Creek at Big Indian, approximately 7 miles from the source. Most of its 30 square mile drainage lies in Ulster County. The stream is classified as B(TS), indicating trout spawning. It receives effluent from the NYCDEP Pine Hill (Village) Sewage Treatn1ent Plant and ppartial drainage from the Belleayre Ski Resort. Birch Creek was previously sampled by the Stream Biomonitoring Unit at the downstream site (Station 4) in 1995 (unpublished) and 1999 (Bode et al., 2000), when water quality was assessed as non-impacted, although nutrient enrichment was indicated. Diatom sampling at this site showed slight enrichment from nutrient and organic sources.

In the present study, water quality was assessed as non-impacted at all sites from above Pine Hill to Big Indian, indicating very good water quality (Figure 1). Macroinvertebrate communities at all sites were dominated by clean-water mayflies. At the most upstream site, Station 1, the fauna appeared to indicate residual headwater effects (see Appendix XI). Although three of the four water quality metrics were within the range of non-ipacted, species richness was within the range of moderate impact. This is a common characteristic of headwater sites. So species richness was determined to be an outlier at this site and' excluded from the profile calculation.

Possible sources of impact to Birch Creek include: Pine Hill village runoff, impoundment effects from the outlet of Pine Hill Lake, discharge from the NYCDEP Pine Hill (Village) Sewage Treatment Plant, and drainage from the Belleayre Ski Resort. None of these appeared to have a deleterious effect on the macroinvertebrate fauna of the stream, as non-impacted water quality was maintained at all downstream sites. Two additional possible sources of impact were discovered during the course of sampling: extensive clay additions downstream of Station 3, and several houses downstream of the Pine Hill (Vi11age) Sewage Treatment Plant that were not connected to the sewage system. Neither produced discernible effects in the macroinvertebrate fauna. Water quality of Birch Creek at Station 4 appeared similar to previous san1plings in 1995 and 1999, except that the present sampling did not show indications of nutrient enrichment that were evident then.. The reason may be related to flow. The summer of 1995 and 1999 were dry and low-flow compared to the rainy, high-flow summer of 2004, which diluted point sources more. An additional factor potentially affecting Birch Creek is a proposed development known as "The Belleayre Res011 at Catskill Park". The project includes 400 hotel rooms, 351 additional hotel and housing units, a 21-lot, single-family, residential subdivision, and two 18-hole golf courses. Most of the proposed development is within the Birch Creek watershed and new wastewater effluent would be discharged to Birch Creek.

An ongoing concern in Birch Creek, observed in the present survey, was the presence of red clay in the stream bank, on the stream bottom, and suspended in the water colun111. Small amounts of clay were evident at the upstream site and amounts increased downstream, especially immediately downstream of Station 3 below Pine Hill. Some of this was due to bank cave-ins caused by heavy rain three days prior to sampling, according to a local resident. This situation is likely to affect the biota and aesthetics of Birch Creek in the future, as well as that of Esopus Creek, which it joins 0.5 miles downstream of Station 4.

In addition to macroinvertebrate san1ples, ambient water san1ples were collected at each site for toxicity testing using *Ceriodaphnia dubia* (C. *dubia)* as the test subject. A 2 liter grab sample was collected at each site and immediately placed on wet ice. Then toxicity testing was performed as described in Appendix XII. Results for mean reproductive rates and survival of C. *dubia* are summarized and included in Table 1.

Table 1. Toxicity testing results from Birch Creek, 2004.

SAMPLE ID	MEAN REPRODUCTIVE RATE # YOUNG/ ♀//7 DAYS (% Control)	ADULT ♀ SURVIVAL (%)
BRCH-1	16.9 (64)	90
BRCH-2	13.2 (50)	90
BRCH-3	18.1 (69)	90
BRCH-4	20.5 (78)	100
HCFS Control	26.4 (100)	100

Chronic toxicity test results for all four Birch Creek samples indicate no significant reproductive or survival impairments to C. *dubia* at p=0.05 (as confirmed via ANOVA, Dunnett's and Fisher's Exact Tests), even though the mean reproductive rates and survival in most instances were lower than the laboratory water control. Also, no significant differences in reproductive rate (Tukey's Test p=0.05) or survival (Fisher's Exact Test p=0.05) occurred within Birch Creek sites. Downstream sites were experiencing some turbidity during sampling, apparently due to recent unearthing of large clay outcroppings, but it did not affect reproduction or survival of C. *dubia.* No significant aquatic toxicity was evidenced for any of the sites collected and tested along Birch Creek, either upstream or downstream of the Pine Hill Sewage Treatment Plant.

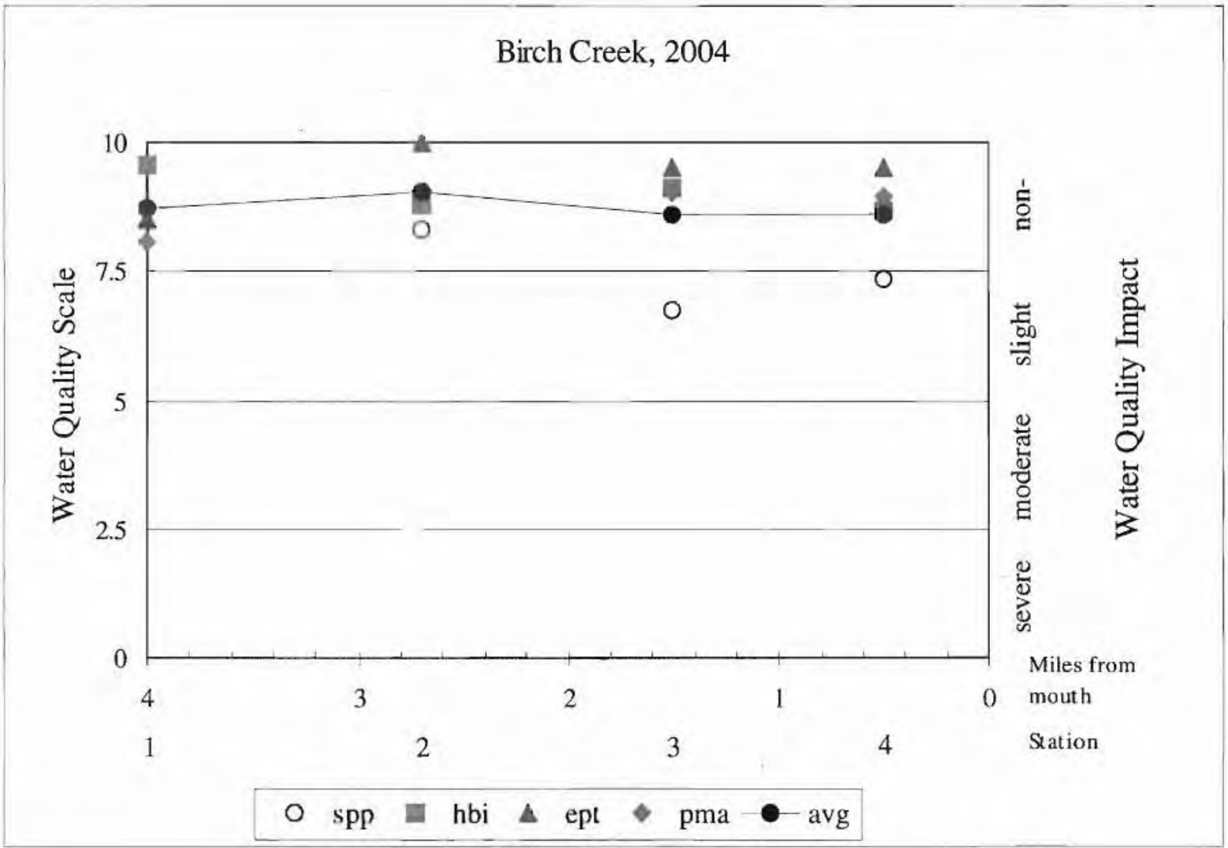
Literature cited

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.

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and S. Passy. 2000. Assessment of water quality of streams in the New York City watershed based on analysis of invertebrate tissues and invertebrate communities, Part II: 1999 sampling results. New York State Department of Environmental Conservation, Technical Report, 70 pages.

Bode, R. W., M. A. Novak, and L. E. Abele. 1990. Biological impairment criteria for flowing waters in New York State. New York State Department of Environmental Conservation, Tech. Report, 110 pages.

Figure 1. Biological Assessment Profile of index values, Birch Creek, 2004. Values represent average of three replicates at each site, plotted on a normalized scale of water quality. The line connects the mean of the four index values for each site, representing species richness*, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for a more complete explanation.



* For Station 1, species richness was determined to be an outlier and was excluded from the profile calculation. Refer back to the Discussion section for more Information

Overview of field data

On the date of sampling, June 29, 2004, Birch Creek at the sites sampled was 4-7 meters wide, 0.2 meters deep, and had current speeds of 83-100 cm/sec in riffles. Dissolved oxygen was 8.9-10.2 mg/l, specific conductance was 51-118 μmhos, pH was 6.5-7.1, and the temperature was 11.1-18.0 °C (52-64 °F). Measurements for each site are found on the field data summary sheets.

Table 2. Impact Source Determination, Birch Creek, 2004. Numbers represent similarity to macroinvertebrate community type models for each impact category. The highest similarities at each station are highlighted. Similarities below 50% are less conclusive. Highest numbers represent probable type of impact. See Appendix X for further explanation.

	Station			
Community Type	01	02	03	04
Natural: minimal human impacts	59	53	59	56
Nutrient additions; mostly nonpoint, agricultural	35	44	42	41
Toxic: industrial, municipal, or urban run-off	30	36	35	26
Organic: sewage, animal wastes	22	27	28	22
Complex: municipal and/or industrial	15	14	15	14
Siltation	31	30	41	36
Impoundment	20	29	27	26

TABLE SUMMARY

STATION	LOCATION	COMMUNITY TYPE
BRCH-01	above Pine Hill, NY	Natural
BRCH-02	Pine Hill, NY	Natural
BRCH-03	below Pine Hill, NY	Natural
BRCH-04	Big Indian, NY	Natural

Table 3. Station Locations for Birch Creek, Ulster County, New York

Sta. 01 above Pine Hill, NY
below Birch Creek Road bridge
4.0 miles above the mouth
Latitude/Longitude: 42°08'48"; 74°28'35"

Sta. 02 Pine Hill, NY
below Main Street bridge
2.7 miles above the mouth
Latitude/Longitude:
42°07'48"; 74°28'33"

Sta. 03 below Pine Hill, NY
off Route 28, above dirt road bridge
1.5 miles above the mouth
Latitude/Longitude: 42°07'09"; 74°27'38"

Sta. 04 Big Indian, NY
above Lasher Road bridge
0.5 miles above the mouth
Latitude/Longitude:
42°06'28"; 74°27'03"

Figure 2 | Site Location Map | Birch Creek

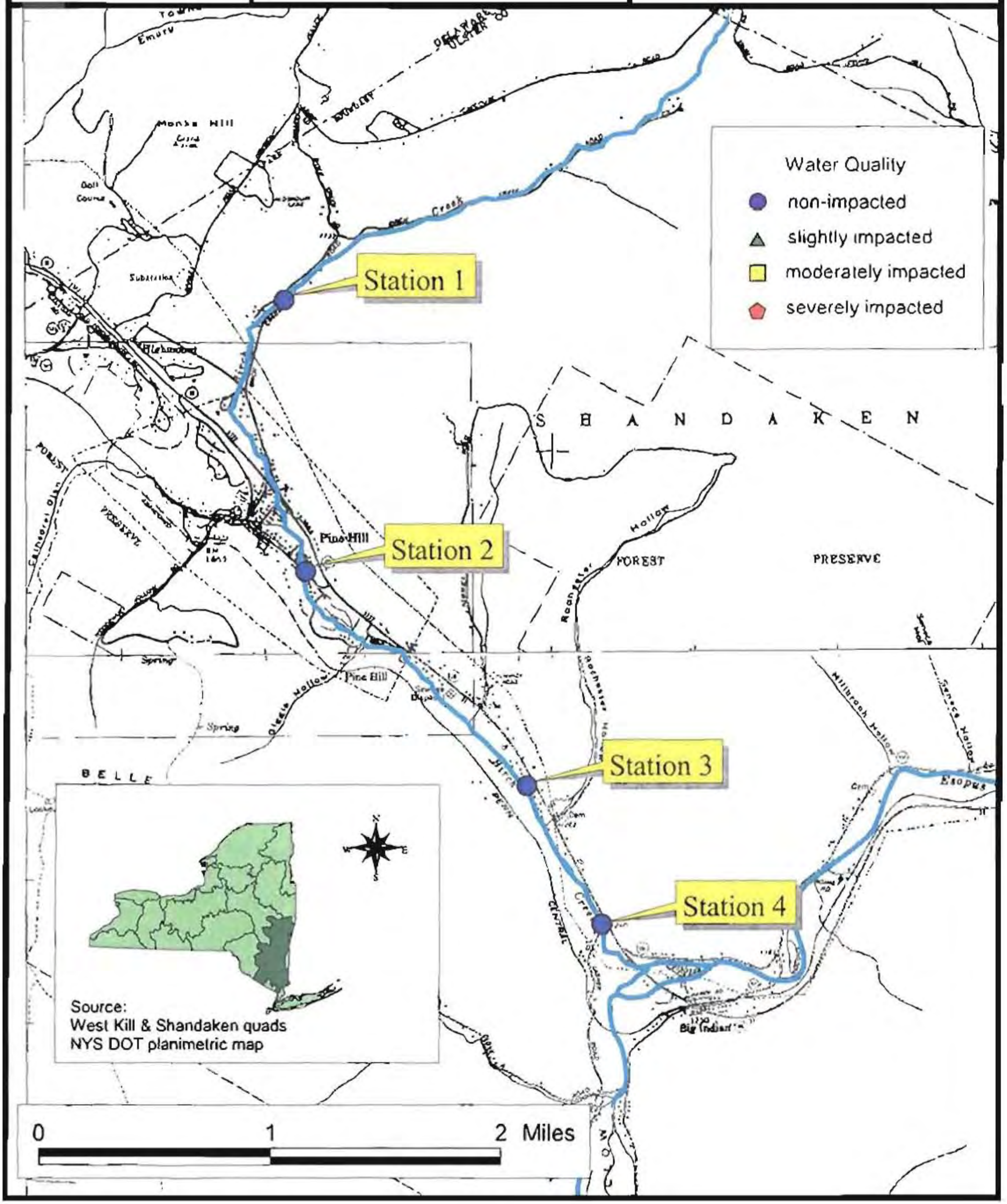


Table 4. Macroinvertebrate Species Collected in Birch Creek, Ulster County, New York, 2004.

PLATYHELMINTHES
- TURBELLARIA
  - Planariidae
    - Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - LUMBRICIDA
    - Undetermined Lumbricina
  - LUMBRICULIDA
    - Lumbriculidae
      - Stylodrilus heringianus
      - Undetermined Lumbriculidae
  - TUBIFICIDA
    - Enchytraeidae
      - Undetermined Enchytraeidae

MOLLUSCA
- PELECYPODA
  - Sphaeriidae
    - *Sphaerium* sp.

ARTHROPODA
- INSECTA
  - EPHEMEROPTERA
    - Isonychiidae
      - *Isonychia bicolor*
    - Baetidae
      - *Acentrella* sp.
      - *Baetis brunneicolor*
      - *Baetis flavistriga*
      - *Baetis intercalaris*
      - *Baetis* sp.
      - *Plauditus* sp.
    - Heptageniidae
      - *Epeorus (Iron)* sp.
      - *Stenacron interpunctatum*
    - Leptophlebiidae
      - *Paraleptophlebia guttata*
      - *Paraleptophlebia mollis*
      - *Paraleptophlebia* sp.
    - Ephemerellidae
      - *Drunella cornuta*
      - *Ephemerella dorothea*
      - *Serratella deficiens*
  - PLECOPTERA
    - Capniidae
      - Undetermined Capniidae
    - Leuctridae
      - *Leuctra* sp.
      - Undetermined Leuctridae
    - Nemouridae
      - *Amphinemura* sp.
      - Undetermined Nemouridae
    - Perlidae
      - *Agnetina capitata*
      - *Paragnetina immarginata*
      - Undetermined Perlidae
    - Peltoperlidae
      - *Tallaperla* sp.
    - Chloroperlidae
      - Undetermined Chloroperlidae
    - Perlodidae
      - *Isoperla holochlora*
      - *Isoperla* sp.
      - Undetermined Perlodidae
    - Pteronarcidae
      - *Pteronarcys proteus*
      - *Pteronarcys* sp.
  - COLEOPTERA
    - Elmidae
      - *Optioservus ovalis*
      - *Optioservus* sp.
      - *Promoresia tardella*
      - *Stenelmis* sp.
  - TRICHOPTERA
    - Philopotamidae
      - *Dolophilodes* sp.
    - Psychomyiidae
      - *Lype diversa*
    - Polycentropodidae
      - *Neureclipsis* sp.
    - Hydropsychidae
      - Cheumatopsyche sp.
      - *Hydropsyche sparna*
      - *Hydropsyche slossonae*
    - Rhyacophilidae
      - *Rhyacophila carolina?*
      - *Rhyacophila fuscula*
      - *Rhyacophila* sp.
    - Hydroptilidae
      - Undetermined Hydroptilidae
    - Brachycentridae
      - *Brachycentrus solomoni*
      - *Brachycentrus* sp.
      - *Micrasema* sp.
      - Undetermined Brachycentridae
    - Glossosomatidae
      - *Glossosoma* sp.
    - Limnephilidae
      - Undetermined Limnephilidae
    - Lepidostomatidae
      - *Lepidostoma* sp.

Table 4. Macroinvertebrate Species Collected in Birch Creek, Ulster County, New York, 2004, cont'd.

DIPTERA
- Tipulidae
  - *Antocha* sp.
  - *Hexatoma* sp.
- Simuliidae
  - *Simulium parnassum*
  - *Simulium pictipes*
  - *Simulium tuberosum*
  - *Simulium* sp.
- Empididae
  - *Chelifera* sp.
  - *Wiedemannia* sp.
- Chironomidae
  - *Thienemannimyia* gr. spp.
  - *Diamesa* sp.
  - *Pagastia orthogonia*
  - *Potthastia gaedii* gr.
  - *Brillia flavifrons*
  - *Brillia* sp.
  - *Cardiocladius obscurus*
  - *Cricotopus vierriensis*
  - *Eukiefferiella brehmi* gr.
  - *Eukiefferiella claripennis gr.*
  - *Eukiefferiella devonica gr.*
  - *Eukiefferiella pseudomontana gr.*
  - *Orthocladius dubitatus*
  - *Orthocladius* sp.
  - *Orthocladius (Euorthoclad.)* sp.
  - *Parametriocnemus lundbecki*
  - *Tvetenia bavarica* gr.
  - Undetermined Orthocladiinae
  - *Endochironomus nigricans*
  - *Microtendipes rydalensis gr.*
  - *Microtendipes pedellus gr.*
  - *Polypedilum aviceps*
  - Undetermined Chironomini
  - *Micropsectra dives gr.*
  - *Micropsectra* sp.
  - *Tanytarsus glabrescens gr.*
  - *Tanytarsus guerlus gr.*
  - *Tanytarsus* sp.
  - *Rheotanytarsus exiguus* gr.

STREAM SITE:	Birch Creek	Station 01			
LOCATION:	Above Pine Hill, NY	below Birch Creek Road bridge			
DATE:	29 June 2004				
SAMPLE TYPE:	Kick sample				
SUBSAMPLE:	100 individuals				
			A	B	C
ANNELIDA					
OLIGOCHAETA					
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	~	~	3
TUBIFICIDA	Enchytraeidae	Undetermined Enchytraeidae	1	~	~
ARTHROPODA					
INSECTA					
EPHEMEROPTERA	Baetidae	*Acentrella sp.*	1	10	11
		Baetis flavistriga	3	13	17
		Baetis intercalaris	4	~	1
		Plauditus sp.	14	16	21
	Heptageniidae	*Epeorus (Iron) sp.*	24	8	5
	Leptophlebiidae	*Paraleptophlebia sp.*	2	3	1
	Ephemerellidae	*Drunella cornuta*	16	16	20
		Ephemerella dorothea	1	~	1
PLECOPTERA	Leuctridae	Undetermined Leuctridae	1	2	~
	Perlidae	Undetermined Perlidae	1	1	~
	Pteronarcidae	*Pteronarcys proteus*	4	2	~
TRICHOPTERA	Philopotamidae	*Dolophilodes sp.*	5	7	2
	Rhyacophilidae	*Rhyacophila fuscula*	5	4	2
		Rhyacophila sp.	~	~	3
	Glossosomatidae	*Glossosoma sp.*	~	1	~
DIPTERA	Tipulidae	*Hexatoma sp.*	~	1	~
	Empididae	*Wiedemannia sp.*	~	1	~
	Chironomidae	*Thienemannimyia gr. spp.*	~	2	~
		Diamesa sp.	~	~	1
		Orthocladius sp.	1	~	~
		Eukiefferiella pseudomontana gr.	~	~	1
		Tvetenia bavarica gr.	2	~	1
		Polypedilum aviceps	11	10	4
		Undetermined Chironomini	1	~	~
		Micropsectra dives gr.	~	1	~
		Micropsectra sp.	3	2	6
SPECIES RICHNESS:			19	18	17
BIOTIC INDEX:			1.93	2.40	2.96
EPT RICHNESS:			13	12	11
MODEL AFFINITY:			74	72	63
ASSESSMENT:			non-	non-	non-

DESCRIPTION: The sampling site was downstream of the Birch Creek Road bridge. The habitat was considered excellent, and many species of mayflies, stoneflies, and caddisflies were found. Red clay deposits were noted along the north streambank. Small brown trout were found in some of the kick samples. Due to influence of headwater effect, the species richness values at this site were determined to be outliers and were excluded from the calculation of profile values. Based on the other 3 metrics, water quality was assessed as non-impacted.

STREAM SITE: Birch Creek Station 02
LOCATION: Pine Hill, NY Below Main Street bridge
DATE: 29 June 2004
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

			A	B	C
PLATYHELMINTHES					
TURBELLARIA					
	Planariidae	Undetermined Turbellaria	~	~	1
ANNELIDA					
OLIGOCHAETA					
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	~	3	~
MOLLUSCA					
PELECYPODA					
	Sphaeriidae	*Sphaerium sp.*	1	~	~
ARTHROPODA					
INSECTA					
EPHEMEROPTERA	Baetidae	*Acentrella sp.*	17	4	17
		Baetis brunneicolor	1	~	~
		Baetis flavistriga	5	~	~
		Baetis sp.	8	3	7
		Plauditus sp.	7	3	9
	Heptageniidae	*Epeorus (Iron) sp.*	6	14	5
		Stenacron interpunctatum	~	~	1
	Leptophlebiidae	*Paraleptophlebia guttata*	1	~	~
		Paraleptophlebia mollis	1	1	1
	Ephemerellidae	*Drunella cornuta*	10	21	6
		Ephemerella dorothea	1	2	2
PLECOPTERA	Capniidae	Undetermined Capniidae	~	3	1
	Leuctridae	*Leuctra sp.*	1	~	~
		Undetermined Leuctridae	~	~	2
	Nemouridae	*Amphinemura sp.*	~	1	~
		Undetermined Nemouridae	~	~	4
	Perlidae	Undetermined Perlidae	~	1	~
	Peltoperlidae	*Tallaperla sp.*	~	~	2
	Perlodidae	*Isoperla sp.*	1	~	~
		Undetermined Perlodidae	~	~	2
	Pteronarcidae	*Pteronarcys proteus*	~	1	~
		Pteronarcys sp.	~	~	1
COLEOPTERA	Elmidae	*Promoresia tardella*	~	1	1
TRICHOPTERA	Philopotamidae	*Dolophilodes sp.*	5	3	2
	Psychomyiidae	*Lype diversa*	~	1	~
	Polycentropodidae	*Neureclipsis sp.*	~	1	1
	Rhyacophilidae	*Rhyacophila fuscula*	2	~	~
	Brachycentridae	*Micrasema sp.*	~	1	~
		Undetermined Brachycentridae	~	~	2
DIPTERA	Tipulidae	*Antocha sp.*	1	~	~
	Simuliidae	*Simulium parnassum*	1	~	2
		Simulium tuberosum	14	14	11

STREAM SITE:	Birch Creek	Station 02			
LOCATION:	Pine Hill, NY	Below Main Street bridge			
DATE:	29 June 2004				
SAMPLE TYPE:	Kick sample				
SUBSAMPLE:	100 individuals				
			A	B	C
DIPTERA	Empididae	*Chelifera sp.*	~	1	1
		Wiedemannia sp.	1	~	~
	Chironomidae	*Thienemannimyia gr. spp.*	~	~	1
		Pagastia orthogonia	1	~	~
		Brillia flavifrons	~	~	1
		Brillia sp.	~	2	~
		Cricotopus vierriensis	3	~	~
		Eukiefferiella brehmi gr.	2	3	~
		Eukiefferiella claripennis gr.	~	2	2
		Eukiefferiella devonica gr.	~	2	1
		Eukiefferiella pseudomontana gr.	1	~	~
		Parametriocnemus lundbecki	2	~	~
		Tvetenia bavarica gr.	2	2	5
		Endochironomus nigricans	~	2	~
		Microtendipes rydalensis gr.	~	~	2
		Polypedilum aviceps	~	2	3
		Micropsectra dives gr.	1	4	~
		Micropsectra sp.	~	~	2
		Tanytarsus glabrescens gr.	~	~	2
		Tanytarsus guerlus gr.	4	~	~
		Tanytarsus sp.	~	2	~
SPECIES RICHNESS:			27	28	31
BIOTIC INDEX:			3.35	2.76	3.51
EPT RICHNESS:			14	15	17
MODEL AFFINITY:			75	85	80
ASSESSMENT:			non-	non-	non-

DESCRIPTION: The kick samples were taken downstream of the Main Street bridge in Pine Hill. The fauna was dominated by clean-water mayflies, although more worms and black flies were noted compared to Station 1. Impact Source Determination indicated mild nutrient enrichment. All metrics were within the range of non-impacted water quality.

STREAM SITE: Birch Creek Station 03
LOCATION: below Pine Hill, NY Off Route 28
DATE: 29 June 2004
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

			A	B	C
ANNELIDA					
OLIGOCHAETA					
LUMBRICIDA		Undetermined Lumbricina	~	~	1
LUMBRICULIDA	Lumbriculidae	*Stylodrilus heringianus*	~	~	1
		Undetermined Lumbriculidae	~	4	5
ARTHROPODA					
INSECTA					
EPHEMEROPTERA	Baetidae	*Acentrella sp.*	15	6	11
		Baetis brunneicolor	~	1	~
		Baetis flavistriga	3	~	1
		Baetis intercalaris	2	~	~
		Baetis sp.	3	4	13
		Plauditus sp.	1	~	2
	Heptageniidae	*Epeorus (Iron) sp.*	13	13	4
		Stenacron interpunctatum	1	1	~
	Leptophlebiidae	*Paraleptophlebia mollis*	1	2	4
	Ephemerellidae	*Drunella cornuta*	15	17	5
		Ephemerella dorothea	8	12	8
PLECOPTERA	Capniidae	Undetermined Capniidae	2	~	1
	Leuctridae	Undetermined Leuctridae	4	2	4
	Perlidae	*Agnetina capitata*	~	~	1
		Paragnetina immarginata	1	~	~
		Undetermined Perlidae	2	~	~
	Peltoperlidae	*Tallaperla sp.*	~	2	~
COLEOPTERA	Elmidae	*Optioservus sp.*	~	2	~
		Stenelmis sp.	~	~	4
TRICHOPTERA	Hydropsychidae	*Hydropsyche slossonae*	~	~	1
	Rhyacophilidae	*Rhyacophila carolina?*	~	1	~
		Rhyacophila fuscula	~	1	~
	Brachycentridae	*Brachycentrus sp.*	1	~	~
	Glossosomatidae	*Glossosoma sp.*	1	~	~
	Limnephilidae	Undetermined Limnephilidae	1	~	~
DIPTERA	Simuliidae	*Simulium parnassum*	~	1	~
		Simulium tuberosum	10	11	10
	Chironomidae	*Thienemannimyia gr. spp.*	~	1	2
		Cardiocladius obscurus	~	1	~
		Eukiefferiella claripennis gr.	1	1	~
		Eukiefferiella devonica gr.	1	4	~
		Eukiefferiella pseudomontana gr.	~	~	2
		Orthocladius (Euorthoclad.) sp.	1	~	~
		Parametriocnemus lundbecki	~	~	2
		Tvetenia bavarica gr.	1	2	2
		Undetermined Orthocladiinae	~	~	2

STREAM SITE:	Birch Creek	Station 03			
LOCATION:	below Pine Hill, NY	Off Route 28			
DATE:	29 June 2004				
SAMPLE TYPE:	Kick sample				
SUBSAMPLE:	100 individuals				
			A	B	C
DIPTERA	Chironomidae	*Microtendipes rydalensis gr.*	-	1	-
		Microtendipes pedellus gr.	3	-	-
		Polypedilum aviceps	8	8	14
		Micropsectra sp.	1	2	-
SPECIES RICHNESS:			25	24	23
BIOTIC INDEX:			2.57	2.46	3.63
EPT RICHNESS:			17	12	12
MODEL AFFINITY:			74	82	85
ASSESSMENT:			non-	non-	non-

DESCRIPTION: This sampling site was approximately 0.8 miles downstream of Pine Hill Lake, and less than 0.5 miles downstream of the discharge of the NYCDEP Pine Hill (V) Sewage Treatment Plant. Access was off Route 28 at a mattress store. Approximately 20 meters downstream of the sampling site, the streambank cut into a bank of red clay, exposed by recent rains and high-flows. The stream bottom at the kick also included red clay and silt on the rocks. Many worms were noted on the nets, but these did not make up a large percentage of the processed samples. Species richness was lower than at the upstream site, but overall water quality was assessed as non-impacted based on the average of the metrics.

STREAM SITE:	Birch Creek	Station 04
LOCATION:	Below Pine Hill, NY	Above Lasher Road bridge
DATE:	29 June 2004	
SAMPLE TYPE:	Kick sample	
SUBSAMPLE:	100 individuals	

			A	B	C
ANNELIDA					
OLIGOCHAETA					
LUMBRICIDA		Undetermined Lumbricina	~	1	~
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	2	1	1
ARTHROPODA					
INSECTA					
EPHEMEROPTERA	Isonychiidae	*Isonychia bicolor*	1	~	~
	Baetidae	*Acentrella sp.*	13	3	21
		Baetis flavistriga	~	~	7
		Baetis sp.	8	9	7
		Plauditus sp.	4	1	1
	Heptageniidae	*Epeorus (Iron) sp.*	1	2	2
		Stenacron interpunctatum	2	~	~
	Leptophlebiidae	*Paraleptophlebia mollis*	3	5	2
	Ephemerellidae	*Drunella cornuta*	3	10	6
		Ephemerella dorothea	13	13	7
		Serratella deficiens	3	1	1
PLECOPTERA	Leuctridae	Undetermined Leuctridae	~	2	~
	Chloroperlidae	Undetermined Chloroperlidae	1	~	~
	Perlodidae	*Isoperla holochlora*	~	~	1
		Isoperla sp.	~	1	
COLEOPTERA	Elmidae	*Optioservus ovalis*	~	~	1
		Optioservus sp.	~	2	~
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche sp.*	~	1	~
		Hydropsyche slossonae	1	2	~
		Hydropsyche sparna	~	1	~
	Rhyacophilidae	*Rhyacophila carolina?*	1	~	~
	Hydroptilidae	Undetermined Hydroptilidae	1	~	~
	Brachycentridae	*Brachycentrus solomoni*	~	~	6
		Undetermined Brachycentridae	4	3	~
	Limnephilidae	Undetermined Limnephilidae	1	~	~
	Lepidostomatidae	*Lepidostoma sp.*	~	1	
DIPTERA	Simuliidae	*Simulium pictipes*	~	~	8
		Simulium tuberosum	6		4
		Simulium sp.	~	6	~
	Chironomidae	*Thienemannimyia gr. spp.*	~	1	~
		Potthastia gaedii gr.	1	3	4
		Brillia flavifrons	~	2	~
		Cricotopus vierriensis	2	1	1
		Eukiefferiella devonica gr.	1	4	~
		Eukiefferiella pseudomontana gr.	~	1	1
		Orthocladius dubitatus	2	~	~
		Parametriocnemus lundbecki	1	2	~

STREAM SITE:	Birch Creek	Station 04
LOCATION:	Below Pine Hill, NY	Above Lasher Road bridge
DATE:	29 June 2004	
SAMPLE TYPE:	Kick sample	
SUBSAMPLE:	100 individuals	

			A	B	C
DIPTERA	Chironomidae	*Tvetenia bavarica gr.*	2	1	~
		Polypedilum aviceps	20	19	18
		Micropsectra dives gr.	1	1	~
		Micropsectra polita	1	~	~
		Micropsectra sp.	1	~	~
		Rheotanytarsus exiguus gr.	~	~	1
SPECIES RICHNESS:			28	29	20
BIOTIC INDEX:			3.54	3.14	3.35
EPT RICHNESS:			16	15	11
MODEL AFFINITY:			77	81	79
ASSESSMENT:			non-	non-	non-

DESCRIPTION: The kick samples were taken approximately 30 meters upstream of the Lasher Road bridge. The water was turbid from the upstream red clay, and many tubificid-like worms were found in the nets. However,all metrics were within the range of non-impacted water quality.

FIELD DATA SUMMARY

STREAM NAME: Birch Creek		DATE SAMPLED: 6/29/2004		
REACH: Above Pine Hill to Big Indian				
FIELD PERSONNEL INVOLVED: Abele, Bode, Wright				
STATION	01	02	03	04
ARRIVAL TIME AT STATION	10:30	11:00	1:05	1:40
LOCATION	Birch Creek Rd Above Pine Hill	Main St. Pine Hill	Rte 28 Below Pine Hill	Above Lasher Rd Big Indian
PHYSICAL CHARACTERISTICS				
Width (meters)	4	4	5	7
Depth (meters)	0.2	0.2	0.2	0.2
Current speed (cm per sec.)	83	85	100	90
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	10	10	10
Rubble (6.35 - 25.4 cm)	30	40	40	40
Gravel (0.2 – 6.35 cm)	30	20	20	20
Sand (0.06 – 2.0 mm)	20	10	10	10
Silt (0.004 – 0.06 mm)	10	20	20	20
Embeddedness (%)	40	30	30	30
CHEMICAL MEASUREMENTS				
Temperature (°C)	11.1	12.4	17.8	18.0
Specific Conductance (umhos)	51	118	114	105
Dissolved Oxygen (mg/l)	10.1	10.2	8.9	9.8
pH	6.7	6.9	6.5	7.1
BIOLOGICAL ATTRIBUTES				
Canopy (%)	30	20	10	90
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous				
algae - diatoms	X			
macrophytes or moss		X		
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	X
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)				
Megalopteradobsonflies, alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X			
Simuliidae (black flies)		X	X	
Decapoda (crayfish)		X		
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)		X	X	X
Other				
FAUNAL CONDITION	Very good	Very good	Very good	Very good

BIOLOGICAL METHODS FOR KICK SAMPLING

A. Rationale. The use of the 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 meters 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 a 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 the dislodged organisms are carried into the net. Sampling is continued for a specified time and for a specified distance in the stream. Rapid assessment sampling specifies sampling five minutes for a distance of five meters. The net contents are emptied into a pan of stream water. The contents are then examined, and the 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% 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 stereo microscope 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 is 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.

MACROINVERTEBRATE COMMUNITY PARAMETERS

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

3. Hilsnhoff Biotic index is a measure of the tolerance of the organisms in the 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 purposes of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. 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 the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, non-impacted; 4.5 1-6.50, slightly impacted; 6.5 1-8.50, moderately impacted; and 8.51 - 10.00, severely impacted.

4. Percent Model Affinity is 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, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. NY S DEC technical report, 89 pp.

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 DEM Tech. Report. 12 pp.

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.

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 Macroinvertebrate Community Parameters Appendix*). 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-organism 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 less. Percent model affinity is greater than 64. 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.

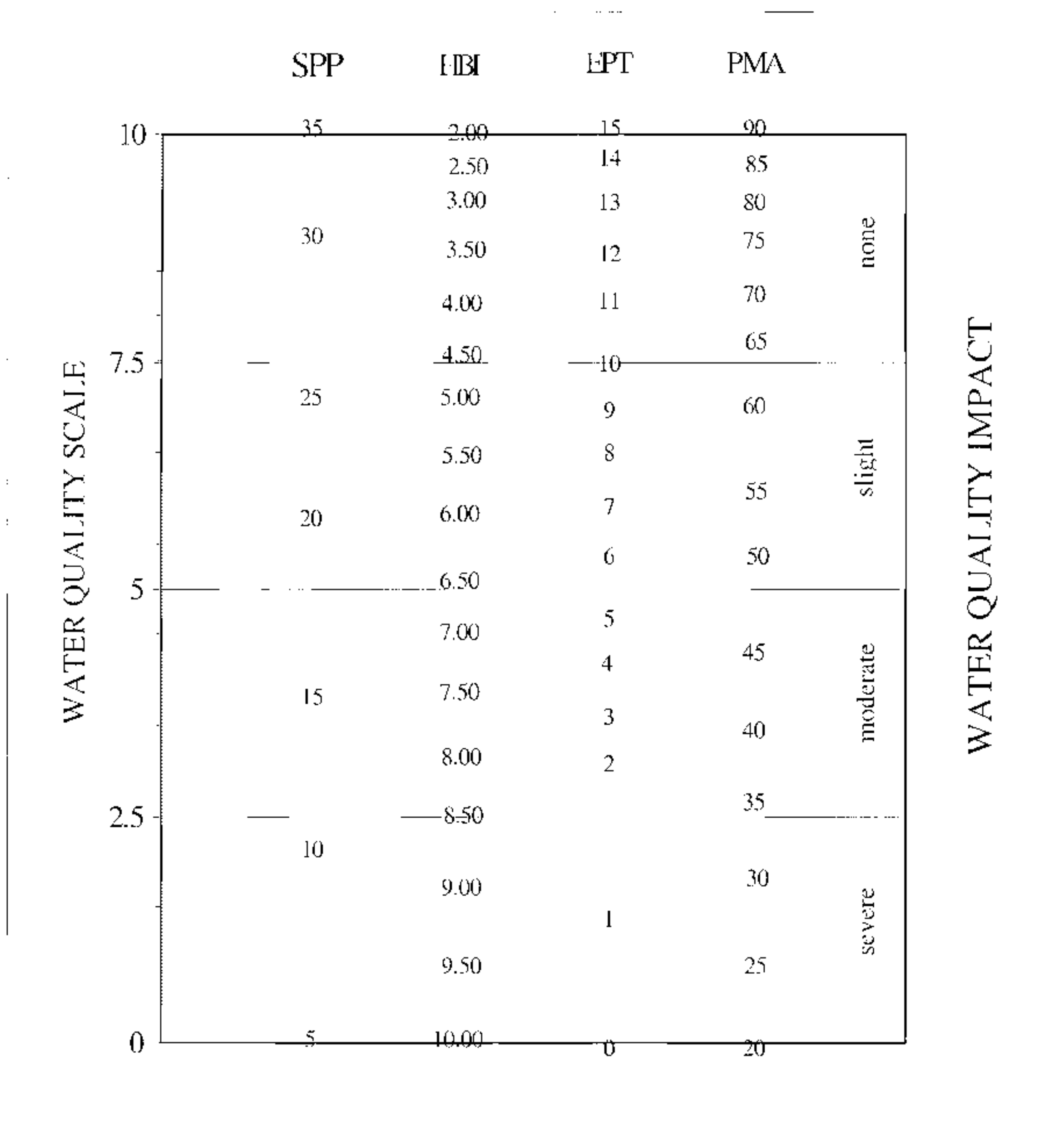
2. *Slightly impacted* Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. 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 usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT richness is 2-5. The biotic index value is 6.51- 8.50. The percent model affinity value is 35-49. 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 less. 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 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.

Biological Assessment Profile: Conversion of Index values to 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 the Macroinvertebrate Community Parameter Appendix, 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.



Biological Assessment Profile: Plotting Values

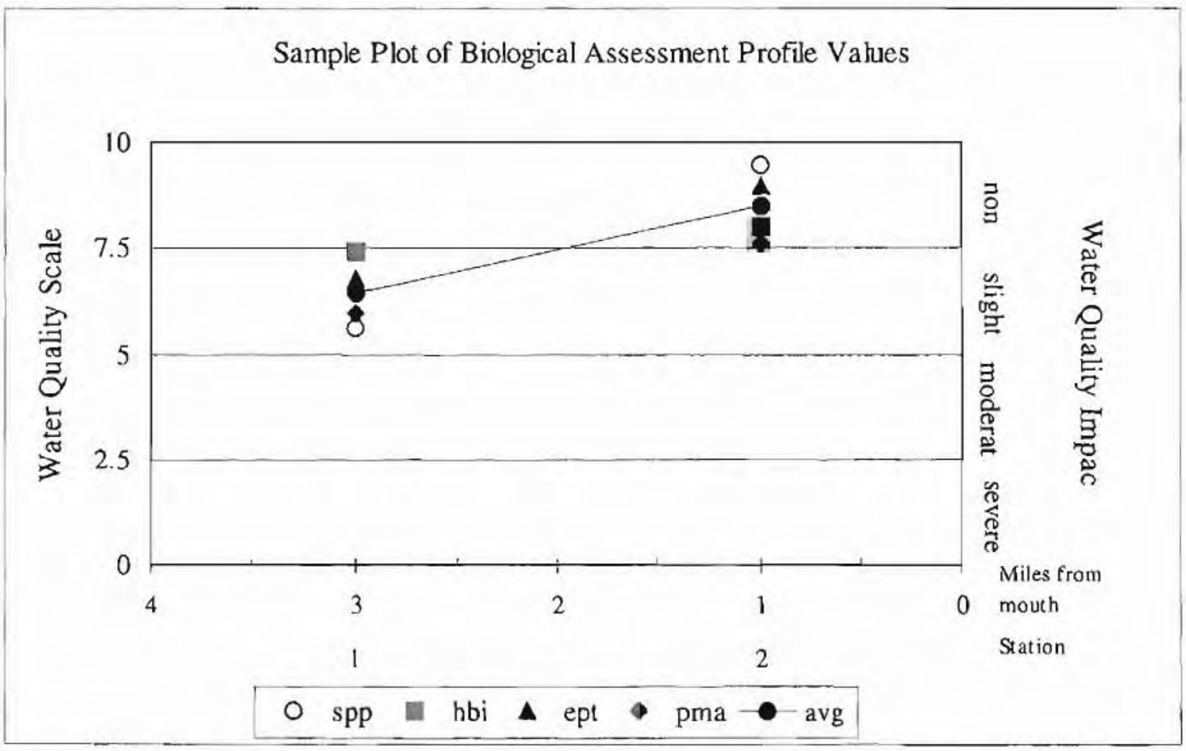
To plot survey data:

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	5.00	7.40	4.00	8.00
EPT richness	9	6.80	13	9.00
Percent model affinity	55	5.97	65	7.60
Average		6.44 (slight)		8.51 (non-)

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



Water Quality Assessment Criteria

Water Quality Assessment Criteria for Non-Navigable Flowing Waters

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

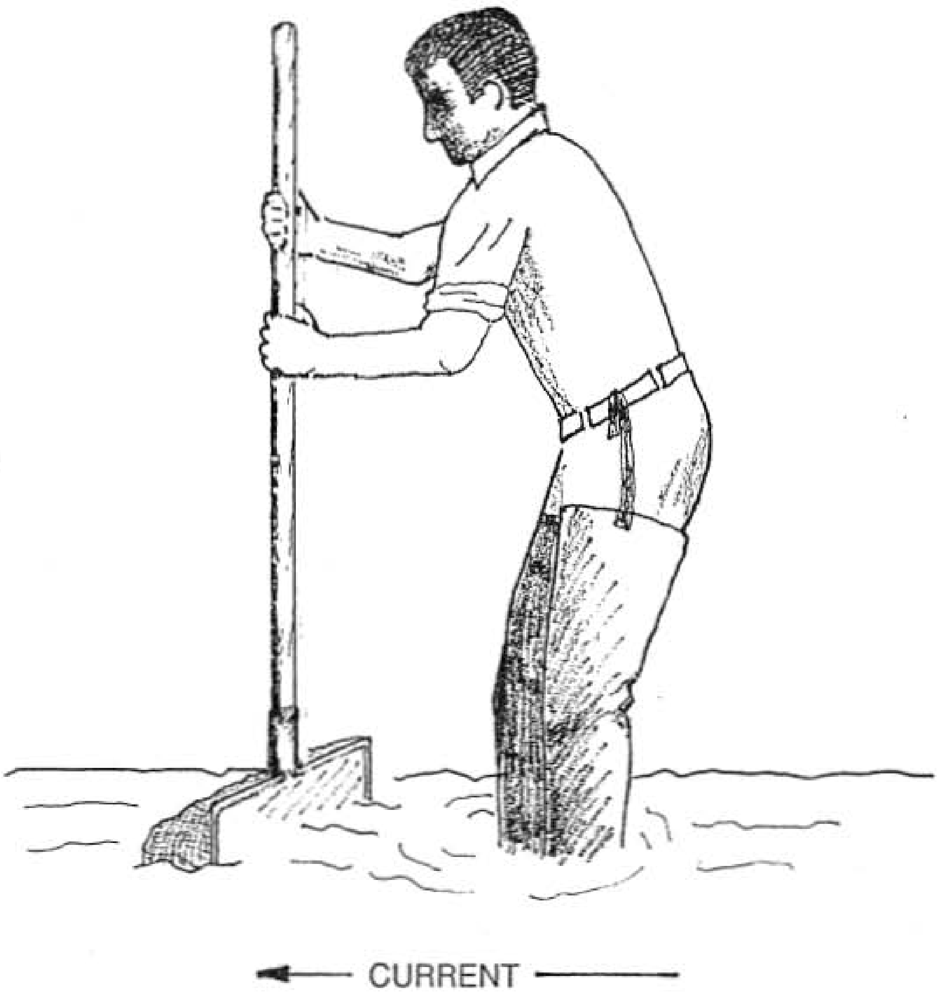
Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.
* Diversity criteria are used for multiplate samples but not for traveling kick samples.

Water Quality Assessment Criteria for Navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	EPT Richness	Species 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.

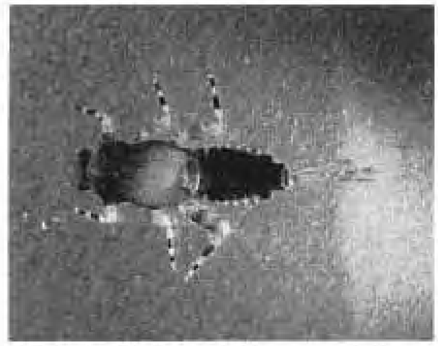
THE TRAVELING KICK SAMPLE



Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current in the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

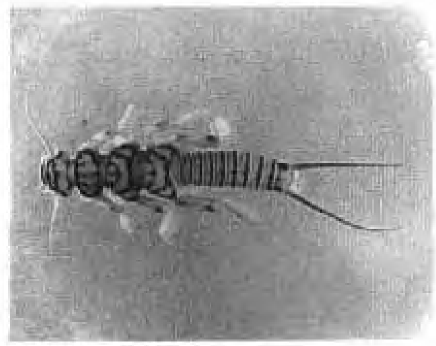
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

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.



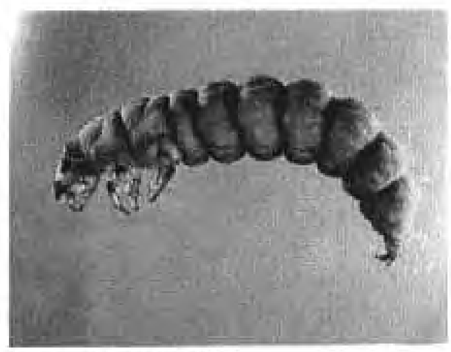
MAYFLIES

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.



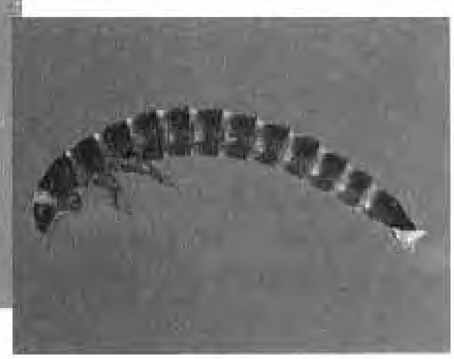
STONEFLIES

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 and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.



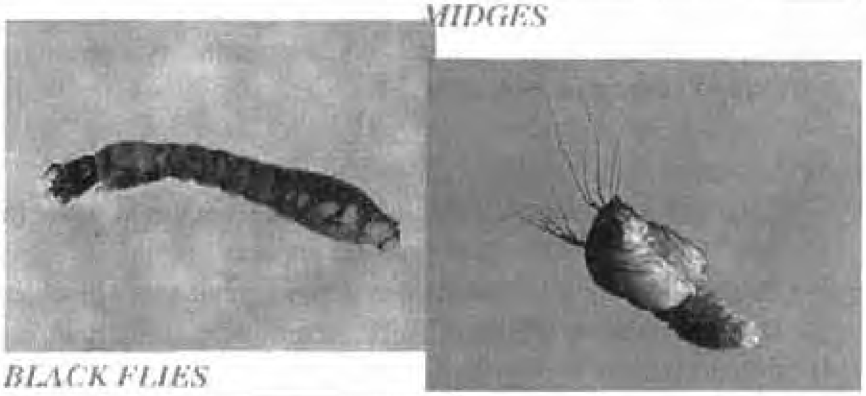
BEETLES

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

Midges are the most common aquatic flies. The 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.

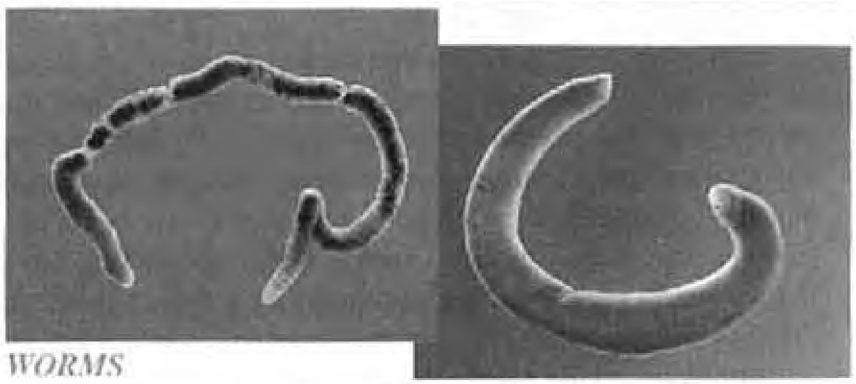
MIDGES

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.



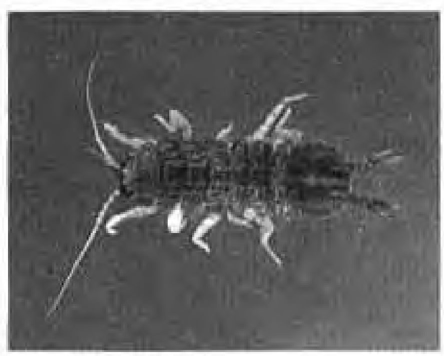
BLACK FLIES

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.

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:

1) they are sensitive to environmental impacts
2) they are less mobile than fish, and thus cannot avoid discharges
3) they can indicate effects of spills, intermittent discharges, and lapses in treatment
4) they are indicators of overall, integrated water quality, including synergistic effects and substances lower than detectable limits
5) they are abundant in most streams and are relatively easy and inexpensive to sample
6) they are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
7) they are vital components of the aquatic ecosystem and important as a food source for fish
8) they are more readily perceived by the public as tangible indicators of water quality
9) they can often provide ail on-site estimate of water quality
10) they can often be used to identify specific stresses or sources of impairment
11) they can be preserved and archived for decades, allowing for direct comparison of specimens
12) they 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.

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 (**E**phemeroptera), stoneflies (**P**lecoptera), and caddisflies (**Tr**ichoptera) 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 time; usually involves kick sampling and laboratory subsampling of the sample

Riffle: wadeable stretch of stream usually having a rubble bottom and sufficient current to break the water surface; 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

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.

Impact Source Determination Models

NATURAL

	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	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia	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
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
Psephenus	5	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	5	-	20	5	5	-	5	5	5	5	-	-	-
Promoresia	5	-	-	-	-	-	25	-	-	-	-	-	-
Stenelmis	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	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	5	-	-	10	-	-	5	-	-	5	5	5
Eukiefferiella/ Tvetenia	5	5	10	-	-	5	5	5	-	5	-	5	5
Parametriocnemus	-	-	-	-	-	-	-	5	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	20	-	-	10	20	20	5	-
Polypedilum (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

Impact Source Determination Models

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
Isonychia	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
Caenis/Tricorythodes	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-
Optioservus	10	-	-	5	-	-	15	5	-	5
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Microtendipes	-	-	-	-	-	-	-	-	-	20
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

	MUNICIPAL/INDUSTRIAL								TOXIC					
	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
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	10	20	-	5	10	5	5	15	10	25	10	5	10
Eukiefferiella/ Tvetenia	-	-	-	-	-	-	-	-	-	-	20	10	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

SEWAGE EFFLUENT, ANIMAL WASTES

	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	-	-
Isonychia	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE										
Tanypodinae	-	5	-	-	-	-	-	-	5	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	60
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

	SILTATION					IMPOUNDMENT									
	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	-
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Optioservus	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-	-	-	-	-	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
Eukiefferiella/ Tvetenia	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

CHARACETERISTICS OF HEADWATER STREAMS SITES

Headwater stream sites are defined as first-order or second-order stream locations close to the stream source, usually less than three miles. The natural characteristics of headwaters may sometimes result in an erroneous assessment of impacted water quality.

1) Headwater sites have reduced upstream recruitment resource populations to provide colonization by drift, and may have reduced species richness.

2) Headwater sites usually are nutrient-poor, lower in food resources, and less productive.

3) The reduced, simplified fauna of headwater sites may result in a community in which a few intolerant species may be very abundant. For 100-organism subsamples, this can affect many community indices: species richness, EPT richness, and percent model affinity. The dominant species averages 37% of the total fauna, and is an intolerant mayfly (e.g., Epeorus, Paraleptophlebia, Stenonema), stonefly (e.g., Leuctridae or Capniidae), caddisfly (e.g., Brachycentrus, Dolophilodes, or Chimarra), or riffle beetle (e.g., Optioservus or Promoresia).

4) Although headwater stream invertebrate communities are dominated by intolerant species, many community indices are low. Average index values are: species richness - 19, EPT richness - 8, Hilsenhoff biotic index - 3.05, and percent model affinity - 57. These indices are based on headwaters of a number of streams across New York State.

5) Recommended corrective action for non-representative indices from headwater sites: a correction factor of 1.5 may be applied to species richness, EPT richness, and percent model affinity. Criteria for the use of the correction factor are: the headwater location is as described above, the community is dominated by intolerant species, and the above indices (species richness, EPT richness, and percent model affinity) are judged to be non-representative of actual water quality. Alternatively, index values may be maintained, and the overall assessment may be adjusted up to non-impacted if the above criteria are met.

Biological Methods for Toxicity Testing

A. Rationale

Toxicity testing measures the chronic toxicity of ambient water to the aquatic invertebrate *Ceriodaphnia dubia* (C. *dubia)* by determining if the survival and reproductive rate of the test organisms differ from the control. Toxicity testing is routinely used to screen NYS ambient water samples for chronic toxicity.

B. Sampling

One 2-iter grab sample is collected in a polyethylene bottle from the water column at each site. The bottle is rinsed three times prior to collection of the final sample for testing. Sample labels are affixed indicating location, RIBS# and collection date and time. Samples are then stored in coolers on wet ice and shipped within 36 hours of collection to the Hale Creek Field Station (HCFS) Toxicity Testing Unit, (TTU), where they are stored in a walk-in cooler at 0-5°C until test set-up.

C. Testing

A modified 7 day (± 1) chronic toxicity test using water flea C. *dubia* as the test subject is performed on the ambient water samples and an external laboratory water control (HCFS culture water), according to the TTU's Standard Operating Procedure*. Prior to test set-up, samples are warmed to the test temperature of 25° C (±2°). Ambient water samples and the control are setup on trays in groups often. A repeat pipettor is used to measure 15 ml aliquots into each of ten 30 ml polystyrene cups. Sample dilutions are unnecessary since ambient water samples and not effluents are being tested. Under a dissecting microscope, C. *dubia* young <24 hours old are distributed individually by pipette (l/cup) into each of the ten sample cups including the control. Sample water is changed on days 3 and 5, and organisms are fed daily with 0.1 ml each of YCT (Yeast, Cerophyl® and Trout Chow) and green algae *Selenastrum capricornutum.* Conductivity, dissolved oxygen, pH and temperature are measured and recorded prior to transferring the adult female to a new cup containing fresh sample. Survival and reproduction are monitored and recorded each day.

D. Data analysis

Data are analyzed using ANOVA and Dunnett' s Tests to determine if there are any statistically significant differences in reproduction from the control elicited by any of the samples (p=0.05). Fisher's Exact Test is used to determine if there are any statistically significant differences in survival from the control in any of the samples (p=0.05). In addition, within site comparisons are also performed using Tukey's Test (p=0.05). Reproductive impairment is defined as a sample eliciting a reproductive rate that is significantly less than the control, and less than 10 young per adult female over the seven-day test period. This dual criterion is necessary in order to account for those NYS ambient waters that contain low hardness and/or nutrient levels. In addition, the test organisms are acclimated to laboratory control water which can induce false positive toxicity test results, causing Type I errors. Impaired survival is defined as when survival in an exposure group is significantly lower than the control.

* *Ceriodaphnia dubia* Seven Day Chronic Screening Test for Toxicity of Ambient Water Samples, February 7, 2002 and derived from the EPA's Whole Effluent Toxicity (WET) testing methods Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, October 2002, EPA-812-R-02-013.