THE 1972
BENTHIC AND FISH
ANALYSIS REPORT

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Grand River Conservation Authority

Land Management Division

Biological Services Branch

Biological Studies Group

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TABLE OF CONTENTS

Introduction 1

A. Canagagigue Creek (proposed Woolwich Reservoir) 3
- i) a) Description of Stations 3
- b) Map Location of Stations 5
- ii) a) Discussion of Benthic Data 6
- b) Summary of Stations
- c) Summary of Data 11
- iii) a) Discussion of Fish Data 16
- b) Summary of Data 16
- iv) a) Discussion of 24 hr. D.O.& W. Temperature Survey 20
- b) Graphs of Data 22
- v) a) Summary of Canagagigue Creek 25

B. Conestogo River (Conestogo Reservoir) 27
- i) a) Description of Stations 27
- b) Map Location of Stations 28
- ii) a) Discussion of Benthic Data 29
- b) Summary of Stations 32
- c) Summary of Data 35
- iii) a) Discussion of Fish Data 39
- b) Summary of Data 41

C. Speed River (proposed Guelph Reservoir) 50
- i) a) Description of Stations 50
- b) Map Location of Stations 51
- ii) a) Discussion of Benthic Data 52
- b) Summary of Stations 56
- c) Summary of Data 58
- iii) a) Discussion of Fish Data 64
- b) Summary of Data 66
- iv) a) Discussion of 72 hr. D.O. Survey 71
- b) Graphs of Data 72

D. Grand River (Belwood Reservoir) 73
- i) a) Description of Stations 73
- b) Map Location of Stations 74

D. Grand River (Belwood Reservoir)
- ii) a) Discussion of Benthic Data 75
  - b) Summary of Stations 78
  - c) Summary of Data 79
- iii) a) Discussion of Fish Data 83
  - b) Summary of Data 84
- iv) a) Discussion of 24 hr. D.O. & W. Temperature Survey 89
  - b) Graphs of Survey 91

E. Analysis of Fisheries of the Grand 92
- i) Grand River Between Elora and Galt 92
  - a) Elora Gorge 92
  - b) Village of Conestogo 92
  - c) Bridgeport Bridge 93
  - d) Breslau Bridge Hwy. 7 93
  - e) Freeport Bridge 93
  - f) Blair Bridge 94
  - g) Queen St., Galt 94
- ii) Laurel Creek Conservation Area 94
- iii) Brant Conservation Area 95
- iv) Sulphur Creek 95
- v) Dunnville (below weir) 96
- vi) Summary of Data 97

F. Summary of the Fisheries of the Grand 105

G. Evaluation and Recommendations of Benthic and Fish Collections. 107

H. Glossary 114

Introduction

"So, although some European workers (e.g. Huet, 1949) have produced lists of animals said to be characteristic of certain levels of pollutions, macroinvertebrates have not become deeply involved in the doctrine. Many of them, however, show clear reactions to organic pollution. It is well established (Carpenter, 1924.; Pentelow and Butcher, 1938) that they react to poisons and simple salts (Liebmann, 1951; Lafleur, *1954.*), so there is reasonable chance that they can serve to detect all kinds of pollution. Simple surveys of the invertebrates have, as I hope to show, great sensitivity, especially if they are quantitative; I know that they give useful results in Britain (Hynes, 1961b; Hynes and Roberts, 1962) and in Africa (Hynes and Williams, 1962). I believe, therefore, they can be useful anywhere, but the interpretation of results does require biological knowledge. In a subject as complex as ecology, I do not see how that can ever be avoided". This is a quotation from a lecture given by Dr. H. B. N. Hynes at the 3rd Seminar for the U.S. Department of Health, Education, and Welfare; entitled Biological Problems in Water Pollution.

In essence, this sums up our objective; to be able to use insects as indicators of water pollution in whatever context you wish to define ‘pollution'. This is the third year of our work. The Authority is accumulating literature relevant and necessary to our work as well as spending time at the local universities in further research. We are able to evaluate streams based on preferential habitat of the various invertebrates and vertebrates collected. By using some aquatic insects as indicators of enrichment, personnel can determine the source and type of enrichment, and work on a solution to resolve this problem. In our research the Authority is attempting to find the requirements, maximum and minimum limitations of various pollution parameters, and habitat preferences of the insects in the field by correlating them with chemical analysis to obtain further information at the species level. Over the period of several years, certain trends will become apparent.

Our benthic samples are collected by kicking a small area of substrate into a net. The sample is put into a gallon jar and reserved with a 10% formaldehyde solution. This is done throughout the year.

Hand picking of rocks and stones is generally done in conjunction with the kick net when the water is free of ice. When picking bugs by hand, the larger insects that are able to escape the net are collected as well as the fact that many larger rocks are surveyed.

Three methods are used for collecting fish for scientific purposes; seine, boat shocker, and portable shocker.

The seine is a large net, 60 feet long and 6 feet wide with a 6' x 6' x 6' bag in the middle. A smaller seine, 10 feet by 3 feet is often used on smaller creeks or as a trap. Seining is most effective by pulling the net downstream slightly faster than the current. Other methods are to seine along the shore, or enclosing a small inlet. This method is used primarily in streams and shore areas of lakes or deep rivers. The portable shocker is a back mounted generator and control unit. Three dead man switches are employed to ensure safety. Two fiberglass poles, one an electrode, the other the anode (net), are immersed into the water and an electric field is produced by the generator to stun the fish. Often the shocker is placed into a rubber raft and pulled along behind the men. When sampling some streams that are very muddy and treacherous in which to walk, the shocker is placed on the shore and the electrodes placed into the water. The portable shocker is used only in small to medium sized streams. The boat shocker is employed in deeper waters such as shore areas of reservoirs and streams deep enough to handle a twenty foot boat.

The boat contains a generator capable of generating 7 - 8 amps at 80 - 90 volts through the anodes which are four ⅜" long brass rods extended in front of the boat on a boom. The boat (aluminum) is the electrode so the field is set up between the electrode and anode. A fourth method we occasionally employ is the creel census. This is generally done at our put and take fisheries.

The insects, after having been preserved in the gallon jars, are placed in a dissecting tray and separated by hand with the help of calcium chloride which allows some of the insects to float thereby facilitating detection. The invertebrates are then identified with the use of a dissecting microscope (63 - 800 power) and various keys. Those specimens that are new to us, are preserved in a 60% solution of alcohol and kept in our collection of insects of the Grand River Basin. The fish, upon collection are also preserved in a 10% solution of formaldehyde until processed in the laboratory.

The fish caught in streams and rivers are identified, measured for fork length, and those species new to us are preserved in 60% alcohol for our collection. The fish caught in large rivers (mouth of Grand) and reservoirs are not preserved unless we don't have the particular species in our collection. The fish are weighed, measured, sexed, aged, and for trout, stomachs are analyzed. This report covers the collection of 47,365 invertebrates and 12,456 fish.

A. **Canagagigue Creek** (Woolwich Dam)

i) Description of Stations

Five stations were established on Canagagigue Creek, three of which were sampled more often than the others. Ca1, sampled nine times in 1972, is located just below the Floradale Mill Pond. The water here is fast, varying from 4 to 5 feet deep at the dam to 1 and 2 feet through the small park in Floradale. The bottom in this area consists generally of large algae-covered rocks. A few pools or eddies of slow water resulted in a muddy sand to stony consistency. It was in these more accessible locations that benthic samples were taken with the kick net. Hand picked samples were taken in the faster areas off the larger rocks. The surrounding environment at this station is rather aesthetically appealing in that many trees and shrubs exist along the watercourse. Few cattails are also present.

Station Ca2, sampled eight times, is located down from the electric plant just outside of Elmira where the creek passes under the road. This station is eight hundred yards below the proposed dam site. Presently it runs through farmland fields that were planted to corn, grasses and pasture. The creek bed is gravelly and silty (clays). The pool just below the bridge is 4 to 5 feet deep and is in a sense a collecting pool for the silt. Benthic samples were taken in the rather shallow (6" to 12"), faster portion of the stream.

The fish were taken from the deeper waters below the bridge by seine and above in the shallow areas with the portable electric shocker. There is little vegetation in the area to provide shade for the area, consequently, it is a warmer water area. The water is very seldom clear, but is rather turbid as a result of erosion of the fields.

Ca3, sampled nine times, is located just south-east of Elmira as shown on the map on page 6. The water quality is poor as shown by OWRC data collected from this location (OWRC, 1971 water quality monitoring program).

The water flow is generally very slow except for the spring runoff. The bottom in the shallow section (6" 12") is gravelly to stony with many of the larger rocks having black undersurfaces (as a result of anaerobic hydrogen sulfide production). The water is 3 to 4 feet deep under the bridge and very slow. Benthic samples were taken in the faster more shallow water above the bridge. Fish were collected several hundred feet on either side of the bridge. The grounds about the creek in this area are very pleasing. Large trees shade much of the watercourse and grasses and shrubs line the stream bank.

Ca5, as shown on the map on page 6, is just above the Town of Elmira behind the Public Works building. The stream runs over a gravelly bottom and has a moderate flow. Evidence of rock bass spawning was found here. The surrounding area presents large shade trees and tall grasses along the shoreline. The water appeared to be cloudy and was approximately 1 to 2 feet deep. This station was sampled three times.

Ca4 is a small spring-fed creek that runs into the proposed Woolwich reservoir. This creek was sampled twice. The stream bed is generally a soft, dark mud in the slower reaches and proceeds to a sandy, gravelly existence near its confluence with Canagagigue Creek. Much of the stream ran through a cedar wood and consequently was a well shaded stream with the roots of the cedars crossing the stream. Duckweed and watercress were evident here. The stream flow is slow and very seldom does it exceed a depth of 2½ feet.

Canagagigue Creek Stations

ii) <u>Discussion of Benthic Data (Canagagigue)</u>

A total of 100 species of aquatic invertebrates and insects and 18 species of fish were taken at the 5 stations on Canagagigue Creek. Since the water quality and creek bed at Ca1 is more suitable to harbouring insects, more species (66) and greater numbers (8,528) were taken here. It is difficult to seine and shock at this station and it is conceivable that there is a greater diversity of fish than our data shows (5 species, 365 fish). Station Ca2 illustrated a greater diversity of fish (12 species, 628 fish) but less diversity in the insect population (60 species, 2,655 invertebrates). Station Ca5, sampled only twice, yielded 25 species of aquatic invertebrates and 4 species of fish. Because of the condition of the stream at this point, there is little reason to doubt that had samples been taken regularly, they would have been as diverse as at Ca1 and Ca2. Ca3, because of its poor water quality, produced only 32 species in 9 samples and 3 species of fish. Ca1, the spring-fed creek, produced 49 species of invertebrates in three samples and 7 species of fish.

<u>Comparison of Stations Ca1, Ca2, and Ca3</u>

The presence of Oligochaetes generally indicates a mud and debris type substrate. Branchiobdellidae are commensal on crayfish (they live on crayfish but do not harm them). The oligochaetes present at Woolwich are able to withstand a low level of dissolved oxygen and even anaerobic conditions for extended periods of time. Tubificidae are found in greater concentrations in streams that are polluted with sewage or poorer water quality. This explains their larger numbers at Ca3. Most of the oligochaetes can be used as indicators of organically enriched waters but it would be more helpful if we were to speciate them since each species has a definite habitat requirement. We would be able to say more about water quality at the species level.

Erpobdella octoculata requires fast and well aerated waters.which explains its presence at Ca1 and not at the slower moving stations. *Helobdella stagnalis* because of its independent respiration is able to withstand stagnant waters, therefore it will be found in almost any type of stream. It also feeds on snails and for this reason is found at many of the stations (if snails are present). *Glossiphonia complanata* has requirements similar to *E. stagnalis* and it would be reasonable to assume that they would be found together. The fact that leeches prefer a rocky bottom, or at least some debris on which to hang on to, may account for the few that were caught at Ca2.

The Isopoda, *Asellus* sp. are inhabitants of a depositing strata and prefer an environment of slow water on a mud surface similar to that found at Ca3.

Amphipods are characteristic of clean unpolluted waters and relatively high dissolved oxygen. Their presence at Ca1 may be accounted for by the fact that they are usually found in streams with rocky bottoms and some aquatic vegetation and actively migrate upstream so that they are often common below dams and absent above.

Most species of Decapods can tolerate a normal but wide range of temperatures. *Orconectes* sp. prefer running water and stony substratum whereas *Cambarus* sp. prefer to burrow into the substratum such as that provided at Ca2 and Ca5. Very seldom do we catch crayfish in our benthic collections; they are more often collected while seining and shocking for fish. Quite often when shocked, they can scoot along the bottom rapidly and escape our nets, or because of the turbid conditions, escape notice altogether. It is possible that many more could be found at many of these stations.

The Mollusca are generally more prominent in rapid streams (some species prefer slower water) as is shown by the presence of 13 species at Ca1 to found in the slower (poorer water quality) waters of Ca3. *Sphaerium* and *Pisidium* require stable sand and gravel substrate on which to live which accounts for their presence but in diminishing numbers from Ca1 at Floradale through Ca2, Ca5 and Ca3 below Elmira. The pulmonate snails (Gastropoda) require sufficient oxygen and are generally absent from polluted waters. *Physa* sp. in such large numbers at Ca3 may be accounted for since they require slower water and much aquatic vegetation along the shoreline which is present at Ca3.

592 specimens of mayflies comprising 8 species were found at Ca1 of which 476 were *Caenis*, a shoreline and burrowing mayfly.

The sample in this area is usually taken in a slower deeper pool area since it offers smaller stones and a sandy, muddy area but also crevices among the rocks in the fast portion of the stream. This would also account for the presence of *Stenonema tripunctatum* which is found in slower moving waters. The other species of

Stenonema and *Baetis* are found in faster, cleaner waters similar to those conditions below Floradale (Ca1). This condition practically repeats itself at Ca2. The substratum being muddy or clay would account for the burrowing species *Hexagenia* sp. being present.

The dragonfly nymphs and damselfly nymphs frequent submerged vegetation and the lack of submerged vegetation at Ca2 would account for the absence of these invertebrates here. *Dromogomphus* sp. found at Ca1 lives deep in the mud, *Belostoma* and Corixidae make their habitat in shallow ponds, lakes or margins of slow streams in vegetation. Many are found in the vegetation along the shoreline at Ca1. They are not commonly found in our samples since they spend most of their time along the shore in vegetation.

Both *Sialis* (alderflies) and *Chauliodes* (fishflies) are indicative of well aerated streams and will burrow into mud and detritus (if vegetation is present). Because of the silt load at Ca2 due to dam construction, both species are absent.

The net builders, Hydropsychidae, Philopotamidae, Psychomyiidae, will be found in faster, well oxygenated waters as is shown at station. Ca1 and Ca2 and to a lesser degree at Ca3. Most caddisflies live in crevices of rocks or attached to the surface. *Cheumatopsyche, Pycnopsyche* and *Rhyacophilia* are also found attached to rocks and stones in faster waters. *Oecetis* sp. and *Leptocella* sp. both prefer warmer waters. Few are tolerant of excessive organic enrichment as shown by the lack of caddisflies at station Ca3.

The presence of such large numbers of blackflies (1133) and midges (2903) at station Ca1 can be accounted for by the suitable habitat of fast waters and rocks for the blackflies and midge larvae. Adequate shade from the trees and cooler waters provide an excellent habitat. This habitat also accounts for the presence of *Antocha* sp. and *Atherix variegata*. The two stations, Ca1 and Ca2 are the only places that the diptera (other than chironomid) show up in any significant numbers because of the desirable habitat.

Chironomids account for the majority of diptera found, 57% at Ca1, 89% at Ca2, and 99% at Ca3. It would be irresponsible to say that in general chironomids prefer polluted waters; the fact is that some do and some don't. This family can be very useful in determining water conditions at the species level. They are the most prolific of the diptera and can be found in practically any environmeat. The greatest number found at Ca3 would indicate a preference for sluggish and muddy waters.

It is questionable that the classification of *Amphizoa* sp. is correct. Its habitat is correct since it prefers cooler streams and fast water. Parts of Ca4 were faster than others, plus driftwood, debris and watercress were present; a habitat preferred by *Amphizoa* sp. The Dytiscidae, preferring slower waters are present also. Two riffle beetles *(Optioservus* and *Stenelmis*) are characteristic of fast waters and both adults and larvae were present in the same locality. *Dubiraphia* prefers ponds and slower waters, feeding on aquatic vegetation and is also found at each station.

Ca5 has characteristics of both Ca1 and Ca2. Ca5 has stones and boulders similar to those at Ca1 and stones, gravel and silt characteristic of Ca2. Many of the invertebrates found at Ca1 and Ca2 are found at Ca5. Both burrowing crayfish *Cambarus* sp. and *Orconectes* sp. characteristic of stony substratum are found at Ca5. The snails and clams (those characteristic of slower flows and muddy to gravelly substrate) are common at Ca5. The substrate is suitable habitat for *H. borealis* and their absence can only be explained by lack of sufficient sampling.

Station Ca4, as explained before, consisted of clear cool waters with a muddy bottom and for this reason many species characteristic of muddy bottoms will be present. Tubificidae are absent since the water is not organically enriched whereas common inhabitants such as Naididae are found here. Snails (gastropods) are common here, clinging to the aquatic vegetation and debris. *Helobdella stagnalis* can survive in stagnant water but feeds on snails and the presence of snails at this location may account for the presence of this leech. The clams (Pelecypoda) *Alasmidonta, Pisidium* and *Sphaerium* can burrow into the muddy bottoms. The burrowing species of mayflies *Caenis, Leptophlebia* sp. and *Paraleptophlebia* sp. are found at Ca4.

The damselfly *Enallagma* sp. found on submerged vegetation was also found here. The true bugs (Hemiptera) as stated before, are not commonly found in our benthic collections since they are more often on the surface and when on the bottom are able to swim by the face of the net. Undoubtedly they are present in this stream. One benthic sample was taken in a sandy, stony location of the creek which would account for the presence of the various caddisflies. *Tipula abdominalis* has a habitat in the drift at the margin of a stream and shows up here (Ca4). The adult horseflies

(*Tabanus* sp.) deposit their eggs on vegetation above slower flowing water (some species prefer fast water) and the eggs drop into the vegetation along the stream banks where the larvae are found. C*hrysogaster* sp. and *Tubifera* sp. are found in muddy bottom streams and are found at Ca4. The predaceous diving beetles characteristic of aquatic vegetation are found here (Ca4).

Benthic Data Collected (Woolwich Reservoir)

Species	Ca1	Ca2	Ca3	Ca4	Ca5
Tricladidae (flatworms)					
Planariidae	86	2	2		
Oligochaeta (aquatic earthworms)					
Branchiobdellidae	15				
Lumbriculidae			80		
Naididae	30	48	170	49	2
Tubificidae	2	8	30		
Hirudinea (leeches)					
Erpobdella octoculata	4				
Glossiphonia complanata				5	
Helobdella stagnalis	2	1		3	1
H. triserialis		1		1	1
Mollibdella grandis	1				
Nephelopsis obscuris	2			5	
Isopoda (aquatic sow bugs)					
Asellus sp.			1		
Amphipoda (side-swimmers)					
Hyalella azteca	1	3			
Decapoda (crayfish)					
Cambarus sp.					3
C. diogenes		2			
Orconectes sp.					3
O. propinquus	4				
O. virilis		5		6	
Acari (water mites)				4	
Gastropoda (aquatic snails)					
Armiger sp.	2		1		
Ferrissia sp.	18	24	2	2	
Gyraulus sp.	4	4	5	5	*2*
Helisoma sp.	3	4	3		1
H. campanulatum	4			1	
Lymnaea sp.	4	4	19	3	3
Physa sp.	40	42	102	11	5
Viviparus sp.	3				
Pelecypoda (clams)					
Alasmidonta sp.	1	4		13	1
Lampsilis sp.	2				
Lasmigona sp.	1				
Pisidium sp.	560	75	17	13	
Sphaerium sp.	1035	97	38	11	
Unionidae	3				

Benthic Data Collected From Canagagigue Creek (Woolwich Reservoir)

Species	Ca1	Ca2	Ca3	Ca4	Ca5
Ephemeroptera (mayflies)					
Ephemeridae					
Ephemeridae					
Hexagenia atrocaudata		2			
H. recurvata		1			
Heptageniidae					
Stenonema canadense	9				
S. fuscum			1		
S. gildersleevei	26				1
S. heterotarsale	13	2	1		
S. nepotellum		2			
S. pulchellum	2	1			
S. tripunctatum	1				
Bactidae					
Leptophlebiinae					
Leptophlebia sp.	1			1	
Paraleptophlebia sp.				1	
Caeninae					
Caenis sp.	476	325		14	2
Baetinae					
Baetis sp.	1	11		2	1
Odonata					
Anisoptera (dragonflies)					
Dromogomphus sp.	1				
Zygoptera (damselflies)					
Enallagma sp.	1		1	2	
Ischnura sp.	1		1		
Hemiptera (true bugs)					
Belostoma sp.	1				
Corixidae	I				
Ochteridae		1			
Saldidae					1
Neuroptera					
Chauliodes sp. (fishflies)			1		
Climacia sp. (spongilla flies)			1		
Sialis sp. (alderflies)	10		5		

Benthic Data Collected From Canagagigue Creek (Woolwich Reservoir)

Species	Ca1	Gat	Ca3	Ca4	Ca5
Tricoptera (caddisflies)					
Hydropsychidae					
Cheumatopsyche sp.	791	215	4	6	
Hydropysche sp.	4	32	2	4	
Hydropysche pupae	1	1		11	1
H. betteni	3	2			
H. bifida	33	132			
H. recurvata	1	9			
H. simulans		6			
H. slossonae	5	1			
Hydroptilidae					
Ochrotrichia sp.		1		9	
Rhyacophilidae					
Rhyacophila lobifera	1				
Rhyacophila sp.		2			
Philopotamidae					
Chimarra obscura	41	4			
Psychomyiidae					
Polycentropus sp.	2				
Leptoceridae					
Athripsodes sp.		8		1	
Leptocella (parvida ?)		1			
Oecetis sp.					1
Helicopsychidae					
Helicopsyche borealis	7	57		37	
Brachycentridae					
Brachycentrus sp.		1			
Micrasema sp.					1
Limnephilidae					
Limnephilus sp.	13	3			
L. pupae	1				
Neophylax sp.				1	
Pycnopsyche sp.	2	1			
Diptera (two-winged flies)					
Nemocera					
Tipulidae (craneflies)					
Antocha sp.	35	62	3	1	
Eriocera sp.	1				
Pedicia sp.			1		
Prionocera sp.		1			
Tipula sp.		5		1	
T. abdominalis	7	3		2	

Benthic Data Collected From Canagagigue Creek (Woolwich Reservoir)

Species	Ca1	Ca2	Ca3	Ca4	Ca5
Simuliidae (blackflies)					
Simulium sp. A		1			
S. exism	874	18			
S. vittatum	1259	48		2	
S. vittatum pupae	2				
Simulium larvae	5	6			
Chironomidae (midges)					
larvae	2903	1244	6931	108	371
Ceratopogonidae (biting midges)	1	1		40	
Brachycera					
Brachycera pupa				1	
Stratiomyidae (soldier flies)					
Stratiomyia sp.					1
Rhagionidae (snipeflies)					
Atherix variegata	18	5			
Tabanidae (horseflies)					
Tabanus sp.			1	9	
Syrphidae					
Chrysogaster ?				1	
Tubifera ?				1	
Hymenoptera (wasps, bees, sawfly)					
Tenthridindae (sawfly)					I
Araneida					
Spider				1	
Coleoptera (beetles)					
Amphizoidae (trout stream beetles)					
Amphizoa sp.					
Dytiscidae (predaceous diving beetles)					
Bidessus sp.	1	14		4	
Dytiscus sp.			2		
Notomircus sp.		1		1	
Oreodytes sp.				1	
Ilybius sp.				1	
Hydrophilidae (water scavenger beetles)					
Berosus sp.		1	14		

Benthic Data Collected From Canagagigue Creek (Woolwich Reservoir)

Species	Ca1	Ca2	Ca3	Ca4	Ca5
Psephenidae (water pennies)				1	
Ectopria sp.					
Elmidae (riffle beetles)					
Dubiraphia sp.	29	4		12	1
Optioservus sp. larvae					
Optioservus sp. adult		34		4	
Stenelmis sp. larvae		93	20	J	
Stenelmis sp. adult	12	30	30	4	
Halodidae (marsh beetles)				5	
Ptilodactylidae				1	
Anchycteis					
Chrysomeildae (leaf beetles) or Ptilodactylidae		1			
No. of organisms	8528	2655	7549	441	492
No. of species	66	60	32	49	25
No. of times sampled	9	8	9	3	2

Grand Total no. of organisms	19665
Grand Total no. of species	100

iii) Discussion of Fish Data

There were 18 species of fish caught at the five stations. Ca1 and Ca4 will be within the reservoir. These stations provided us with an excellent variety of forage fish for the rock bass that were caught at Ca1. Rock bass spawning beds were seen at Ca5 and Ca1 which indicates that the fish thrive here. The water of the reservoir will be too warm to support the brook trout population that spawns in the Spring Creek (Ca4). All stations except Ca3 showed that they could support a viable fish population. Ca3 yielded only 50 fish of 3 species of which 47 were common shiners which indicates that the environment of this area is very poor.

Hopefully with the development of the reservoir, water quality will improve throughout the creek especially at Ca3. This will result in a more viable population of fish as well as an excellent environment for the benthos.

Ca1	No. of Fish	Size Range	Age
Common White Sucker	1	185 mm	
	2	83, 85	0+
	1	226	3+
Common Shiner	32	53 -126	
	24	35 - 50	0+
	153	60 - 75	14+
	112	75 - 90	1+ -2+
	20	90 -110	3+
	2	115 -120	3+
Hornyhead Chub	5	42 - 69 mm	
	1	29	0+
	1	50	1+
	2	73, 73	2+
	1	98	2+
	2	110, 115	3+
Longnose Dace	3	57 - 74	
Rock Bass	3	40, 145, 235	
Total No. of Fish	365		
Total No. of Species	5		

Ca2	No. of Fish	Size Range	Age
Common White Sucker	3	89 -102 mm	
	6	80 - 92	1+
	4	120 - 135	2+
	1	168	3+
	2	215 - 220	5+
	8	185 - 208	5+
	1	264	5+
Northern Hog Sucker	1	99	
Common Shiner	71	16 -108	
	13	35 - 40	0+
	25	55 - 60	0+
	30	67 - 73	2+
	22	80 - 95	2+ - 3+
	9	105 -110	3+
	5	112 -120	3+
	2	130 -133	4+
Hornyhead Chub	47	35 -111	
	249	34 - 50	0+
	5	60 - 68	1+
	6	73 - 75	1+ - 2+
	10	80 - 95	2+
	1	118	3+
	1	140	4+
Creek Chub	11	70 -106	
	3	60 - 73	0+
	1	95	2+
	1	145	3+
	2	208 - 212	5+
Brassy Minnow	6	65 - 68	
Bluntnose Minnow	6	42 - 57 mm	
	2	38 - 40	0+
	7	48 - 60	1+
	26	62 - 80	2+
Fathead Minnow	1	67	
Johnny Darter	3	60 - 67	
	1	40	0+
	3	56, 64, 65	1+ - 2+
Barred Fantail	9	43 - 62	
	2	27, 30	0+

Ca2	No. of Fish	Size Range	Age
Least Darter	5	27	0+
	1	35	1+
Rock Bass	10	18 -129 mm	
	1	38	0+
	5	60	1+
Total No. of Fish	628		
Total No. of Species	12		

Ca3	No. of Fish	Size Range
Common Shiner	47	20 -102
Bluntnose Minnow	1	50
Iowa Darter	2	approx. 50
Total No. of Fish	50	
Total No. of Species	3	

Ca4 (Spring Creek)	No. of Fish	Size Range	Age
American Brook Lamprey	6	105 - 110	
Brook Trout	6	73 - 96	0+
Common White Sucker	2	58, 65	0+
Common Shiner	2	72, 74	2+
	1	95	3+
Brassy Minnow	2	73, 80	3+
Creek Chub	1	65	1+
	1	77	2+
Blacknose Dace	2	35	0+
	2	47, 53	0+ - 1+
	8	60, 62	1+
	18	65 - 73	2+
Total No. of Fish	51		
Total No. of Species	7		

Ca5 (just above Elmira)	No. of Fish	Size Range
Central Mud minnow	1	100 mm
Common Shiner	64	36 -160
Creek Chub	1	85
Rock Bass	2	56, 57
Total No. of Fish	68	
Total No. of Species	4	

iv) Discussion of 24 Hr. Dissolved Oxygen and Water Temperature Survey

August 30 - 31, 1971 a 24 hr. dissolved oxygen and water temperature survey was done on Ca1 and Ca2. On the 29th and 30th of August 1972, a 24 hr. dissolved oxygen and water temperature survey was done on Ca1, Ca2, and Ca3. It was done to determine the effects of the clearing of Woolwich Reservoir on dissolved oxygen and water temperature of Canagagigue Creek. As shown in graph no. 6, there was a slight increase in water temperature at Ca2 (19.2 in 1971 and 21.1 in 1972) of 1.9 C. The water was also warmer at Ca1 in 1972 than in 1971 (1.2°C) which could be accounted for by a warmer summer in 1972 than in 1971. To equate the condition to illustrate if the clearing did affect the temperature one must look at the increase between Ca1 and Ca2 in 1971 and the increase in temperature between Ca1 and Ca2 in 1972. The increase in 1971 was 0.1°C whereas in 1972 it was 0.8°C. This shows that there was an increase in water temperature as a result of the removal of the bush along Canagagigue Creek. Working along the same lines, an increase is evident in dissolved oxygen between the two stations. Since dissolved oxygen decreases to a certain point with an increase in water temperature in oligotrophic streams and increases to a certain point with an increase in water temperatures in eutrophic streams, one can assume, based on the increase in water temperature that the dissolved oxygen will increase between Ca1 and Ca2. In 1971 a 0.6 mg/L increase was apparent between Ca1 and Ca2; in 1972 a 0.8 mg/L increase was noticed. Two reasons can be stated for the increase as a result of the woods being cut down:

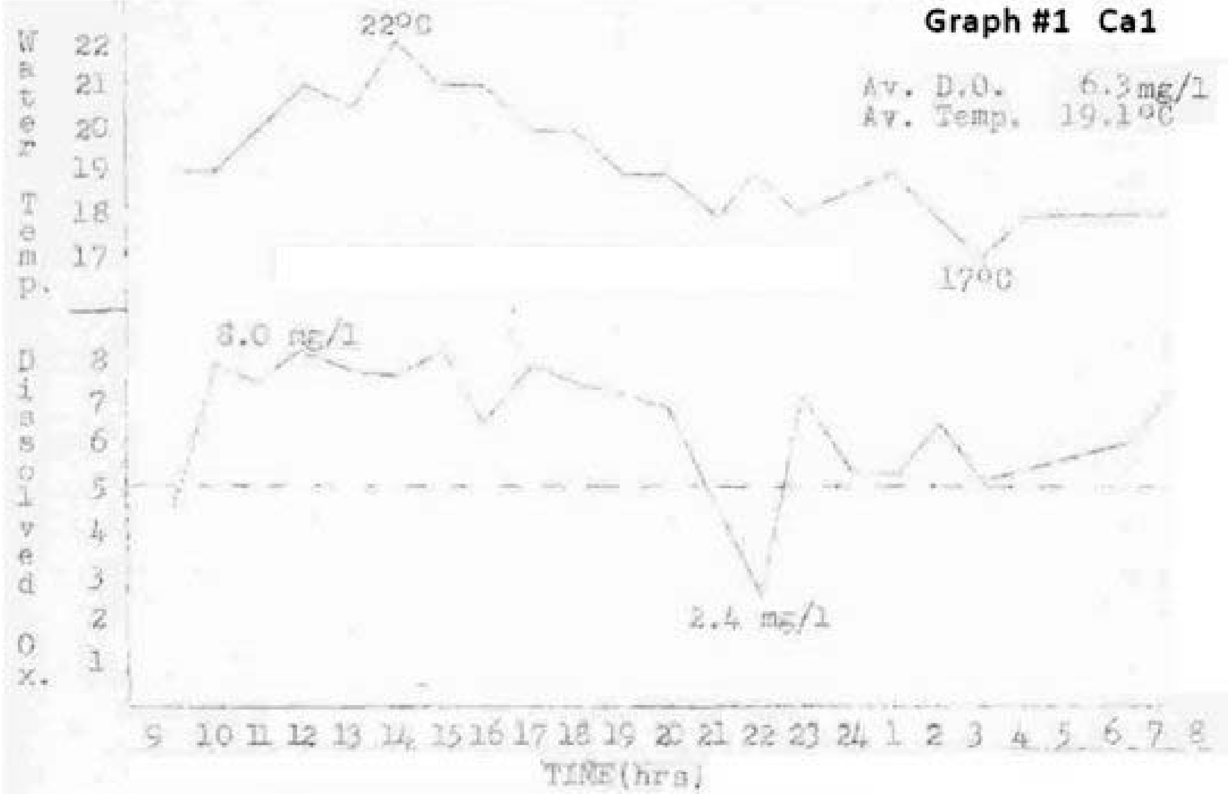
1. With the increase of sunlight in this area of the stream, photosynthetic activity will increase greatly resulting in a greater release of dissolved oxygen.

2. The stream may have eroded slightly because of lack of bank stabilization causing the water to increase slightly in velocity and therefore aerating more and increasing the dissolved oxygen. Since an increase in silt load of a stream tends to decrease the amount of dissolved oxygen, it is conceivable that had the silt load not been so great at Ca2, the dissolved oxygen could have been higher and the difference between the two stations greater.

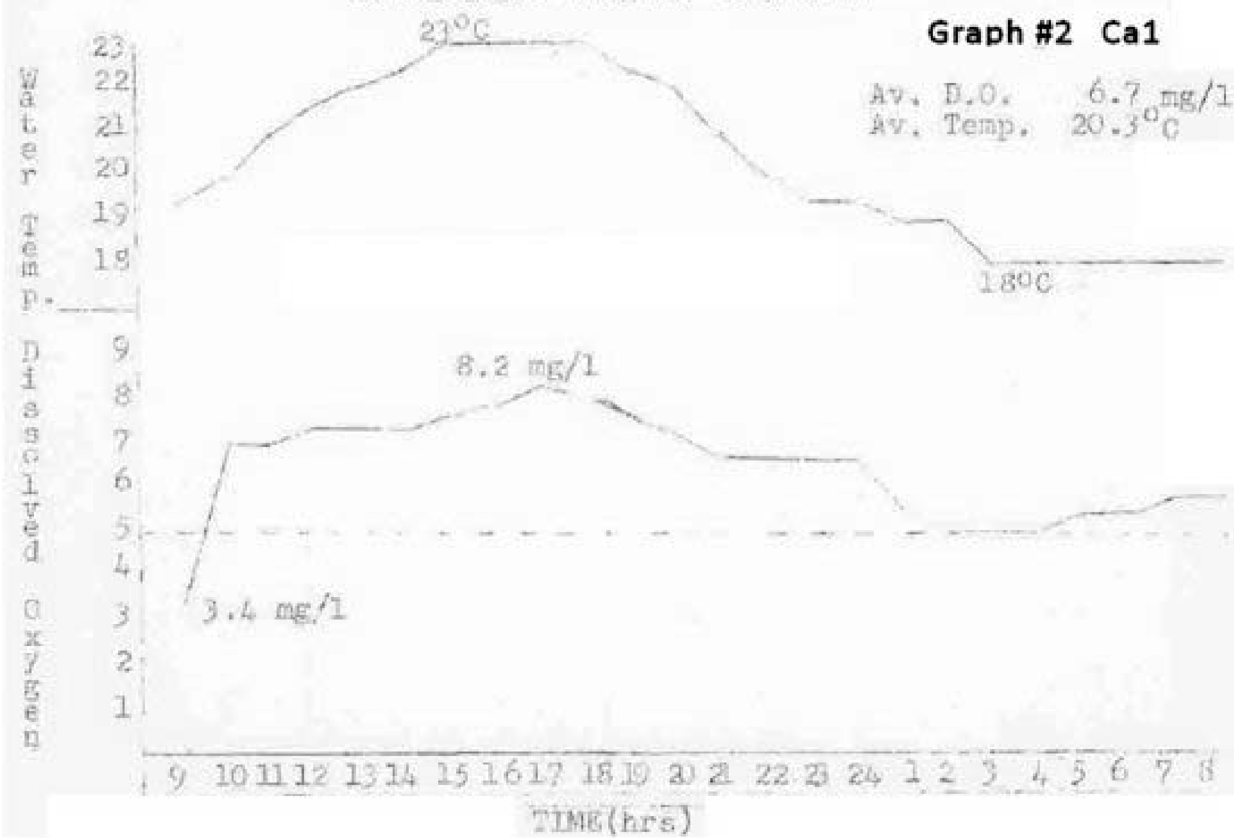
Each graph, 1 - 5, points out how the dissolved oxygen varies with water temperature (actually sunlight). Very seldom did the dissolved oxygen go below 5 mg/L at Ca1 and Ca2 in 1971 and 1972. At Ca3, the dissolved oxygen falls below 5 mg/L quite often. The greatest range in dissolved oxygen also occurs at Ca3 which is an indication of a great oxygen demand on the water. This could be due to the fact that slightly upstream from this station (Ca3), the Elmira sewage treatment plant has its outflow. The resultant sewage type algae would put an oxygen load on the stream and therefore account for the large range in dissolved oxygen. This range and especially the low dissolved oxygen would undoubtedly account for the lack of fish at this station.

Graph 6 illustrates the averages in dissolved oxygen and water temperatures at all stations. Most important are the August 1972 values which point put the increase in dissolved oxygen and water temperature at Ca1 and Ca2.

Canagagigue Aug. 30 - 31, 1971

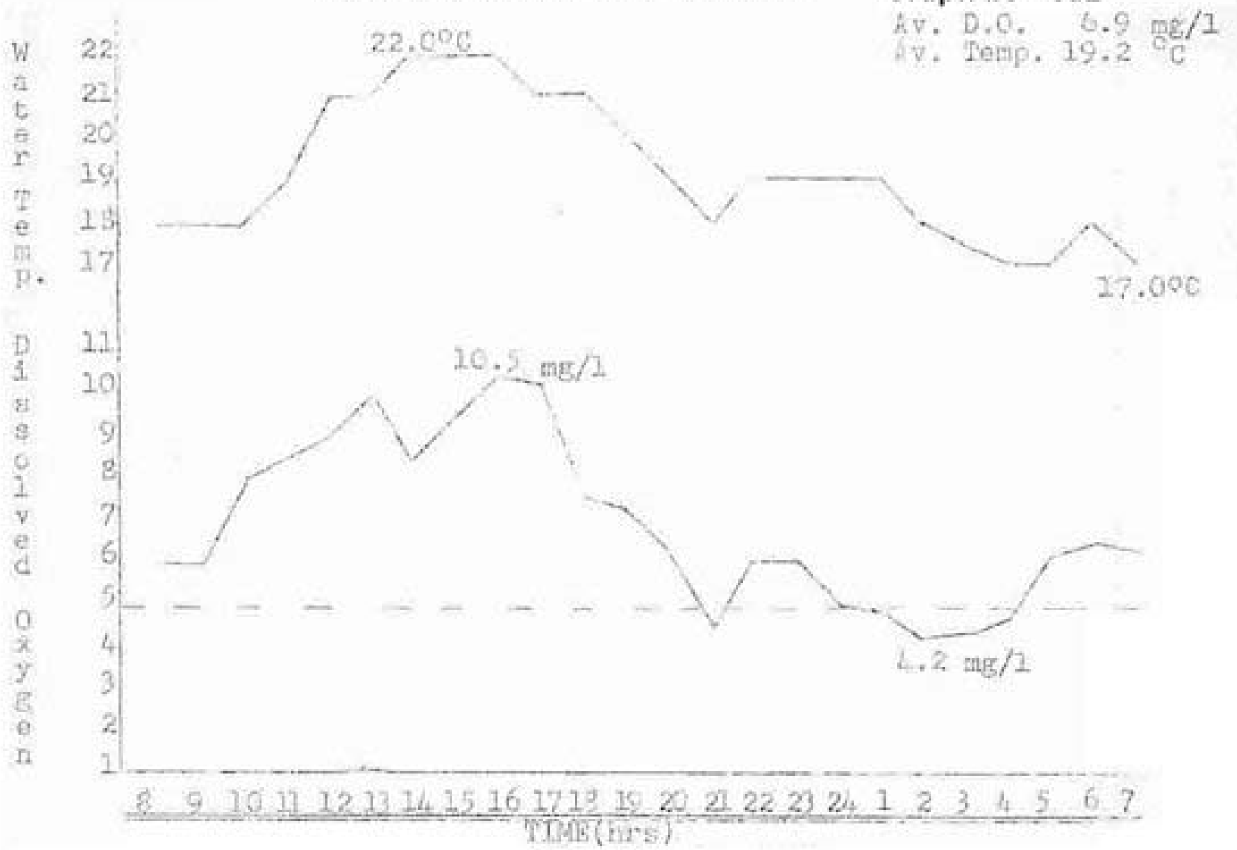


Canagagigue Aug. 29 - 30, 1972

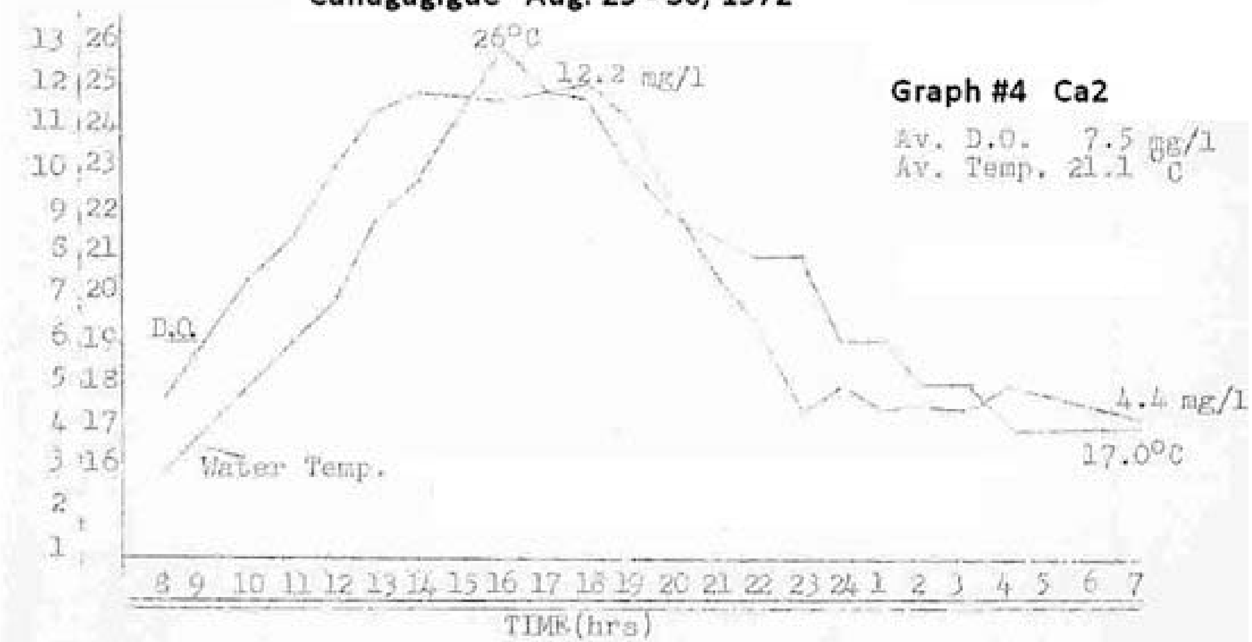


Canagagigue Aug. 30 - 31, 1972

Graph #3 Ca2

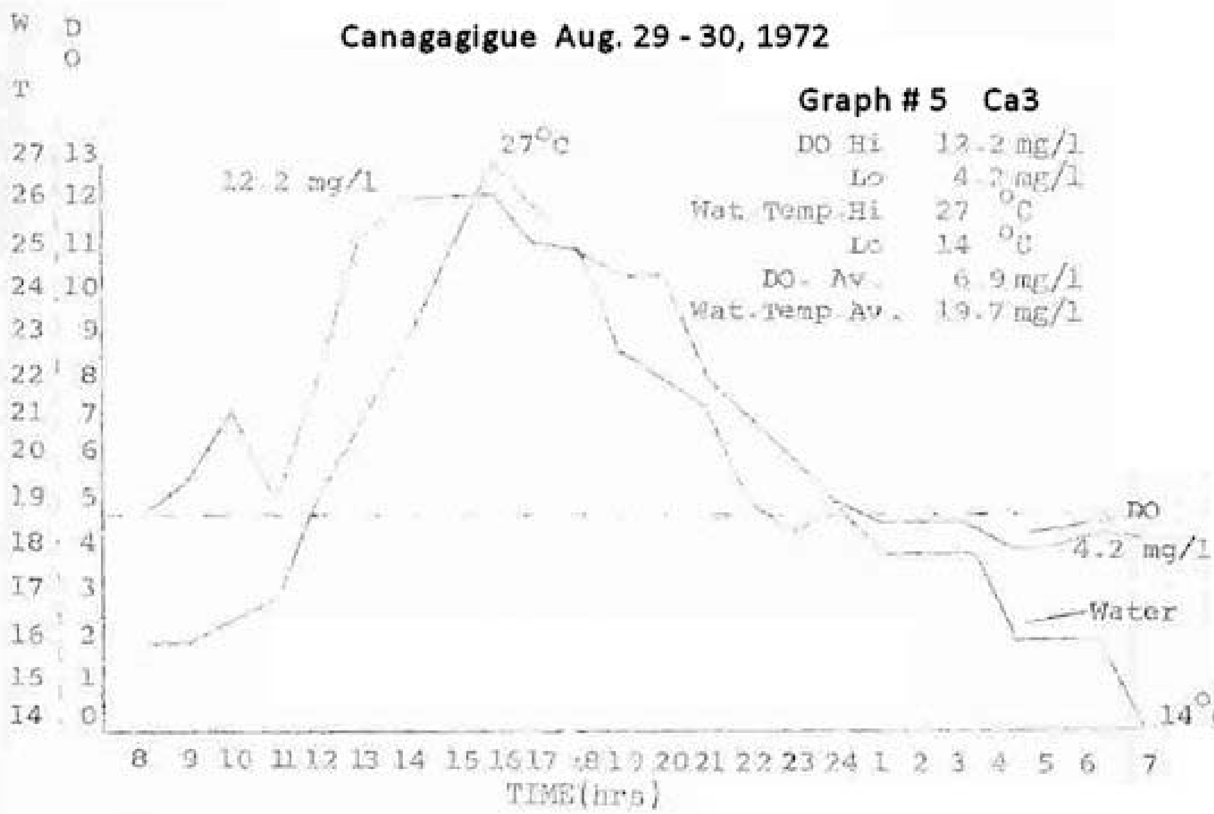


Canagagigue Aug. 29 - 30, 1972



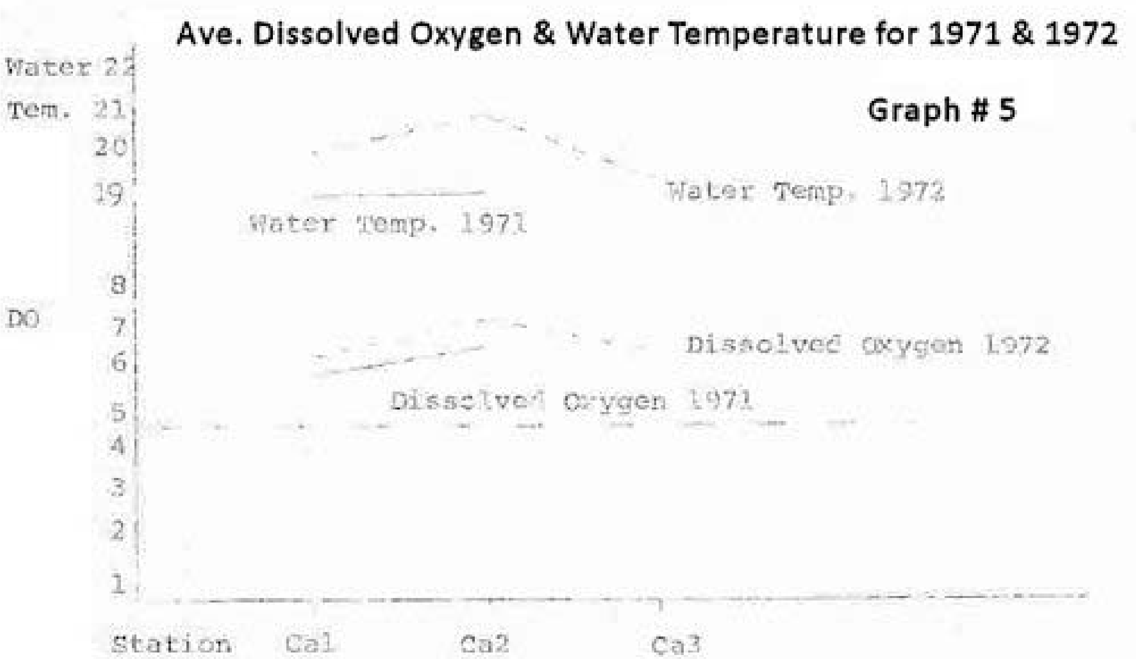
Canagagigue Aug. 29 - 30, 1972

Graph # 5 Ca3



Ave. Dissolved Oxygen & Water Temperature for 1971 & 1972

Graph # 5



v) Summary of Canagagigue Creek

As a result of the Floradale Mill Pond, the water in Canagagigue Creek is slightly enriched. The small dam creates warmer water temperatures below the dam because of surface drawoff. Last year because of a cedar woods lining the bank upstream of Ca2, the water was slightly cooler. We found this year, through the 2)$_{+}$ hr. water temperature and dissolved oxygen survey that there was a slight increase in water temperature and dissolved oxygen at Ca2 as compared to Ca1. This increase was attributed to the fact that the cedar woods above Ca2 had been removed in the process of reservoir clearing. As you follow the stations downstream from Floradale Ca1 through Ca2 above Elmira and Ca3 below Elmira you can see, based on the species diversification of insects and fish and through changes in dissolved oxygen and water temperature, the increase in eutrophication of the stream.

At Floradale (Ca1) the stream is slightly enriched but is relatively rapid (has periods of very slow water) and shows the greatest number of species. Station Ca2 above Elmira illustrates the finding of lesser species (60 compared to 66 at Ca1) due to an increase in enrichment as a result of the removal of the woods and unstable banks. Station Ca3, below Elmira, presented only 32 species and a greater fluctuation in dissolved oxygen and water temperature. This portion of the stream exhibits extreme overloading due to shallow waters, slow flow, having passed through the park in Elmira that doesn't allow for adequate shade of the water, and the fact that some effluents from various factories in Elmira are received by this stream.

Last year (1971) only Ca1 and Ca2 were sampled. It was shown in 1971 that Floradale (Ca1) was the poorer in water quality of the two stations. Ca1 yielded less insects than Ca2. This year (1972) however, it appears that some improvement has occurred at Ca1 and the quality of water at Ca2 has deteriorated.

Ca1 (Floradale) and Ca2 (above Elmira) presented a representative sample of fish. Ca3 because of poor water quality showed only 3 species of fish. To assess the fish populations more accurately, more fishing should be done at each station.

Station Ca4 is on a small spring-fed creek which runs into Canagagigue creek above station Ca2 and below Floradale. This creek yields excellent water and is not enriched in the slightest. Unfortunately this creek will be under water when the Woolwich Reservoir is completed. Because of its slow flow and size, it will not improve the water quality in the reservoir.

The reservoir, upon completion, will be a shallow water impoundment with a surface area of 256 acres. Consequently the water temperature will be fairly warm and because of the rather shallow banks surrounding most of the reservoir, excessive submergent and emergent aquatic vegetation will result. The insect population complements the fish population in that adequate numbers of invertebrates are present for the forage fish. Chubs, suckers, dace, and shinners provide sufficient forage for an indigenous rock bass population. The reservoir will not be suited for a recreational use type area but will allow for an intensive wildlife (aquatic birds) area.

The impoundment will provide an excellent environment for the fish and hopefully will permit some running water at station Ca1 just below the Foradale Mill Pond. The main purpose of the reservoir is for stream flow augmentation. It is planned to release water at a rate of at least 10 cfs which will improve the water quality at Ca2, Ca5 and Ca3 below Elmira. The condition expected will permit the stocking of largemouth bass in the reservoir although with fluctuating water levels, spawning may not be possible. However, the construction of by-pass ponds below the dam could provide excellent breeding potential of largemouth bass. The major change in insect types will be the elimination of those common to running water to those commonly found in a typical "frog pond" habitat. This will not result in a reduction of the available food but merely replace what is present now in a running water situation.

Collection of fish and benthic samples should continue on a regular basis for two years after the reservoir's completion.

B. Conestogo River (Conestogo Reservoir)

i) Discussion of Stations

Four regular stations (C1, C2, C4, C5) were the same as last year. One sampling was done at Glen Allan.

C1 is situated in Drayton. The flow through here, except in the spring is very slow. The bottom consists of large boulders to large gravel on a clay type bed. The stream in this area appeared always to be cloudy and only 6" to 12" in depth. The banks were eroded gravel with no apparent vegetation for stabilization.

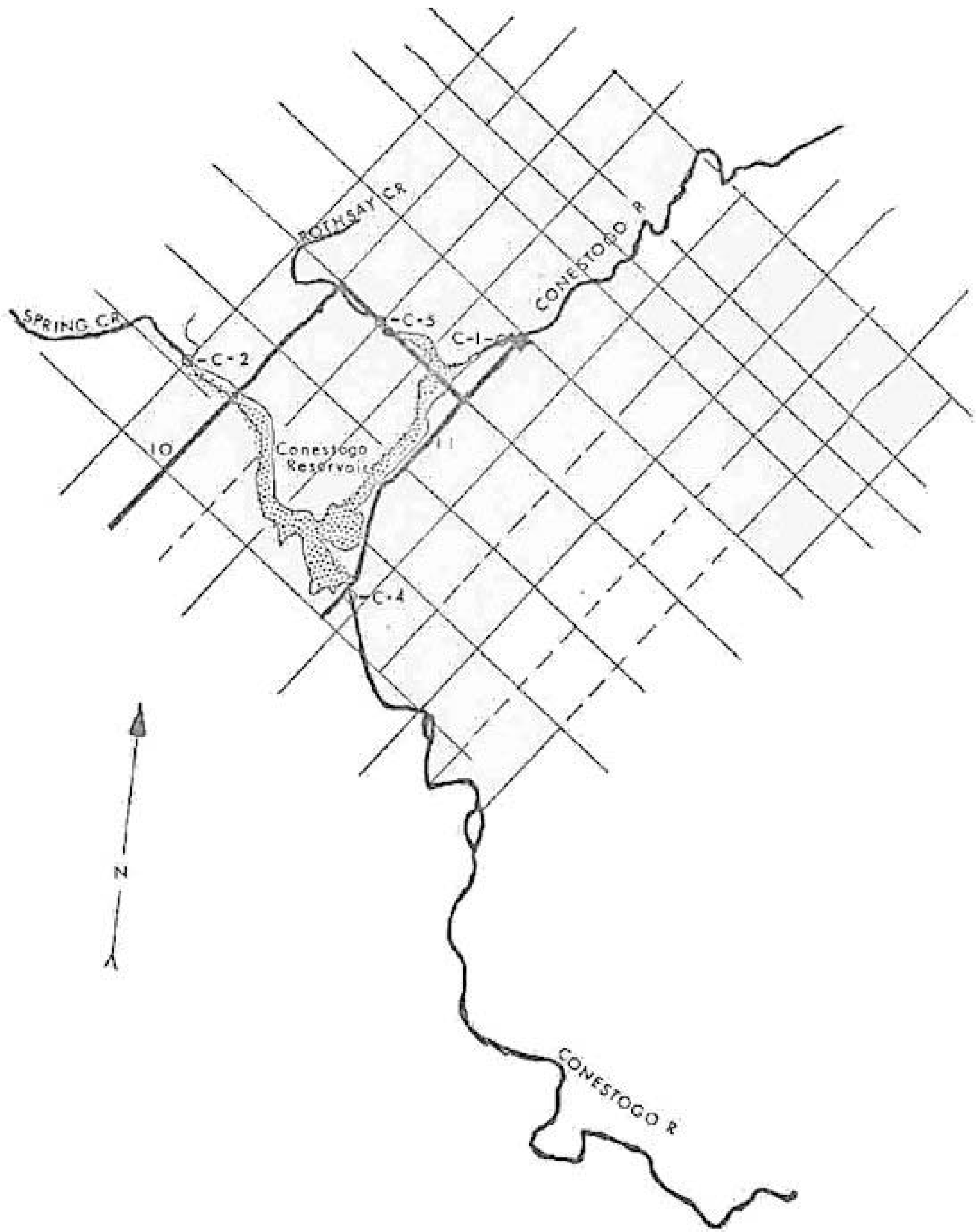
C2, a very slow flowing stream is on the Spring Creek Arm of Conestogo Reservoir. The depth of water is two to three feet with about a foot or two of mud on the bottom. The banks are edged with long grasses and a few marshy areas.

Below Conestogo Dam, C4 is a very fast flowing station. Where the sample is taken, the water is two to three feet deep. The station is located 300 yd. below the dam where trout are stocked for the put and take fishery. The banks are gradually sloped and consist of gravel, composing part of the dam's spillway. The bottom of the river is similar to the shore with areas of smaller gravel.

C5 is west of Drayton on Moorefield Creek (Rothsay creek). The stream is moderately fast in flow and 2 to 3 feet deep where the sample is taken. The bottom is composed of fine gravel and sand. The banks are flat marshy areas leading up to a steeper bank 20 to 30 feet from the stream's edges. Trees, tall grasses and cattails line the stream. The stream meanders through farmers' fields from its source near Rothsay.

The station at Glen Allan is present where the Conestogo River passes through Glen Allan. The stream is moderately fast having run through fields with little protection from trees. The banks at the station are 1 to 2 feet vertical banks leading to flat farmland surrounding the river. The bottom was moss covered stones and gravel.

Conestogo River Stations



ii) Discussion of Benthic Data

Naididae and Tubificidae are the most prominent forms of Oligochaeta. The substrata at each station is characteristic of their habitat. Only one Naididae and five Tubificidae were found at Ca1 (Drayton) which may be attributed to the bulldozing of the stream at this point. The slower water and depositing substrata of C2 presents 17 Naididae and 47 Tubificidae. Seventeen of each are found at C4 (below the dam) and 13 Naididae on the sandy, gravelly bottom of C5. Last year the channel at C1 was bulldozed and therefore would account for the lack of some of the more sedentary invertebrates.

C2, a very slow and an occasionally intermittent creek, and C5, a moderately flowing creek, show a leech population evident of the poor swimming leeches, whereas C4, below the dam, is fast water, yields *Erpobdella octoculata*, as a leech capable of swimming against swift currents. C1 again does not show any leech population. *Asellus* sp. is found at C2, a slow mud bottom depositing strata creek characteristic of its habitat. It is possible, based on the substrata at C5, that *Asellus* would be found. here. The sideswimmers are common in unpolluted water, with a high DO.

C1 provides a riffle area and C5 provides algae in which the amphipod may live. The waters at C4 are probably too fast and possibly higher in silt than the other stations. Silt tends to get caught in the legs of sideswimmers and prevents them from swimming upstream.

C2 is intermittent and may account for the absence of *Hyalella azteca*. Few crayfish were found at the five stations. Although the stony substratum at C1, C4 and Glen Allan would provide an excellent habitat for certain *Orconectes* sp., they were only found below the dam. The presence of only one *Orconectes* sp. at C2 cannot be explained other than it may have been incorrectly identified.

Again, because of the bulldozing at C1, very few snails and clams are present compared to last year. Six of ten molluscs were found on a depositing substrata and the occasionally intermittent stream at C2. Most molluscs prefer a faster well-aerated water. *Ferrissia* sp. prefers fast, well-aerated water and is found at C4. C5 provides a stony, gravelly substratum with well-oxygenated water (average DO 9.8 mg/L), and accounts for 8 of 10 species found. *Lymnaea* sp. prefers a stony substratum and is apparent at C1, C2, C4, C5 and Glen Allan.

Only 10 species of mayflies were found at our stations which would indicate slightly enriched water quality since a good population of mayflies is indicative of fairly good water quality. Last year, a total of 15 species of mayflies were found at the stations, 14 of which were found at Drayton (C1). This year only 4 species were found at C1 due to the bulldozing of the channel. Only the burrowing species *Caenis* sp., and 1 *Baetis* sp. were found in the mud of C2. Again because of inability to sample in the middle of the channel at C4 during the winter and spring, only those mayflies characteristic of slow waters were present at C4. C5 yields the greatest diversity of species of all the stations, (6 of 10 species). *Stenonema* sp. are evidence of clean streams. An excellent habitat is provided in the stony substratum with some sand and mud along the shore area. *Ephemera simulans* and *Caenis* sp. are also found here.

Stoneflies require moving, well-aerated water. Last year 5 specimens were found at C1, and one at each C4 and C2. This year only three *Acroneuria* sp. were caught below the dam (C4). It is important to note that any enrichment of the water, construction on the water, dredging or water diversion will eliminate a stonefly population. Stoneflies were present on the Grand River below the Shand Dam before its construction and even to this day, we have not been able to find a stonefly below Shand Dam. When you consider that the channel at C1 was bulldozed and the diversity of species reduced from 44 to 35 and the total number of organisms from 1339 to 667, you can understand that it may be quite a long time before the stonefly returns. The stonefly *Acroneuria* sp. was taken in January 1972, several months before the channel work was done.

Dragonflies and Damselfly nymphs were not found at any of the stations and they are considered rare in polluted waters. Last year, several were found, mostly at C2 but since the stream was almost dry this year, it is possible they were eliminated or migrated further downstream to the reservoir or simply missed in samples. Notonecta sp., a true bug characteristic of quiet water, was found at C2. The dobsonfly, Chauliodes sp., was found at C5.

Most of the species of caddisflies indicative of fast water, were found at C1, C4, C5. Few species were found at C2. *Limnephilus* sp. builds its home out of twigs and debris and is found in slower water as illustrative of its finding at C2. Most of the netspinners were found at C1, C4, and C5, the majority being found at C5, probably because of its light silt load capacity. The species *Ochrotrichia* sp. is indicative of fast, clean streams. Its presence below the dam indicates good water quality. It appears in the data that we have found more caddisflies this year than last. There is approximately the same diversity of caddisfly species but this year we have acquired some new and much more beneficial tricoptera keys. This allows us to speciate more and to be able to determine preferences at the species level rather than at the family level.

Antocha sp. lives in silken cases on stones in fast-flowing streams and is apparent at C1, C4 and C5. *Tipula abdominalis* may be found under stones in rapid water or in debris and drift along the margin of a stream such as at C1 and C2. Simuliidae or the black flies prefer fast water. They need the water splashing over them. The water at C4 is the proper speed and temperature but there are no rocks in the fast water. Rocks exist along the shoreline but at this point, the water is much slower and fluctuates. It is interesting to note the abundance of midges at each station. At C1, they account for 80% of the sample, C2, 81%, C4, 52%, C5, 70% and Glen Allan 89%. These percentages point out the disadvantages of not being able to speciate Chironomids. Many genera within the family have their own requirements and are indicative of certain conditions. To be able to speciate the Chironomidae would only lead us to a more thorough use of insects as indicators of pollution.

To speciate Chironomids would be difficult since the mouth parts are used in identification. We lack the necessary equipment such as a microscope and proper dissecting tools. It would be a very time-consuming process when you consider it can take between 1 and 4 days to identify the invertebrates of one benthic sample. As shown in our data, Chironomids account for 50% to 80% of each sample.

Atherix variegata is indicative of fast water and vegetated stream banks (tree lined) as is apparent at C1 and C2. *Tabanus* sp. and *Chrysops* sp. are more often found in slower spring fed creeks such as C2, although they are also found in rapid waters among the shoreline vegetation.

Only four families of beetles were found at all the stations, most of which were found at C5. If a stream is deep enough 2 - 4', the bottom water flows slower than the surface water. Small pools often are present just off fast water creating a diversity of habitats within the same area. Many of the rapid waters provide this type of condition whereas slow waters do not. It is for this reason that many times insects of different habitats are found in the same sample.

C5 presents an excellent example. Most of the beetles found are characteristic of faster water (*Ectopria, Psephenus*, and some of the Elmidae). Whereas, at the same time, *Celina* (Aubé) sp. and *Berosus* sp. are found in the same sample but are characteristic of a totally different habitat.

Summary of Conestogo Benthic Samples

Last year (1971), C1 at Drayton proved to be slightly organically enriched based on the invertebrate collections, but no apparent chemical overloads. This year (1972), there have been some changes, not in water quality, but in disruption of the stream bed. Bulldozing was done in the channel in the summer of 1972 and consequently removed many of the habitats required by many invertebrates. In 1971, 44 species were identified at C1; in 1972, 36 species were found. Fewer fish were caught which may be indicative of lack of food. The clearing done here by the bulldozer has been especially harmful to the stonefly population which is often used as indicators of clean waters. In 1971, five stoneflies were caught at Ca1; this year none were caught after bulldozing. 1973 sampling will tell us if the Drayton station (C1) has been restored.

Spring Creek, Ca2, has changed little from last year. A few more species were found and the water is of good quality when flowing. In 1971, one stonefly was caught and none were caught last year which may indicate slight enrichment. It is quite possible that stoneflies in 1972 were just missed in our collections. This is a poor habitat for the stonefly and the fact that it was found last year is surprising.

The station below the dam, C4, has not changed at all from last year. It presents invertebrates characteristic of fast water. A few new species were found and a few species found in 1971 were not found in 1972. Because of the relatively constant flow and constant water temperature, the conditions are not changed.

C5 is a new station this year and it showed a great diversity of invertebrates indicating satisfactory water quality. The greater the diversity of mayflies present, the better the quality of water.

The station at Glen Allan was only sampled once and produced 10 species. This station was chosen to see the effects of the dam farther downstream. This station should be sampled at regular intervals, the same as the other Conestogo stations.

The study was initiated on Conestogo reservoir to determine the influence on benthic fauna, fish populations and water quality that the dam may cause. The incoming water quality was tested both chemically and with the use of benthic fauna as was the outflow from the dam.

Much has been said about the ill effects created by the impoundment of water on a scale of the size of Conestogo Dam. Little has been said about the benefits derived from impoundments. The benthic study illustrates some of these advantages. The quality of water of the Conestogo River above Conestogo Dam is not suitable for the establishment of a viable rainbow trout population because of the slow flow. Rainbow trout have been placed in a put and take fishery below the dam. They are able to grow slightly before they are fished out or released downstream because of the available invertebrates. The point of interest is that two and three years later, large rainbow trout have been caught in the Conestogo River below the park indicating that water quality is sufficiently good to allow rainbow trout to over winter and survive.

Slow, shallow and unprotected water, such as the upper reaches of the Conestogo. River, can be considered to be slightly polluted in the sense that water temperature increases and in some of the pools a stagnant situation can arise. The flow below the dam is kept relatively constant permitting trout, as well as the necessary forage species and a viable insect population to survive, also diluting agricultural runoffs.

The reservoir creates an environment in which rainbow trout can survive. Rothsay creek, which runs into Conestogo reservoir, experienced a spill last year that resulted in a fish kill within the creek. The dilution effects of the impoundment nullified the effects downstream, therefore eliminating the possibility of a further fish kill.

Stations will be sampled three to four times a year for benthic fauna and once a year for fish. Having established what is common to the area, it is necessary now to sample occasionally to determine any changes in the fauna which will illustrate changes in water quality.

Benthic Data Collected From Conestogo River (Conestogo Reservoir)

Species	C1	C2	C4	C5	Glen Allan
Tricladida (flatworms)					
Planariidae				9	
Oligochaeta (aquatic earthworms)					
Eisenella (earthworm)		1		1	
Lumbriculidae	3		1		
Naididae	1	17	13	13	1
Tubificidae	5	47	13		
Hirudinea(leeches)					
Erpobdella sp.		1			
E. octoculata			2		
E. punctata		4			
Helobdella stagnalis		1			
H. triserialis		1			
Placobdella ornata				1	
Isopeda (aquatic sow bugs)					
Asellus sp.		1			
Amphipoda (side-swimmers)					
Hyalella azteca	9			1	
Decapoda (crayfish)					
Orconectes sp.		1	1		
O. virilis			1		
Gastropoda (aquatic snails)			78		
Ferrissia sp.		107		1	1
Gyraulus sp.		65			
Helisoma sp.					
H. campanulatum				4	
H. corpulentum corpulentum		23			
H. trivolvis trivalvis		1			
Hydrobus sp.					
Lymnaea sp.	3	51	1	45	2
Physa sp.		40	1	15	
Valvata tricarinata			78		
Pelecypeda (clams)					
Alasmidonta ? sp.				4	2
Pisidium sp.	2	13		4	2
Sphaerium sp.		29	3	13	
Collembola (springtails)					
Isotomurus palustris			1		

Benthic Data Collected From Conestogo River (Conestogo Reservoir)

Species	C1	C2	C4	C5	Glen Allan
Ephemeroptera (mayflies)					
Heptageniidae					
Stenonema gildersleevei	1				
S. heterotarsale			2	6	
S. nepotellum	1		1		
S. pallidum				1	
S. pudicum				1	
S. tripunctatum				1	
Baetidae					
Leptophlebiinae					
Paraleptophlebis sp.	1				
Ephemerellinae					
Ephemeridae					
Ephemera simulans	1		6		
Caeninae					
Caenis sp.		3	12	74	
Baetinae					
Baetis sp.		1		5	
Plecoptera (stoneflies)					
Acroneuria sp.	2				
? nymph	1				
Hemiptera (true bugs)					
Notonecta sp.		2			
Neuroptera (fishflies, dobsonflies)					
Chauliodes sp. (dobsonflies)				11	
Lepidoptera (aquatic caterpillars)					
Cataclysts sp.	6				
Tricoptera (caddisflies)					
Hydropyschidae					
Cheumatopsyche sp.	5		34	86	
Hydropsychidae adult		1			
Hydropysche sp.				1	
H. betteni	18				
H. bifida			1	2	
H. cuanis	4				
H. recurvata	7				
Hydroptilidae					
Hydroptilidae larvae (not keyed)	1	1	3	1	
Ochrotrichia sp.			1		

Benthic Data Collected From Conestogo River (Conestogo Reservoir)

Species	C1	C2	C4	C5	Glen Allan
Pyschomyiidae					
Polycentropus sp.			4	14	
Helicopsychidae					
Helicopysche pupa				1	
Brachycentridae					
Brachycentrus sp.	2				
Beraeidae					
Beraea sp.		1		1	
Limnephilidae					
Limnephilis sp.		1		2	
Pychopsyche sp.	3			2	
Diptera (two-winged flies)					
Nemocera					
Tipulidae					
Antocha sp.	2		2	10	
Tipula sp.	1	1			
T. abdominalis	11	10			
Psychodidae					
Mariuna sp.		2			
Pericoma sp.			2		
Simuliidae					
Simuliidae larvae	1			20	
Similium vittatum larvae	8	2			
Chironomidae (midges)	540	2057	284	1364	102
Ceratopogonidae (biting midges)	1	5			2
Stratiomyidae (soldier flies)					
Euparyphus sp.	3				
Nemotelus sp.	1				
Stratiomyidae		1			
Stratiomyis sp.		1			
S. normula					
Rhagionidae (snipeflies)					
Atherix variegata	1	1		2	1
Tabanidae (hornflies)					
Chrysops sp.		2			
Tabanus sp.	9	20	1		2
Dolichopodidae (long -legged flies)					
Aphrosylus sp.	1				
Syrphidae (flower flies)					
Tropida quadrata	1				
Unidentified diptera		2			

Benthic Data Collected From Conestogo River (Conestogo Reservoir)

Species		C1	C2	C4	C5	Glen Allan
Coleoptera (beetles)						
Dytiscidae (predaceous diving beetles)						
Celina (Aubé) sp.					13	
Hydrophilidae (water scavinger beetles						
Berosus sp.		1			5	
Psephenidae (water pennies)						
Ectopris sp.		1			19	
Psephenus sp.					1	
Elmidae (riffle beetles)						
Elmidae					1	reminants
Dubiraphia sp.		2	16		30	
Optioservus sp.				1		
Stenelmis sp.		6			5	
Total number of organisms		667	2533	547	1801	115
Total number of species		16	34	25	41	10
Number of times sampled		6	6	6	5	1
Grand total of organisms	5663					
Grand total of species	87					

iii) A Discussion of Fish Data

Fishing in 1972 was done only once at each station by both seining and using the portable shocker. Fish were collected in Conestogo Reservoir using the electric boat shocker and seine net.

Five species of fish were caught at C1 resulting in only 28 fish and I feel the reason for this is lack of food resultant from the channel improvement. Each fish found here is characteristic of stony substratum and riffle areas.

The brook stickleback is common in bog streams and are found in the slow water of C2. The redbelly dace prefer small slow creeks and are found at C2. The other fish present at C2, common white sucker, common shiner, bluntnose minnow and rock bass, are indigenous to a substratum of gravel. It is likely that each of these fish ventured up the creek at C2 from the shallows of the reservoir. Two hundred & forty-one common shiners were found below the weir at C4 in a small pool just off the faster waters of the river. The creek chub and bluntnose minnow prefer clear rivers and creeks with stony gravelly bottoms.

The brown bullhead is an extremely hardy fish and can withstand very adverse conditions. Its preferable habitat is slow, quiet waters and weed and mud infested bottoms. They are also found in this pool just off the rapid water below Conestogo Dam. C5 yielded a rainbow trout. This is conceivable since we stock the trout at this point for the reservoir. The trout caught was likely one of the ones that were stocked this year since we stocked trout of 8" - 10". The common white sucker, common shiner, creek chub and blue-gill are again characteristic of stony, gravelly substratum. A fairly large (15") brown bullhead was also taken here. Since the shore is lined with aquatic weeds and mud, it is probable that this fish is indigenous to this area as well as Conestogo Lake.

Glen Allan produced 152 fish representing 7 species. The fish were caught in a small almost stagnant pool off the river. This small invagination had much submergent aquatic growth, muddy rock and gravel bottom, and very little, if any, flow of water. The brassy minnow, fathead minnow, and least darter, prefer dense vegetation over a soft bottom in quiet waters as is found at this location. The other four species-common white sucker, common shiner, lake emerald shiner and rock bass will be found over a gravelly substrate in moving waters.

Conestogo Reservoir

The fore bay of Conestogo Reservoir was sampled using the electric shocking boat, October 24, 1972, when the water was extremely low. The purpose was to catch some rainbow trout that had been stocked over the past 3 years and determine their diet and age. Seining was also done along the shoreline to catch forage fish. The shocking was done after dark so as to make full use of the field range of Our shocker. Since the shocker is only effective to a depth of 10 to 15 feet, sampling was done at night since the fish come closer to the surface to feed.

The common shiner, bluntnose minnow, brassy minnow, lake emerald shiner, rock bass and both darters provide excellent forage fish for the rainbow trout. All the fish found at C1, C2 and C5 are found in the reservoir. The rock bass at age 4+ and 6+ and 0+ show that adequate breeding grounds exist. The brown bullheads and white suckers also breed rather prolifically as their age classes illustrate.

Of the 34 trout stomachs analysed, 3 were empty, 5 contained debris, 1 contained debris and insects and fish and 13 contained fish only. Of the four that contained fish and insects, the majority of the diet consisted of fish which would account for 17 of 34 of the trout having converted to a fish diet. The empty stomachs do not mean that the fish are not feeding since they were put in in May; they could not have lived through the summer months without food; it is possible they had not fed that evening.

Stomach contents were based on a 12 point system, 12 points being full, 6 points half full, 3 points one-quarter full, and so on. Of the total contents eaten, 81.6% was fish matter, 7.0% was invertebrate matter, and 11.3% was undigested material. This data points out the fact that the majority of hatchery raised rainbow trout stocked in Conestogo Reservoir convert quite readily from a trout pellet food diet to one of insects and then to a final stage consisting of a fish diet or immediately to a fish diet.

Trout are stocked between 202.4 mm and a maximum of 303.6 mm. so that according to the data, many fish are overwintering in the reservoir. There is no evidence to indicate that spawning has occurred. More extensive sampling will reveal more precise data.

C1	No. of Fish	Size Range mm
Northern Hog. Sucker	2	108, 125
Silver Redhorse Sucker	1	160
Common Shiner	15	85 -115
Emerald Shiner	9	56 - 79
Rock Bass	1	176
No. of Fish	28	
No. of Species	5	

C2	No. of Fish	Size Range
Common White Sucker	1	15"
Common Shiner	14	35 - 95 mm
Bluntnose Minnow	1	50 mm
Redbelly Dace	1	59 min
Brook Stickleback	1	40 mm
Rock Bass	1	128 mm
No. of Fish	19	
No. of Species	6	

C4 (below weir)	No. of Fish	Size Range mm
Common Shiner	241	50 -144
Lake Emerald Shiner	6	43 - 64
Bluntnose Minnow	2	60, 85
Brassy Minnow	8	55 - 85
Creek Chub	1	95
Brown Bullhead	1	
No. of Fish	269	
No. of Species	6	

C5	No. of Fish	Size Range.
Rainbow Trout	1	12" - 15"
Common White. Sucker	2	15"
Common Shiner	4	33 -180 mm
Creek Chub	1	41 mm
Brown Bullhead	1	15"
Bluegill	5	46 - 51 mm
No. of Fish	14	
No. of Species	6	

Glen Allan	No. of Fish	Size Range
Common White Sucker	1	14"
Common Shiner	131	33 -148 mm
Lake Emerald Shiner	14	34 - 65 mm
Brassy Minnow	2	67 - 70 mm
Fathead Minnow	1	79 mm
Least Darter	1	28 mm
Rock. Bass	2	84 - 200 mm
No. of Fish	152	
No. of Species	7	

Conestogo Lake	No. of Fish	Size Range (mm)	Weight	Winters
Rainbow Trout	1	260	185	1
	1	304	360	1
	1	322	317	1
	1	229	120	1
	1	250	130	1
	1	210	85	1
	1	249	150	1
	1	253	135	1
	1	255	160	1
	1	270	175	1
	1	240	125	1
	1	238	125	1
	1	266	150	1
	1	250	155	1
	1	270	175	1
	1	253	150	1
	1	267	235	1
	1	258	175	1
	1	243	175	1
	1	265	185	1
	1	275	185	1
	1	271	175	1
	1	355	570	2
	1	382	750	2
	1	373	770	2
	1	288	225	2
	1	279	235	2
	1	282	190	2
	1	340	480	2
	1	354	645	2
	1	295	325	2
	1	318	415	2
	1	372	580	2
	1	318	375	2
	1	285	275	2
	1	290	250	2
	1	490	1560	3
				Age
Common White Sucker	2	215, 215		3+
	1	230		5+
	2	237, 235		5+
	1	245		5+

Conestoga Lake	No. of Fish	Size Range (mm)	Weight	Age
Common Shiner	685	25 - 35		0+-1+
	203	37 - 48		0+-1+
	41	47 - 55		1+
	17	57 - 70		1+-2+
	2	80, 85		2+
	1	100		3+
Bluntnose Minnow	87	26 - 50		0+
Fathead Minnow	63	36 - 46		0+
	38	48 - 54		1+
	6	58 - 70		2+
Brassy Minnow	5	38 - 40		0+
	153	48 - 60		14
	6	65 - 73		2+
Lake Emerald Shiner	41	3 8 - 58		0+
	9	58 - 68		0+-1+
Rock Bass	10	29 - 43		0+
	1	290	415	4+
	1	425	1575	6+
Iowa Darter	2	37, 38		0+
Johnny Darter	1	42		0+
Brown Bullhead	12	148-185		2+
	1	173		3+
	1	186		4+
No. of Fish	1426			
No. of Species	11			

Conestoga Rainbow Trout Stomachs   Oct. 24, 1972

Number of stomachs examined	34
Total number of points	124
Average number of points	3.7
Average fullness	30%
Number of empty stomachs	8
Percentage of stomachs empty	23.5%

Food Item	No. of Points	% of Total
Unidentified Cyprinids	43.00	
Emerald Shiners	8.00	
Johnny Darters	13.00	
Rock Bass	7.50	
Digested Fish Remains	29.75	
Crayfish	0.75	
Coleoptera : Carabidae	0.25	
Coleoptera : Dytiscidae	2.25	
Coleoptera : *Helichus*	0.25	
Chironomidae	0.50	
Tricoptera cases	4.00	
Notonecta	0.50	
Millipede	0.25	
Feathers	5.25	
Weed Seeds	2.50	
Detritus: twigs, leaves, stones, etc.	6.25	
	124.00	
Total fish eaten	101.25 points	81.6
Invertebrates	8.75	7.0
Undigestible matter	14.00	11.3

Rainbow Trout Stomachs - Conestogo, Oct. 24, 1972

1.	empty - 0 points	0 pts.
2.	2 points	
	fish remains - 2 pts.	2 pts.
3.	12 pts.	
	cyprinid fish - emerald or common shiner	11½ pts.
	Coleoptera : Dytiscidae	½ pt.
4.	6 pts.	
	fish remains	6 pts.
5.	1 pt.	
	1 stick	
	milkweed seeds	1 pt.
6.	empty	0 pts.
7.	12 pts.	
	1 rock bass fry	4 pts.
	1 Johnny darter	4 pts.
	digested fish remains	4 pts.
8.	8 pts.	
	1 minnow	8 pts.
9.	empty	0pts.
10.	½ full - 6 pts.	
	Chironomidae - 1 Coleoptera: Dytiscidae	1 pt.
	caddisfly case	4 pts.
	1 stone, 1 seed, milkweed seeds	1 pt.
11.	⅔ full - 8 pts.	
	7 emerald shiners	8 pts.
12.	¼ full - 3 pts.	
	detritus	3 pts.
13.	$^1/_6$ full - 2 pts.	
	fish remains	2 pts.
14.	empty - 0 pts.	0 pts.
15.	full - 12 pts.	
	7 Johnny darters	4 pts.
	1 cyprinid	3½ pts.
	fish remains	4¼ pts.
	Coleoptera : Carabidae	¼ pt.

Rainbow Trout Stomachs - Conestogo (cont'd)

16.	full - 12 pts.	
	cyprinid remains	8 pts.
	2 Johnny darters	2 pts.
	1 rock bass fry	1½ pts.
	2 Coleoptera : Dytiscidae	½ pt.
17.	$^{1}/_{6}$ full - 2 pts.	
	fish remains	2 pts.
18.	$^{1}/_{12}$ full - 1 pt.	
	fish remains	1 pt.
19.	empty - 0 pts.	0 pts.
20.	full - 12 pts.	
	1 Coleoptera : Dytiscidae	½ pt.
	2 Cyprinidae	2 pts.
	1 rock bass	2 pts.
	10 Johnny darters	3 pts.
	digested fish. remains.	4½ pts.
21.	$^{1}/_{6}$ full - 2 pts.	
	fish remains	2 pts.
22.	¾ full - 9 pts.	
	cyprinid fish	9 pts.
23.	empty - 0 pts.	0 pts.
24.	empty - 0 pts.	0 pts.
25.	4 pts.	
	hitchhickers (weed seed)	1 pt.
	feathers	3pts.
26.	1 pt.	
	fish backbone	1 pt.
27.	1 pt.	
	1 Notonecta	¼ pt.
	wood chips	¾ pt.
28.	1 pt.	
	feathers	½ pt.
	twigs, leaf fragments	½ pt.
29.	2 pts.	
	cyprinid fish	1 pt.
	feathers	½ pt.
	bark, twigs, leaf remnants	½ pt.

Rainbow Trout Stomachs - Conestogo (cont'd)

30.	1 pt.	
	feathers	½ pt.
	twigs, flower	½ pt.
31.	1 pt.	
	crayfish	¾ pt.
	feather, some bark	¼ pt.
32.	2 pts.	
	1 notonecta	¼ pt.
	feather	½ pt.
	twig, seed	½ pt.
	millipede	¼ pt.
	cocoon	
	Helichus	¼ pt
	Dytiscus	¼ pt.
33.	1 pt.	
	fish remains	1 pt.
	1 claw of crayfish	
34.	empty - 0 pts.	0 pts.

C. Guelph Stations (Speed River)

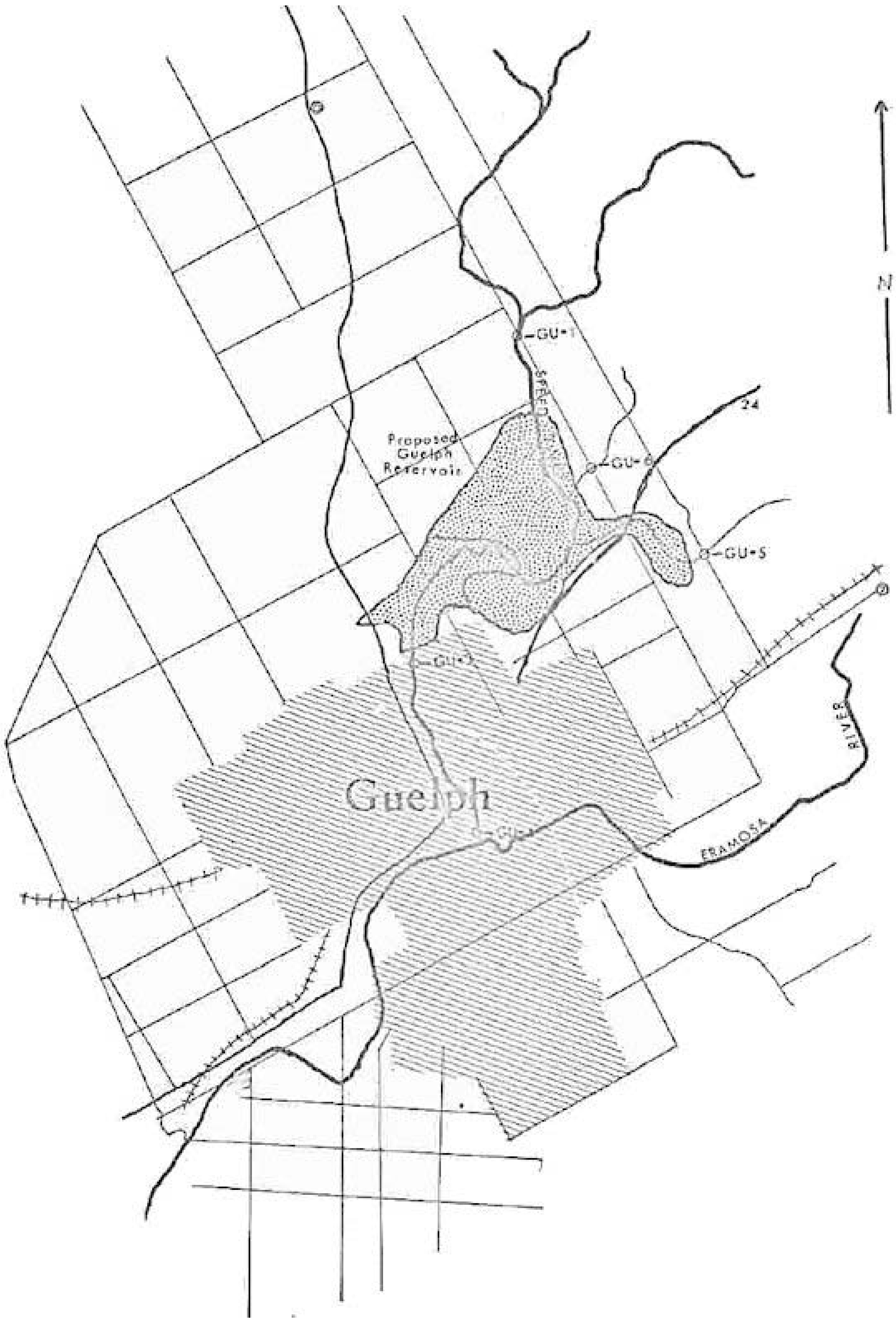
i) Description of Stations

Gu1 sampled 10 times, is located on the Speed River that passes under the bridge of the Guelph - Eramosa Twp. line. The flow is very rapid as evidenced by the white water. The reaches of this station vary in depth from 3 - 4 feet to 1 - 2 feet. The bottom consists of marl encrusted rocks and boulders to gravelly, sandy areas. The kick net benthic samples were taken in fast water 2 to 3 feet deep on a rocky to gravelly bottom; whereas the hand picking was done on the larger rocks and boulders in both fast and slower waters. Fish were seined and shocked throughout the entire area. Trees line the river bank and provide shade and excellent habitat for adult insects. Some of the willows stretch out over the water and provide protection for fish in their roots. The rocky bottom causes the water to splash about creating well oxygenated waters.

Gu3,on Woodlawn Avenue in Guelph, is a moderately fast stream. The riverbed is also large rocks (dolomite?) encrusted with marl as at Gu1. The depth of the water is 6" to 2 feet. At this point, the river runs through a park area and enters the downtown area of Guelph. The banks are lined with field grasses and trees are present but not close enough to provide shade for the stream. Farther upstream from the station, trees do line the river banks creating a small forest.

Gu4 is located just a few yards upstream from where the Eramosa River runs into the Speed in the City of Guelph. The water is slightly slower than that at Gu3 provided there is a depth of 3 to 4 feet. Last year (1972) the water was occasionally very low (4" - 6") and consequently very slow. The bottom is gravelly to sandy and often strewn with debris. The stream banks are either grass-covered and lined with trees or cement retaining walls. Cattails are present where the Eramosa enters the Speed, Gu5 is situated on a tributary of the Speed River on County road 29, south of Hwy. 24. It is a very slow stream, running through a cedar woods from a man-made pond in which trout were stocked. The bottom consists of sand, gravel and mud to a rocky area covered with mud. The depth ranges from 6" to 2'. Grass banks line much of the stream and many stumps and fallen logs lie across the stream in the cedar woods immediately upstream from the station.

Speed River Stations



Gu6 is a small creek which is a tributary of the Speed. It is located on the Guelph - Eramosa Twp. line just north of Hwy. 24. It runs primarily through pasture land and consequently its banks have been eroded by cattle drinking from it. The creek is very slow running and is more often than not very turbid. The depth varies from 2 - 6 feet with possibly 3 - 4 feet of mud on the bottom. One small area provides a stony gravelly area leading up to a small spit. The water apparently was capable of supporting trout at one time.

Stations Gu1, Gu5, and Gu6 are located above the proposed Guelph reservoir. Gu3 and Gu4 are located in the City of Guelph below the reservoir. Gu1, Gu5, and Gu6 will establish the fauna that exists above the reservoir and Gu3, and Gu4 will establish what exists below the reservoir. When the reservoir is complete changes in benthic fauna will be noted since these same stations will be maintained for a few years after the completion of the reservoir.

ii) Discussion of Benthic Samples

Planariidae (flatworms) prefer a habitat of well aerated, cooler waters but can be found in practically any aquatic situation. Comparatively they are more abundant above the reservoir than below. The oligochaetes mentioned (Lumbriculidae, Naididae, Tubificidae) point out that the water quality in the Speed River below the reservoir (Gu3 and Gu4) is slightly enriched with debris and mud compared to the relative number at Gu1. Gu5 consists of a mud and debris strewn bottom therefore creating a desirable habitat for the aquatic earthworms. Gu5 provides a slower flow of water but has mud and silt mixed among the rocks.

Gu4 is the only station that shows a greater number of leeches. Leeches prefer rocky bottoms or bottoms with debris scattered about and this description is characteristic of Gu4. The samples at Gu5 were taken at a spot where there appeared to be little for leeches to hang on to which could account for their absence. *Asellus* is found on a depositing strata as illustrated by stations Gu3, Gu4, and Gu5. They were not found at Gu5 but there is no apparent reason for their absence since the substrata is characteristic of their environment.

Crayfish are fairly common in many aquatic systems and the variety illustrated in the data indicates a healthy population. Some of the burrowing crayfish (*Cambarus* sp.) are found in the depositing strata environment whereas those characteristic of a rocky substrate and moving waters (*Orconectes* sp.) are found at Gu1, Gu2, and Gu3.

Generally, the Mollusca (clams and snails) are found in faster flowing streams where the environment is more rich than in a slower setting. The types of strata at each station provide a habitat for many of the molluscs and as is shown in the data, practically every genera shown (*Ferrissia, Gyraulus, Helisoma, Lymnae, Physa, Pisidium* and *Sphaerium*) are present at each station.

Work to date done on the environmental requirements of mayflies is limited practically to type of substratum, water temperature for nymphal development and dissolved oxygen for emergence. It appears that substratum is probably the most important requirement factor in the dispersion of mayfly species. By establishing what species are present in a particular stream now in relation to its habitat, we will be able to re-sample the same station at a later date and be able to determine if the same species are there. Provided that the substratum has not been changed considerably, the presence or absence of or the change in relative numbers, along with the study of the chemistry of the water, we will be able to determine the chemical requirements or limitations of a particular species in a particular habitat.

For now all we can really state is the type of substratum and flow of water preferred by certain mayflies. The Heptagenids and Baetids prefer according to our data, faster flowing, well aerated waters with a rocky bottom often covered with marl characteristic of stations Gu1 and Gu3. The quieter, slower waters with detritus and mud bottoms reveal the presence of burrowing types of mayflies such as Caenis, Tricorythodes, and some species of Baetis. These mayflies will still be present after dam completion since the high water of the reservoir will not reach these points.

Members of the Odonata prefer unpolluted waters and are generally found in submerged vegetation. Much of this vegetation is found along the shoreline of Gu3. Although they don't show up at Gu1, it is possible that some may be found here since there are eddies as well as a few smaller islands lined with vegetation in the slower reaches of Gu1. The presence of *Orthemis* at Gu6 can only he explained by the existence of much submerged and emergent vegetation.

The stoneflies illustrate their preference of fast, clean waters in their presence at station Gu1 and Gu3. Stoneflies require moving water for the development of the nymphs. The moving water is the most important controlling factor since it controls the oxygen content of the water, to some extent the water temperature, substratum and the available food. Pure sand or muddy bottoms are deplete of stoneflies as noted by their absence at Gu5 and Gu6.

Organic wastes can eliminate stonefly populations by depleting the oxygen supply, producing toxic wastes through decomposition and by changing the nature of the substratum. The construction of dams, dredging and water diversion can influence stonefly distribution. The possibility exists that because of the construction of a dam (increase in silt deposition) and clearing of land (increase in water temperature) that the stoneflies and many other insects may be eliminated from Gu3.

The Hemiptera found in our collections represent those found in more quiet waters often with aquatic weed growth present along the shoreline or submergent.

Chauliodes lives under stones in well aerated streams and would naturally be found at station Gu1 and Gu3. Its presence at Gu5 can only be explained by the presence of some rocks which are surrounded by mud. *Sialis* prefers quieter waters with a mud and detritus bottom. It is found at stations of slower moving waters as is evident at Gu4, Gu5, and Gu6.

Twenty-five of the twenty-nine species of caddisflies found at the five stations were found at Gu1 and Gu3. These two stations show a preponderance of the faster water net spinning caddisfiies (Hydropsychidae, Psychomyiidae, Philopotamidae). Thirteen species were found at Gu5 and this can be explained by the presence of some riffles (small rapids) over a stony section of the stream. It would appear as shown in our data, that 2 species of Brachycentridae prefer slow, warmer waters and muddy substratum.

Caddisflies are tolerant of a wide range of chemical factors and *Cheumatopsyche* and *Hydropsyche*_ seem to be most tolerant especially to pollution.

Antocha sp. inhabit faster waters and live in silken cases attached to stones in the riverbed. It is for this reason that they are prominent at. Gu1 and Gu3. *Tipula abdominalis* is found under stones and detritus in slower waters which may explain its presence at Gu5 and Gu6. The midges are present in practically every aquatic environment and represent the majority of insects found. Few of the diptera are found at stations Gu3 and Gu4. The only possible explanation is that both stations are unprotected in that they are open, wide and shallow reaches of the river and the samples are taken in the middle rather than close to the shore which might account for more diptera.

Of the 5 families of Coleoptera present, the greater number found were of the riffle beetle family represented by *Stenelmis* and *Optioservus* characteristic of faster waters. Again, most of the beetles found were of the fast water species as shown in the appendix. Of the 3 Elmidae found *Optioservus* is the most abundant at Gu1 and became the least abundant in the slower waters of Gu3, Gu4, Gu5, and Gu6. *Dubiraphia* sp. increases slightly as the stations progress from faster to slower water. *Ectopria* and *Psephenus*, the water pennies, show their preference for fast water and stony substrate by decreasing in numbers from the rapid waters of Gu1 to the slow muddy waters of Gu6. Since the samples are taken in the middle of the stream, many of the slower shoreline (because of vegetation) beetles (crawling water beetles, predaceous diving beetles, marsh beetles) would not be collected in our benthic samples. I am sure that many of the beetles are strongly represented at many of the slower flow stations.

Summary of Guelph Stations

The quality of water at Gu1 is excellent as shown by the great number of species found here (101). The water is rapid, clear and cool. As the major source of water for the Guelph reservoir, it is certainly acceptable. Gu5 and Gu6 will also enter the reservoir. The water quality of Gu5 is very good although the flow is very slow. Gu6 was a trout stream at one time. Due to cattle drinking from it, the banks have become eroded and the water is almost always turbid. The water is enriched in that it is high in nitrates and phosphates due to passage through farmlands and accepting tile drain runoff. Stabilizing the streambanks with vegetation and controlling cattle usage of the stream, the eutrophication of this stream will be curtailed somewhat.

Again the flow is not great so that its presence in the reservoir will not be noticed. Fish contributed by each of these streams; Gu1, Gu5 and Gu6 will be of the forage and bait type species (ie suckers, shiners, dace, and chubs). Stocking of rainbow trout and large and smallmouth bass will provide an excellent fishery and good growth potential because of the presence of bait fish.

Compared to last year's (1971) collection, 24 more species were found at Gu1. Conceivably many of these (24) species were in last year's sample but the addition of more literature in the form of keys results in more accurate identification to the species level this year.

The stations below the proposed reservoir (Gu3, Gu4) showed slight enrichment, Gu4 more so than Gu3. A few small dams in the City of Guelph between Gu3 and Gu4 result in warmer waters at Gu4. Gu3 is much the same as last year (1971). A small creek running parallel to Woodlawn Avenue runs into the Speed at station Gu3. This stream always has phenolic wastes in it.

It is our intention to find the source of this creek and the reason for the wastes which are dumping enriched waters into the Speed River. Several species of stoneflies were found at Gu3 indicating satisfactory water quality. The construction of the dam may have an adverse effect on this portion of the stream as a result of an increased silt load. A change will be noticed at Gu3 as clearing of the reservoir takes place. Initially this will be harmful to the invertebrates of Gu3 but upon the completion of the reservoir the situation will be improved by creating a more constant flow and constant water temperature. The water quality at Gu4 will also be improved as a result of the reservoir. We have established the invertebrate fauna and water quality of Gu3 and Gu4, and monitoring of these two stations during construction and after completion will point out the effects of the reservoir on downstream water quality.

BENTHIC DATA COLLECTED FROM SPEED RIVER (GUELPH RESERVOIR)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Tricladida (flatworms)					
Planariidae	14	4	9	8	
Oligochaeta (aquatic earthworms)					
Branchiobdellidae		1			
Lumbricullidae			33	3	2
Naididae	58	59	116	31	177
Tubificidae			12	27	35
Hirudinae (leeches)					
Erpobdella punctata	1		9		1
Glossiphonia complanata			1		
Helobdella stagnalis	1	1	29		2
Isopoda (aquatic sow bugs)					
Aselius sp.			1		2
Amphipoda (side-swimmers)					
Crangonyx sp.	2		4		
Gammarus sp.		1			
Hyalella azteca		11	9	2	1
Decapoda (crayfish)					
Cambarus bartoni	1				1
C. (? longulus)			5		
Orconectes sp.	1				1
O. lancifer				1	
O. palmeri		3			
O. propinquus		1		1	
O. virilis	2	1			
Procambarus sp.	1				
Acri (water mites)		4			
Gastropoda (snails)					
Ferrissia sp.	11	11	31		24
Gyraulus sp.	8	1	6		18
Gyraulus deflectus					1
Helisoma sp.	4	1	4	1	
H. anceps	3				4
H. campanulatum	4			3	24
H. corpulentum corpulentum				1	
Hydrobia sp.	6			5	
Lymnaea sp.	6	6	9	2	23
Physa sp.	14	4	59	15	20

Benthic Data Collected From Speed River (Guelph Reservoir)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Pelecypoda (clams)					
Alasmidonta sp.	4				
Lasmigona (?)sp.	2				
Pisidium sp.	260	6	7	68	3
Sphaerium sp.	276	26	39	133	51
Collemba (spring tails)					1
Ephemeroptera (mayflies)					
Ephemeridae					
Ephoroninae sp.					
Ephoron sp.		1			
Ephemerinae					
Ephemera simulans	21	4			
Heptageniidae					
Stenonema sp.		1			
S. canadense				5	
S. fuscum	6	1	1	5	
S. gildersleevei	1	2	6	6	
S. heterotarsale	4	17	16		
S. nepotellum	24	1			
S. pudicum	2	6	2		
S. pulchellum	5				
S. tripunctatum	3	6	4		
Heptagenia (elegantula ?)	2				
H. hebe	7				
Baetidae					
Siphlonurinae					
Isonychia sadleri	2				
Siphlonurus sp.	4	3			
Leptophlebiinae					
Cheroterpes sp.	3	1	1		
Habrophleboides sp.	2				
Leptophlebia sp.	2	2		2	
Paraleptophlebis adaptiva	3	2			
P. moerens	13	4			
P. mollis	1	3			
Ephemerellinae					
Ephemerella sp.	2	1			
E. (? aurivilli)	3	2			
E. bicolor	4	2			
E. deficiens	25	1			
E. (lata ?)	4				
E. lutulenta	1				
E. needhani		2			
E. serrata	1				
E. sordida		4			
E. subvaria	1	2	2		

Benthic Data Collected From Speed River (Guelph Reservoir)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Caeninae					
Caenis sp.	105	218	45	5	11
Tricorythodes sp.	7	16	1		
Baetinae					
Baetis sp.	29	8	6	8	1
Necelceon sp.	7				
Pseudocloean sp.	1				
Odonata					
Anisoptera (dragonflies)					
Orthemis sp.					1
Zygoptera (damselflies)					
Argia sp.		2			
Enallagma sp.		3			
Ischnura sp.		3			
unidentified nymph		1			
Plecoptera (stoneflies)					
Acroneuria sp.	1				
A. lycorias	2	2	2		
Allocapnia pygmaea	1	5			
Capniidae exuvia		1			
Nemoura (Prestoria) completa	1				
N. (Ostrocera) truncata	3				
Paragnetina media	6	1			
Phasganophora capitata	5	1			
Taeniopteryx nivalis	1	1			
T. parvula		1			
Hemiptera(bugs)					
Lethocerus sp.				1	
Mesoveloidae (water treaders)			3		
Mesovelia sp.		2			
Notonecta sp. (backswimmers)					1
Ochteridae	1	1		1	
Ranata sp. (water scorpions)				1	
Neuroptera					
Chauliodes (fishflies)	2	1		1	
Sialis (alderflies)		1	4	I	1
Lepidoptera					
Cataclysta (aquatic caterpillars)	5	13		1	

Benthic Data Collected From Speed River (Guelph Reservoir)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Tricoptera (caddisflies)					
Hydropsychidae					
Cheumatopsyche	368	23	11	91	7
Hydropysche betteni		1			
H. bifida	183	11			
H. recurvata	4				
H. simulans	14	1			1
H. glossonae	18				
H. larvae	173	13	7	11	
H. pupae	2		1		
Hydropsychidae pupae	5			1	
Macronemen zebratum ?				1	
Hydroptilidae					
Ochrotrichia	4	1			
Rhyacophilidae					
Rhyacophila sp.	41	5	4	1	
R. fuscula	4				
Philopotomidae					
Chimarra sp.	1				
C. obscura	6				
Psychomyiidae					
Polycentropus sp.	13				
Psychomiid Genus A	1				
Molannidae					
Molannidae pupa		1			
Leptoceridae					
Athripsodes sp.	3	2		2	
A. dilutus				1	
Leptocella sp.				2	
Leptoceridae pupa		1			
Oecetis avaris	3				
Helicopsychidae					
Helicopsyche borealis	94	330	1		4
Sericostomatidae					
Sericostoma sp. ?	1				
Brachycentridae					
Brachycentrus sp.					1
Micrasema sp.					1

Benthic Data Collected From Speed River (Guelph Reservoir)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Limnephilidae					
Astenophylax sp.	1				
Limnephilus sp.	7	2		3	1
Limnephilidae				10	
Neophylas sp.	3	15	1	4	
N. autumnus				1	
Pychopsyche sp.	3	1	1	13	
Diptera					
Nemocera					
Tipulidae (craneflies)					
Antocha sp.	624	91		19	
Antocha pupae	2				
Dicranota pupa ?	1				
Eriocera sp.				2	3
E. (fultonensis ?)	5				
Geranomyia sp.		2			
Pedicia sp.				6	
Pilaria larva					1
Prionocera sp.				1	
Pseudolimnophila sp.	2				1
Tipula sp.					
T. abdominalis				5	2
Simuliidae (blackflies)					
Simuliidae larvae	4			27	
Simulium sp. *A* larvae				64	
Simulium sp. *A* pupa				1	
S. vittatum larvae				27	
S. vittatum pupa				1	
Chironomidae larvae (midges)	1502	2960	1051	870	1325
pupae				2	
Ceratopogonidae (biting midges)	9	1	1	3	9
Brachyptera					
Stratiomyidae (soldier flies)					
unidentified larvae				1	
Stratiomyis sp.	2			1	
Rhagionidae (snipeflies)					
Atherix variegata	19	15	1	19	1
Tabanidae (horseflies)					
Chrysops sp.	1				1
Tabanus sp.	11			16	9
Anthomyiidae					
Limnophora sp.	1				

Benthic Data Collected Speed River (Guelph Reservoir)

Species	Gu1	Gu3	Gu4	Gu5	Gu6
Coleoptera (beetles)					
Haliplidae (crawling water beetles)					
Haliplus sp.	4				
Peltodytes sp.		1			
Dytiscidae (predaceous diving beetles)					
Notomicrus sp.	2				
Psephenidae (water pennies)					
Ectopria larvae	17	7	1	4	4
Ectopria adult					1
Psephenus sp.	134	9			
Elmidae (riffle beetles)					
Dubiraphia larvae	9	47	5	16	13
adult	4			3	
Optioservus larvae	319	24		12	1
adult	9				
Stenelmis larvae	311	55	12	57	5
adult	22	2		4	2
Elmidae adult	1	2			
Helodidae (marsh beetles)					
Helodidae adult	4				
Helodidae			1		
Diplopoda (centipedes)					
Strongylosomidae					1
No. of organisms	5021	4156	1574	1668	1799
No. of species	101	83	44	54	42
No. of times sampled	10	8	9	8	8
Grand total amount of organisms	14,218				
Grand total amounts of species	157				

iii) Discussion of Fish Data

Sixteen species of fish were caught at Gu1, Gu3 and Gu4, most of them characteristic of the substratum. The northern hog sucker is found in riffles of clear streams and stony substratum as is found at Gu1 and Gu3. The common white sucker is characteristic of small to large streams with stony bottoms. The creek chub prefers clear, small creeks, stony, gravelly bottoms and slightly warmer waters. It is found in decreasing numbers from Gu1 to Gu4. It is known to compete with the brook trout for food and is found in trout streams. It may be considered a successor of brook trout and act as an indicator in that they may indicate that brook trout have lived in a particular stream or are still present.

Blacknose dace, longnose dace and bluntnose minnow are also characteristic of faster waters with a gravelly bottom. The common shiners, in increasing numbers from station Gu1 (15) to Gu3 (134) to Gu4 (968) are found in warm streams and lakes with a gravelly bottom. The barred fantail is found in faster waters as at Gu1, whereas the Johnny darter is found in quiet waters, riffles or weedy places (Gu4). The brook stickleback is more commonly found in boggy lakes and streams and alkali lakes but is also found in cool creeks often associated with brook trout. Also in association with brook trout is the mottled sculpin which prefers cool creeks and small northern lakes.

Largemouth bass and pumpkin seed were found at Gu4 close to where the Eramosa joins the Speed. At this point, the water is rather turbid with cattails and a muddy bottom. Both these fish prefer this warmer existence. Largemouth bass will spawn in the mud whereas the pumpkinseed will spawn on the gravel bottom of the Speed. Four small smallmouth bass were also caught here and since they prefer cooler streams, it is possible that they spawned farther upstream on the Speed.

The fishing at Gu5 was done at two locations. The first part was at the outfall of a small pond which consisted of faster water and a gravel to sandy bottom. The stream then runs through a cedar woods in which many cedars have fallen over the stream. The substrata in this area was muddy and debris was scattered about. The second location for fishing was done in a narrow section of stream with a riffle area and cleared stones surrounded by mud from the cedar bush. Thirteen species of fish were caught at these stations numbering 351 fish in all. The fish found were those characteristic of a stony substratum, cooler waters and smaller streams. A few species preying upon or competing with brook trout are also present (redbelly dace, bluntnose minnow, creek chub, and stickleback) indicating the possibility of the existence of trout and rock bass found in rocky streams and cool waters found here.

The fishing at Gu6 was not done where the benthic samples were taken but farther downstream. Just downstream a small pond is present, leading into a narrow channel 4 feet wide and 2 - 3 feet deep. The bottom was strewn with junk and gravel and stones were covered with 2 - 3" of mud. The stream flows at a moderate pace with steep and muddy grass-lined banks. 671 fish were caught comprising 11 species of which 262 were common white suckers, approximately 40%. As stated previously, common white sucker are found in small to large streams but are most frequently found in smaller streams. Creek chub, common shiner and brook stickleback account for over 30% of the sample. All prefer warmer water with a gravelly bottom.

Although this creek bed had more silt than gravel, the pond section of slower water and some shade would provide suitable conditions for these fish. Again the type of fish that are considered food fish for trout and those that are present in trout waters are found here (creek chub, stickleback, bluntnose minnow and redbelly dace). Trout were originally indigenous to this stream and later were stocked here by the former Lands and Forests. Rock and smallmouth bass (one of each) were found illustrating the contrast of habitats within a small reach of the stream.

Gu1	No. of Fish Caught	Size Range	Age
Northern Hog Sucker	33	90 -223	
	1	65	0+
	2	187-190	3+
Common White Sucker	1	102	1+
Common Shiner	7	38 - 90	
	2	42, 49	0+
	2	58, 63	0+
	1	73	2+
	2	84, 88	2+
	1	110	3+
Blacknose Dace	13	43 - 53	0+
	26	70 - 75	2+
	21	76 - 82	2+
Longnose Dace	14	57 - 87	
	2	71, 79	1+
	1	105	3+
Redbelly Dace	1	55	
Bluntnose Minnow	2	62 - 85	
	3	65 - 63	2+
Creek Chub	7	86 -146	
	1	63	0+
	1	73	1+
	2	78, 80	1+ -2+
	4	110-118	2+
	7	100-105	2+
Barred Fantail	2	47 - 49	
	1	42	1+?
	1	48	1+
	2	51, 55	2+
	2	61, 64	3+
Brook Stickleback	1	35	
Mottled Sculpin	2	45, 52	
	2	74, 83	
Total No. of Fish	180		
Total No. of Species	11		

Gu3	No. of Fish	Size Range mm	Age
Common White Sucker	7	37 - 50	
Northern Hog Sucker	8	35 -120	
Common Shiner	134	43 -118	
Bluntnose Minnow	31	36 - 73	
Creek Chub	16	32 -118	
Longnose Dace	3	67 - 93	
Redbelly Dace	1	60	
Johnny Darter	1	40	
Barred Fantail	3	49 - 59	
Brook Stickleback	1	39	
Total No. Caught	197		
Total No. of Species	10		

Gu4	No. of Fish	Size Range mm	Age
Common White Sucker	211	44 -370	
Creek Chub	1	75	
Hornyhead Chub	3	57 - 84	
Longnose Dace	3	40 - 65	
Blacknose Dace	2	59	
Common Shiner	968	41 -135	
Bluntnose Minnow	176	34 - 75	
Johnny Darter	66	33 - 58	
Barred Fantail	1	29	
Pumpkinseed	11	110-123	
Largemouth Bass	1	204	
Smallmouth Bass	4	41 - 45	
Total No. of Fish	1447		
Total No. of Species	12		

Gu5	No. of Fish	Size Range mm	Age
Common White Sucker	3	42 -102	
	2	56, 63	0+
	8	73 - 112	1+
	12	105 - 115	1+-2+
	6	117 - 130	2+
	1	145	3+
	5	130 - 140	3+-4+
	1	173	4+
	12	160 - 205	5+
	2	210, 230	6+
Creek Chub	41	65 - 170	
	28	43 - 65	0+
	1	75	1+
	28	77 -112	2+
	4	153 - 160	3+
	2	127 - 138	3+-4+
	3	140, 145, 165	4+
	14	165 - 205	5+
	1	210	6+
Hornyhead Chub	1	88	2+
Blacknose Dace	19	56 - 67	
	3	34 - 3 6	0+
	3	70 - 75	2+
Redbelly Dace	6	50 - 58	
	10	56 - 63	1+-2+
Pearl Dace	1	73	
	2	35	2+
	1	95	3+
Common Shiner	30	56 - 70	
	7	38 - 46	0+
	11	56 - 75	1+
	3	75 - 85	2+
		82 - 90	2+-3+
	5	90 -124	3+
	1	160	4+
Bluntnose Minnow	6	47 - 75	
	25	75 - 85	3+

Gu5	No. of Fish	Size Range mm	Age
Fathead Minnow	2	4- 60	
	5	48 -57	1+
	7	65 - 75	2+
Brassy Minnow	2	75, 75	2+
Rock Bass	2	68, 71	2+
Mottled Sculpin	12	51 -30	
Brook Stickleback	14	33 - 50	
Total No. of Fish	351		
Total No. of Species	13		

Gu6	No. of Fish	Size Range (mm)	Age
Common White Sucker	148	50 - 85	0+
	73	90 -130	1+-2+
	7	150 -160	3+
	10	170 - 190	3+-4+
	18	195 - 230	4+
	6	250 - 280	5+
Creek Chub	20	45 - 55	0+
	15	65 - 80	1+
	28	85 -100	2+
	8	105 -120	2+ -3+
	8	145 - 165	3+
Redbelly Dace	26	50 - 60	1+
Pearl Dace	20	50 - 60	0+
	2	68, 70	1+
	13	70 - 80	1+ -2+
	3	82 - 90	2+
Common Shiner	10	45 - 60	0+ -1+
	54	65 - 93	1+
	5	95 -100	2+
	6	110 - 125	3+
Bluntnose Minnow	29	45 - 65	1+
	18	66 - 75	1+ -2+
	5	76 - 80	2+
Fathead Minnow	21	50 - 60	1^4
	13	60 - 70	1+ -2+
Brassy Minnow	1	71	2+
Rock Bass	1	135	3+
Smallmouth Bass	1	65	0+
Brook Stickleback	92	35 - 52	
Total No. of Fish	662		
Total No. of Species	11		

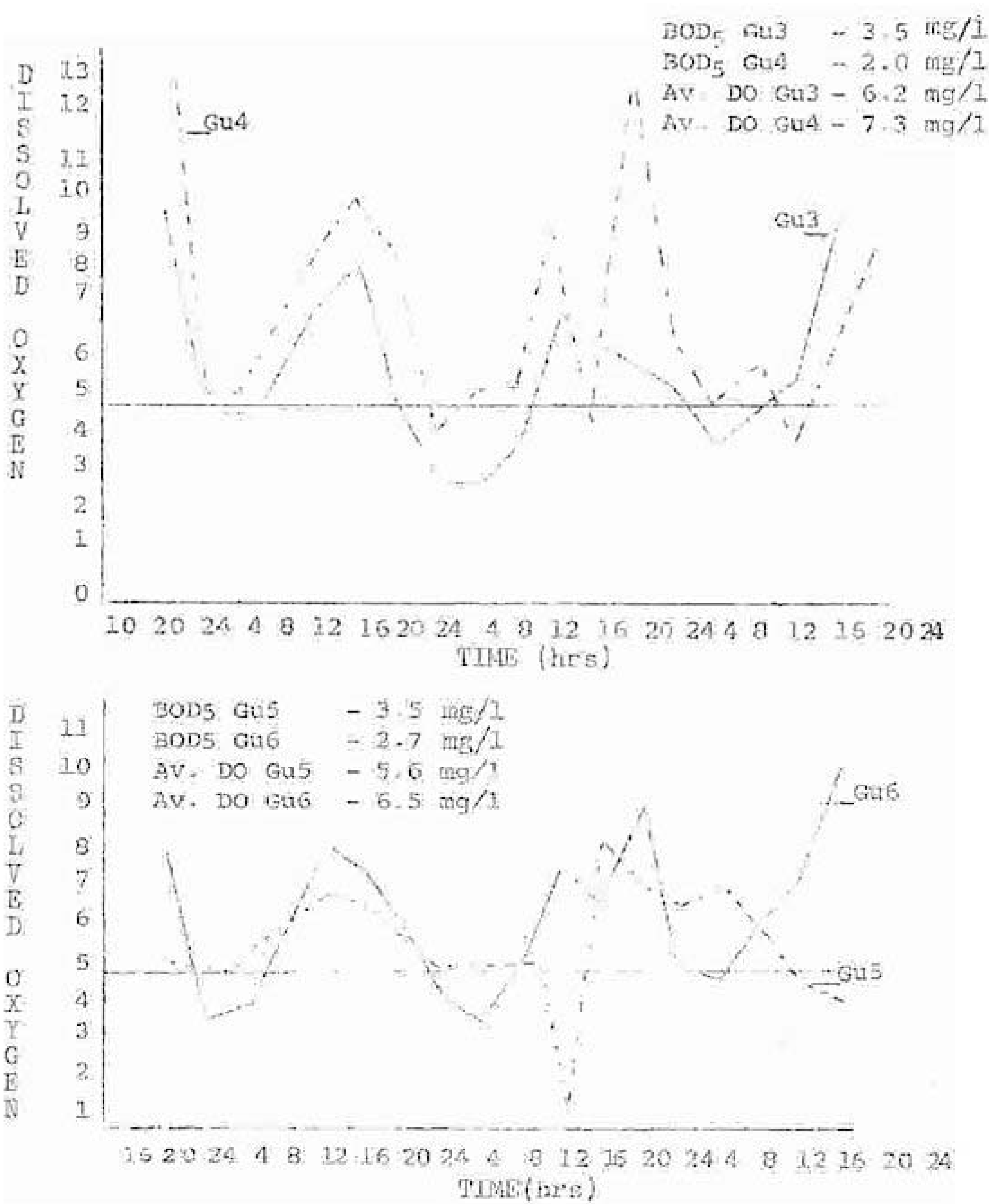
iv) 72 Hour Oxygen Survey of Gu3, Gu4, Gu5 and Gu6

A continuous 72 hour survey was done on the Speed River in conjunction with the Speed River Survey done by G.R.C.A. in 1972. The four stations, Gu3, Gu4, Gu5 and Gu6 were included in the Speed survey; Gu1 was not. It was designed to study the dissolved oxygen diurnal cycle which points out the high and low dissolved oxygen levels. In a normal fluctuation in a 24 hour period two high dissolved oxygen readings and one low dissolved oxygen reading would be apparent. For instance, our survey started at 4:00 o'clock in the afternoon showing a high dissolved oxygen reading at each station. As night progressed, the temperature of the water decreased, the phytoplankton started to use the dissolved oxygen and the dissolved oxygen decreased to a low between midnight and 4:00 o'clock in the morning.

At this point, between 4:00 o'clock and 7:00 the day (sunlight) begins, the water temperature increased, photosynthesis activity started again producing dissolved oxygen and the dissolved oxygen increased throughout the day to a maximum again between 11:00 o'clock and 4:00 o'clock and the cycle then repeats itself. OWRC sets a minimum dissolved oxygen for fish waters of 5 mg/L and to fall slightly below this level during a 24 hour period for a short time is not detrimental to aquatic life. To remain constantly below 5 mg/L, certain forms of life would cease to exist but other forms would take over to a certain point. A biological oxygen demand (BOD) is often done in conjunction with a 24 hour dissolved oxygen and temperature (water) survey.

The BOD indicates the amount of oxygen required for the stabilization of decomposable organic matter present in water. In essence then if the BOD is high, there is likely to be some very low lows in the dissolved oxygen curve since there is a greater demand for oxygen at night. The established maximum for BOD is 4.0 ppm. Both stations, Gu3 and Gu4, show acceptable BOD although Gu3 is slightly higher than Gu4 and each have an average dissolved oxygen of 6.3 mg/L and 7.3 mg/L respectively. The dissolved oxygen at Gu3 fell below the acceptable 5 mg/L for 28 hours out of 72 hours, whereas Gu4 was below for b hours of the 72 hours. Gu5 and Gu6 both have acceptable values of 3.5 mg/L (BOD), 5.65 mg/L average dissolved oxygen and 2.7 mg/L (BOD), 6.5 mg/L average dissolved oxygen respectively.

Graph of 72 hr Oxygen Survey of The Speed River



D. Belwood

i) Description of Stations

The two stations (B1, B3) used last year were sampled regularly this year (6 times) and were complemented by samples taken at B2 and Fergus (see map on page for location).

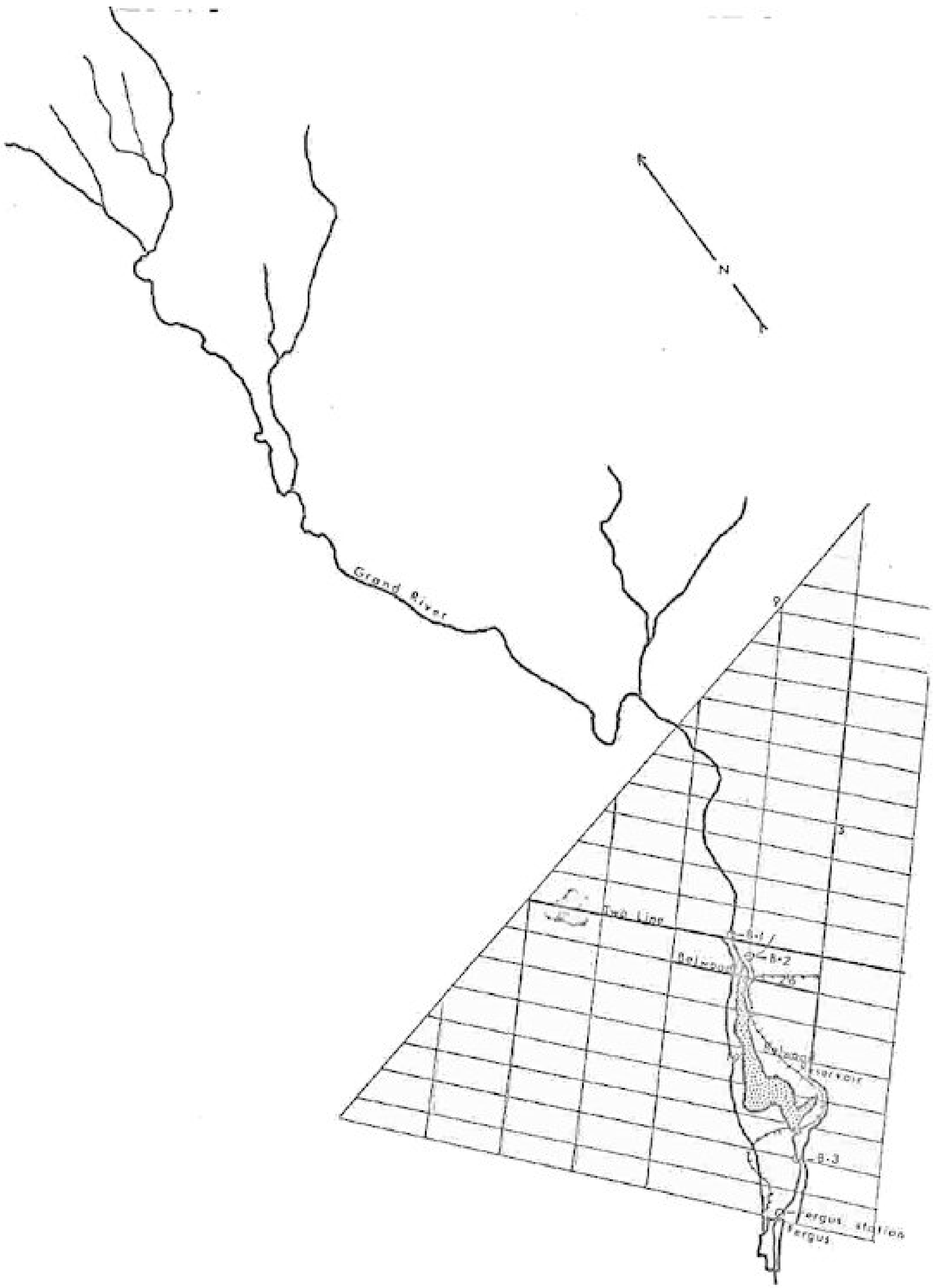
B1, located above Belwood Village, illustrates a moderately fast water flow condition. Most of the stream bed in this area is flat layered bedrock except for a few areas where large boulders and gravel are present. Hand picking was done in areas where the boulders were present. Water appearance is very clean and appears turbid only during spring runoff and heavy summer storms. The river is lined by a forest on one side and a grazing cattle field on the other. Cattle occasionally enter the water here but because the slope is gradual and hard, little erosion has occurred. The water is approximately 3 to 4 feet deep with a few pools 6 to 7 feet deep.

B3, situated below Belwood dam, has a similar bottom to that of station B1. Large plates of bedrock are spread over the floor of the river. Several sections in the rapids consist of large pieces of broken bedrock. Areas of tailraces provide smaller stones and sand. The velocity of the water is constant and fast (dam regulation) and is approximately 1 to 2 feet deep above the bridge. The river banks are lined with woods and grass banks. The water being bottom draw-off water from the dam allows for a cooler constant water temperature aided by the shade of the trees.

B2 is a small creek east of Belwood Village and drains into the reservoir. It is a spring-fed creek originating in a wooded area. The bottom is a muddy silt on top of a stony, gravelly bottom. Watercress and duckweed were found here. The water flows slowly at a depth of 6 inches to 1 foot.

We sampled once on the outskirts of Fergus. The water is very slow since it is just above the first small dam in Fergus. Consequently the water is very deep. The banks are grassed with an occasional tree well back from the normal water level except for farther upstream where the river is lined with trees; mostly cedar.

Grand River Stations



ii) <u>Discussion of Benthic Data</u>

Lack of suitable substrate will account for the absence of Tubificidae and low numbers of Naididae at B1. B3 does provide some slower muddy bottomed water close to an island in the middle of the river at our sampling station. The muddy substrate and slower water of B2 provides adequate accommodation for the Naididae as does Fergus. *Erpobdella octoculata* shows up in the greatest concentration of leeches and it is present in its inherent habitat of fast water at B1 and B3. *H. stagnalis* is apparent also at B3 and Fergus. *Lirceus* sp., an aquatic sowbug, is found in a depositing strata of cleaner waters which explains its presence at B2. *Hyalella azteca* inhabits algae on rocks in cooler waters. It is in the algae at B1 that *H. azteca* is found and quite likely in the watercress and algae at B2. Members of the Decapoda are not very common since the substrata of flat plating limestone does not create a suitable habitat for many crayfish. *Orconectes propinquus*, a crayfish is characteristic of hard substrata as is present at B1 and 33 but *O. propinquus* is found only at B3.

Again the flats of shale provide a suitable habitat for all the snails found at B1 and B3 and an adequate habitat at B2 for *Physa* sp. among the luxuriant vegetation. The larger rocks and sand-filled crevices in a slower portion of B1 and B3, and the mud of B2, provide a characteristic situation for *Alasmidonta, Pisidium*, and Sphaerium. 15 species of mayflies occur at B1, 8 of which are *Stenonema* species which are characteristic of cleaner waters. Members of *Ephemera* sp. are bottom sprawlers generally characteristic of more quiet waters, however, as stated before, there is a very small area on the bottom in which the water velocity is extremely reduced therefore allowing invertebrates of slower water habitats to exist around rapid water.

Baetis sp. is able to withstand fast water and is found at B1 and B3. *Caenis sp.,* a burrowing mayfly is found at B1 in some of the sand and gravel. B3, below Shand dam shows a lack of many species of mayflies, even less than present last year.

The lack of *Stenonema* sp. would appear to indicate enriched or poorer water quality compared to above the dam at B1. I feel their absence is because of lack of a greater range in temperature rather than poor water quality. The number of Stenonema sp. increases with an increasing temperature range. Station B2 produced species characteristic of slower water, *Ephemera* (ss. *subvaria*?), *E. deficiens, Neocloeon* sp. and some species of *Baetis* (many of which prefer faster water). If more sampling had been done here, I think that more species of mayflies would have been found. *Cordulegaster* sp., a dragonfly indicative of clean water was also present at B2.

Acroneuria lycorias and *Phasganophera capitata* were found at B1 but not below the dam at B3. Two hundred stoneflies were transplanted from B1 to B3 to see if they would populate the area. Extensive hand picking of the rocks should be carried out occasionally to see if our efforts were worthwhile. It is suggested that next year more should be transplanted since, if the 200 survived, they could cover a large area and would be difficult to detect. Two species of stoneflies, *Paracapnia angulata* and *Isoperla* sp. were found in the pristine stream at B2. Plecoptera prefer clean, well aerated water as illustrated by the proverbial "babbling brook" at B2. The stream runs through the woods (before the station) over rocks and stones and into a slight riffle area where the sample was taken. The bottom in areas of B2 being covered with mud and much vegetation provides an excellent habitat for the alderfly *Sialis* sp.

Cheumatopsyche sp., *Hydropsyche* sp., and *Helicopsyche* sp. have a wide range of habitats and are found in many aquatic situations. *Cheumatopsyche* sp., *Hydropsyche* sp., and *Polycentropus* sp. are net spinners and for this reason are found below the reservoir feeding on the algae. They will also be found in many fast water environments spinning nets to catch food such as at E1. *Chimarra obscura* and *Polycentropus* sp. both net spinners are found in the riffle area of B2. Species of the Rhyacophilidae are found in faster waters such as B1 and B3 as illustrated and B2 to some extent. Goeridae are more familiar with fast, clean, cool waters and some gravel substrata out of which they make their cases.

Of the members of the cranefly family, *Antocha* is shown to prefer rapid water (B1, B2, B3), *Eriocera* sp. prefers sand and gravel near running water and makes its home under stones in shallow streams in the bottom silt as illustrated at B2, *Pedicia* sp. will be found in the algae of cold, rapid waters (B1) and the Tipulids are found under stones and drift along the margin of a stream (B2 and B3). *Simulum vittatum*, a blackfly, is present in large numbers in the rapid cold water of B3. The midges also find a suitable habitat at all stations, especially B3. The silt and sand in the crevices of the broken-up shale provide an excellent site for chironomids. The snipe fly, *Atherix variegate*, is prevalent in fast water that is lined with trees. The eggs are laid on trees above a rapid watercourse and fall into the water and develop through to adult in the water. The snipe fly is apparent at B1, B3, B2 but not in the slow waters of the Fergus station. The habitat of the larval horsefly *Tabanus* sp. can vary from the edges of fast water to the margins of swamps. The eggs are also laid on vegetation along a watercourse and develop to the adult in the water.

Ectopria sp. and *Psephenus* sp., water pennies, are found above the dam at B1 but not below at B3. Last year only one of each was found below the dam at B3. Two explanations may account for their absence at B3;

1. they prefer less rapid water than at B3;
2. they prefer warmer water.

The riffle beetles show by their relative abundance that *Optioservus* sp. prefers very rapid water (B3, 698; B1, 38; B2, 40), *Senelmis* sp. prefers less fast water (B1, 54; B3, 59), and that *Dubiraphia* sp. may prefer a more muddy existence such as is evident at the Fergus station. The Fergus station showed only 7 species of invertebrates. The water is extremely slow here because of the presence of a small dam just about 100 yards from where the sample was taken. The slope of the river bed is great and therefore the water becomes deep rapidly.

In spite of the fact that only one sample was taken, I feel it may be stated that this sample was a fairly representative sample. It is likely that only a few more species characteristic of the substrata would have been found. Only one sample was taken at B2 and yielded 41 species which is only a few less than the 46 found at B3 in 6 samples taken. It is possible then, although not totally accurate, to take one benthic sample and be able to determine through species diversification the merits of a particular stream.

Summary of Belwood Stations

Belwood Station 1 (above Belwood dam)

Our data shows that the quality of water at this station is very good. The 24 hr. dissolved oxygen and water temperature pointed out that even at night the dissolved oxygen does not fall below the standard of 5 mg/L. An excellent diversity of insects and fish have been found here.

Belwood Station 3 (below Belwood dam)

Although our data shows that a lesser diversity of insect species was found here than above (B1), it does not indicate that the water is enriched. The water temperature below is cooler than above (B1) with a smaller variation in maximum and minimum. This factor combined with faster water sets physical limitations on the fauna below the dam (B3) but does not imply poor water quality.

The station at Fergus illustrates slightly enriched water. Three facts account for this:

1. The river passes through cattle farmland where much agricultural runoff (cattle waste, therefore N & P) occurs.
2. The cattle erode what grass and soil is on the banks, resulting in silt and increasing field runoff.
3. The small dam in Fergus backs up the water far 200 or 300 yards and allows the water to warm up appreciably.

These three factors ultimately combine to create severe aquatic algae blooms which are detrimental to water quality and therefore affect fish and invertebrates adversely.
This problem can be rectified by:

1. stabilizing the banks between B3 and Fergus (fence to curtail cattle and possible planting of cedar)
2. curtail farm runoff
3. elimination of the small mill dam at Fergus and the small mill dam at Elora.

Benthic Bata Collected From Grand River (Belwood Reservoir)

Species	B1	B3	B2	Fergus
Order Tricladida(flatworms)				
Planariidae	1	6		
Oligochaeta (aquatic earthworms)				
Lumbriculidae			1	2
Naididae	2	139	105	2
Hirudinea (leeches)				
Dina parva	1			
Erpobdella octoculata	5	10		
Helobdella stagnalis		2		1
H. triserialis		1		
Macrobdella ?	1			
Thermoyzon rude				
or *tessualtum*		1		
Isopoda (aquatic sow bugs)				
Lirceus sp.			4	
Amphipoda (side-swimmers)				
Crangonyx sp.		2		
Hyalella azteca	61	3	12	
Decapoda (crayfish)				
Orconectes sp.	1			
O. propinquus		2		2
Gastropoda (aquatic snails)				
Ferrissia sp	2	27	1	
Gyraulus sp.	6	31		
Helisoma sp.		34		
H. campanulatum				2
Lymnaea sp.	4	3	3	
Physa sp.	2	87	7	
Valvata tricarinata	57	9		
Pelecypoda (clams)				
Alasmidonta sp.	1			
Pisidium sp.	38	15	3	
Sphaerium sp.	155	99	60	

BENTHIC DATA COLLECTED FROM GRAND (BELWOOD RESERVOIR)

Species	B1	B3	B2	Fergus
Ephemeroptera (mayflies)				
Heptageniides				
Stenomema sp.	1			
S. fuscum	9		1	
S. gildersleevei	7			
S. heterotarsale	17	1		
S. nepotellum	2			3
S. pudicum	1			
S. pulchellum	2			
S. tripunctatum	3			
Hertagenia hebe	1	1		
Baetidae				
Siphlonurinae				
Siphlonurus (phyllis ?)	1			
Leptophlebiinae				
Leptophlebia sp.			2	
Paralentophlebis adoptiva			47	
Ephemerellinae				
Ephemera bicolor	5			
E. deficiens			2	
E. serrata	1			
E. (ss. subvaria ?)			68	
E. temporalis	1			
Caeninae				
Caenis sp.	22			
Baetinae				
Baetis sp.	20	157	3	
Neocloen sp.			3	
Odonata				
Anisoptera (dragon flies)				
Cordulegaster sp.			2	
Plecoptera (stonefiles)				
Acroneuria lycerias	3			
Isoperla sp.			1	
Paracapnia angulata			2	
Phasganophera capitata	3			
Hemiptera (true bugs)				
Mesovelia sp.	1			
Neuroptera (fishflies, dobsonflies)				
Sialis (alderflies)			7	

Benthic Data Collected From Grand River (Belwood Reservoir)

Species	B1	B3	B2	Fergus
Lepidoptera (aquatic caterpillars)				
Cataclysta	30			
Tricoptera (caddisflies)				
Hydropsychidae				
Cheumatopsychidae sp.	23	738	60	
Hydropsychidae pupa	1			
Hydropsyche sp.	2	141		
H. betteni		30		
H. bifida	2	25		
H. recurvata		5		
H. simulans	1	7		
H. slossonae	1	131	58	
Hydroptilidae				
Hydroptillidae (not keyed)	2			
Leucotrichia sp.	2			
Rhyacophilidae				
Agapetus sp.			14	
Glossosoma sp. pupae			1	
Rhyacophila sp.	11	20		
H. fuscula		1		
Philoptamidae				
Chimarra obscura			1	
Psychomyiidae				
Polycentropus sp.	6	72	3	
Leptoceridae				
Athripsodes sp.		1		
Nystacides longicornis			1	
Phryraneidae				
Phryganeid Genus A			1	
Heliocopsychidae				
Heliocopsyche borealis	37	38		
Goeridae				
Goeridae larvae			21	
Limnephilidae				
Astenophylax sp.			1	
A. argus		2		
Limnephilus sp.	5	2		
Pycnopsyche sp.		4		
Diptera (two-winged flies)				
Nemocera				
Tipulidae (craneflies)				
Antocha sp.	88	75	42	
Eriocera sp.			1	
Pedicia sp.		1		
Tipula sp.	1	3		
T. abdominalis		1	1	
T. pupa		1		

Benthic Data Collected From Grand River (Belwood Reservoir)

Species	B1	B3	B2	Fergus
Simuliidae (blackflies)				
S. larva	2	8		
S. vittatum		354		
Chironomidae (midges)	985	1794	230	57
Ceratopogonidae (biting midges)	3		10	
Brachycera				
Rhagionidae (snipeflies)				
Atherix variegata	2	24	38	
Tabanidae (horseflies)				
Tabanus sp.		3	6	
Coleoptera (beetles)				
Dytiscidae (predaceous diving beetles)				
Celina (Aubé) sp.	10			
Hydrophilidae (water scavenger beetles)				
Hydrobius sp.	1			
Psephenidae (water pennies)				
Ectopria sp. larvae	61		2	
Ectopria sp. adult				
Psephensus sp. larvae	111			
Psephenus sp. adult	4			
Limnichidae (minute marsh beetles)				
Lutrochus sp.	1			
Elmidae (riffle beetles)				
Dubiraphia sp. larvae	52	13	1	25
Dubiraphia sp. adult				
Optioservus sp. larvae	38	698	40	
Optioservus sp. adult		16		
Stenelmis sp. larvae	54	9	2	
Stenelmis sp. adult	15			
Elmidae adult	19	1		
Helodidae (marsh beetles)				
Helodidae adult	1	3		
No. of organisms	2008	4851	866	94
No. of species	60	46	41	7
No. of times sampled	6	6	1	1
Grand total of species 106				
Grand total of organisms 7819				

iii) <u>Discussion of Fish Data</u>

Only once at B1, B3, and Fergus were the fish sampled. This did not give a very good picture of fish present when one considers that last year B1 yielded 15 species, and B3 12 species in several samplings. In one sampling this year, B1 presented 4 species, B3 5 species and Fergus, 7 species.

Electroshocking and seining was done at Belwood reservoir in October to determine the eating habits of the stocked rainbow trout and the forage fish. Fourteen stomachs were analysed, 6 contained only fish, 4 contained only insects, and 4 contained insects and debris. The majority of points were accumulated by fish remains (76% of total stomach contents) and 12% represented the insect remains.

Yellow perch was the most common forage fish used as trout food. Fathead minnows and common shiners are also found in the reservoir and would provide excellent food for the trout. The yellow perch must be very crowded in the reservoir since most of the ones caught appeared to be stunted or very small for their age class. The fact that the rainbow trout have fed almost exclusively on them would also indicate their abundance. 100 northern pike were put in at B1 above the reservoir since we felt that the perch population was overcrowded. The condition of both the trout and pike over the years should alleviate the perch Overpopulation and hopefully result in a greater growth rate in the perch providing another game fish species worthwhile catching.

The rainbow trout have converted well from a pellet fed diet to a fish diet. This fact alone points out that rainbow trout can survive in Belwood reservoir although the data explaining the size and age class would indicate that the fish are not spawning. More detailed collection and analysis should be made of Belwood reservoir and Conestogo reservoir. The addition of otter trawl would greatly facilitate our data and allow us to practice advanced fish management techniques thereby providing better fisheries for our waters.

B1	No. of Fish Caught	Size Range (mm)
Common White Sucker	1	142
Common Shiner	28	65 - 160
Yellow Perch	5	87 - 117
Iowa Darter	1	59
Total No. of Fish	35	
Total No. of Species	4	

B3	No. of Fish Caught	Size Range (mm)
Common Shiner	25	37 - 110
Brassy Minnow	5	65 - 70
Western Golden Shiner	1	67
Fathead Minnow	2	67 - 72
Yellow Perch	37	72 - 120
Total No. of Fish	70	
Total No. of Species	5	

Fergus	No. of Fish Caught	Size Range (mm)
Common White Sucker	13	54 - 75
Fathead Minnow	55	53 - 62
Bluntnose Minnow	1	40
Common Shiner	25	36-45

Fergus	No. of Fish Caught	Size Range (mm)
Creek Chub	121	30 - 70
Yellow Perch	3	65 - 130
Iowa Darter	1	53
Total No. of Fish	226	
Total No. of Species	7	

Belwood Lake Oct. 25, 1972

Belwood Reservoir	Standard Length (mm)	Weight (g)	Winter
Rainbow Trout	170	200	1
	240	145	1
	140	120	1
	155	165	1
	140	145	1
	250	160	1
	250	158	1
	248	528	2
	171		2
	173		2
	175		2
	185		2
	220		2
	340	468	2
	390	810	2
Total No. of Trout	15		
			Age
Fathead Minnow	37		0+
	47		0+
Common Shiner	48		0+
	140		3+
	145		3+
	150		3^{-}+
Central Mud minnow	87		

Belwood Rainbow Trout Stomachs

Number of stomachs examined	14
Total number of points	81
Average number of points	5.8
Average fullness	48.3%
Number of empty stomachs	0
Percentage of stomachs empty	0.00%

Food Item No.	No. of Points	of Total
yellow perch	46.00	
unidentified fish remains	16.00	
Coleoptera: Dytiscidae (80 specimens)	5.00	
Hymenoptera	0.25	
digested invertebrates	2.50	
Valvata tricarinata (26)	2.00	
feathers	3.50	
detritus: twigs, Weeds, sand, etc.	5.75	
	81.00	
Total fish eaten	62.00	
Total invertebrates	9.75	
Undigestible matter	9.25	

Rainbow Trout Stomachs - Belwood Lake   Oct. 25, 1972

1.	full - 12 pts. 1 fish	12 pts.
2.	full - 12 pts. 1 perch	11 pts.
	backbone of fish	1 pt.
3.	full (distended) - 12 pts.	
	5 perch	12 pts.
4.	full - 12 pts.	
	2 perch	12 pts.
5.	full - 12 pts.	
	2 perch	11 pts.
	backbone	1 pt.
6.	4 pts.	
	feathers	2 pts.
	49 Dytiscus	2 pts.
7.	1 pt.	
	17 Dytiscus	1 pt.
8.	2 pts.	2 pts.
	1 *Valvata tricarinata* feathers, twigs	
	2 Hymenoptera (?) (poor specimen) weeds	
9.	2 pts.	
	feathers	½ pt
	twigs, weeds	½ pt.
	5 Dytiscus	½ pt.
	1 Coleoptera (poor)	½ pt.
1Q.	2 pts.	
	feathers	½ pt.
	twigs, leaf fragments	½ pt.
	fragments of coleoptera, possibly Dytiscus dirt, sand, mud	1 pt.
11.	3 pts.	
	1 fish	2 pts.
	Dytiscus feathers	½ pt. ½ pt.

Rainbow Trout Stomachs - Belwood Lake (cont'd)

12.	3 pts. - mostly digested	3 pt.
	very poor condition *Stenonema* head various Coleoptera heads Tricoptera heads mostly fragments of vegetable matter various wings of insects 1 chironomid	
13.	2 pts.	
	8 *dytiscus*	½ pt.
	bark, twigs, feathers seeds	1½ pts.
14.	2 pts.	
	Valvata tricarinata	1¾ pt.
	twigs	4 pt.

iv) Discussion of 24 hr. Dissolved Oxygen and Water Temperature Survey

On September 20-21, 1972 a 24 hr. dissolved oxygen and water temperature survey was carried out on three Belwood stations (B1, B2, B3). The main reason for the survey was to see if there was any difference in the two parameters above and below the dam (B1, B3). B2 is a small spring creek which runs into the reservoir above the Village of Belwood.

The average dissolved oxygen and water temperature above was 8.0 mg/L and 15.2°C whereas below it was 7.3 mg/L and 13.8°C. The range in dissolved oxygen and temperature above was 4.6 mg/L to 10.8 mg/L and 12.0°C to 19.0°C, and below at B3 the range was 5.4 mg/L to 8.6 mg/L and 12°C to 17°C.

Our data shows that the reservoir creates slightly cooler water downstream (B3) and confines the ranges to a 5^{0}C variation as opposed to a 7.0°C variation at B1. This lower water temperature, especially in the spring, would account for the absence of some minnow species (Spence & Hynes, 1969) due to lack of proper spawning temperatures. Also, the confined range and generally cooler water temperatures explain the finding of fewer *Stenonema* sp. since they are more abundant and tolerant of a wider water temperature range. The dissolved oxygen also shows a smaller range, 3.2 mg/L at B3 whereas at B1 the range is 6.2 mg/L. The important point to note is that only once at B1 does the dissolved oxygen drop below 5 mg/L (possible error in measurement), other than that the dissolved oxygen at both stations remained above 5 mg/L throughout the 24 hour period. It appears that as far as dissolved oxygen and water temperature go, the reservoir has very little affect in altering the water below the reservoir to something appreciably different than that above.

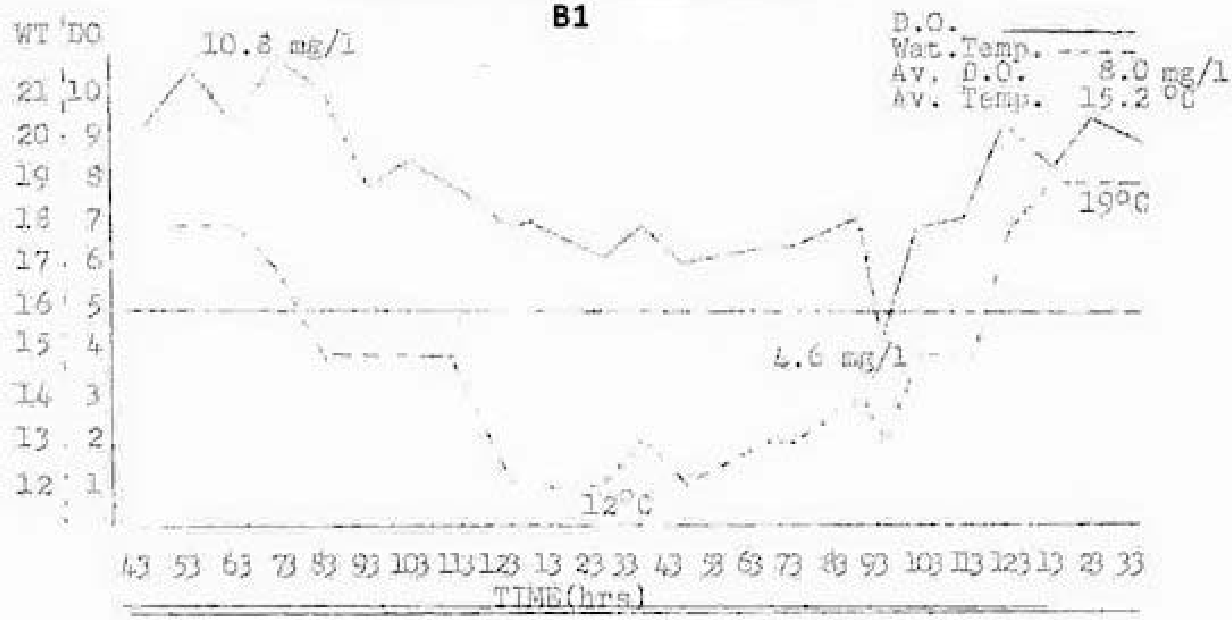
Spence and Hynes, 1969 found that there was a 4 week delay before water temperatures below the dam (B3) reached a maximum summer temperature in the spring and early summer. It was shown that the absence of some fish below (B3) that were found above (B1) would be accounted for because of lack of suitable water temperature for spawning. Our data shows the slight difference in water temperature and dissolved oxygen during the summer. Undoubtedly this delay in reverse would occur in the fall. That is, that the minimum water temperature at B3 (below dam) would lag behind the minimum water temperature above by a certain period of time provided the reservoir remained full until winter.

B2 illustrates its unpolluted qualities with an average dissolved oxygen of 7.7 mg/L and an average water temperature of 16.3°C with only a 4.2 mg/L range in dissolved oxygen and an 8.0°C range in water temperature. It is possible that a mistake was made in reading the thermometer since there is a change from 14°C to 11°C and back up to 16°C within a 2 hour period. If this is so, then the variation in water temperature would only be 5°C.

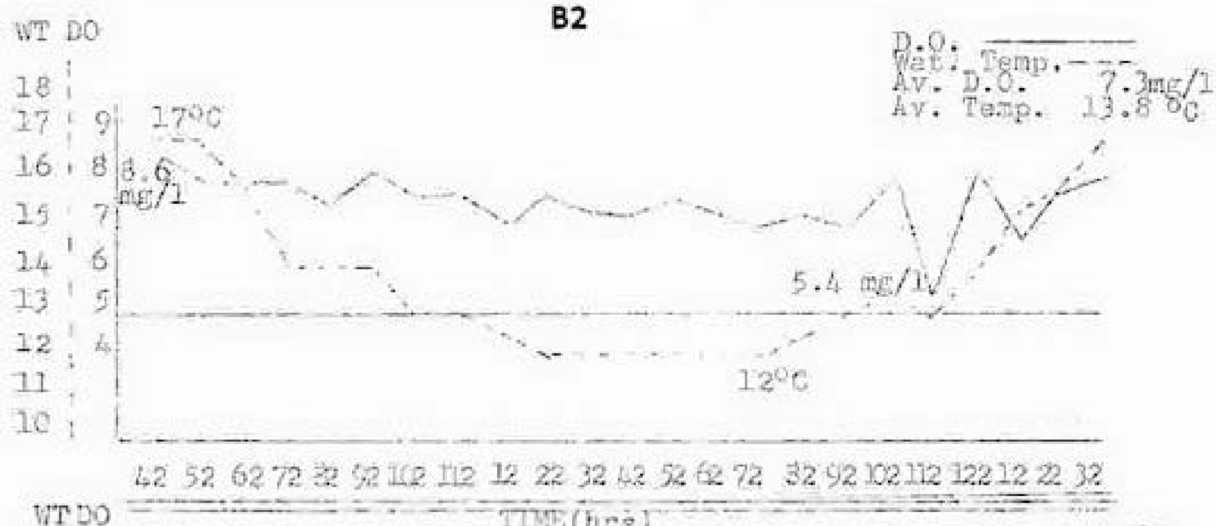
Considering these two parameters, dissolved oxygen and water temperature conditions are excellent. It would be worth our while to do a survey (dissolved oxygen and water temperature) within the reservoir as well as water quality.

Belwood Sept. 20 - 21, 1972

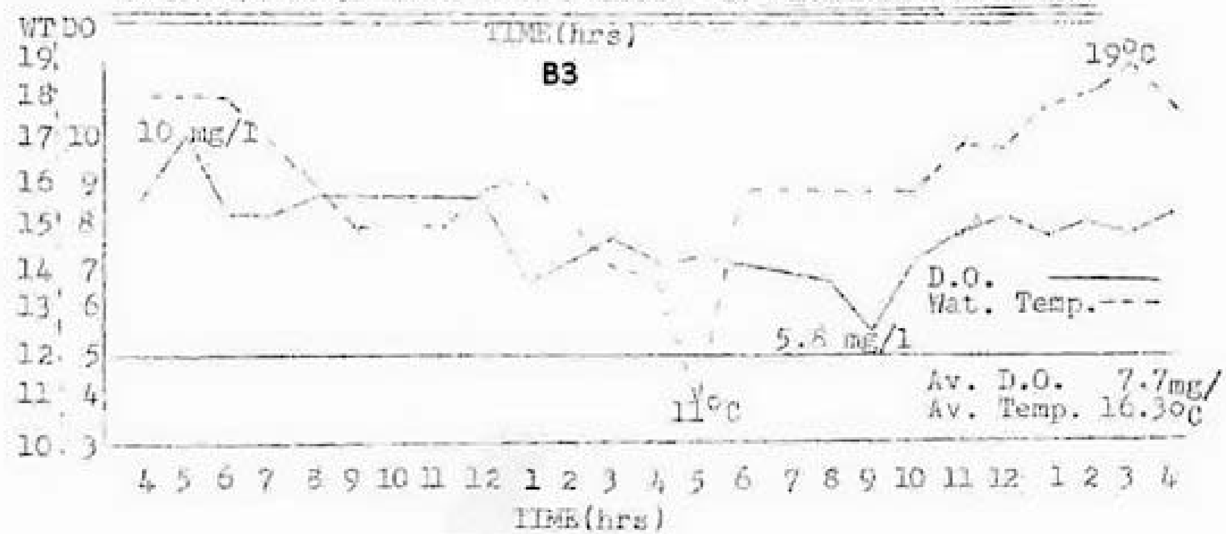
B1



B2



B3



E. Analysis of the Fisheries of the Grand

i) Grand River Between Elora and Galt.

Last year in the 1971 G.R.C.A. Fish Report, speculations were made based on available water quality, on the types of fish that may be found in the reach of the Grand River from Elora to Galt. The author speculated mostly species of the minnow family, suckers, and bullheads. Rock bass and pumpkin seeds, possibly rainbow and brown trout from the Irvine River could be the only game fish present. His assumptions were quite accurate and much to our pleasure three more game species were found; smallmouth bass, pike and perch. Although no trout were found, fishermen claimed (in 1972) having caught rainbow trout in Elora Gorge. The fish were apparently caught in the "Punch Bowl" in Elora Gorge, just below the high bridge in the park. This hole is fairly deep and we were unable to seine and shock effectively.

a) Elora Gorge

Over three hundred fish were caught within Elora Gorge Park, three species of which were game or pan fish. Smallmouth bass from age 1+ to 4+ were caught, the largest one being 155 mm (approx. 6.2"). This age class illustrates that these fish were spawning in the vicinity. Rock bass, aged 3+ to 6+ years, the largest being 188 mm (approx. 7.5") obviously spawn in the area. The final game fish found here was the perch, unfortunately stunted for their age. A 5+ year fish was 135 mm (approx. 5.4") in length which is quite small for a perch of that age. Other than these 3 pan fish, 10 other species were caught; common white sucker, northern hog sucker, northern shorthead redhorse, common shiner, lake emerald shiner (most abundant) bluntnose minnow, hornyhead chub, brown bullhead and longnose dace.

b) Village of Conestoga

Only 4 species were caught and several common white suckers were seen. Rock bass was the only game fish caught. Slightly downstream, the Conestoga River runs into the Grand. At this location we observed several people jigging for carp. Carp are difficult to catch and it is possible that carp are to be found in this stretch of the Grand River.

c) Bridgeport Bridge

Much to our surprise, 12 smallmouth bass and 1 northern pike were caught here. The pike was quite large (660 mm, approximately 26.4"). The smallmouth bass were also a fair size (380 mm, approximately 16") and appeared to be in excellent health. Five perch were also caught. The other fish were silver redhorse, carp, common shiner and lake emerald shiner.

d) Breslau Hwy. #7

Construction of the new bridge at Breslau was possibly part of the reason so few fish were caught. A small diversion dyke (earth type) caused the water to back up slightly resulting in waters too deep to allow the seine to drag the bottom. Four hundred & fifteen fish were caught, 233 of which were lake emerald shiners and 177 being common shiners. One rock bass was caught illustrating the possibility of a population further upstream. A carp, sucker, creek chub, bluntnose minnows and a brook stickleback were caught.

e) Freeport Bridge

The author of last year's fish report was correct in speculating the species here based on water quality. The dissolved oxygen and water temperature when the fishing was done was 13.8 mg/L and 21°C respectively. The water was moving very slow and appeared stagnant in certain places; the bottom was muddy with a few gravelly areas and strewn with, tires and junk. One each of two pan species were caught, rock bass and pumpkinseed. The substrate, water temperature and dissolved oxygen are suitable for spawning of these two fish. A northern hog sucker was found here; it is characteristic of riffle areas and clear water. Farther upstream, the water is faster and shallow with many rapids and riffle areas characteristic of the niche that the hog sucker would occupy. Fishing was done upstream with great difficulty and few were caught, among them the northern hog sucker and the common white sucker. Again, carp being very difficult to catch in shallow waters and especially difficult at Freeport, were seen approximately 150 to 500 mm (approximately 6" to 20"). River chubs, creek chubs, common shiners and a sculpin were among the other species caught at Freeport.

f) Blair Bridge

Four species were caught here and one species, the common white sucker was seen. The water at Blair is moderately fast in the many shallow areas creating rapids and riffles, and several fairly deep areas along the shore. The common white sucker is a very elusive fish in rapid water since it is able to swim quite rapidly. Many were seen vigorously swimming away from the net. Four common carp were caught in one of the deeper holes and several were seen feeding on the bottom underneath the Blair bridge. The four caught ranged in size from 250 to 380 millimeters (approximately 10" to 16"). One specimen of rock bass was caught although rater small (45 mm; approx. 2"). Common shiners and bluntnose minnows were the other two species obtained at Blair.

g) Queen Street in Galt

Six species of fish were found here; common white sucker, common carp, common shiner, bluntnose minnow, lake emerald shiner and Johnny darter. The Queen Street dam caused the water in this area to be rather slow and very deep with a rather steep sided river bank bed. Again it was difficult to seine effectively in the deeper water. The island underneath the train bridge behind G.C.I. yielded a few fish but the water dropped off rapidly 2 to 3 feet off shore. Seining was done behind Cobble Industries on the left bank facing downstream. One hundred & seventy-two fish were caught.

Fishing in this area would be much more effective and yield a better census if the boat shocker were to be used. There weren't any game fish caught but a better census might yield some rock bass. Last year 3 rock bass, 4 smallmouth bass, 1 yellow perch, and 5 pumpkin seeds were caught here.

The rock bass appears to be the only game fish common to this stretch of the Grand (Blair to Elora). The rock bass is a warmer water fish (as opposed to trout) but prefers weedy lakes and rocky, gravelly bottoms on which to nest. The smallmouth bass warrant further consideration as a possible game fish indigenous to this area.

ii) Laurel Creek (Conservation Area)

Using the boat shocker along the shoreline areas and in the weedy stump ridden areas of Laurel Creek reservoir, eleven species yielding 263 fish were caught. Two hundred largemouth bass between 150 and 360 mm (approx. 10" to 16") taken from Pinehurst Conservation Area were stocked at Laurel Creek to check the numerous stunted perch population since there were no other predator fish in Laurel Creek. The shocker enabled us to catch a few largemouth bass (7) aged 0+ to 3+ years. Several small (young of the year) largemouth bass were allowed to escape. We were pleased to see these young of the year since it showed that the largemouth are breeding in Laurel Creek and hopefully will be prolific enough to check the perch population and result in greater yield of more hardy fish of each species.

Four species of scavenger fish, common white sucker, common carp, mirror carp and brown bullhead are fairly abundant. All of these fish are prolific breeders as shown by their age class from 0+ to 6+ years. The two types of carp were the largest fish caught; the mirror carp was 500 mm long (approx. 20") and weighed 3,675 grams (approx. 8 lb.). The weedy, stump ridden area and muddy bottom are excellent breeding grounds for the carp. The other species common in this type of water were the common shiner, fathead minnows and mimic shiners.

iii) <u>Brant Conservation Area</u> (Grand River)

Five healthy smallmouth bass were caught below the dam at Brant Park, three other species of game fish or pan fish were caught, the bluegill, pumpkinseed and a 10" yellow walleye. It would be worth our while to seine here again, more intensively to see if these fish are breeding in the area. Other fish caught common to the Grand River were common white suckers, common carp, common shiners, lake emerald shiners, brassy minnows and brown bullheads.

iv) <u>Sulphur Creek</u>

Fish common to the Great Lakes and large river mouths are common at Sulphur Creek. We employed the boat shocker here in hopes of finding fish that were not caught last year. The types of fish were noted and returned to the water. Measurements were not taken. Of the 18 species of fish found here, 12 species are considered game fish. Gizzard shad, rainbow trout, coho salmon, pickerel, northern smallmouth bass, northern largemouth bass, green sunfish, longear sunfish, white and black crappie, freshwater drum and pumpkinseed provide excellent fishing for the avid fishermen. Naturally in the slow waters, detritus feeding fish will be and were found such as the quillback carpsucker, common carp, goldfish and silver redhorse. Intensive surveying should be done to evaluate the fishery well and determine beyond any doubt if many of these fish spawn in the area. If so, it may be plausible to arrange for methods to allow them to enter the waters of the Grand River.

v) Dunnville (below weir)

Shocking was done at Dunnville again this year but not nearly as intensively as last year, Size and age were measured on many of the fish we caught. The results and types of fish were much the same as last year and not much different than those caught at Sulphur Creek. The alewife, pike and white crappies were the only game fish present.

Elora Gorge.	No. of Fish	Size Range (mm)	Age
Common White Sucker	2	115, 120	1+
	3	160 - 165	2+
	3	180 - 185	3+
	1	235	4+
	2	235 - 275	5+
Northern HogSucker	3	137 - 155	2+
	13	185	3+
	3	220 - 230	4+
Northern Shorthead	1	222	3+
Redhorse	1	200	4+
Common Shiner	27	58 - 68	1+
	35	70 - 90	2+
	15	97 - 115	3+
	3	125 - 150	4+
Lake Emerald Shiner	4	70 - 80	0+
	25	100 - 110	1+
	123	115 - 135	2+
Bluntnose Minnow	1	63	1+
	3	77 - 83	2+
Hornyhead Chub	1	89	1+
	9	100 - 125	2+
	3	122 - 140	3+
Brown Bullhead	1	115	2+
	2	153, 154	3+
	1	210	5+
Smallmouth Bass	1	93	1+
	2	120	2+
	1	125	3+
	1	155	4+
Rock Bass	3	95 - 110	3+
	7	120 - 150	4+
	6	130 - 160	5+
	3	160 - 180	6+
Yellow Perch	14	95 - 110	3+
	7	105 - 125	4+
	1	135	
No. of Species	11		
No. of Fish	320		

Elora Park

Dissolved Oxygen 10.4 mg/L
Air Temperature 76°F
Water Temperature 12.5°C

	No. of Fish	Size Range mm
Common White Sucker	6	210 - 254
Northern Hog Sucker	2	176 - 325
Common Shiner	Too many to count	3 - 150
Hornyhead Chub	2	138 - 141
Longnose Dace	2	67
Brown Bullhead	1	130
Yellow Perch	8	95 -138

Village of Conestogo (Golf Club)

Dissolved Oxygen 14.00 mg/L
Air Temperature 80°F
Water Temperature 21^{0}C

	No. of Fish	Size Range mm
Common White Sucker	Sight	
Common Shiner	23	43 -122
Emerald Shiner	141	39 -135
Creek Chub	1	116
Rock Bass	4	77 -123

Bridgeport Bridge

Water Temperature 23°C.

	No. of Fish.	Size Range mm
Northern Pike	1	660
Silver Redhorse	1	174
Common Carp	1	509
Common Shiner	6	50 -131
Lake Emerald Shiner	148	41 -109
Smallmouth Bass	12	310 - 380
Rock Bass	3	77 - 95
Perch	5	107 - 158

Breslau Bridge on Hwy. 7

Dissolved Oxygen 7.0 mg/L
Water Temperature 20°C

	No. of Fish	Size Range mm
Common White Sucker	1	72
Common Carp	1 *several seen*	250 - 380
Common Shiner	177	42 -132
Lake Emerald Shiner	233	50 -111
Bluntnose Minnow	23	42 - 66
Creek Chub	1	71
Brook Stickleback	1	3 8
Rock Bass	1	93

Freeport (Bridge on Hwy. 7)

Dissolved Oxygen 13.8. mg/L
Air Temperature 82°F
Water Temperature 21°C

	No. of Fish	Size Range mm
Common White Sucker	several	150 - 500
Northern Hog Sucker	1	150
Common Carp	saw several	up to 500
Bluntnose Minnow	15	39 - 62
River Chub	2	88 - 90
Creek Chub	1	150
Common Shiner	several	2.5 - 10
Rock Bass	1	10
Sunfish	1	13
Sculpin	1	7

Blair Bridge

Dissolved Oxygen 14.6 mg/L
Air Temperature 73°F
Water Temperature 22°C

	No. of Fish	Size Range mm
Common White Sucker	sight	
Common Carp	4	250 - 380
Common Shiner	7	86 - 130
Bluntnose Minnow	2	46 - 50
Rock Bass	1	45

Queen Street (Galt)

Dissolved Oxygen 7.2 mg/L
Air Temperature 72°F
Water Temperature 23°C

	No. of Fish	Size Range mm
Common White Sucker	6	62 - 182
Common Carp	1	192
Common Shiner	99	31 - 118
Bluntnose Minnow	51	39 - 70
Lake Emerald Shiner	12	43 - 108
Johnny Darter	2	39 - 47

Laurel Creek	Number of Fish	Average Length mm	Average Weight grams	Age
Common White Sucker	4	117	27	0+
	3	193	119	1+
	22	254	259	2+
	42	270	299	3+
	18	345	499	4+
	1	365	600	5+
Carp	1	190	170	1+
	5	391	1195	3+
	1	405	1750	4+
	1	400	1400	5+
	2	510	3675	6+
Mirror Carp	1	190		3+
	1	500	3150	5+
Common Shiner	1	170		3+
Brassy Minnow	6	77.5		2+
Fathead Minnow	4	67.5		1+
	29	82		2+
Mimic Shiner	1	190		3+
Brown Bullhead	29	90	9.7	0+
	16	104	16	1+
	9	171	70	2+
	3	186	71.6	3+
	7	224	192.8	4+
Largemouth Bass	3	69	2.71	0+
	2	81	3.18	1+
	1	94	3.7	2+
	1	134	5.2	3+
Yellow Perch	24	66.5	2.61	0+
	2	80.0	3.1	1+
	11	98.5	3.8	2+
	10	125	4.9	3+
	1	146	5.7	4+
Iowa Darter	1	47		1+
No. of Species	11			
No. of Fish	263			

Brant Conservation Area

	No. of Fish	Size Range (in.)
Common White Sucker	15	2 - 15
Common Carp	1	6 - 15
Common Shiner		up to 2
Lake Emerald Shiner	6	up to 5
Brassy Minnow	6	up to 2
Brown Bullhead	1	6
Smallmouth Bass	5	6 - 15
Bluegill	5	up to 6
Pumpkinseed	5	up to 4
Yellow Walleye	1	10

Shocking Sample - Sulphur Creek Oct. 16, 17, 18, 20/72

Gizzard Shad
Rainbow Trout
Coho Salmon
Northern Quillback
Carpsucker
Silver Redhorse Carp
Goldfish
Spottail Shiner
Yellow Walleye
Northern Smallmouth Bass
Northern Largemouth Bass
Green Sunfish
Longear Sunfish
White Crappie
Black Crappie
Brook Silverside
Freshwater Drum
Pumpkinseed

Dunnville (below weir) - Seine Oct. 19, 1972

	No. of Fish	Size Range mm	Age
Alewife	48	33 - 40	0+
	39	43 - 53	1+
Northern Pike	2	210 - 230	5+
Bluntnose Minnow	32	40 - 45	0+-1+
	15	53 - 59	1+
	2	70 - 75	2+
Western Golden Shiner	39	48 - 50	0+
	5	55 - 58	1+-2+
	2	68 - 70	2+
	2	93 - 96	3+-4+
Great Lakes Spottail Shiner	5	78 - 85	2+
Lake Emerald Shiner	7	59 - 65	1+
	4302	31 - 55	2+
White Crappie	5	30 - 34	0+
	1	130	3+
Northern Log Perch	3	50 - 53	1+
	3	70 - 78	2+
Northern Brook Silverside	2	69, 65	0+

F. Summary of the Fisheries of the Grand

Of interest to us is the existence of a viable sports fishery. The presence of rock bass between Elora and Blair (possibly Galt) is indicative of an indigenous population. The smaller bass provide much entertainment and enjoyment as a sports fish. Further analysis should be done on the rock bass to determine its extent in the Grand River. The presence of smallmouth bass at two locations, Elora and Bridgeport allows us to believe that these fish also breed in the Grand River. Water quality might just be too slightly enriched for a prolific existence. Apparently adequate spawning ground s exist for this species. They prefer a cooler clear water and are found in pools or riffle areas. The temperatures indicate that their existence may be border line. The northern pike that was caught at Bridgeport seemed rather sluggish and weak. It was caught in the same seine haul as the smallmouth bass were, indicating that it may have been feeding on these bass.

Spawning substrate preferred by pike as pointed out in research is dense mats of short vegetation with the presence of silt and some stones or gravel. They generally spawn at depths of 38 to 76 cm. During the summer, pike show a preference for the weedy shallows of lakes. The substrate and proper habitat are available in this portion of the river to allow for the existence of pike. Sufficient forage fish are present for their consumption and it is not unlikely that there are more present. Further analysis of this section of the river (water quality, flow, depth, etc.) could indicate that stocking of pike in this area would be advantageous. I feel it is necessary first to study more intensely the area between Bridgeport and Elora for the existence of proper and suitable spawning grounds for these game fish and also to obtain a more accurate census of the sports fish in this area.

It will also be necessary this year to fish at Laurel Creek to determine how well our bass are making out. A reasonable amount of time should be allowed to survey this area to obtain an adequate census. The bass should be tagged and recorded as to size, age, and weight.

The fact that many game fish are present below Dunnville entertains the possibility that these fish spawned up the Grand and its tributaries. Extensive work should be done to evaluate the possibility of creating more efficient means to allow these fish to enter the upper reaches of the Grand River and its tributaries (ie. more efficient fish ladders).

SUMMARY

G. Evaluation and Recommendations of Benthic and Fish Collections .

The collection and analysis of the samples went extremely well this year. The personnel involved are very competent and pleased with their work. Being more familiar with their responsibilities, mare familiar with the watershed and specific areas, and confident of the results enables us to promptly evaluate a stream and present it in a scientific manner. It takes approximately 3 to 4 days to analyse a sample. The sample must be collected (kick net for benthic, seine and shocking for fish) mechanically separated (benthic) and identified (benthic and fish). As we become more familiar with the insects, identification will be easier. Presently only one person has the time to identify the invertebrates and this is the most time consuming stage. We have added to our library much more valuable literature in the form of research papers and much needed, updated keys.

Information concerning the biology (ecological requirements, life cycles, current research on benthic fauna) of the invertebrates is invaluable to us; we are constantly looking for new material. Valuable resources of information are available at the local universities. We have spent many hours at the university libraries and much more time will have to be spent there. Our work this past year has pointed out the importance and necessity of our studies and the need for more intensive work in certain areas.

The collection of fish and benthos permits us to go back to a particular station years later and by collecting samples, determine the changes that may take place due to changes in water quality (as well as physical changes in the environment). For instance, our collections on Canagagigue Creek (proposed Woolwich reservoir) and on the Speed River (proposed Guelph dam) present an excellent opportunity to study the effects of a large reservoir on the ecology of a system. Having accumulated data at these sites as well as water quality analysis for two years previous to construction gives us a great basis on which to study the effects of construction and a completed reservoir on the fauna. The data collected at the existing reservoirs allows us to re-examine at a later date the situation and determine the changes that may occur.

The importance of our benthic work has had effects on some local municipalities. We were asked by the City of Galt to assess the quality of Devils and Moffats creek. The City of Brantford asked us to evaluate Mohawk Lake. We used not only water quality but also invertebrates to determine the conditions of these problems. We are constantly asked by citizens where the best places are to fish and swim in the watershed other than our parks. In every respect, our program is progressing very well.

<u>Results Obtained Through the Biological Program</u>

1. As stated in the Conestogo summary, the general consensus of opinion publicly, is that dams are more harmful than beneficial. The biological studies have shown that there are few problems with large dams such as the Conestogo Dam and Shand Dam at Belwood. The quality Of water leaving these reservoirs is as good or better than that of the inflowing waters. There is a delay or lag in water temperature of 2 or 3 weeks below the dam as opposed to the inflowing water above the dam. As a result this will effect the spawning time of the same fish below the impoundment. A problem does exist during construction of a dam with the increase in silt load and increase in water temperature as a result of tree removal in the reservoir. This results in the destruction of habitats and deterioration in water quality which is detrimental to the ecology of the downstream enrichment.

   Studies have been initiated on the Woolwich and Guelph reservoirs to determine how great the effects are and how long it may take to repopulate or restore the condition downstream from the impoundment. The analysis of this data will illustrate methods that may be used to help alleviate the effects downstream due to construction. The information points out the need for collection of biological information prior to purchase of the land and input into the design of the dam as well as the reservoir which has up to now basically been well advanced before biological input is allowed or asked for.

2. The studies have pointed out the causes of pollution such as erosion due to cattle on stream banks, the use of poor septic systems by people on reservoirs and bordering valley lands, the dumping of wastes by citizens and industry, inadequate sewage treatment plants, county garbage dumps, small dams, unprotected stream banks and slow running water. Few of these causes can be eliminated through the Authority.

    1. Stream bank stabilization through the use of trees and grasses.
    2. Construction of small farm ponds for cattle use rather than stream banks (fencing off streams, etc.).

3. Elimination of many smaller dams that result in warm stagnant water.
4. Stricter standards concerning septic systems at our conservation areas (cottagers).

The above improvements involve mainly stream bank stabilization, something the Authority should be intensively involved with. The other major causes of pollution require legal enforcement such as the prevention of the dumping of wastes by industries and the use of inadequate septic systems to prevent pollution. The Authority can point out these causes but has little or no jurisdiction to do anything about it. The solution is not stream flow augmentation, but rather the prevention of the causes.

3. The biological study poses many problems and solutions for reservoir management. After evaluation of the fishery in Belwood reservoir, it was determined that the resident perch population was large and stunted in fish size. Introduction of a predator fish, rainbow trout and pike will thin out the perch population and allow for greater growth rates of the perch as well as providing a forage fish for the predator fish. The same problem occurred at Laurel Creek Conservation Area. This being a rather shallow and warmer water reservoir, it was felt that rainbow trout as a predator fish was undesirable. Largemouth bass, a warmer water fish was introduced as a predator to feed on the stunted perch population.

4. The study has enabled the Authority to assess a future reservoir site as to probable water quality and the type of fauna and flora that will result. Having done this, a management plan can be formulated before reservoir completion which may facilitate the incorporation of various management techniques that are more feasible before dam completion. This technique has been employed for the Woolwich reservoir and the result is found in the report "A Preliminary Fish and Wildlife Management Plan for Woolwich Reservoir" May 1973.

5. As a result of the biological program the Authority is able to process a fish kill and determine the cause. Often the Authority works in conjunction with various agencies such as the Ministry of Natural Resources and the Ministry of the Environment as well as the public health agencies of the municipalities in the watershed.

6. The program has presented the opportunity for the Authority to become acquainted with personnel in related fields (biological sciences) which is beneficial in that it introduces us to projects and policies that may be taking place elsewhere.

7. Through our fish studies, the public is informed of places within the watershed where adequate fishing is provided. This is very helpful to the citizens of the watershed as well as many outside our watershed since it provides a fishery close to home. Many fishermen feel they have to go north for adequate fishing and this involves much time and money. A family fisherman can go out for an afternoon or a day and fish in certain areas of the Grand River and be completely satisfied.

The studies outlined in the following recommendations should be carried out to present the Authority with more information concerning the fisheries of the Grand Rivet and acquaint itself with the causes of pollution. The continuation of the biological studies program will instill respect and confidence in the public in the field of conservation.

Recommendations

1. To spend more time researching the literature at the various universities in our area to study current information and update our knowledge of the ecology of the invertebrates and fish of our watershed.

2. The accumulation of more recent identification keys concerning our work.

3. Bi-yearly sampling of stations at Conestogo and Belwood (benthic and fish).

4. Continuation of monthly benthic sampling of stations at Canagagigue Creek and Speed River (with a reduction of stations on the Speed to Gu1, Gu3 and Gu4), and fish census 3 times a year at each station.

5. An intensive study of one major river and its tributaries each year therefore allowing time for special projects.

6. The collection of benthic samples and survey for adequate spawning grounds for game fish in the Grand River, from Galt to Elora.

7. The collection of benthic samples in the reservoirs (not along the shores but at the deepest points in the reservoirs).

8. The study of information concerning the types of soils through which streams we are studying run.

9. Benthic collections on the Eramosa in and around the proposed Everton reservoir.

10. A study involving stream improvement on Carrol Creek to ascertain the value of various techniques employed for stream improvement.

11. A special project involving the effects of salts on aquatic benthos in the upper reaches of Canagagigue Creek.

12. A very intensive survey of a small spring creek at Taquanyah to evaluate the preferences of aquatic invertebrates (special project).

13. A biological survey of the Nith River and many of its tributaries.

14. A biological survey of Griffin Pond that will be used as an experimental farm pond to be practically applied to actual situations.

15. The continuation of the stocking program:
    i) rainbow trout for the put and take fishery at Conestogo
    ii) rainbow trout for the put and take fishery at Elora
    iii) rainbow trout for Belwood reservoir
    iv) northern pike for Belwood reservoir
    v) the possibility of introducing more largemouth bass into Laurel Creek

16. An intensive survey of game fish in the Grand River from Galt to Elora.

17. Intensive survey of game fish in Conestogo, Belwood and Laurel Creek reservoirs, to include tagging, measuring (length, depth), weighing and determination of age to determine if our stocking efforts are worthwhile.

18. A survey of the reservoir floor of the proposed Guelph reservoir to determine the proper location of placing gravel for bass spawning grounds in relation to water levels at spawning time.

19. To initiate a study of the aquatic plants of the watershed.

SECTION H

GLOSSARY

Acari:	water mites
Acroneuria:	stonefly
Aeshna:	dragonfly
Aeshnidae:	a family of dragonflies
Agapetus:	caddisfly
Agrion:	damselfly
Agrypnia:	caddisfly
Alasmidonta:	clam
Alderflies:	common name for Megaloptera
Allocapnia:	stonefly
Alloperla:	stonefly
Amnicola:	snail
Amphinemura:	stonefly
Amphipoda:	scuds, sideswimmers
Amphizoa:	beetle
Ampumixis:	beetle
Anisoptera:	sub-order of Odonata, the dragonflies
Anthomyiidae:	aquatic fly family
Antocha:	cranefly
Aphrosylus:	aquatic fly
Argia:	dragonfly
Armiger:	snail
Arthropoda:	all those articulates having jointed legs
Asellus:	isopod, aquatic sowbug
Astenophylax:	stonefly
Atherix:	snipe fly
Athripsodes:	stonefly
Baetidae:	family of mayflies
Baetis:	mayfly
Banksiola:	caddisfly
Belostoma:	giant water bugs
Beraea:	caddisfly
Beraeidae:	family of caddisflies
Berosus:	beetle
Bezzia:	beetle
Bidessus:	beetle
Bivalves:	clams
Brachycentridae:	family of caddisflies
Brachycentrus:	caddisfly
Branchiobdellidae:	family of aquatic earthworms

Caddisflies:	Tricoptera
Caenidae:	family of mayflies
Caenis:	mayfly
Callibaetis:	mayfly
Cambarus:	crayfish(Decapoda)
Capnia:	stonefly
Cataclysta:	aquatic caterpillar
Celina (Aubé):	beetle
Centroptilum:	mayfly
Ceratopogonidae:	biting midges
Chaetogaster	sludge worm
Chauliodes:	fishfly
Chimarra:	caddisfly
Chironomidae:	midge
Choroterpes:	mayfly
Chrysogaster:	aquatic fly
Chrysomelidae:	beetle
Chrysops:	horsefly
Cinygma:	mayfly
Clams :	bivalve molluscs
Climacia:	Spongilla fly
Cloeon:	mayfly
Coleoptera:	beetle order
Collemba	spring tail
Cordulegaster:	dragonfly
Corixidae:	water boatmen
Corydalus:	dobsonfly
Crangonyx:	sideswimmer, amphipod
Crayfish:	common name for decapods
Crustacea:	the class of the phylum Arthropoda containing the crab, lobsters etc.
Cybister:	beetle
Damselflies:	members of the sub-order Zygoptera
Decapoda:	crayfish and shrimps
Dicranota:	cranefly
Dina:	leech, bloodsucker
Diptera:	two-winged fly order
Dixa:	dixa-midge
Dixidae:	family of dixa-midges
Dobsonflies:	member of the order Neuroptera
Dubiraphia:	beetle
Dytiscidae:	beetle family
Dytiscus:	beetle

Ectopria:	water penny
Eiseniella	aquatic earthworm
Elmidae:	family of beetles
Enallagma:	damselfly
Ephemera:	mayfly
Ephemerella:	mayfly
Ephemerellidae:	family of mayflies
Ephemeridae:	family of mayflies
Ephemeroptera:	order of mayflies
Ephoron:	mayfly
Eriocera:	cranefly
Erpobdella:	leech
Erpobdellidae:	family of leeches
Ferrissia:	snail
Gammarus:	amphipod
Gastropoda:	clans of molluscs
Gerridae:	water striders family
Gerris:	water strider
Glossophonia:	leech
Goera:	caddisfly
Goeridae:	family of caddisflies
Gomphus:	dragonfly
Gyrinidae:	beetle family
Habrophlebia:	mayfly
Habrophlebiodes:	family of mayflies
Haliplidae:	family of beetles
Haliplus:	beetle
Helicopsyche:	caddisfly
Helicopsychidae:	caddisfly family
Helisoma:	snail
Hellgrammites:	dobsonflies, alderflies, spongilla flies
Helobdella:	leech
Helodidae:	beetle family
Hemerodromia:	long-legged flies
Hemiptera:	true bugs
Heptagenia:	mayfly
Heptageniidae:	family mayfly
Hexagenia:	mayfly
Hirudinea:	order of leeches
Hyalella:	amphipod, side swimmer
Hydrobius:	beetle
Hydrophilidae:	family of beetles
Hydrophilus:	beetle
Hydropsyche:	caddisfly
Hydropsychidae:	family of caddisflies
Hydroptilidae:	family of caddisflies

Ilybius:	beetle
Ischnura:	damselfly
Isonychia:	mayfly
Isoperla:	stonefly
Isopoda:	aquatic sowbug order
Lampsilis:	clam
Lasmigona:	snail
Leptocella:	caddisfly
Leptoceridae	family of caddisflies
Leptocercus:	caddisfly
Leuctra:	stonefly.
Libellula:	dragonfly
Limnephilidae:	caddisfly family
Limnephilus:	caddisfly
Limnophila:.	cranefly
Limnophora:	anthomyiids
Lirceus:	isopod
Lumbriculidae:	aquatic earthworm family
Lutrochus:	beetle.
Lymnaea:	snail
Marqaritifera:	clam
Maruina:	moth fly
Mesovelia:	water treader
Mesoveliidae:	water treader family
Micrasema:	caddisfly
Molanna:	caddisfly
Mollusca:	snails and clam order
Mooreobdella:	leech
Naididae:	aquatic earthworms
Nemoura:	stonefly
Neoperla:	stonefly
Neophylax:	caddisfly
Neuroptera:	dobsonflies, fishflies, spongilla flies
Noteridae:	beetle family
Notonecta:	back swimmers
Nymphs:	a young stage of insect with an incomplete Metamorphosis
Nymphula:	aquatic caterpillar
Ochrotrichia:	caddisfly
Odonata:	order of damselflies & dragonflies
Oecetis:	caddisfly
Oligochaeta:	order of round worms
Optioservus:	beetle
Orconectes:	crayfish genus
Orthotrichia:	caddisfly

Pedicia:	cranefly
Pelecypoda:	mollusca class of bivalves
Pericoma:	cranefly
Phasganophora:	stonefly
Phryganea:	caddisfly
Phryganeidae:	family of caddisflies
Physa:	snail
Pisidium:	clam
Placobdella:	leech
Plecoptera:	order of stoneflies
Promoresia:	beetle
Psephenidae:	family of water pennies
Psephenus:	water penny
Psychoda:	moth fly
Psychodidae:	moth fly family
Ptilodactylidae:	beetle .family
Pupae:	intermediate stage between larva and adult
Pycnopsyche:	caddisfly
Ranatra:	water scorpions
Rhagionidae:	snipe fly family
Rhyacophila:	caddisfly
Rhyacophilidae:	caddisfly family
Sericostoma:	caddisfly
Sericostomatidae:	caddisfly family
Setodes:	caddisfly
Sialidae:	dobsonfly family
Sialis:	dobsonfly
Simuliidae:	blackfly family
Siphlonuridae:	mayfly family
Siphlonurus:	mayfly
Sphaerium:	clam
Springtails:	Collembola
Stenelmis:	beetle
Stoneflies:	Plecoptera
Stratiomyidae:	soldier flies family
Tabanidae:	horsefly family
Tabanus:	horsefly
Taeniopteryx:	stonefly
Tipula:	cranefly
Tipulidae:	cranefly family
Triaenodes:	caddisfly
Trichoptera:	caddisfly order.
Tricladida:	flat worms

Tricorythodes:	mayfly
Tubifera:	aquatic fly
Tubifex:	sludge worm
Tubificidae:	sludge worm family
Unionidae:	clams
Valvata:	snail
Viviparus:	snail