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AQUATIC MACROINVERTEBRATES OF THE PIGEON RIVER, MINNESOTA

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Abstract: Aquatic macroinvertebrates were collected from the Pigeon River between Partridge Falls and the mouth of the river during summer 1992 and 1993. A total of 163 taxa (genus or species) were identified from qualitative and quantitative samples. Insects comprised the majority of the taxa (151) with mollusks (8) and crustaceans (4) comprising a small part of the community. Ephemeroptera, Plecoptera, and Trichoptera were well represented (71 taxa) in the invertebrate community, and several uncommon taxa were collected. Functional group community composition varies little from Partridge Falls down to the rapids below Pigeon Falls. There is a surprisingly large predator component throughout the river, comprising up to 30W of the-taxa at a given site. Collector/gatherers and scrapers dominate the remainder of the community, indicating that particulate and diatom food sources are most important in the river, while shredders are nearly absent.

The water quality appears to be very good to excellent, with little or no evidence of organic enrichment detected. While water clarity is very good up at Partridge Falls, there appears to be more particulate matter in the river further downstream (below Horn Falls). This may be a result of input from the Arrow River in Canada.

The occurrence of numerous taxa intolerant of organic . degradation highlights the need for careful planning of: park improvements. Nutrient enrichment, siltation, and runoff must be avoided to prevent impact to the invertebrate community. Routine monitoring should be used to determine if impacts are occurring.

Introduction

The Pigeon River forms the northern boundary of the newly created Grand Portage State Park. The legislation forming the park was passed in 1989, with park improvements scheduled in coming years. Park management plans (Grand Portage State Park Management Plan - Draft). call for trail and scenic overlook construction centering around the highest falls in the state (Pigeon Falls), as well as visitor amenities (picnic area, parking lot).

Despite the acquisition of this area and the planned development, little is known of the aquatic macroinvertebrates in the river. Construction of any facilities for the park has the potential to impact this community. Therefore, it is important to establish baseline information on the aquatic life in the river prior to any planned improvements. This will allow monitoring of the invertebrate community to determine if any impacts occur during park development. Additionally, information on the aquatic invertebrates can be a significant component in interpretive efforts to the park visitor. Finally, there is a scarcity of data on distribution of aquatic invertebrates in Minnesota, preventing biologists from determining which species may be rare or unique and warrant protection.

The objectives of this study were to document the aquatic macroinvertebrate community of the Pigeon River, to use this information to assist interpretive naturalists in informing the public about the organisms and their roles in the environment, and to communicate this information to other invertebrate biologists to expand knowledge of distribution of aquatic invertebrates in Minnesota.

Study Area

The Pigeon River is located in Cook County in northeastern Minnesota and forms part of the border between the U.S. and Canada (Figure 1). The river originates in South Fowl Lake, then flows generally east until it meets Lake Superior. The Grand Portage State Park is located on the eastern end of the Pigeon River, fronting approximately 3960m of the river.

The Pigeon River contains the highest falls (Pigeon Falls, approximately 32m high) in the state, as well as Middle Falls and a rocky, vertical-walled gorge. The surrounding land is forested, with development almost non-existent. Much of the land has been undisturbed for nearly fifty years, although there are some large areas of logging on both sides of the border. Substrate in the river is varied. Most study sites (Table 1, 2) contained boulder/cobble mixture over a sand or sand/gravel bottom. The substrate at the Partridge Falls area was ledge bedrock, with small accumulations of sand. Some areas of silt . and clay deposition can be found from the Middle Falls area downstream to the gorge. Approximately 500m downstream of Pigeon Falls the river widens and slows. The substrate above the bridge is sand and gravel, and finer substrates accumulate downstream to the mouth.

Methods

Both qualitative and quantitative samples were collected from sites above Partridge Falls to the mouth of the river (approximately 30km). Qualitative samples were collected by kick net, hand picking off substrate from the sites, or by drift net.

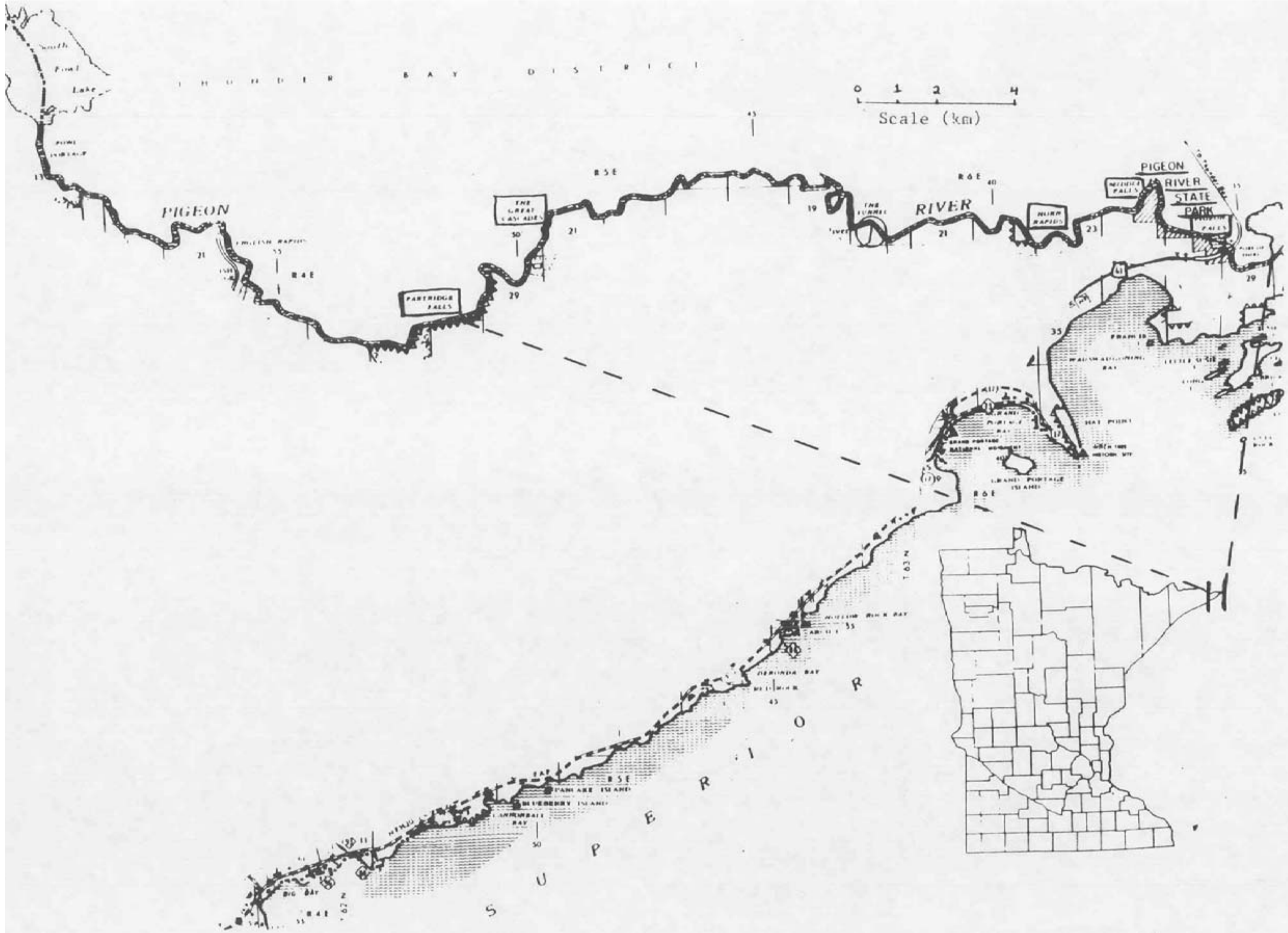

Figure 1. The Pigeon River, in northeast Minnesota showing study area between Partridge Falls and the mouth of the river, and approximate locations of major landmarks

Table 1. Sample sites for qualitative samples collected from the Pigeon River in June and August 1992, and July 1993. Samples collected with a kick net, drift net or hand collected.

Sample site	Substrate	Location
Pigeon Falls - downstream	Boulder, rock, cobble on top of sand	200m downstream of Pigeon Falls
Pigeon Falls - upstream	Boulder, rock, cobble on top of sand	Composite from rapids 150m upstream of Falls and lower area of gorge (700m upstream of Falls)
Gorge - upstream	Boulder, rock on top of sand	Above start of gorge, 1500m downstream of Middle Falls Provincial Park
Middle Falls Provincial Park	Rock, cobble, boulder on top of sand	At Middle Falls Provincial Park, Ontario, Canada
Below Horn Falls	Rock, boulder on top of sand	150m downstream of Horn Falls
Above Horn Falls	Rock, cobble on top of sand	300m upstream of Horn Falls
Cowboy Trail Access	Rock, cobble, on top of sand and silt; sparse vegetation	Approximately 5200m downstream of The Cascades
Above Fort Charlotte	Silt, clay, woody debris; some vegetation	Approximately 1000m downstream of Partridge Falls
Below Partridge Falls	Rock, cobble on top of sand	150m downstream of Partridge Falls
Above Partridge Falls	Ledge bedrock, sand; sparse vegetation	1,5m upstream of Partridge Falls

Table 2. Sample sites for quantitative samples collected from the Pigeon River collected with a petite Ponar grab (15cm x 15 cm) and sieved through a 590Am mesh sieve.

Sample site	Substrate	Location
Above Highway 61	Gravel, sand, rock	500m upstream of Highway 61 bridge
Below Highway 61	Gravel, sand	50m downstream of Highway 61 bridge
Tribal access	Silt, fine sand	At Grand Portage Tribal access
Below access	Silt, clay	75m downstream of Grand Portage Tribal access
Downstream 1	Silt, clay, fine sand	1100m downstream of Highway 6:1 bridge
Downstream 2	Silt, clay	1200m downstream of Highway 6:1 bridge
Downstream 3	Silt, clay	1400m downstream of Highway 6:1 bridge
Downstream 4	Clay, silt	1500m downstream of Highway 6:1 bridge
Downstream 5	Gravel, silt, sand, rock	At mouth of Pigeon River

Densities of organisms collected in drift samples were very low, so these samples were not treated in a quantitative manner. Quantitative samples were collected using a petite Ponar grab (15.25cm x 15.25cm) in unconsolidated substrates. The samples were sieved through a 590Am sieve in the field. All samples were placed in Whirl-paks, preserved with ethanol and transported to the laboratory.

Organisms were sorted from sediments under a dissecting microscope at 1Ox magnification. All taxa were identified to the lowest practical taxonomic level using the following taxonomic keys: aquatic insects, Hilsenhoff 1981, Merritt and Cummins 1984; molluscs, Eddy and Hodson 1982; crustaceans, Pennak 1989. Chironomidae were rehydrated, mounted on slides using CMC mounting media and identified to the lowest possible level.

The invertebrates collected were used to assess water quality. Taxa were ranked as rare (0 - 1), present (2 - 4), common (5 - 10), or abundant (11+) from each sample. A numerical value was assigned to the rankings as follows: rare = 1, present = 2, common = 4, abundant = 7. These values were used to calculate biotic index values using Hilsenhoffs Biotic Index (Hilsenhoff 1987) which assesses water quality as affected by organic enrichment.

Results and Discussion

A total of 163 macroinvertebrate taxa were identified (Table 3), with the majority (151) being insects. The Chironomidae (Diptera) had the most taxa identified (39). However, this group was not a dominant part of the community until the lower reaches of the river. The Trichoptera and Ephemeroptera comprise over 1/3 of the insect taxa (32 and 28 taxa respectively). Plecoptera (11), Odonata (12) and Coleoptera (11) account for most: of the other organisms identified.

With the exception of Chironomidae and Simuliidae, Diptera were uncommon in the samples.

The number of insect taxa collected in qualitative samples was highest in July (61) compared to June (56) and August (49) (Table 4, 5, 6). However, not all sites were sampled each month, so the significance of this difference is unclear.

The site above the Highway 61 bridge had substantially more invertebrates in June quantitative samples (Table 7), while the rest of the sites were comparable in densities. The August densities (Table 8) show no apparent trend, with variation in the size of the chironomid population accounting for the major differences in numbers. As is common in softer sediments, the chironomids comprise the majority of the community. There is a stretch of the lower river downstream from the Tribal access site that supports Hexagenia limbata populations. These organisms are likely to be very important to the river community in terms of the large amounts of biomass produced by this mayfly.

Community composition has been examined in terms of functional feeding groups along river systems (Cummins 1975, Vannote et al. 1980). Taxa collected in qualitative samples were assigned to functional feedings groups according to classifications in Merritt and Cummins (1984). Chironomidae were omitted from the analysis due to low numbers or absence of this group from many samples. The functional groups in the Pigeon River were similar to those predicted to be found in medium size rivers, with collector/gatherers and scrapers comprising a large part of the community, and shredders serving a minor role. This can be explained by the types of food available in the river. As rivers ,widen, there is less shading from terrestrial vegetation. More sunlight reaches the substrate, allowing more algal growth, which can support higher numbers of grazers (scrapers). The larger river is also carrying more small organic particles, which are utilized by gatherers or collectors (filter feeders). There is less input from the terrestrial system, in terms of leaf fall, and the shredder community has very little to feed on.

The functional community was similar throughout most of the sites sampled in the river, and varied little in the percent composition from month to month, or between the two years sampled. One difference from the model presented by Cummins (1975) is the large predator component found in the river. Predator species comprised approximately 30 % of the community taxa in ail sample periods. The major predators in most of the sites were the perlid stoneflies and the gomphid dragonflies. At Partridge Falls another large predator, Nigronia serricornis, was collected in the samples. This abundance of predators was surprising. Fish are major predators on larger invertebrates and can change the size structure of the invertebrate community. A fish survey (Schmidt 1991) reported 15 species in sites above and below Pigeon Falls with the majority of the fish collected classified as insectivores in their food habits. Although a diverse population of insectivores is present, most of these were not collected from the same habitats as the larger invertebrate predators. Additionally, most of the fish species were of small size and would not likely be able to handle larger stoneflies, hellgrammites, or dragonflies (Schmidt, personnal communication). Thus, it would appear that the larger invertebrates are separated in habitat and size from the fish predators, and are likely not exposed to high levels of predation.

The functional community composition was examined over the longitudinal gradient for the July sample period. The site above Fort Charlotte was excluded from the analysis due to low numbers of invertebrates collected. The percent composition of the invertebrate community from the Pigeon Falls downstream site to above Partridge Falls (over 25km) was very similar. The only difference was at the site above Partridge Falls, where the community had slightly higher numbers of predators and slightly lower numbers of scrapers than the downstream sites. The lower number of scrapers may have been due to the fact that this site had deeper water than the other sites. This depth combined with the bog-stain color may reduce light penetration and the growth of diatoms, causing a scarcity of food for this group.

Aquatic macroinvertebrates are being used by resource management agencies to assess water quality in streams and rivers. Most of the life cycle of the invertebrates are spent in the aquatic system, and they are relatively immobile. Any taxa which cannot handle a certain level of disturbance will be eliminated from the community. The invertebrate community collected in the qualitative samples was used to assess water quality in the Pigeon River. Biotic index values throughout the study area indicated very good to excellent water quality, with little or no organic enrichment. While the biotic index does not use relative rankings as were used in this study, the numerous intolerant taxa (such as Acroneuria sp., Pteronarcvs sp., Epeorus vitrea, Rhithrogena sp.,Glossosoma sp., Nigronia serricornis) found commonly throughout the river would tend to support these results. The water quality values also varied little between sample periods.

Based on observations during the study, the Pigeon River receives sediment loading at some point between the Partridge Falls and Horn Falls. The water at Partridge Falls is bogstained, yet very clear. However, at the sites downstream from the Horn Falls area, the river has a suspended load of what may be fine grain sediment. One possible input may be the Arrow River, which joins the Pigeon approximately halfway between The Cascades and Horn Falls. This river seemed to have a higher particulate load when examined in July, but it is not known if this is the actual cause of the sediment downstream. This sediment does not appear to have altered the invertebrate community as community compositions and biotic index values are similar to sites above Horn Falls. It may be that either this amount of sediment dies not fill interstitial spaces, or that flow in the river is sufficient to prevent substantial deposition.

There were several taxa collected that have been uncommonly reported from Minnesota. Several specimens of Psilotreta indecisa (Odontoceridae) were collected from one site. This particular caddisfly was not listed by Holzenthal and Monson in their list of Trichoptera in Minnesota (Holzenthal and Monson, unpublished). Discussions with Dr. Holzenthal indicated that this taxa has been documented from Ontario, so the occurrence in the Pigeon River is not necessarily unexpected. Another caddisfly not commonly reported in studies is Ithytrichia clavata (Hydroptilidae). Numerous individuals were found in the July drift net sample below Pigeon Falls. The small size of this organism may cause it to be overlooked in collections and it may actually be more common in this state.

An interesting Diptera was collected from the Pigeon River. The net winged midge (Blepharicera sp.) is normally reported from cold, clean, rapid streams or the spray areas of waterfalls. Hilsenhoff (1981) lists its distribution as uncommon in Wisconsin. It is one of the few aquatic insects to have suckers on the ventral surface of its body that enable this larvae to hold onto rocks in swift current while it grazes on algae.

The invertebrate community in the Pigeon River is well adapted to the physical environment in the river. Rapid spring snowmelt can cause enormous amounts of water to move through the river, scouring substrate and moving large rocks and boulders. This instability during high flows creates an extreme stress on macroinvertebrate life in the river. The river also receives little input from terrestrial sources (leaves, needles) in the reaches from Partridge Falls downstream. This prevents the establishment of any large shredder community. The particulate organic matter in the river and the diatom growth on the substrate form the largest food base for the herbivorous invertebrates, which in turn form the food base for the abundant predators in the system.

While adapted to natural disturbances, this community may be highly susceptible to impacts from park activities. Many of the taxa (Paragnetina media, Leucrocuta hebe, Ophiogomphus sp., Rhyacophila fuscula) are intolerant of organic enrichment. I believe it is very important that any facilities for the park (restrooms, RV pumping facilities, garbage collection) be sited and constructed so that they do not add any nutrients to the river. Excess nutrients would lead to excessive growth of algae. This growth could alter the food availability for grazers, as well as altering the habitat suitability for filter feeders (Plafkin, et al. 1989). The proposed picnic area for the park is located where the river begins to widen and thus is spatially separate from many of the habitats occupied by intolerant organisms. However, this area needs to be as natural as possible and the potential problems from nutrient addition should be kept in mind when designing this area.

Another possible impact is siltation. Park plans call for construction of scenic overlooks and improvement of hiking trails.

While this is important for public enjoyment of the park, it is critical that any activities be planned and conducted so that no sediments are flushed into the river. This is particularly important as the overlooks and trails are likely to be adjacent to areas of the river with rocky substrate and turbulent flow. The invertebrate communities in these areas may not be able to handle inorganic silt loading into the habitat. Serious consideration should be given to regular monitoring of the invertebrate community at set points during construction of the trails/overlook system to ensure that the macroinvertebrate community is remaining unimpacted.

A final concern is the unknown impact from increased runoff from the trail (if it is a hard surface) and the parking area for the visitors. The trail could be designed to direct runoff away from the river, forcing the runoff to percolate through the soil before entering the system. This should also be kept in mind for the parking area, as runoff will undoubtedly contain small amounts of oil and other fluids leaked from vehicles.

I recommend that routine macroinvertebrate monitoring should be included at various construction phases throughout the development of the park. Specific sites (such as the rapids below the Pigeon Falls) could be sampled on a regular basis and compared to upstream reference sites to assure that no disruption of the invertebrate community is occurring. Although much of the river lies upstream of the intended park, care needs to be exercised for the area within the boundaries of the park.

The aquatic macroinvertebrate community in a significant portion of the Pigeon River remains unknown. The entire stretch above Partridge Falls has not been sampled, yet Megaloptera were collected only at this area. Additionally, the highest diversity of Odonata (9 taxa) was collected in the Partridge Falls area. Further work on nymphs and adults of this group might show a surprisingly diverse assemblage in this river.

There are also large stretches of the river which were not sampled due to being almost completely inaccessible from land. It would be interesting to document the community in the vicinity of The Cascades in comparison to other similar areas. However, much of this area is only accessible by boat, thus making examination of the invertebrates downstream of The Cascades extremely difficult.

The fisheries community in the Pigeon River was classified by Schmidt (1991) as a warm or cool water assemblage. As such, this makes this river relatively unique among the rivers in this area of the state. Most of the streams and rivers in the northeast portion of Minnesota contain coldwater assemblages (trout). It would be extremely interesting to sample a nearby coldwater system to compare the invertebrate fauna, with particular attention to the large invertebrate predators and their relative abundance in both systems.

The information gathered in this study is important as it documents and establishes baseline on the invertebrate community of a unimpacted river. Aquatic macroinvertebrates are a major part of bioassessments of water quality being conducted by resource agencies. However, biological assessments of water quality need reference sites of unimpacted waters to compare to areas which may be suffering degradation. It is increasingly difficult to find unimpacted reference sites. Additionally, the knowledge of the distribution of aquatic macroinvertebrates in Minnesota is not sufficient for most groups to determine which species may be rare. Studies such as this can help broaden our knowledge on the abundance of the invertebrates.

Finally, interpretive personnel at the Grand Portage State Park can use this information to expand visitor awareness of this interesting and varied community. Awareness of this kind can play a vital role in protection of the aquatic environment throughout the state.

Table 3. Aquatic macroinvertebrates collected June and August 1992, and July 1993 from the Pigeon River in qualitative or quantitative samples.

EPHEMEROPTERA
Leptophlebiidae
- Paraleptophlebia sp.

Baetidae
- Baetis sp.
- Pseudocloeon sp.
- Cloeon sp.
- Centroptilum sp.
- Callibaetis sp.
- Callibaetis ferrugineus

Ephemeridae
- Ephemera sp.
- E. simulans
- Hexagenia limbata

Ephemerellidae
- Eurylophella sp.
- E. aestiva?
- Seratella deficiens
- Attenella attenuata

Oligoneuridae
- Isonychia sp.

Caenidae
- Caenis sp.

Siphloneuridae
- Siphlonurus sp.
- S. alternans

Tricorythidae
- Tricorxthodes sp.

Heptageniidae
- Rhithrogena sp.
- Eneorus vitrea
- Leucrocuta hebe
- Heptagenia sp.
- H. pulla
- Stenonema sp.
- S. modestum
- S. vicarium
- S. exiquum

PLECOPTERA
Perlidae
- Acroneuria sp.
- A. lycorius
- A. abnormis
- A. internata?
- Acrnetina caoitata
- Paragnetina media
- Perlesta sp.

TRICHOPTERA
Glossosomatidae
- Glossosoma sp.

Philopotamidae
- Chimarra socia
- C. atterima
- C. obscura

Psychomyiidae
- Psychomyia flavida

Lepidostomatidae
- Lepidostoma sp.

Leptoceridae
- Ceraclea sp.
- Triaenodes sp.
- Setodes sp.

Rhyacophilidae
- Rhyacophila fuscula

Limnephilidae
- Pycnonsyche sp.
- Glyphopsyche sp.
- Anabolia sp.

Polycentropodidae
- Neureclipsis sp.
- Polycentropus cinereus
- P. flavus
- Phylocentropus sp.

Odontoceridae
- Psilotreta indecisa

Hydropsychidae
- Cheumatopsyche sp.
- Hvdropsyche sp.
- H. morosa
- H. slossone?
- H. bronta
- H. sparna
- H. alhedra
- H. betteni
- H. walkeri??

Hydroptilidae
- Hydroptila sp.
- Oxyethira sp.
- Ithytrichia clavat

Brachycentridae
- Brachycentrus numerosus

Phryganeidae

Table 3. (continued)

PLECOPTERA (continued)
Pteronarcyidae
Pteronarcys dorsata?
Chloroperlidae
Alloperla? sp.
Hastaperla sp.
Perlodidae
Isoperla frisoni?

ODONATA
Gomphidae
Optioservus sp.
O. anomalus
Haqenius brevistylus
Gomphus spicatus
Aeshnidae
Boyeria grafiana
B. vinosa
Basiaeschna sp.
Macromiidae
Macromia illinoiensis
Corduliidae
Somatochlora sp.
Calopterygidae
Calopteryx sp.
Lestidae
Lestes sp.
Coenagrionidae
Enallagma sp.

DIPTERA
Empididae
Hemerodromyia sp.
Ceratopogonidae
Probezzia sp.
Tipulidae
Hexatoma sp.
Limnophila? sp.
Simuliidae
Simulium sp.
S. pictipes?
S. jenningsi??
Stegopterna?? sp.
Athericidae
Atherix varieqata
Blephariceridae
Blepharicera sp.
Chironomidae
Diamesinae
Potthastia? sp.

COLEOPTERA
Elmidae
Stenelmis sp.
S. crenata
Optioservus sp.
O. fastiditus
Dubiraphia sp.
Macronychus sp.
Dryopidae
Holichus sp.
Gyrinidae
Gyrinus sp.
Dytiscidae
Coptotomus sp.
Hydrophilidae
Sperchopsis tesselatus
Chrysomelidae
Donacia sp.

MEGALOPTERA
Sialidae
Sialis sp.
Corydalidae
Nigronia serricornis

HEMIPTERA
Veliidae
Rhagovelia obesa
Corixidae
Sigara sp.
Palmacorixa sp.
Notonectidae
Buenoa sp.
Gerridae
Gerris sp.
Belostomatidae
Belostoma sp.

CRUSTACEA
Amphipoda
Hyalella azteca
Gammarus lacustris
Isopoda
Caeciadotea sp.
Decapoda
Orconectes rusticus

Table 3. (continued)

DIPTERA (continued)
Chironomidae
Prodiamesinae
- *Monodiamesa* sp.

Tanypodinae
- *Ablabesmvia* sp.
- *A. mallochi*
- *Clinotanypus* sp.
- *Labrundinia* sp.
- *Procladius* sp.
- *Thienemannimyia* complex
- *Zavrelimyia* sp.

Orthocladiinae
- *Brillia* sp.
- *Cricotopus* sp.
- *C. bicinctus* group
- *C. tremulus* group
- *Eukiefferiella* sp.
- *E. gracei* group
- *E. devonica* group
- *Lopescladius* sp.
- *Nanocladius* sp.
- *N. narvulus* group
- *Parametriocnemus* sp.
- *Psectrocladius* sp.
- *Synorthocladius* sp.
- *Tvetenia discoloripes* group

Chironominae
Chironomini
- *Cryptochironomus* sp.
- *Demicryptochironomus* sp.
- *Endochironomus* sp.
- *Microtendipes pedallus* group
- *Paratendipes* sp.
- *Paralauterborniella*? sp.
- *Polypedilum* sp.
- *P. fallax* group
- *P. convictum* group
- *Stenochironomus* sp.
- *Stictochironomus* sp.
- *Tribelos*? sp.

Tanytarsini
- *Cladotanytarsus* sp.
- *Micropsectra* sp.
- *Rheotanytarsus* sp.
- *Tanytarsus* sp.

MOLLUSCA
Pelecypoda
Sphaeriidae
Gastropoda
- *Feressia* sp.
- *Planorbula* sp.
- *Physa* sp.
- *Amnicola* sp.
- *Helisoma* sp.
- *Promenetus* sp.
- *Gyraulus*? sp.

Table 4. Aquatic macroinvertebrates collected in qualitative samples from the Pigeon River, June 1992. PFD = Downstream of Pigeon Falls; PFU = Upstream of Pigeon Falls; GU = upstream of Gorge area; MF = Middle Falls Provincial Park; HFU = Upstream of Horn Falls

	Station				
Taxa	PFD	PFU	GU	MF	HFU
EPEHEMEROPTERA					
Leptophlebiidae					
Paraleptophlebia sp.	X	X	X	X	X
Baetidae					
Baetis sp.	X	X	X	X	X
Callibaetis sp.				X	
Pseudocloeon sp.	X	X	X	X	X
Ephemeridae					
Ephemera sp.	X	X	X	X	
Ephemerellidae					
Eurylophella lutulenta	X		X	X	
Seratella deficiens	X	X	X	X	
Oligoneuridae					
Isonychia sp.				X	
Heptageniidae					
Rhithrogena sp.	X	X	X	X	X
Epeorus vitrea	X	X	X	X	X
Leucrocuta hebe	X	X	X	X	X
Heptagenia sp.			X		
Stenonema modestum	X	X	X	X	X
S . vicarium	X	X	X	X	
TRICHOPTERA					
Glossosomatidae					
Glossosoma sp.	X	X	X	X	X
Lepidostomatidae					
Lepidostoma sp.	X	X	X	X	X
Philopotamidae					
Chimarra socia	X	X	X	X	X
Rhyacophilidae					
Rhyacophila fuscula		X	X		X
Psychomyiidae					
Psychomxia flavida					x
Leptoceridae					
Oecetis sp.					
Setodes sp.		x	x		
Hydropsychidae					
Cheumatopsyche sp.	x	x			
Hydropsyche sp.	x	x	x	x	X
H. morosa	x	x	x	x	X
H. slossone?	x			x	
H. bronta??		x			
H. sparna				x	
H. walkeri?					x

Table 4. (continued)

Taxa	Station PFD	PFU	GU	MF	HFU
PLECOPTERA					
Perlidae					
Acroneuria sp.	X	X	X	X	X
A. internata?			X		
Agnetina canitata	X	X	X	X	X
Paragnetina media	X	X	X	X	X
Chloroperlidae					
Alloperla? sp.			X		
Hastaperla sp.		X	X		
Perlodidae					
Isoperla frisoni?				X	
Pteronarcyidae					
Pteronarcys sp.				X	X
COLEPTERA					
Elmidae					
Stenelmis sp.	X	X	X	X	X
S. crenata			X		
Optioservus sp.	X	X	X	X	X
O. fastiditus				X	
Macronychus sp.				X	
Dryopidae					
Helichus sp.		X			
ODONATA					
Gomphidae					
Ophiogomphus sp.	X		X	X	X
O. anomalus		X	X		X
Aeshnidae					
Boyeria grafiana				X	X
DIPTERA					
Empididae					
Hemerodromyia sp.	X	X	X		X
Tipulidae					
Hexatoma sp.	X		X	X	
Limnophila? sp.					X
Simulidae					
Simulium sp.	X	X	X		X
S. jenningsi??	X	X	X		X
Stegopterna?? sp.		X			
Blephariceridae					
Blepharicera sp.		X			
Athericidae					
Atherix sp.			X		
Dolichopodidae			X		
MOLLUSCA					
Pelecypoda					
Sphaeriidae		X	X		
Gastropoda					
Feressia sp.	X		X		X

Table 5. Aquatic macro invertebrates collected in qualitative samples from the Pigeon River, July 1993. PFD = Downstream of Pigeon Falls; MF = Middle Falls Provincial Park; HFD = Downstream of Horn Falls; CTA = Cowboy Trail area; FCU = Upstream of Fort Charlotte site; PTD = Downstream of Partridge Falls; PTU = Upstream of Partridge Falls

	Station						
Taxa	PFD	MF	HFD	CTA	FCU	PTD	PTU
EPEHEMEROPTERA							
Leptophlebiidae							
Paraleptophlebia sp.		X					X
Baetidae							
Baetis sp.	X	X	X	X		X	X
Callibaetis sp.					X		
Pseudocloeon sp.	X	X	X	X		X	X
Ephemeridae							
Ephemera sp.				X		X	X
Hexagenia limbata					X		
Ephemerellidae						X	X
Attenella attenuate					X		X
Seratella deficiens				X		X	X
Oligoneuridae							
Isonychia sp.	X	X		X		X	
Heptageniidae							
Rhithrogena sp.	X		X				
Epeorus vitrea	X	X	X			X	
Leucrocuta hebe		X					
Heptagenia sp.	X			X		X	
Stenonema modestum	X	X				X	X
S. vicarium							
Siphloneuridae							
Siphlonurus sp.					X		X
Tricorythidae							
Tricorythodes sp.				X			
Caenidae							
Caenis sp.	X	X		X			
TRICHOPTERA							
Glossosomatidae							
Glossosoma sp.	X	X	X	X		X	X
Limnephilidae							
Pycnonsvche sp.	X						
Glvnhoglyche sp.					X		
Philopotamidae							
Chimarra socia	X	X	X				
C. atterima	X					X	X
Rhyacophilidae							
Rhyacophila fuscula							
Odontoceridae							
Psilotreta indecisa					X		
Leptoceridae							X
Ceraclea sp.							

Table 5. (continued)

Taxa	Station PFD	MF	HFD	CTA	FCU	PTD	PTU
Hydropsychidae							
Cheumatopsyche sp.	X			X		X	
Hvdropsyche sp.	X	X	X	X		X	X
H. morosa	X		X				
H. slossone?	X		X			X	X
H. bronta??		X	X	X		X	
H. sparna						X	X
Hydroptilidae							
Hydroptila sp.							
Ithytrichia clavata	X						
Polycentropodidae							
Neureclipsis SP.				X			X
Brachycentridae							
Brachycentrus numerosus				X			
Phryganeidae					X		
PLECOPTERA							
Perlidae							
Acroneuria sp.	X	X	X	X		X	X
Agnetina capitata	X	X	X	X			
Paragnetina media	X	X	X			X	X
Pteronarcyidae							
Pteronarcys sp.							X
MEGALOPTERA							
Sialidae							
Sialis sp.							
Corydalidae					X	X	X
Nigronia serricorms							
COLEPTERA							
Elmidae							
Stenelmis sp.	X	X	X	X		X	X
S. crenata				X			
Ontioservus sp.	X			X		X	X
O. fastiditus				X		X	X
Dubiraphia sp.	X				X		
Gyrinidae							
Gyrinus sp.					X	X	X
Dytiscidae							
Coptotomus sp.							
Hydrophilidae							
Sperchopsis tesselatus					X		
Chrysomelidae							
Donacia sp.							

Table 5. (continued)

Taxa	Station						
	PFD	MF	HFD	CTA	FCU	PTD	PTU
ODONATA							
Gomphidae							
Ophiogomphus sp.	X	X		X	X	X	
O. anomalus				X			
Hagenius brevistylus							X
Gomphus spicatus					X		
Aeshnidae							
Boyeria grafiana				X		X	X
Basiaeschna? sp.							
Corduliidae							
Somatochlora sp.					X		X
Calopterygidae							
Calonteryx sp.							
HEMIPTERA							
Veliidae							
Rhagovelia obesa		X	X			X	X
Corixidae							
Sigara sp.							
Palmacorixa sp.							X
Notonectidae							
Bueno sp.					X		
DIPTERA							
Tipulidae							
Hexatoma sp.	X		X	X			
Simulidae							
Simulium sp.							X
S. pictipes??	X						
Athericidae							
Atherix sp.							
MOLLUSCA							
Pelecypoda							
Sphaeriidae		X		X		X	X
Gastropoda							
Feressia sp.			X	X			X
Physa sp.					X		X
Amnicola sp.				X	X		X
Planorbula sp.							X
Gyraulus? sp.					X		
Promenetus sp.					X		
Helisoma sp.				X	X		
AMPHIPODA							
Hyalella azteca					X	X	X

Table 6. Aquatic macroinvertebrates collected in qualitative samples from the Pigeon River, August 1992. PFD = Downstream of Pigeon Falls; GD = Downstream of Gorge Area; GU = upstream of Gorge area; HFD = Downstream of Horn Falls; PTU = Upstream of Partridge Falls.

	Station				
Taxa	PFD	GD	GU	HFD	PTU
EPEHEMEROPTERA					
Leptophlebiidae					
Paralepto hlebia sp.	X				X
Baetidae					
Baetis sp.	X	X	X	X	X
Pseudocloeon sp.	X	X	X	X	X
Ephemeridae					
Ephemera sp.			X		X
Ephemerellidae					
Eurvlophella sp.					X
Attenella attenuata					
Oligoneuridae					
Isonychia sp.	X	X	X	X	
Heptageniidae					
Epeorus vitrea	X	X			
Leucrocuta hebe	X	X	X		
Heptagenia sp.	X	X	X		
Stenonema vicarium	X	X		X	X
Caenidae					
Caenis sp.	X			X	
TRICHOPTERA					
Glossosomatidae					
Glossosoma sp.	X	X	X	X	
Philopotamidae					
Chimarra socia	X				X
C. atterima		X			
C. obscura					
Psychomyiidae					
Psvchomvia flavida	X				
Leptoceridae					
Ceraclea sp.					X
Hydropsychidae					
Cheumatogsyche sp.	X	X	X	X	X
Hvdropsyche sp.	X	X	X	X	X
H. morosa	X	X	X	X	
H. bronta			X		X
H. sparna					X
H. alhedra					X
H. betteni					
Hydroptilidae					X
Hyroptila sp.					
Oxyethira sp.					X
Polycentropodidae					X
Neureclinsis sp.					
Phryganeidae					

Table 6. (continued)

Taxa	Station PFD	GD	GU	HFD	PTU
PLECOPTERA					
Perlidae					
Acroneuria sp.			X		X
A. abnormis	X	X	X		
A. 1, corius	X	X	X		X
Agnetina ca ip tata	X	X	X		X
Paragnetina media	X	X	X		X
Pteronarcyidae					
Pteronarcys dorsata?	X				X
COLEPTERA					
Elmidae					
Stenelmis sp.	X	X			X
S . crenata			X		X
Optioservus sp.	X	X	X	X	X
O. fastiditus					X
Macronvchus sp.	X	X			
Dubirap,hia sp.	X				X
Gyrinidae					
rin sp.					X
ODONATA					
Gomphidae					
Ophiogomphus sp.	X	X	X		X
Hagenius brevist ylus					
Aeshnidae					
Boyeria grafiana			X		X
Boyeria vinosa					X
Macromiidae					
Macromia illinoiensis					X
Calopterygidae					
Calonteryx sp.					X
HEMIPTERA					
Veliidae					
Rhagovelia obesa					X
Belostomatidae					
Belostoma sp.					X
Gerridae					
Gerris sp.					X
Corixidae					
Sigara sp.					X
DIPTERA					
Tipulidae			X		
Hexatoma sp.					
Simulidae		X			X
Simulium sp.	X				X
Athericidae					
Atherix sp.			X		

Table 6. (continued)

Taxa	Station				
	PFD	GD	GU	HFD	PTU
MOLLUSCA					
Sphaeriidae				X	X
Gastropoda					
Feressia sp.		X	X	X	X
Planorbula sp.					X
AMPHIPODA					
Hyalella azteca					X

Table 7. Mean densities (#'s/m^2) of aquatic macroinvertebrates collected in Ponar grab samples in June 1992 on the Pigeon River. All samples sieved through 590Am mesh sieve. AB = Above Highway 61 bridge approximately 500m; BB = Below Highway 61 bridge, approximately 50m, TA = Grand Portage Tribal access; BTA = Downstream of Grand Portage Tribal access approximately 75m. n = number of samples at site.

	Site			
Taxa	AB n=2	BB n=3	TA n=3	BTA n=4
EPHEMEROPTERA				
Hexagenia sp.			43	56
Eurylophella sp.	22			
Caenis SP.				13
TRICHOPTERA				
Oectis sp .				13
COLEOPTERA				
Dubiraphia sp.		13		13
Optioservus sp.	22			
DIPTERA				
Probezzia? sp.		30		86
Chironomidae	5418	1088	1062	925
MOLLUSCA				
Sphaeriidae			30	357
TOTALS #/m^2	5462	1131	1135	1463

Table 8. Mean densities (#'s/m2) of aquatic macroinvertebrates collected in Ponar grab samples in August 1992 on the Pigeon River. All samples sieved through 590 µm mesh sieve. Site locations: 1 = 1100m downstream of Highway 61 bridge; 2 = 1200m downstream of Highway 61 bridge; 3 = 1400m downstream of Highway 61 bridge; 4 = 1500m downstream of Highway 61 bridge; 5 = mouth of Pigeon River. n = number of samples at a site.

	Site				
	1	2	3	4	5
Taxa	n=3	n=4	n=3	n=4	n=2
EPHEMEROPTERA					
Hexagenia limbata	159	56		43	
Cloeon sp.	228				
Caenis sp.	13				
Siphloneuridae	13				
TRICHOPTERA					
Oecetis sp.		13		13	
Phylocentropus sp.		13			
PLECOPTERA					
Paragnen sp.		13			
Perlesta sp.	13				
COLEOPTERA					
Stenelmis sp.					43
Dubiraphia sp.		13		34	
HEMIPTERA					
Corixidae		13		13	13
ODONATA					
Gomphidae			13		
DIPTERA					
Probezzia sp.	30				
Chironomidae	1621	6149	2537	7839	3440
CRUSTACEA					
Gammarus lacustris	13				22
Hyalella azteca	30				
Caeciadotea sp.					43
MOLLUSCA					
Sphaeriidae	473	271	185	99	
Gastropoda					
Physa sp.	30				
Feressia sp.	13				
Amnicola sp.	56				
Planorbula sp.	56				
TOTALS #/m^2	2761	6528	2890	8041	3548

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