TITLE: Biological stream assessment, Rawson Creek, Cattaraugus and Allegany counties, New York.

AGENCY: Novak, Margaret A.// New York (State). Stream Biomonitoring Unit

CHECKLIST: April 2002: 350.

1/2

#350

New York State
Department of Environmental Conservation

Division of Water

Rawson Creek

Biological Assessment

2001 Survey

GEORGE E. PATAKI, *Governor*

ERIN M. CROTTY, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Rawson Creek
Cattaraugus and Allegany Counties, New York

Survey date: August 28, 2001
Report date: March 28, 2002

Margaret A. Novak
Robert W. Bode
Lawrence E. Abele
Diana L. Heitzman
Alexander J. Smith

Stream Biomonitoring Unit
Bureau of Watershed Assessment and Research
Division of Water
NYS Department of Environmental Conservation
Albany, New York 12233-3502

CONTENTS

Stream: Rawson Creek at Rawson, Cattaraugus and Allegany Counties, New York

Reach: Porter Rd. to Lyndon Center Rd, Rawson, New York

Background:

At the request of NYS DEC Region 9 personnel, the Stream Biomonitoring Unit conducted biological sampling on Rawson Creek, a tributary to Cuba Lake (Allegany County) on August 28, 2001. A large animal-feeding operation recently had a spill of silage leachate that caused a fish kill in the stream. This survey was conducted to document water quality in the stream above the point of the spill, and determine other effects of the spill on the waterbody. Traveling kick samples were taken in two locations, using methods described in the Quality Assurance document (Bode *et al.*, 1996) 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. Water quality assessments were based on resident macroinvertebrates (aquatic insects, worms, mollusks, crustaceans). Community parameters used in the determination of water quality included species richness, biotic index, EPT value, and percent model affinity (see Appendices II and III). Macroinvertebrate data reports for each sampling location provide the raw invertebrate data, and locations and descriptions of the two sites.

Results and Conclusions:

1. The location upstream of where the spill occurred was assessed as moderately impacted; the effects were due in part to habitat factors. The calf-feeding operation near the streambank may contribute to diminished water quality.

2. The location downstream of the spill site exhibited significant biological impairment. Although it was also assessed as moderately impacted, the community was dominated by tolerant aquatic worms and leeches, and all metrics declined compared to upstream values. The dissolved oxygen concentration at the time of sampling was 1.1 mg/l, far below the level required by most fish and invertebrates.

3. Once silage storage is relocated, as is planned, re-sampling at these two locations could document water quality improvement and help pinpoint other runoff or discharges at the facility that are entering the stream.

Discussion:

Rawson Creek, a tributary to Cuba Lake in Allegany County, was selected for sampling as part of the RIBS (Rotating Intensive Basin Studies) ambient water quality monitoring program. At the request of NYS DEC Region 9 Division of Water personnel, two sites that bracketed the location of a June 22, 2001 spill of silage leachate were sampled. The survey was conducted to document water quality in the stream above the location of the spill, and determine effects of the spill other than the fish kill on the waterbody. Leachate from a silage storage facility contains large amounts of organic matter with a high biological oxygen demand (BOD), capable of significantly reducing available dissolved oxygen in the stream.

Based on the resident invertebrate communities, both sites were assessed as moderately impacted, but the samples collected were strikingly different from one another. Upstream, effects on the community were due in part to habitat factors. Near the stream headwaters, the substrate at this site is less than optimal for the support of a diverse fauna. Runoff from the calf-feeding operation near the streambank may contribute to diminished water quality, but the site is adequate for providing a baseline community with which to compare the fauna below the spill. Dissolved oxygen (7.8 mg/l) and specific conductance (257μmhos) indicate that no gross pollution of the stream by organic wastes is occurring. The invertebrate community was dominated by midges, but stoneflies, caddisflies, and beetles were collected. While the downstream location was also assessed as moderately impacted, several physical/chemical factors, as well as the invertebrate community, were strikingly different. Dissolved oxygen at the time of sampling was 1.1 mg/l, far below the level required by most fish and invertebrates; conductance was 598 μmhos, a substantial increase from 1 mile upstream. The fauna here was heavily dominated by tolerant worms and leeches, organisms tolerant of low dissolved oxygen typical of locations receiving large amounts of organic materials. In particular, the tubificid worms are thought to be bacterial feeders (Brinkhurst and Cook, 1974), and flourish where an abundant supply of bacteria, coupled with a lack of predators, exists.

Impact source determination (ISD) was inconclusive in indicating the type of impact affecting Station 1, but pointed to organic or municipal/industrial inputs at Station 2. While no true municipal or industrial sources lie upstream, inputs from the animal-feeding operation may contribute some toxic compounds, such as ammonia, to the waterbody. ISD at this site also reflected impoundment effects resulting from the ponded area just upstream of the sampling location (Table 2).

Using biological impairment criteria (Bode et al., 1990) to determine if a significant change occurred as a result of the discharge, a significant change was documented, with 3 of the 5 criteria exceeded (Table 1).

Since the downstream site was not sampled before the silage leachate spill and the fish kill occurred, it is not possible to determine if the poor water quality is due the acute effects of the spill or to chronic inputs to the stream. Once the silage storage is relocated, as is planned, re-sampling at these two locations could help pinpoint other runoff or discharges at the facility that are entering the stream.

TABLE 1. APPLICATION OF BIOLOGICAL IMPAIRMENT CRITERIA

INDEX	Station 1 2 above	Station below	Change	Criterion	Exceedance?
SPECIES RICHNESS	23	12	-11	-8	YES
BIOTIC INDEX	6.21	8.12	+1.91	+1.50	YES
EPT RICHNESS	4	1	-3	-4	NO
MODEL AFFINITY	42	36	-6	-20	NO
SPECIES DOMINANCE	21	40	+19	+15	YES

Literature cited:

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, Albany, NY. NYS DEC Technical Report, 110 pages.

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Albany, NY. NYS DEC Technical Report, 89 pages.

Brinkhurst, R. O. and D. G. Cook. 1974. Aquatic Earthworms (Annelida:Oligochaeta) *in* Pollution Ecology of Freshwater Invertebrates. C. W. Hart, Jr. and S. L. H. Fuller (editors). Academic Press: New York. 389 pp.

Overview of field data:

On the date of sampling, August 28, 2001, the two Rawson Creek sites sampled were one meter wide, 0.1 meter deep in the riffle areas, and had current speeds of 63-67 cm/sec in riffles. Dissolved oxygen was 1.1 - 7.8 mg/l, specific conductance was 257 - 598 μmhos, pH was 7.4 - 7.5, and the temperature was 19.2 - 22.7 °C (66 - 73 °F). Measurements for each site are also found on the field data summary sheets.

FIGURE 1. Biological Assessment Profile of index values, Rawson Creek, 2001. Values are plotted on a normalized scale of water quality. The line connects the mean of the 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.

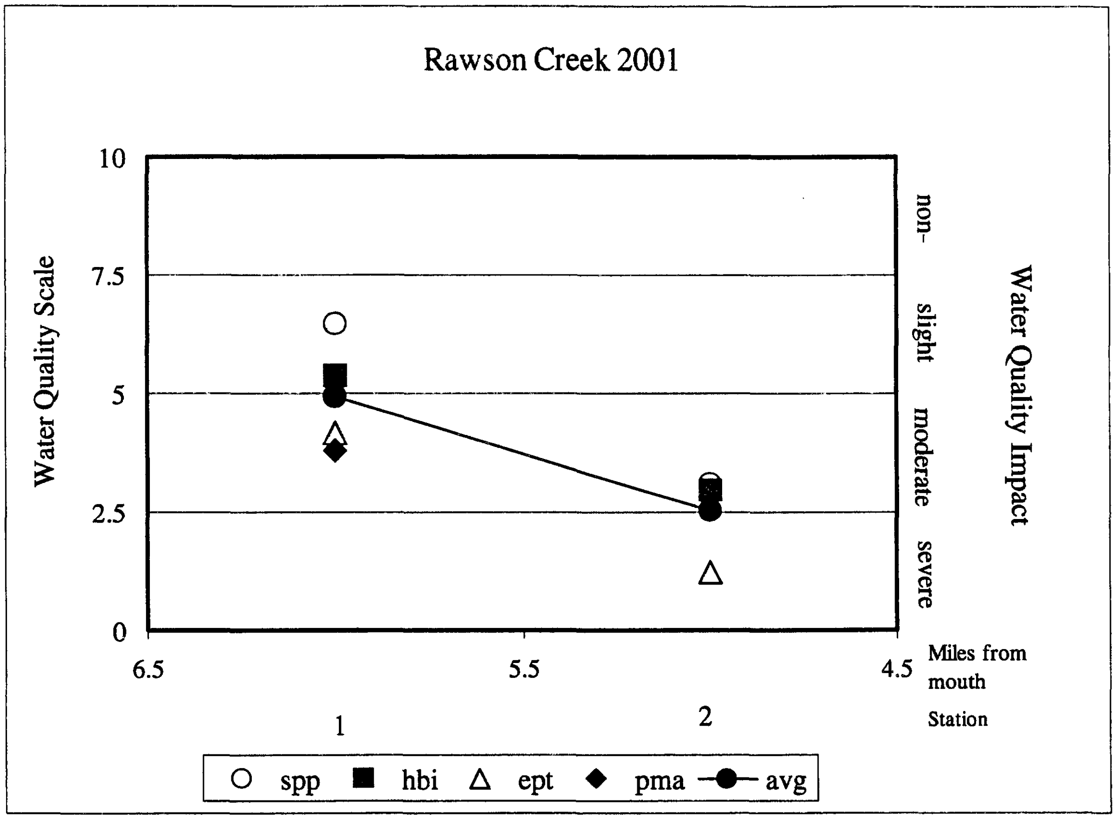


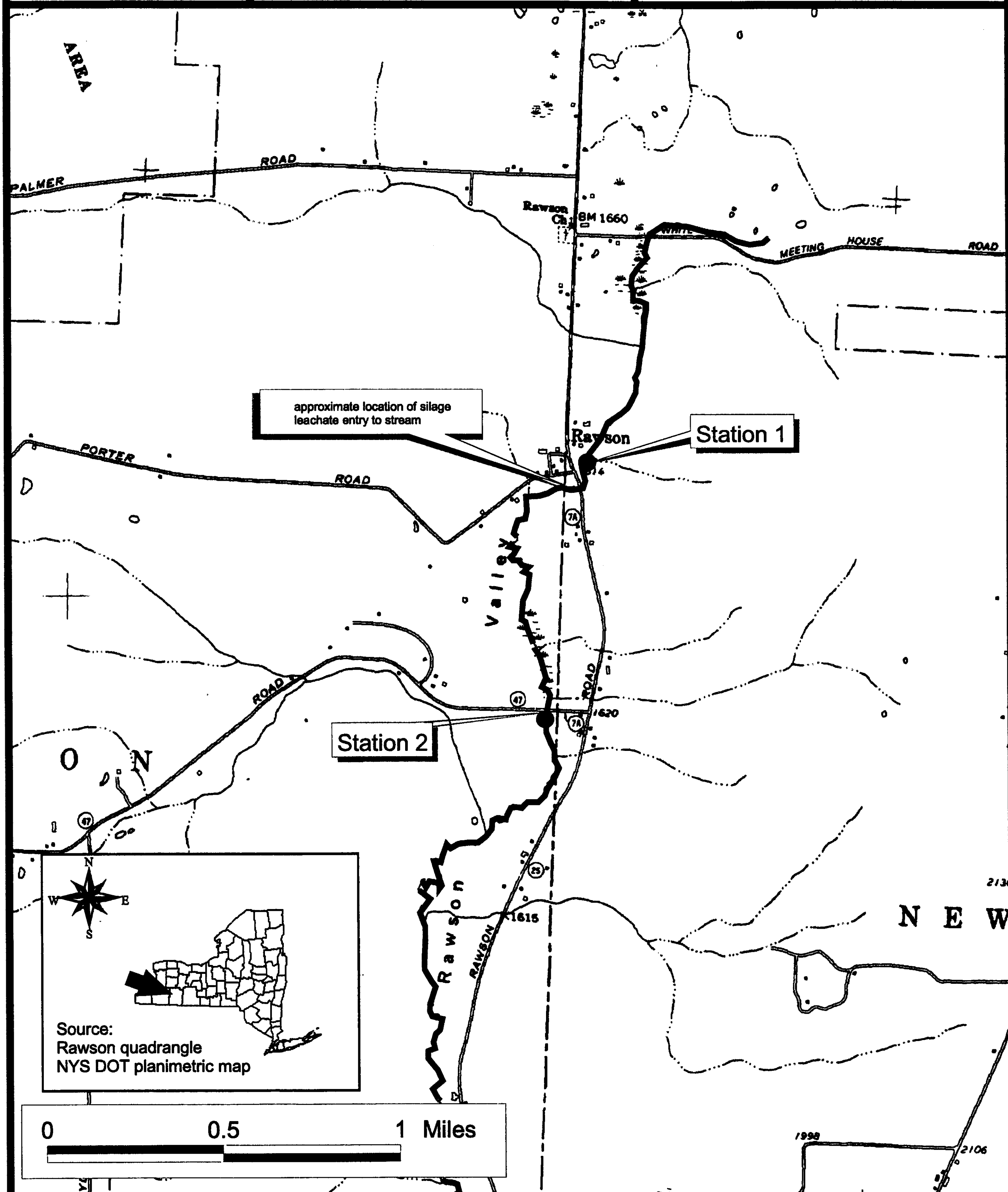
TABLE 2. Impact Source Determination, Rawson Creek, August 28, 2001. Numbers represent similarity to community type models for each impact category. The highest similarities at each station are highlighted. Similarities less than 50% are less conclusive. See Appendix X for a more complete explanation of Impact Source Determination.

	STATION	
Community Type	1	2
Natural: minimal human impacts	26	17
Nutrient additions; mostly nonpoint, agricultural	23	13
Toxic: industrial, municipal, or urban run-off	39	35
Organic: sewage effluent, animal wastes	27	51
Complex: municipal/industrial	25	51
Siltation	20	31
Impoundment	36	47

TABLE 3. STATION LOCATIONS FOR RAWSON CREEK, CATTARAUGUS AND ALLEGANY COUNTIES, NEW YORK (see map).

STATION	LOCATION
01	Rawson above Porter Rd 6.0 miles above mouth latitude/longitude: 42°19'18"; 78°18'30"
02	Rawson 30 meters below Lyndon Center Rd. bridge 5.0 miles above mouth latitude/longitude: 42°18'41"; 78°18'35"

Figure 2 | Site Location Map | Rawson Creek



stream flow

TABLE 4. MACROINVERTEBRATE SPECIES COLLECTED IN RAWSON CREEK, CATTARAUGUS AND ALLEGANY COUNTIES, NEW YORK, AUGUST 28, 2001.

ANNELIDA
 OLIGOCHAETA
  Tubificidae
   Undet. Tubificidae w/ cap. setae
   Undet. Tubificidae w/o cap. setae
  Naididae
   Dero sp.
   Ophidonais serpentina
 HIRUDINEA
   Undetermined Hirudinea
MOLLUSCA
 GASTROPODA
  Physidae
   Physella sp.
ARTHROPODA
 INSECTA
  PLECOPTERA
   Leuctridae
    Undetermined Leuctridae
  COLEOPTERA
   Elmidae
    Optioservus sp.
  MEGALOPTERA
   Sialidae
    Sialis sp.
  TRICHOPTERA
   Hydropsychidae
    Hydropsyche bronta
    Hydropsyche slossonae
   Limnephilidae
    Undetermined Limnephilidae
  DIPTERA
   Ceratopogonidae
    Undetermined Ceratopogonidae
   Empididae
    Hemerodromia sp.
   Muscidae
    Undetermined Muscidae
   Chironomidae
    Tanypodinae
     Thienemannimyia gr. spp.
    Orthocladiinae
     Cricotopus tremulus gr.
     Heterotrissocladius sp.
     Parametriocnemus lundbecki
    Chironominae
     Chironomini
      Cryptotendipes sp.
      Dicrotendipes fumidus
      Dicrotendipes neomodestus
      Microtendipes pedellus gr.
      Paracladopelma nais
      Polypedilum illinoense
     Tanytarsini
      Micropsectra dives gr.
      Micropsectra polita
      Micropsectra sp.
      Paratanytarsus confusus
      Rheotanytarsus exiguus gr.
      Tanytarsus sp.

STREAM SITE:	Rawson Creek Station 1
LOCATION:	upstream of Porter Rd., Rawson, New York
DATE:	August 28, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/ cap. setae	1
		Undet. Tubificidae w/o cap. setae	3
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	6
ARTHROPODA			
INSECTA			
PLECOPTERA	Leuctridae	Undetermined Leuctridae	1
COLEOPTERA	Elmidae	Optioservus sp.	2
MEGALOPTERA	Sialidae	Sialis sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche bronta	1
		Hydropsyche slossonae	2
	Limnephilidae	Undetermined Limnephilidae	2
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	3
	Empididae	Hemerodromia sp.	1
	Muscidae	Undetermined Muscidae	5
	Chironomidae	Thienemannimyia gr. spp.	21
		Cricotopus tremulus gr.	1
		Heterotrissocladius sp.	7
		Parametriocnemus lundbecki	7
		Dicrotendipes fumidus	5
		Microtendipes pedellus gr.	1
		Paracladopelma nais	1
		Micropsectra dives gr.	10
		Micropsectra polita	12
		Rheotanytarsus exiguus gr.	3
		Tanytarsus sp.	4

SPECIES RICHNESS	23 (good)
BIOTIC INDEX	6.21 (good)
EPT RICHNESS	4 (poor)
MODEL AFFINITY	42 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION

A traveling kick sample was taken in a small area of rubble above the Porter Rd. stream crossing. The habitat was not ideal, as much of the stream has a muddy bottom, and the fauna reflects both the effects of poor habitat and diminished water quality. While the 100-organism sub-sample was dominated by midges, a few caddisflies, beetles, and stoneflies were present. While mayflies were noted in the field assessment, none was present in the laboratory assessment. Water quality was assessed as moderately impacted.

STREAM SITE:	Rawson Creek Station 2
LOCATION:	30 meters downstream of Lyndon Center Rd., Rawson, New York
DATE:	August 28, 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/o cap. setae	40
	Naididae	Dero sp.	1
		Ophidonais serpentina	1
HIRUDINEA		Undetermined Hirudinea	33
ARTHROPODA			
INSECTA			
TRICHOPTERA	Hydropsychidae	Hydropsyche bronta	1
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	1
	Chironomidae	Thienemannimyia gr. spp.	8
		Cricotopus tremulus gr.	9
		Cryptotendipes sp.	1
		Dicrotendipes neomodestus	3
		Polypedilum illinoense	1
		Rheotanytarsus exiguus gr.	1

SPECIES RICHNESS	12 (poor)
BIOTIC INDEX	8.12 (poor)
EPT RICHNESS	1 (very poor)
MODEL AFFINITY	36 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION

This location was sampled downstream of a pooled area at the Lyndon Center Rd. bridge. While the substrate was composed of more gravel than optimal, it was satisfactory for a kick sample. The water was very muddy, as a result of recent heavy rain. The fauna collected was strongly dominated by aquatic worms and leeches. Dissolved oxygen was measured at 1.1 mg/l, a level at which many invertebrate groups would be killed. Water quality was assessed as moderately impacted.

LABORATORY DATA SUMMARY				
STREAM NAME: Rawson Creek	**DRAINAGE: 02**			
DATE SAMPLED: 08/28/01	**COUNTY: Cattaraugus, Allegany**			
SAMPLING METHOD: Traveling Kick				
STATION	01	02		
LOCATION	Porter Rd.	Lyndon Center Rd.		
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Thienemannimyia gr. spp. 21 % facultative midge	Undet. Tubificid. w/o cap. setae 40 % tolerant worm		
2. **Intolerant = not tolerant of poor water quality**	Micropsectra polita 12 % facultative midge	Undetermined Hirudinea 33 % facultative leech		
3. **Facultative = occurring over a wide range of water quality**	Micropsectra dives gr. 10 % facultative midge	Cricotopus tremulus gr. 9 % facultative midge		
4. **Tolerant = tolerant of poor water quality**	Heterotrissocladius sp. 7 % intolerant midge	Thienemannimyia gr. spp. 8 % facultative midge		
5.	Parametriocnemus lundbecki 7 % facultative midge	Dicrotendipes neomodestus 3 % tolerant midge		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	72.0 (11.0)	23.0 (6.0)		
Trichoptera (caddisflies)	5.0 (3.0)	1.0 (1.0)		
Ephemeroptera (mayflies)	0.0 (0.0)	0.0 (0.0)		
Plecoptera (stoneflies)	1.0 (1.0)	0.0 (0.0)		
Coleoptera (beetles)	2.0 (1.0)	0.0 (0.0)		
Oligochaeta (worms)	4.0 (2.0)	42.0 (3.0)		
Other	16.0 (5.0)	34.0 (2.0)		
SPECIES RICHNESS	23	12		
BIOTIC INDEX	6.21	8.12		
EPT RICHNESS	4	1		
PERCENT MODEL AFFINITY	42	36		
FIELD ASSESSMENT	moderate	severe		
OVERALL ASSESSMENT	moderately impacted	moderately impacted		

FIELD DATA SUMMARY				
STREAM NAME: Rawson Creek DATE SAMPLED: 08/28/01 **REACH: vicinity of Rawson** **FIELD PERSONNEL INVOLVED: Novak, Andrews, Hourigan (Region 9)**				
STATION	01	02		
ARRIVAL TIME AT STATION	4:15	4:55		
LOCATION	Porter Rd.	Lyndon Center Rd		
PHYSICAL CHARACTERISTICS				
Width (meters)	1.0	1.0		
Depth (meters)	0.1	0.1		
Current speed (cm per sec.)	63	67		
Substrate (%)				
Rock (>25.4 cm, or bedrock)				
Rubble (6.35 - 25.4 cm)	30	30		
Gravel (0.2 – 6.35 cm)	40	40		
Sand (0.06 – 2.0 mm)		10		
Silt (0.004 – 0.06 mm)	30	20		
Embeddedness (%)	40	30		
CHEMICAL MEASUREMENTS				
Temperature (°C)	19.2	22.7		
Specific Conductance (umhos)	257	598		
Dissolved Oxygen (mg/l)	7.8	1.1		
pH	7.5	7.4		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	80	20		
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous	abundant	abundant		
algae - diatoms	present	present		
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	x			
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	x			
Coleoptera (beetles)				
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)	x			
Chironomidae (midges)	x	x		
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)				
Mollusca (snails, clams)	x	x		
Oligochaeta (worms)		x		
Other		x		
FIELD ASSESSMENT	moderate	severe		

Appendix I. 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 5 minutes for a distance of 5 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 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 is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol. Following identification of a subsample, if the results 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. This is the total number of species or taxa found in the sample. Expected ranges for 100-specimen subsamples of kick samples in most streams in New York State are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted; less than 11, severely impacted.

2. EPT value. EPT 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. Biotic index. The Hilsenhoff 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; 4.51-6.50, slightly impacted; 6.51-8.50, 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 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <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. NYS 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.

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 value, biotic index, and percent model affinity. The consensus is based on the determination of the majority of the parameters; since parameters measure different aspects of the community, they cannot be expected to always form unanimous assessments. The ranges given for each parameter are based on 100-organism subsamples of macroinvertebrate riffle kick samples, and 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; the EPT value 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 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

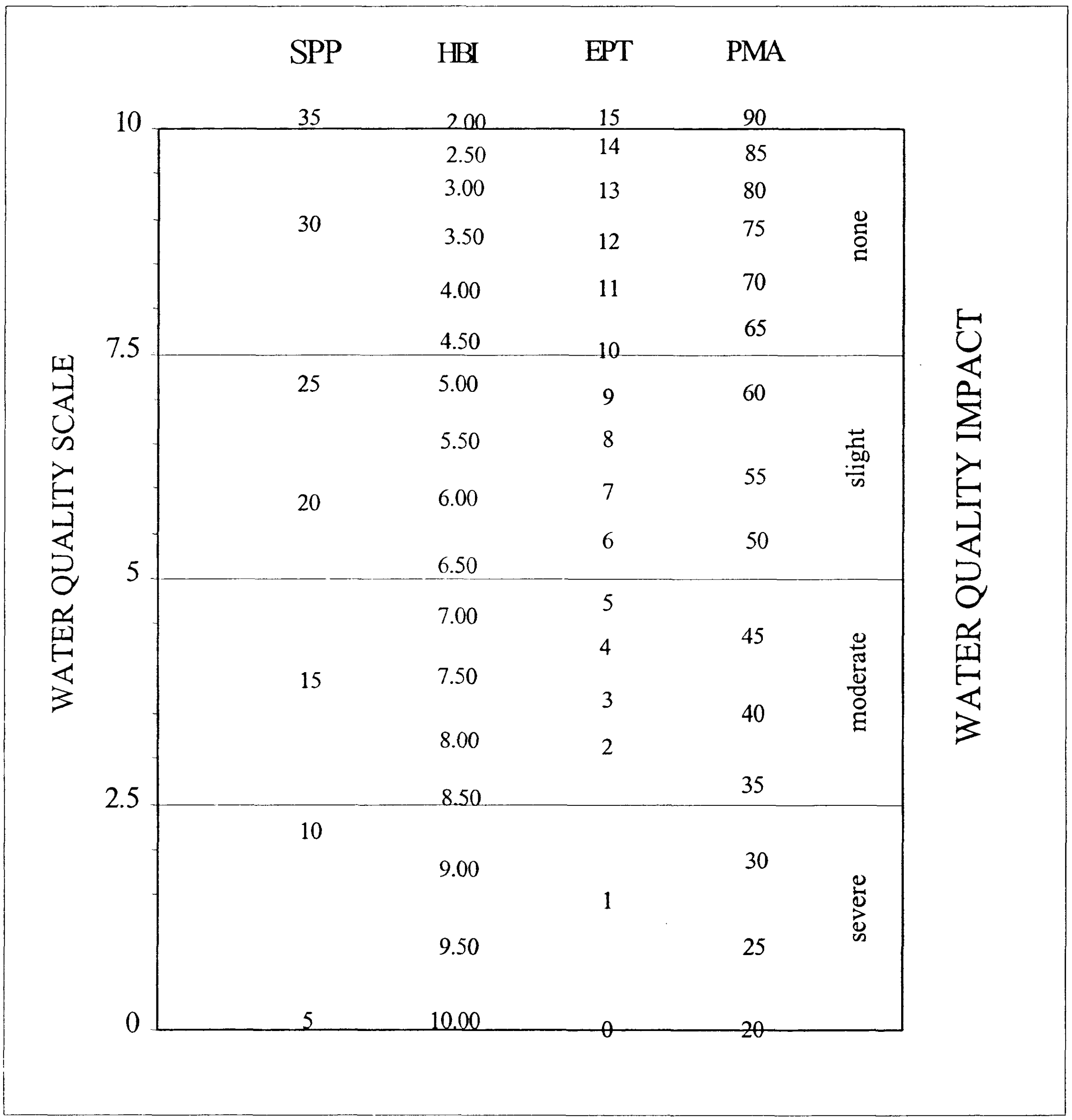
Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. 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 value 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.

Appendix IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

The Biological Assessment Profile of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, 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 as shown in the figure below.



To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices represents the assessed impact for each site.

Appendix V.
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity#	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

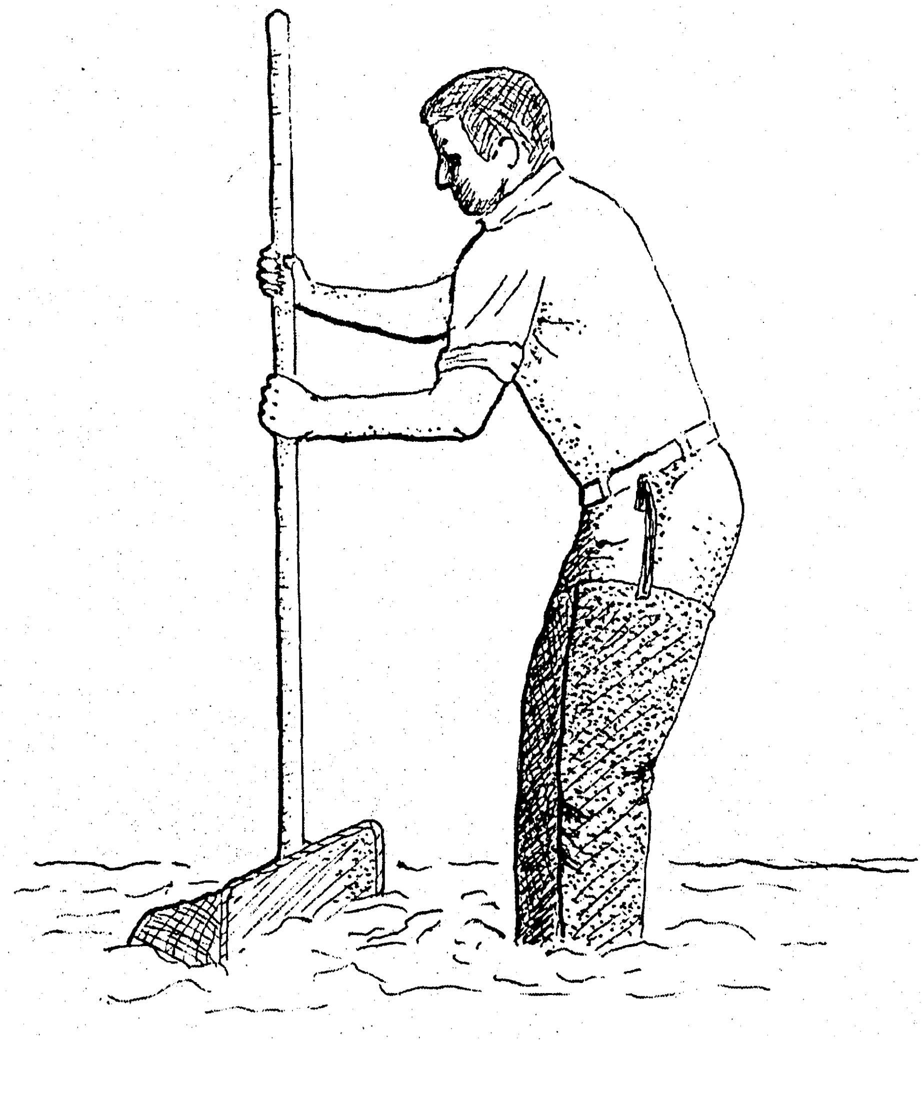
Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.
* Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA
for navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT 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



← current

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

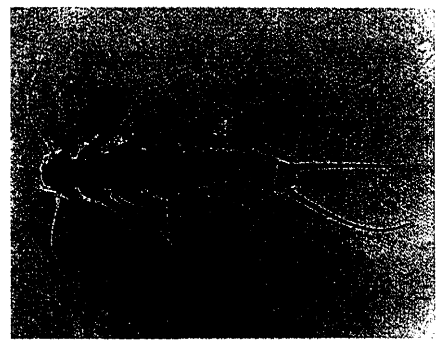
Appendix VII. A.

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 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.

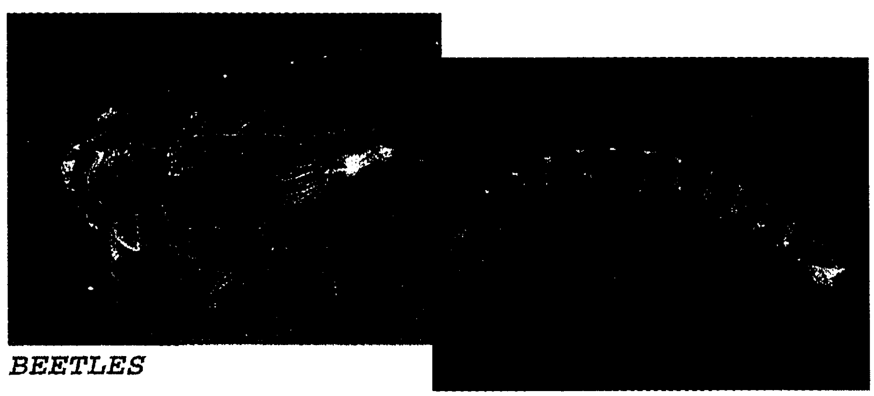


STONEFLIES

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

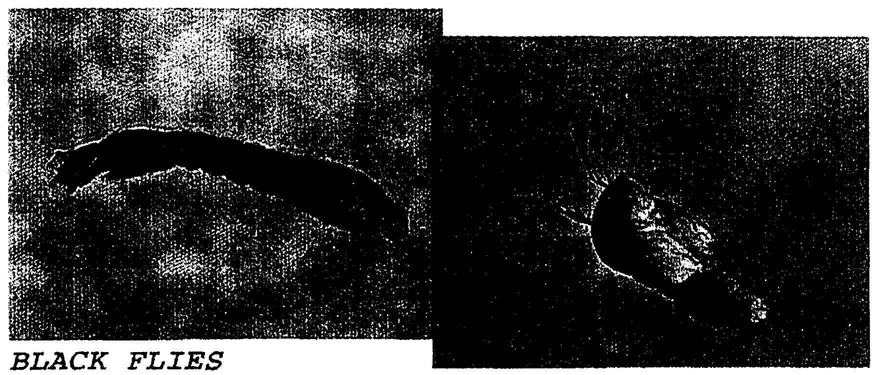
Appendix VII. B.

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.

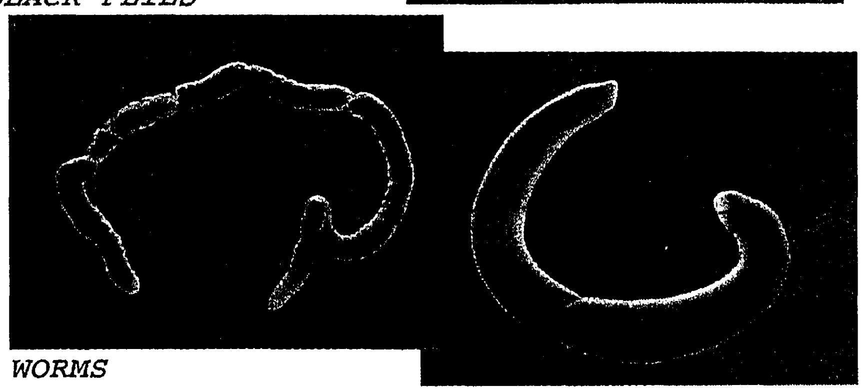
MIDGES

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.



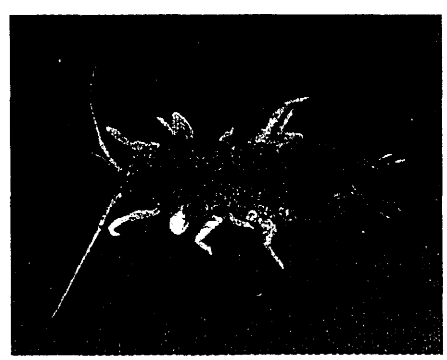
BLACK FLIES

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.

APPENDIX VIII. THE RATIONALE OF BIOLOGICAL MONITORING

Biological monitoring as applied here 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 an 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.

APPENDIX IX. GLOSSARY

assessment: a diagnosis or evaluation of water quality

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

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 value: the number of species of mayflies, stoneflies, and caddisflies in a sample

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

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

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

tolerant: able to survive poor water quality

APPENDIX X. METHODS FOR IMPACT SOURCE DETERMINATION

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. Impact Source Determination 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 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 Impact Source Determination (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%, 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 100-organism subsamples of traveling kick samples from riffles of New York State streams. Application of the methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the 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

	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

	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
<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/ Orthocladius</u>	5	10	20	-	5	10	5	5		15	10	25	10	5	10
<u>Eukiefferiella/ 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

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

	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