# BIOLOGICAL SURVEY
# OF THE
# UPPER CREDIT RIVER

## 1965

ONTARIO WATER RESOURCES COMMISSION

# BIOLOGICAL SURVEY of the UPPER CREDIT RIVER

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by

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## INTRODUCTION

A biological survey of the upper Credit River was carried out in August, 1965, to supplement data collected during the course of an assimilation study in late July, 1965, by the Water Quality Surveys Branch, Sanitary Engineering Division.

Examination of fish and fish-food organisms was particularly appropriate in this stream because of its extensive use and value for the snort fishery which it supports. In addition, the whole Credit watershed and the upper reaches in particular rank high among the scenic areas of Southern Ontario. Several parks have been developed, mainly by the Credit Valley Conservation Authority, and certainly many more will be developed in the years to come. Plans have been prepared for the development of several multiple-use reservoirs, two of which will be developed above the Forks, one north of Orangeville and one north of Cataract, on the main branch.

The importance of water of good quality is apparent, and, to this end, biological parameters are useful in assessing water quality. Most of the changes in water quality which adversely alter the amenities of lake or stream, such as deoxygenation, toxicity and other factors, are associated with changes in the plant and animal communities. The degree of upset of the biological balance reflects the extent to which properties of the water have been changed.

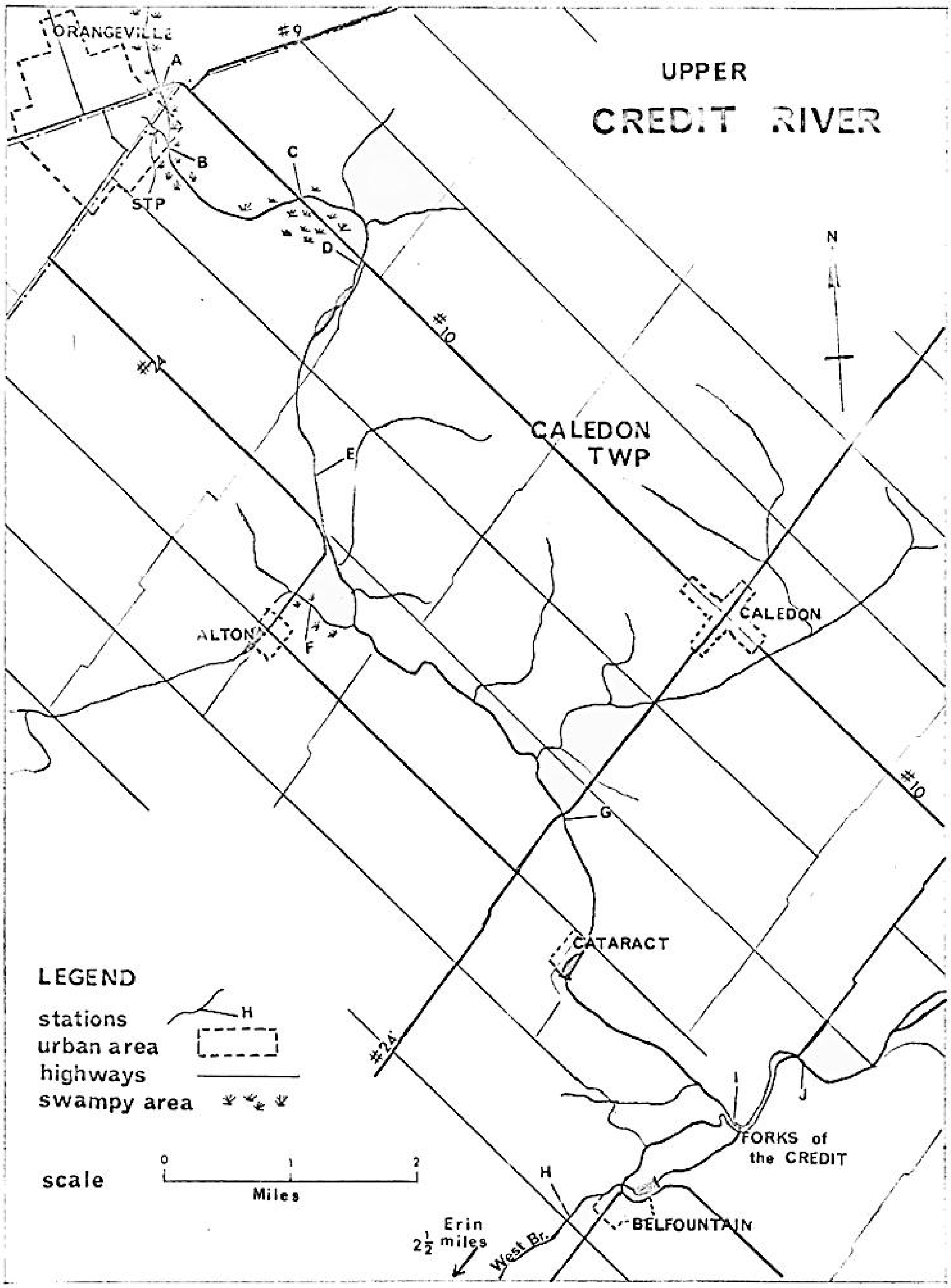
## DESCRIPTION OF THE UPPER CREDIT

The main branch of the Credit River rises in the swamps among sandy and gravelly hills and terraces a few miles north of Orangeville (Figure 1). The stream gradient between Orangeville and 1 mile north of Cataract is only 11 feet per mile. Consequently, this stretch of 9 miles was composed mainly of silted pools. The stream at Stations A, B and C was 12 to 30 feet wide, 2 to 4 feet deep and the current velocity was approximately ¼ foot per second. At Stations D, E and G the stream was of similar width but only about one-half as deep and, of course, the velocity was greater, between 1½ and 2 feet per second.

The first tributary of importance drains the land surrounding Caledon Lake and flows through Alton to join the main branch 1 mile downstream. Station F was located between Alton and the main branch and the Alton branch at that point was similar to the Credit River at Stations A, B and C.

The west branch of the Credit rises in swamps near Hillsburgh and flows through Erin and Belfountain where it meets the main branch at the scenic Forks of the Credit. Station H, located ½ mile west of Belfountain was similar to Station G.

Stations I and J were located at the forks and about 1 mile downstream respectively. At the time of the survey the stream was 45 feet wide, about ½ foot deep and rapidly flowing. The stream gradient of each branch was 100 feet per mile above the forks and 35 feet per mile below.


UPPER
CREDIT RIVER
ORANGEVILLE
#9
A
B
C
STP
D
#10
#24
N
CALEDON
TWP
E
ALTON
F
CALEDON
G
#10
CATARACT
LEGEND
stations
H
urban area
highways
swampy area
scale
0
1
2
Miles
#24
I
J
FORKS of
the CREDIT
H
BELFOUNTAIN
Erin
2½ miles
West Br.

Therefore, the area of study included the main and west branches of the upper Credit, both of which cross wide and swampy spillways and drop from the crest of the Niagara escarpment in spectacular falls and rapids at Cataract and Belfountain, joining at the Forks. However, most attention was focused on the main branch which receives wastes from the town of Orangeville.

The treatment plant at Orangeville serves about 5000 residents and several industries. It was built in 1952, enlarged in 1960 to a capacity of 0.75 mgd, but only one-sixth of the wastes receive secondary treatment at present. However, all wastes receive primary treatment and the mixed primary-secondary effluent is chlorinated.

Alton and Erin are smaller communities, have no central treatment of wastes, but, apparently, have not created problems in receiving streams. Nevertheless, both receiving streams were examined to determine what effect, if any, Erin and Alton may have had on them.

## METHODS

Sampling of invertebrate and fish communities was carried out at 10 stations - one above Orangeville, 5 downstream to the Forks, one on each stream below Erin and Alton and two at and just below the Forks (Figure 1).

Bottom fauna and fish were sampled as follows:

<u>Bottom fauna</u>

One or two collections each consisting of 20 minutes of effort in all common habitats with a 20-mesh (per inch) sieve was made at each station. One collection was made where the habitat was entirely pool or riffles but, where both pools and riffles were found, two separate collections were made. However, only one collection from each station was selected for use in making comparisons among stations.

Fish

One general collection was made at each station. The catch in several seine hauls provided data on the common species at each station and their relative abundance. Trout were returned to the streams.

## BIOLOGICAL ASSESSMENT OF WATER QUALITY

The effluent from the Orangeville sewage treatment plant comprised approximately one-tenth of the flow in the upper Credit at the time of the survey. The bottom fauna community was composed mainly of tolerant sludgeworms and midges at Station B located ½ mile below the plant. However, one species each of moderately intolerant damselfly and mayfly also were present. The bottom fauna community was similar at Stations C and D, although damselflies and mayflies were not found at Station C and one amphipod was collected. Table 1 illustrates the similarity of Stations B, C, D, and Provides a comparison with Station A located above the treatment plant outfall. The main difference noted above and below the outfall was in the respective small and large numbers of sludgeworms and midges. Because of its level gradient and sluggish nature the stream supports only a limited number of invertebrate species between Stations A and D. However, excessive organic enrichment was evident from the outfall to Station D, with little evidence of improvement through that particular stretch of river.

**Table 1.** Numbers of animals collected of the common groups of invertebrates arranged in order of decreasing tolerance to organic pollution. Station A was located upstream from the Orangeville sewage treatment plant and the others were located in sequence on the main branch downstream to the Forks.

<-------------- increasing tolerance ------------------------------------ decreasing tolerance -------------------->

| Station | Tubificids | Midges | Leeches | Beetles | Dragonflies Damselflies | Amphipods | Caddisflies | Mayflies | Stoneflies |
|---|---|---|---|---|---|---|---|---|---|
| A | 0 | 2 | 1 | 0 | 10 | 3 | 1 | 1 | 0 |
| B | 280 | 362 | 3 | 21 | 15 | 0 | 0 | 2 | 0 |
| C | 14 | 526 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| D | 24 | 333 | 4 | 44 | 24 | 0 | 0 | 12 | 0 |
| E | 1 | 20 | 5 | 0 | 0 | 13 | 39 | 8 | 0 |
| G | 2 | 63 | 0 | 0 | 0 | 0 | 114 | 577 | 2 |
| I | 0 | 55 | 0 | 1 | 0 | 1 | 188 | 106 | 0 |
| J | 0 | 7 | 0 | 0 | 0 | 2 | 8 | 4 | 3 |

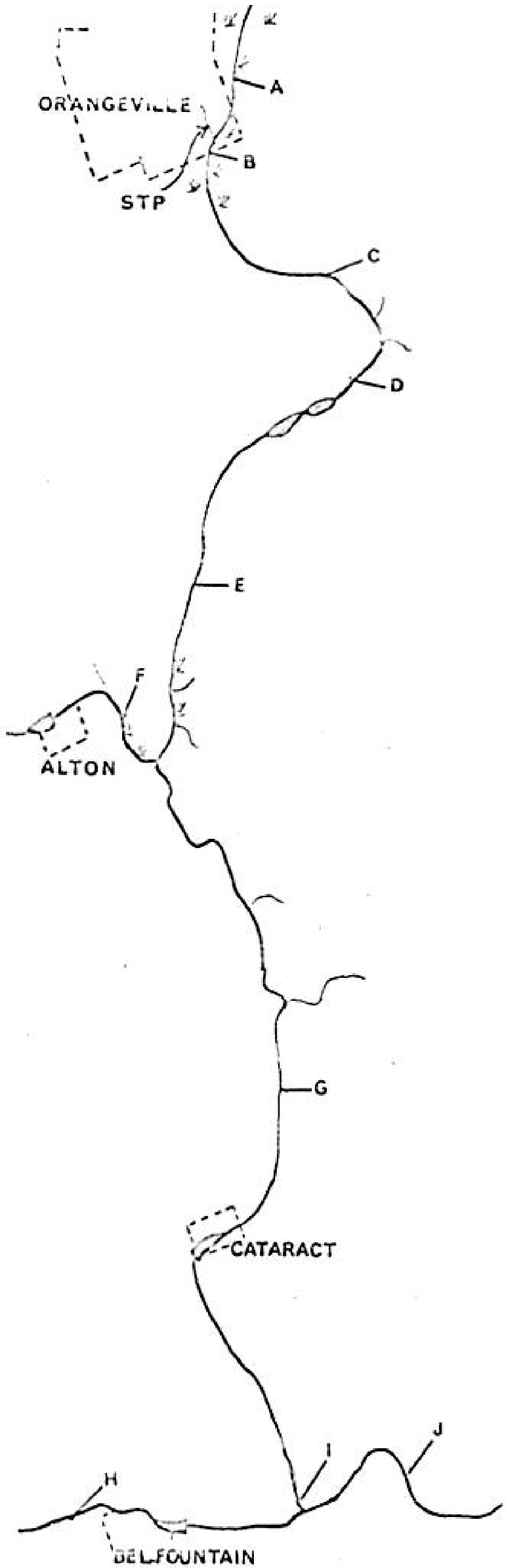
* larvae beetles only

A marked improvement in water quality was indicated at Station E below the Orangeville Golf Course pond shown in Figure 1. Mayflies, caddisflies and amphipods were numerous while sludgeworms and midges were very much reduced (Table 1). The increase in stream gradient and occurrence of riffle areas was mainly responsible for the change in bottom fauna. However, the character of the bottom fauna at Station E indicated good water quality over the past several months.

Collections at Stations G, I and J further downstream included a variety of intolerant species of caddisflies, mayflies and stoneflies and indicated good water quality.

The number of bottom fauna forms and number of individuals collected at each station on the main branch are shown in Figure 2. The temporary reduction in number of forms below the outfall and downstream recovery is evident.

Differences in bottom fauna among the stations on the main branch may be compared with differences in several chemical parameters of water quality used by the Water Quality Surveys Branch, particularly dissolved oxygen. The concentration of dissolved oxygen was low at Stations G and D in comparison with Station A (Table 2). A low level of 0.8 ppm was found during the pre-dawn hours and the average concentration was depressed also. Oxygen levels were greater one mile above Station E and were quite satisfactory ½ mile below. BOD decreased over the same stretch of stream from Station C to Station E, as did all of the nitrogen and phosphorus fractions which were measured.



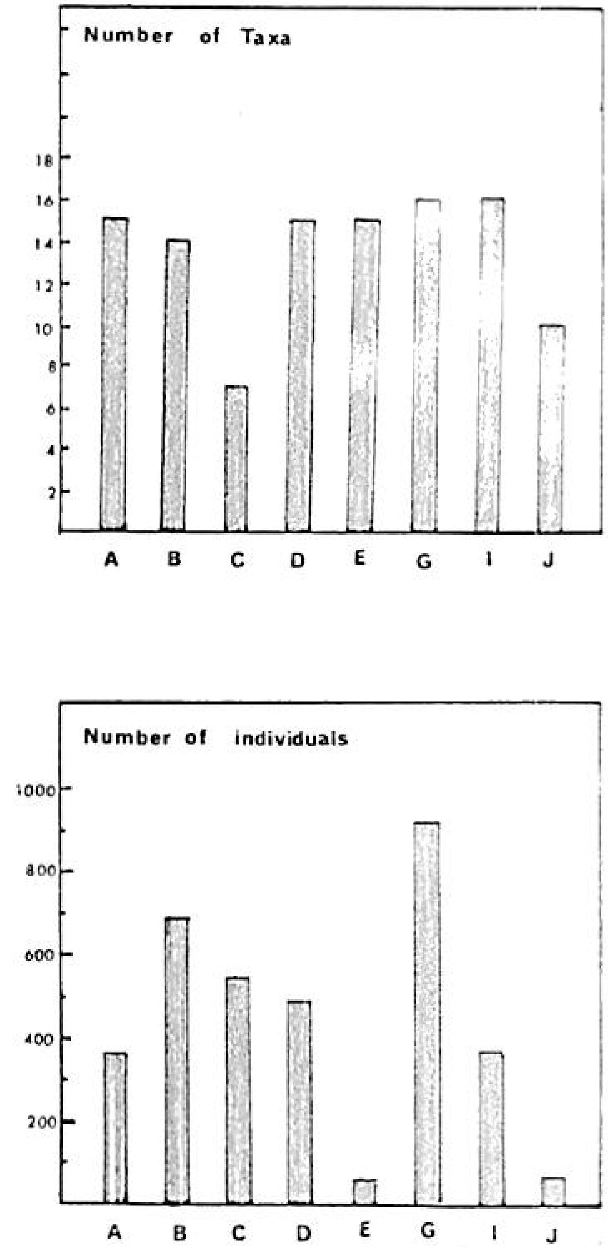




Fig. 2. Number of taxa ( genera except families in the case of midges, sludge-worms, and corixids ) and individuals collected from the bottom fauna at eight stations on the upper Credit River in August, 1965.

**Table 2.** Chemical characteristics of water in the Upper Credit River during the period July 26 to 28, 1965. Data on solids, phosphorus and nitrogen fractions are means of four analyses; data on dissolved oxygen and BOD are means of 12 observations. All data were provided by the Water Quality Surveys Branch.

| Station* | Dissolved Oxygen | | | Biochemical oxygen demand | Solids | | Phosphorus | | Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Mean | | Susp. | diss. | Sol. | total | $NH_3$ | TKN | $NO_2$ | $NO_3$ |
| I (A) | 4.0 | 10.7 | 6.5 | 1.3 | 16 | 335 | 0.2 | 0.2 | 0.1 | 0.5 | - | 0.19 |
| 4 (C) | 0.8 | 4.4 | 1.8 | 2.8 | 10 | 430 | 4.1 | 6.2 | 2.1 | 3.0 | 0.02 | 0.15 |
| 5 (D) | 0.8 | 10.6 | 4.7 | 4.6 | 21 | 368 | 2.9 | 3.6 | 0.2 | 1.4 | 0.03 | 0.69 |
| 6 (1 mi. above E) | 5.8 | 18.0 | 8.4 | 3.7 | 21 | 349 | 2.5 | 3.3 | 0.3 | 0.9 | 0.02 | 0.23 |
| 7 (½ mi. below E) | 5.6 | 12.8 | 8.7 | 3.1 | 46 | 350 | 1.9 | 2.6 | 0.1 | 0.9 | 0.01 | 0.19 |

* Water Quality Surveys Branch stations with Biological survey stations in parentheses.

The levels of nutrients, phosphorus and nitrogen, were initially quite great and were reduced during passage downstream, but the effects of enrichment were evident in large standing crops of bottom animals notably at Stations G and I.

A variety of invertebrates was collected at Station F below Alton on the Alton branch tributary to the upper Credit. The presence of several intolerant and moderately intolerant forms provided evidence that pollution from Alton, if any, must be quite limited in amount and effect. Similarly, the collection at Station H demonstrated that the west branch of the upper Credit was in excellent condition below Erin.

Qualitative collections of fish add further to the biological assessment of water quality in the upper Credit River. The stream north of Orangeville had a fish population of a limited number of species adapted to this sluggish, bog-stream habitat including the mud minnow, redbelly dace, brook stickleback, blacknose shiner and white sucker. No fish were taken at Station B, possibly because of the low average concentration of dissolved oxygen of 1.8 ppm. Further downstream at Stations C and D most of the above species were collected. The mud minnow, redbelly dace and sucker are among the fish most tolerant of organic contamination. The white sucker was particularly abundant probably because of the large population of midge larvae there.

The composition of the fish population was quite different in the more rapid waters at Station E and downstream to Station J. The creek chub, blacknose dace longnose dace and white sucker were abundant. The dace are probably only moderately tolerant of organic contamination. Several brook trout were netted and returned to the water at Station G. The number of species of fish and number of individuals collected at each station on the main branch are illustrated in Figure 3.

Fish populations on the Alton branch and west branch appeared to be quite normal. Trout were observed at Station H.

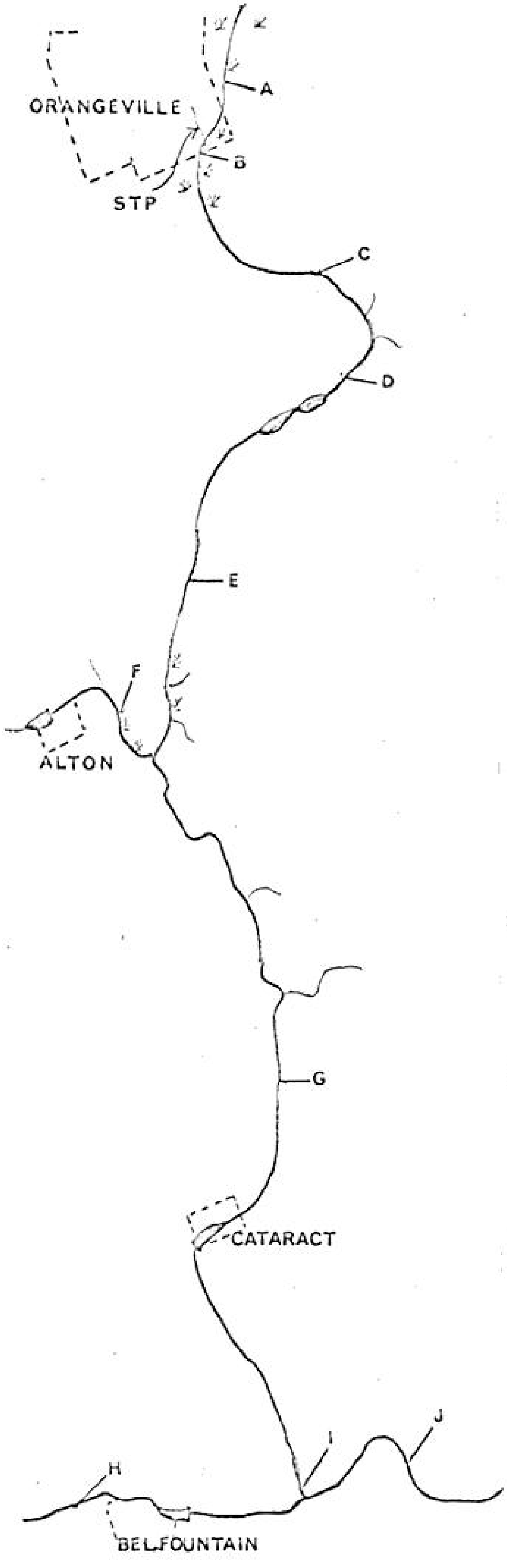
## CONCLUSIONS

Bottom fauna and fish communities both indicated moderate impairment of water quality at Stations B, C and D. Organic enrichment produced large populations of tolerant species. No evidence of any directly toxic waste component was indicated.

Considerable improvement in water quality was indicated at Station E. Apparently the detention time in the upper slow-moving part of the river and in the pond is sufficient to provide for nearly complete recovery from contamination with organic wastes at Orangeville.

Water of reasonably good quality was indicated at Stations E and G. Dissolved oxygen was in ample supply during both daytime and nighttime periods. Enrichment by inorganic materials such as nitrogen and phosphorus did not appear to have any deleterious effects on the aquatic communities downstream from Station E. On the contrary, the degree of enrichment appeared to be beneficial because large standing crops of valuable fish-food organisms were produced. Brook trout were present at Station G.

No impairment whatsoever was evident at the Forks of the Credit, and the Alton and west branches of the upper Credit appeared to be quite satisfactory.



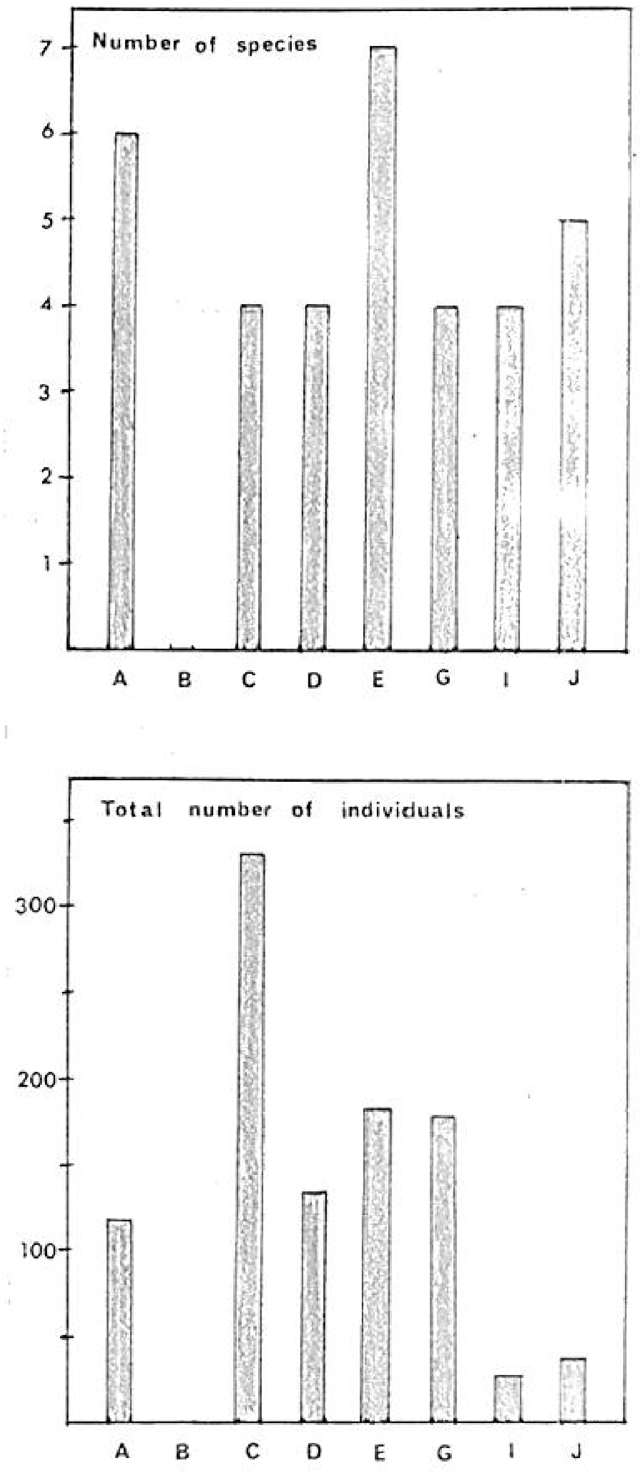




Fig. 3. Number of species and number of individual fish collected at eight stations on the upper Credit River in August, 1965.

Some improvement to treatment facilities in Orangeville, particularly by expanding the secondary treatment capacity of the plant, would result in more satisfactory conditions for fish between Orangeville and the Orangeville Golf Course pond. Probably no changes would occur further downstream. The proposed multi-purpose reservoir to be constructed at Cataract will receive considerable inorganic enrichment, but, considering the present population of Orangeville and the relatively large area of the recreation lake, about 160 acres, no serious aquatic nuisance problems are foreseen.

However, water quality in the lake should be examined following construction of the Cataract dam, and such studies may indicate the advisability of additional waste treatment, for example, nutrient removal, at Orangeville. The value of the Credit River to the well being of the population of the expanding metropolitan area in south-central Ontario should be maintained. Good water quality is of utmost importance in this connection.

Report approved by

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D. Pugh, G. Westlake, D. Osmond and R. Hunsinger took part in the field survey.

## APPENDIX

**Table 1.** Specimens collected at 10 stations on the Upper Credit River, Collecting methods are outlined in the text of the text of the report.

| | | STATIONS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Class | | A | B | C | D1 | D2 | E1 | E2 | F | G1 | G2 | H1 | H2 | I | J |
| STONEFLIES | *Togoperla* | | | | | | | | | 2 | | | 4 | | 3 |
| | *Leuctra* | | | | | | | | | | | | 2 | | |
| | *Acroneuria* | | | | | | | | | | | | 4 | 1 | |
| | *Neophasganophora* | | | | | | | | | | | | 5 | | |
| MAYFLIES | *Callibaetis* | 1 | 2 | | 11 | 2 | 27 | | 9 | | 6 | 2 | | | 1 |
| | *Baetis* | | | | | | | 5 | | 530 | 20 | | 65 | 89 | |
| | *Caenis* | | | | 1 | | | | 1 | | | | 22 | | |
| | *Tricorythodes* | | | | | | 1 | 2 | | 12 | 6 | 12 | 7 | 5 | |
| | *Stenonema* | | | | | | | 1 | | 20 | | | | 8 | 2 |
| | *Isonychia* | | | | | | | | | 11 | | | | 1 | |
| | *Heptagenia* | | | | | | | | | 4 | | | 2 | | 1 |
| | *Ephemerella* | | | | | | | | | | | | 8 | 3 | |
| | *Paraleptophlebia* | | | | | | | | | | | | | | |
| CADDISFLIES | *Cheumatopsyche* | 1 | | | | | | 39 | | 41 | | | 1 | 21 | 3 |
| | *Hydroysyche* | | | | | | | | | 71 | | | 2 | 161 | 4 |
| | *Hydroptila* | | | | | | | | | 2 | | | | 1 | |
| | *Sortosa* | | | | | | | | | | | | 30 | 4 | |
| | *Rhyacophila* | | | | | | | | | | | | 7 | | |
| | *Glossosoma* | | | | | | | | | | | | 12 | 1 | |
| | *Pycnopsyche* (pupa) | | | | | | | | | | 1 | | | | 1 |
| | *Oecetis* | | | | | | | | | | | | 1 | | |

continued ........

## **APPENDIX A** (continued)

| General Class | | A | B | C | D1 | D2 | E1 | E2 | F | G1 | G2 | H1 | H2 | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRAGON FLIES | *Anax* | | | | 1 | | | | | | | | | | |
| | *Aeshna* | | | | | | | | 1 | | | | | | |
| | *Basiaeschna* | | | | | | 1 | | | | | | | | |
| DAMSELFLIES | *Ischnura* | 10 | 15 | | 24 | | 13 | | 19 | | | | | | |
| | *Enallagma* | | | | | | 1 | | 1 | | | | | | |
| | *Agrion* | | | | | | | | 1 | | | | | | |
| FLIES | Tendipedidae | 2 | 362 | 526 | 333 | 580 | 4 | 20 | 7 | 63 | 41 | 7 | 19 | 55 | 7 |
| | Ephydridae | | | 1 | | | | | | | | | | | |
| | *Dixa* | 2 | | | | | | | 3 | | | | | | |
| | *Eulalia* | | | 1 | 1 | | | | | | | | | | |
| | *Stratiomys* | | | | | | | | 1 | | | | | | |
| | *Atherix* | | | | | | | | | 4 | | | | | |
| | *Simulium* | | | | 2 | 1520 | 1 | | | 127 | | | | 1 | |
| | *Chrysops* | | | | | | | | 1 | | | | | | |
| | Unidentified Larva | | 1 | | | | | | | | | | | | |
| FISHFLIES | *Sialis* | | | | | | | 1 | | | | 1 | | | |
| | *Chauliodes* | | | | | | | | | | | | 2 | | |
| BEETLES | *Rhantus* | | 9 | | | | | | | | | | | | |
| | *Agabinus* | | 3 | | 10 | | | | | | | | | | |
| | *Hydroporus* | | 3 | | | | | | | | | | | | |
| | *Laccophilus* | | 3 | | | | | | | | | | | | |
| | *Enochrus* | | 3 | | | | | | | | | | | | |
| | *Galerucella* | | | 1 | | | | | | | | | | | |
| | *Haliplus* | | | | 34 | 1 | | | | | | | | | |
| | *Pomoresia* | | | | | | | | | | | | 2 | | |
| | *Stenelmis* | | | | | | | | | | | | 1 | | |
| | *Paracymus* | | | | | | | | | | | | | 1 | |
| | Unidentified Adults | 16 | 32 | 13 | 3 | | 16 | 2 | 3 | 1 | 1 | | 12 | 2 | |

**APPENDIX A** (continued)

| General Class | | A | B | C | D1 | D2 | E1 | E2 | F | G1 | G2 | H1 | H2 | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUGS | *Ranatra* | 1 | | | | | | | | | | | | | |
| | Corixidae | 11 | | | 33 | 1 | 26 | 1 | 4 | 2 | 337 | 197 | | | 11 |
| | *Lethocerus* | 2 | | | | | | | | | | | | | |
| | *Trepobates* | 1 | | | | | | | 3 | | | | | | |
| | *Belostoma* | | | | | | | | 1 | | | | | | |
| | *Gerris* | | | | | | | | | | | 1 | | | |
| ISOPODS | *Asellus* | | | | | | 2 | 4 | | | 14 | | | | |
| AMPHIPODS | *Hyallela* | 3 | | 1 | | | 105 | 13 | 9 | | 28 | | | | |
| | *Gammarus* | | | | | | | | | | | | | 1 | 2 |
| LEECHES | *Helobdella* | | | | 1 | | | 2 | | | | | | | |
| | *Glossiphonia* | | 3 | | 1 | | | 1 | | | | | | | |
| | Unidentified genus A | 1 | | | | | | | | | | | | | |
| | Unidentified genus B | | | | 2 | | | | | | | | | | |
| | Unidentified genus C | | | | | 15 | | 2 | | | | | | | |
| MOLLUSCS | *Physa* | 86 | 1 | 19 | 15 | 1 | | 1 | 23 | 1 | 36 | | | 1 | |
| | *Helisoma* | 306 | 2 | | | 3 | 1 | | 7 | 1 | | | | | |
| | *Lymnaea* | 2 | | | | | | | | | | | | | |
| | *Gyraulus* | 40 | 1 | | | | | | | | | | | | |
| | *Sphaerium* | | | | | | 1 | | | | | | | | |
| SLUDGEWORMS | Unidentified | | 280 | 14 | 24 | | 11 | 1 | 1 | 2 | 16 | | 1 | | |

## APPENDIX

**Table 2.** Catches of fish made by seining at 10 stations on the Upper Credit River in August, 1965. All available habitats within a length of approximately 250 feet were examined at each station.

| | Stations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | A | B | C | D | E | F | G | H | I | J |
| Brook trout | | | | | | | 5 | 4 | | |
| Central mud minnow | 3 | | | | | | | | | |
| White sucker | 7 | | 243 | 98 | 47 | 1 | 61 | | 6 | 4 |
| Pearl dace | | | | | | 1 | | | | |
| Redbelly dace | 10 | | 82 | 2 | 7 | | | | | |
| Blacknose dace | | | | 2 | 39 | 1 | 36 | 15 | 1 | 5 |
| Longnose dace | | | | | 84 | | 76 | 33 | 18 | 19 |
| Creek chub | | | | | 8 | 4 | | | | 6 |
| Blacknose shiner | 98 | | 7 | | | | | | | |
| Fathead minnow | | | | | 2 | | | | | |
| Brook stickleback | 8 | | 4 | 36 | 2 | | | | | |
| Rainbow darter | 1 | | | | | | | | | |
| Mottled sculpin | | | | | | | | | 1 | 2 |
| Total fish | 117 | 0 | 336 | 138 | 189 | 7 | 178 | 52 | 26 | 36 |
| Total species 13 | 6 | 0 | 4 | 4 | 7 | 4 | 4 | 3 | 4 | 5 |