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A BIOLOGICAL ASSESSMENT OF THE THOMPSON RIVER SYSTEM DURING THE LOW FLOW PERIOD OF APRIL, 1973

SURVEILLANCE REPORT EPS 5-PR-73-9

PACIFIC REGION

A BIOLOGICAL ASSESSMENT OF THE THOMPSON RIVER SYSTEM DURING THE LOW FLOW PERIOD OF APRIL, 1973

by

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Pollution Abatement Branch

Environmental Protection Service

Department of Environment

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Mr. Don Holmes of the Kamloops District office of the Pollution Control Branch and Mr. John Cartwright of the Kamloops office of the B.C. Fish and Wildlife Branch were responsible for the collection of the biological samples.

The organisms within the samples were identified and counted by Mr. Russ Hilland[1], Miss Linda Thorson and Miss Jane Lee of the Fresh Water Biology Laboratory of the Environmental Protection Service, Environment Canada.

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1. INTRODUCTION

A joint Federal-Provincial Interagency task force issued a preliminary report, "A Preliminary Report On Sources and Effects of Colour, Foam, and Algal Growth In The Thompson River System", in May 1973. The report included all the chemical analyses and a cursory look at the biology of the Thompson River System.

This report is an addendum to the above mentioned report and gives a more detailed look at the biology. However, the biological samples only show the conditions as they were during low water for one particular year and as the original report states, a detailed sampling program will have to be conducted to fully understand the system.

2. SAMPLE LOCATIONS AND SAMPLING PROCCEDURES

2.1 Kamloops Lake Plankton

Three sites were used on Kamloops Lake for the lake sampling (Cherry Bluff, Station "G"; Painted Bluff, Station "D"; and West End, Station "E"). All sites are referred to in Wards (1964) study of the lake (Fig. 1). Only one sample at each station was obtained.

The zooplankton samples were collected by 30.5 meter vertical hauls with a Wisconsin sample net. The samples were preserved in 10% formalin. For identificiation and counts the samples were subsampled by splitting the samples in two and counting both subsamples. However, for the West End Haul the sample was split into 4 subsamples, two of which were counted.

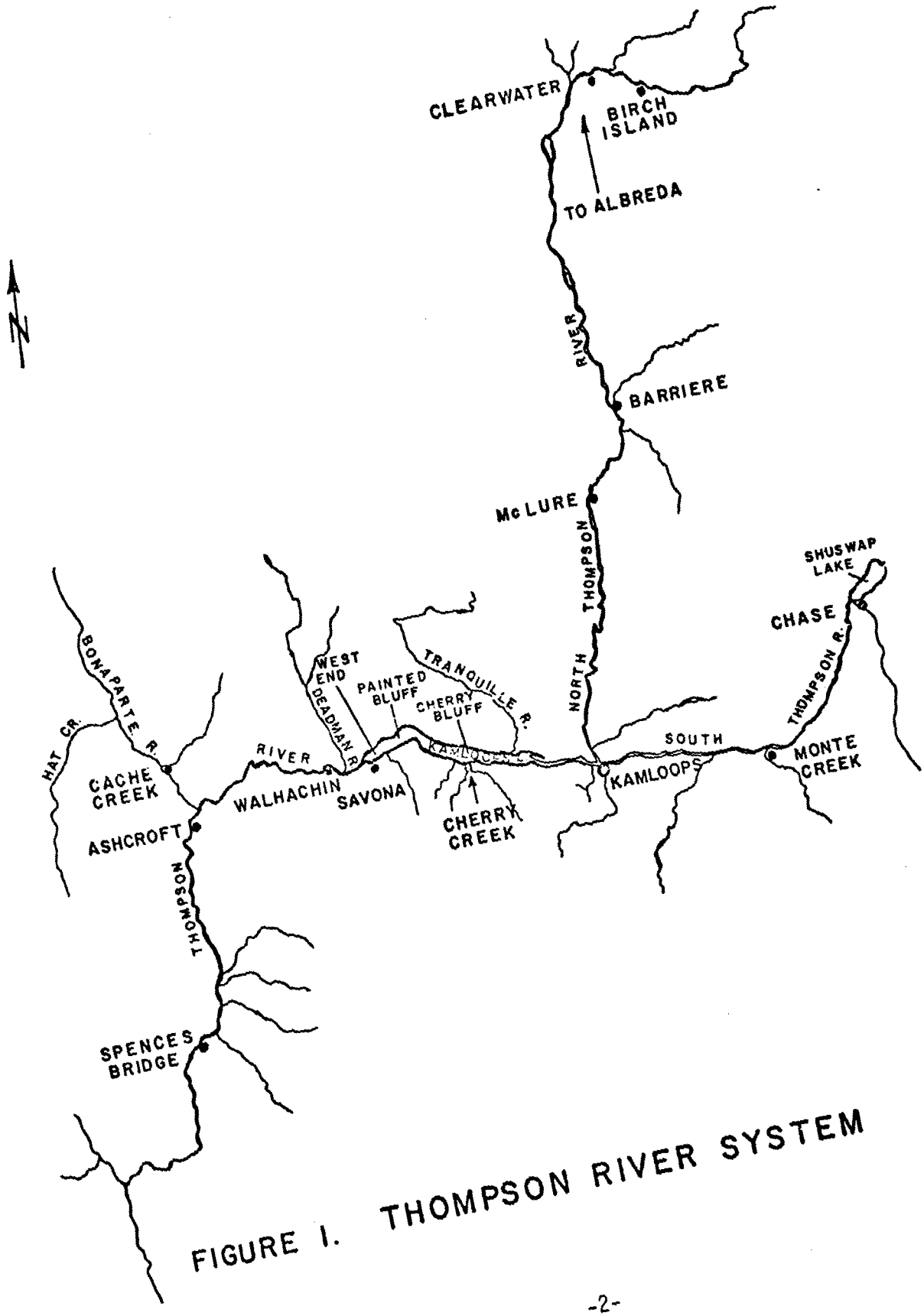

FIGURE 1. THOMPSON RIVER SYSTEM

The phytoplankton samples for the lake were collected at 30.5 meters in depth and at the surface with a 4 litre Van Dorn sampler. A 154 ml subsample was then taken and preserved with Lugal's solution.

2.2 Thompson River Algae and Benthic Fauna

Five river sampling stations were selected (Table 1 and Fig. 1).

Table I: Sample locations on the Thompson River System:

(1)	North Thompson at Albreda: 11.4 miles north of Blue River Bridge on Highway 5; 200 yards downstream of Bone Creek Forest Road Bridge on west shore.
(2)	North Thompson at McClure:- 200 yards downstream of McClure Ferry on Westsyde Road; west shore.
(3)	South Thompson at Chase:- 100 yards downstream of Chase Bridge; on south shore.
(4)	Thompson River at Savona:- at Steelhead Park below Savona Bridge; on east shore.
(5)	Thompson River at Walhachin:- 100 yards downstream of old CNR train station; on south shore.

All bottom fauna and attached algae samples were obtained in similiar ecological areas with the substrate consisting of fine rubble and some boulders in riffle areas of moderate flow with

the water depth approximately 1 1/2 - 3 ft.

For the bottom fauna, two sets at each station were sampled with a 1 square foot Surber sampler. At each site three Surber samples were taken and the organisms preserved in 10% formalin.

For the algae samples, rock scrapings were taken and preserved in Lugal's solution. No attempt was made to obtain a quantitative sample. In order to determine the diversity of organisms present at each station, a count was made using prepared slides and a 10 cm counting chamber.

3. RESULTS

3.1 Kamloops Lake Zooplankton

The west end of the lake near Savona showed the largest number of zooplankton with Copepoda being the greatest in abundance. However, there were a large number of nauplii present at all stations (Table II).

Table II: Relative abundance of zooplankton in Kamloops Lake (100 foot wisconsin haul, April, 1973)

Number/Litre/Lake Station

Species	West End	Painted Bluff	Cherry Bluff
COPEPODA			
Diaptomus aschlandi	.523	.224	.361
Cyclops biscupidatus thomasi	.121	.056	.444
CLADOCERA			
Daphnia longispina	.016	.007	.017
Bosmina longirostris	.011	.007	.042
nauplius	1.405	.774	1.301

3.2 Kamloops Lake Phytoplankton

Several species of algae dominated all the samples. *Melosira italica* and *Tabellaria fenestrata* were consistently abundant in the surface samples, while *Asterionella formosa* and species of *Fragilaria* were prominent in the 100 foot samples. *Fragilaria vaucheriae* was the most dominate at the surface at Painted Bluff. (Table III)

The greatest variety of species occurred at the Painted Bluff sample site and the least at the West End site. All counts indicated a fairly stable abundance of algae. Of these cells the Bacillariophyceas (or diatoms) comprised nearly the entire phytoplankton.

TABLE III

KAMLOOPS LAKE PHYTOPLANKTON

(Sampled with Van Dorn water bottle)

(a) WEST END, APRIL 18/73

SURFACE

SPECIES	COUNT/10 ccm
Melosira italica	1230
Tabellaria fenestrata	1098
Asterionella formosa	408
Melosira ambigua	216
Melosira distans	252
Stephanodiscus astrea	36
Synedra tenera	30
Cymbella turgida	18
Achnanthes minutissima	6
Cymbella cistula	6
Hannaea arcus	6
Navicula sp.	6
Nitzschia spectabilis	6
Chlamydomonas sp.	6

TABLE III (cont'd)

KAMLOOPS LAKE PHYTOPLANKTON

(b) PAINTED BLUFF, APRIL 18/73

SURFACE		100 FT.	
SPECIES	COUNT/10 ccm	SPECIES	COUNT/10 ccm
Fragilaria vaucheriae	4304	Cymbella cistula	8532
Gomphonema olivaceum	1883	Fragilaria vaucheriae	4842
Diatoma tenue var. elongatum	1614	Gomphonema olivaceum	3497
Achnanthes minutissima	1614	Asterionella formosa	2152
Hannaea arcus	1614	Achnanthes minutissima	1345
Cymbella turgida	1345	Cymbella turgida	1345
Tabellaria fenestrata	1345	Hannaea arcus	1345
Navicula sp. (I)	1076	Melosira italica	1158
Eunotia sp.	1076	Tabellaria fenestrata	1076
Nitzschia capitellata	807	Diatoma tenue var. elongatum	1076
Navicula pupula	807	Eunotia sp. (I)	1076
Cymbella cistula	654	Fragilaria construens	538
Melosira italica	642	Gomphonema sp.	538
Navicula sp. (II)	538	Nitzschia frustulum	538
Stauroneis sp.	538	Oscillatoria sp.	288
Achnanthes sp.	538	Eunotia sp. (II)	269
Asterionella formosa	294	Fragilaria crotonensis	269
Achnanthes c.f. lanceolata	269	Gomphonema c.f. major	269
Fragilaria construens	269	Nitzschia acicularis	269
Meridion circulare	269	Nitzschia capitellata	269
Navicula c.f. subcapitata	269	Nitzschia palea	269
Nitzschia acicularis	269	Melosira ambigua	165
Synedra amphicephala	269	Synedra tenera	51
Synedra pulchella	269	Stephanodiscus astrea	36
Oscillatoria sp.	246	Chlamydomonas sp.	3
Gomphonema lanceolata	3		
Gomphonema major	3		
Protozoan: Halteria sp.	3		

TABLE III (cont'd)

KAMLOOPS LAKE PHYTOPLANKTON

(c) CHERRY BLUFF APRIL 17-18/73

SURFACE		100 FT.	
SPECIES	COUNT/10 ccm	SPECIES	COUNT/10 ccm
Tabellaria fenestrata	5910	Fragilaria crotonensis	3228
Melosira italica	2160	Asterionella formosa	3192
Ulothrix sp.	720	Synedra tenera	2152
Melosira ambigua	600	Cymbella cistula	807
Asterionella formosa	120	Melosira italica	768
Cymbella turgida	90	Ulothrix sp.	696
Synedra tenera	90	Cymbella turgida	538
Achnanthes minutissima	60	Fragilaria vaucheriae	538
Hannaea arcus	60	Synedra ulna	538
Nitzschia subtilis	60	Tabellaria fenestrata	360
Synedra ulna	60	Achnanthes flexella	269
Achnanthes sp.	30	Cyclotella comta	269
Eunotia sp.	30	Diatoma tenue var. elongatum	269
Gomphonema geminatum	30	Gomphonema olivaceum	269
Gomphonema c.f. lanceolata	30	Hannaea arcus	269
Gomphonema sp.	30	Navicula sp.	269
Hannaea arcus var. amphioxys	30	Stephanodiscus astrea	269
Navicula c.f. lanceolata	30	Synedra pulchella	269
Nitzschia capitellata	30	Rhizosolenia sp.	192
Nitzschia pellucida	30		
Rhizosolenia sp.	30		
Stephanodiscus astrea	30		

3.3 River Benthic Fauna

The organisms were grouped according to their reported general resistance to pollution conditions (Servizi and Burkhalter, 1970). As stated by Servizi and Burkhalter these groupings are only used as a guideline to assess possible pollution.

The samples at McClure on the North Thompson River contained the largest number of organisms of all the sample sites, while Albreda contained the least number. (Table IV.). Diptera were the most common at each station. The greater number of Diptera in the North Thompson might partially be explained by the cold water temperature and thus later hatching time. The sample at Savona on the Thompson River had a smaller number of organisms than at Walhachin or Chase. However, this is based only on one sample site and that sample contained a large amount of detritus and algae from rock scrapings and was very difficult to process.

3.4 River Algae

No quantitative samples were taken for algae in the river. However, a greater abundance of algae was noted in the Thompson River below Kamloops Lake than above the lake. Few algae were found at Albreda on the North Thompson River.

Each sample was subsampled and counts were made in order to determine the species diversity at each station. (Table V). The Bacillariophycease (diatoms) far exceeded the Chlorophyceae (green algae) and Cyanophyceae (blue green algae) except at Savona, where the genus Ulothrix sp (Chlorophyceae) was the

TABLE IV

MACROINVERTEBRATE FROM THE THOMPSON RIVER
SPRING 1973

(Each sample contained 3-one square foot surber samples.)

STATION:	T.R. WALHACHIN		T.R.* SAVONA	S.T.R. CHASE		N.T.R. MCLURE		N.T.R. ALBREDA	
SAMPLE:	1	2	-	1	2	1	2	1	2
DATE:	9/4	9/4	9/4	5/4	5/4	4/4	4/4	4/4	4/4
Sensitive									
Plecoptera (stonefly)									
Nemouridae	3	6	5	25	61	18	17	29	21
Chloroperlidae	2	-	-	--	60	--	--	15	10
Leuctrinae	-	-	-	--	--	--	--	--	1
Perlidae	-	-	-	--	--	--	--	2	--
Ephemeroptera (mayfly)									
Baetidae	22	18	56	34	25	79	62	20	17
Heptageniidae	16	14	26	--	--	--	18	37	26
Trichoptera (caddisfly)									
Rhyacophilidae	60	44	3	27	7	52	17	2	--
Hydroptilidae	10	19	--	1	--	112	163	--	--
Hydropsychidae	156	97	1	1	33	29	10	--	--
Limnephilidae	1	3	1	--	--	4	2	--	--
Psychomiidae	1	7	1	3	6	8	8	2	4
Philopotamidae	---	2	--	--	--	---	2	--	--
Brachycentridae	---	--	--	--	--	18	2	--	--
Leptoceridae	---	--	--	--	--	7	8	--	--
Lepidostomatidae	---	--	--	--	--	---	11	--	--
Coleoptera	---	--	--	--	--	4	2	--	--
Faculative									
Diptera (two-wing fly)									
Tendipedidae	176	380	104	175	130	1414	447	4	11
Simuliidae	1	1	---	1	---	----	---	--	--
Dixidae	---	1	---	---	---	----	---	--	1
Heleidae	---	---	---	1	---	----	---	--	--
Tipulidae	---	---	---	---	---	----	1	1	--
Culicidae	---	---	---	---	---	----	1	--	--
Tabanidae	---	---	---	---	---	----	1	--	--
Tolerant									
Oligochaeta (worm)	---	---	---	2	1	1	4	1	1
Unclassified									
Hymenoptera (aquatic parasites)	---	---	---	---	2	----	---	--	--
Arthropoda (beetle)	---	---	---	---	---	7	12	--	--
Mollusca (clam)	---	---	---	---	---	----	1	--	--
	448	592	197	270	325	1753	789	113	92

*This sample contained scrapings from rocks and thus contained a large amount of debris and algae making it very difficult to cull out the invertebrates.

TABLE V

COMPOSITION OF ALGAE SAMPLES
TAKEN FROM ROCK SCRAPINGS
IN THE THOMPSON RIVERS
AT 5 LOCATIONS,
APRIL, 1973

(These are not quantitative samples and only show the diversity within each station.)

A. North Thompson River -- Albreda:

Bacillariophyceae

100,000/10 ccm	75,000
Achnanthes minutissima	Fragilaria vaucheriae
	Cymbella turgida

50,000/10 ccm	25,000
Stauroneis cf minor	Navicula sp.
Gomphonema olivaceum	Cymbella cistula
Hannaea arcus	Achnanthes sp.
Nitzschia palea	Achnanthes flexella
Synedra ulna	Eunotia sp.
Synedra acus	Fragilaria leptostauron
Navicula cf pupula	Cyclotella ocellata
Amphora sp.	Frustulia rhomboides
Nitzschia dissipata	Stephanodiscus niagare
Nitzschia sp.	Melosira italica
Fragilaria crotonensis	Gomphonema intricatum

Chlorophyceae

100,000/10 ccm	25,000
Draparnaldia cf Judayi	Ulothrix sp.

TABLE V - (Cont'd)

B. North Thompson River - McLure:

Bacillariophyceae

500,000/10 ccm

Achnanthes minutissima
Fragilaria vaucheriae
Hannaea arcus
Fragilaria crotonensis
Gomphonema olivaceum (on stalks)
Cymbella turgida
Nitzschia palea
Synedra acus

250,000

Stauroneis cf minor
Gomphonema cf lanceolata
Synedra ulna
Diatoma tenue var. elongatum
Amphora sp.
Navicula cf cryptocephala
Fragilaria construens
Nitzschia sp. (I)
Eunotia sp. (I)
Nitzschia sp. (II)
Achnanthes sp. (I)
Frustulia rhombcides
Navicula cf lanceolata
Achnanthes flexella

100,000/10 ccm

Navicula cf pupula
Nitzschia dissipata
Amphipleura pellucida
Eunotia sp. (II)
Achnanthes sp. (II)
Tabellaria flocculosa
Navicula cf subcapitata
Cymbella cistula
Cocconeis placentula
Cyclotella stelligera

75,000

Cymbella parva
Gomphonema sp.
Caloneis sp.
Cymbella cf cuspidata
Tabellaria fenestrata

Chlorophyceae

100,000/10 ccm

Ulothrix sp.
Draparnaldia sp.

TABLE V - (Cont'd)

C. South Thompson River -- Chase Bridge:

Bacillariophyceae

100,000/10 ccm

Fragilaria vaucheriae
Cymbella turgida
Fragilaria construens

75,000

Fragilaria crotonensis
Synedra rumpens
Gomphonema olivaceum
Nitzschia cf sublinearis
Achnanthes cf lanceolata
Tabellaria fenestrata
Diatoma tenue var. elongatum

50,000/10 ccm

Achnathes minutissima
Meridion circulare
Eunotia sp.
Synedra ulna
Synedra acus

25,000

Cocconeis placentula
Navicula sp.
Gomphonema sp.*
Gomphonema cf major
Hannaea arcus
Amphora sp.
Achnanthes flexella
Stephanodiscus niagare
Asterionella gracillima
Epithemia sorex
Tetraedon cf trigonum
Cyclotella stelligera
Cymbella cistula
Nitzschia acicularis
Tabellaria flocculosa
Nitzschia cf littoralis

Chlorophyceae

25,000/10 ccm

Ulothrix sp.
Cylindrocapsa sp.

Cyanophyceae

100,000/10 ccm

Oscillatoria sp. (I)

75,000

Oscillatoria sp. (II)

* unknown species found choking Fulton Spawning channel (possibly Gomphonema geminatum)

TABLE V - (Cont'd)

D. Thompson River -- Savona:

Bacillariophyceae

1,000,000/10 ccm

Fragilaria construens
Hannaea arcus
Fragilaria vaucheriae

750,000

Gomphonema olivaceum
Fragilaria crotonensis
Cymbella cistula
Synedra mazamaensis
Synedra pulchella
Fragilaria crotonensis var. oregona
Diatoma tenue var. elongatum
Cymbella turgida
Nitzschia palea
Synedra ulna
Achnanthes minutissima

500,000/10 ccm

Stauroneis cf minor
Cymbella gracilis
Navicula cf cryptocephala
Gomphonema major
Eunotia sp.
Synedra cf cyclopum
Navicula pupula
Gomphonema cf subclavatum
Synedra acus
Amphora sp.
Tabellaria fenestrata
Stephanodiscus niagare
Cyclotella ocellata
Cocconeis placentula
Gomphonema sp.*

250,000

Melosira italica
Achnanthes peragalli
Amphipleura pellucida
Achnanthes cf hauckiana
Cyclotella stelligera
Achnanthes cf lanceolata
Amphora sp.
Cyclotella comta
Tabellaria flocculosa
Cymbella lepoceros
Gomphonema quadripunctatum

Clorophyceae

1,000,000/10 ccm

Ulothrix sp. **

750,000

Ulothrix sp. (II)
Ulothrix sp. (III)

Cyanophyceae

1,000,000/10 ccm

Oscillatoria sp. **

* unknown species found choking Fulton Spawning channel (possibly Gomphonema geminatum).

** far exceeds Bacillariophyceae

TABLE V - (Cont'd)

E. Thompson River -- Walhachin Rd. Bridge:

Bacillariophyceae

250,000/10 ccm
Fragilaria vaucheriae
Hannaea arcus
Diatoma tenue var. elongatum
Fragilaria construens
Cymbella turgida
Gomphonema olivaceum

100,000
Fragilaria crotonensis var. oregona
Fragilaria crotonensis
Cymbella cistula
Synedra ulna
Achnanthes minutissima
Tabellaria fenestrata
Synedra ulna var. contracta
Synedra mazamaensis
Diatoma vulgare
Synedra rumpens
Stauroneis minor
Nitzschia sp.
Eunotia sp.
Amphora sp. (large)
Nitzschia palea
Gomphonema cf major
Synedra rumpens var. fragilaroides
Synedra pulchella

75,000/10 ccm
Nitzschia acicularis
Achnanthes sp.
Navicula cf pupula
Amphora sp. (small)
Gomphonema cf helveticum
Cymbella cf amphicephala
Nitzschia dissipata
Cocconeis placentula
Achnanthes cf lanceolata
Navicula cf parva
Navicula sp.
Stephanodiscus astrea
Amphipleura pellucida

50,000
Cyclotella stelligera
Melosira elegans
Cyclotella ocellata
Stephanodiscus niagare
Melosira sp.
Epithemia sp.

Chlorophyceae

100,000/10 ccm
Ulothrix sp.
Chlamydomonas sp.

Cyanophyceae

100,000/10 ccm
Oscillatoria sp.

* * * * * * * *

most abundant. There were a large variety of diatoms at each station but the most common were:

Fragilaria	vaucheriae	Gomphonema	olivaceum
F.	construens	Synedra	ulna
Hanaea	arcus	Achnanthes	minutissima
Cymbella	turgida	Navicula	pupula
C.	cistula		

Tabellaria fenestrata, Gomphonema c.f. major, and Diatoma tenue were also in abundance at Walhachin and Savona.

4. DISCUSSION

The purpose of the interim study conducted by the Federal-Provincial Task Force was to determine the state of the Thompson River System during the low flow of Spring 1973. Only one set of biological samples at one point in time was taken.

4.1 Kamloops Lake

The greatest abundance of zooplankton was at the West End of Kamloops Lake and at Cherry Bluff. The relative abundance of the organisms are probably typical for the early spring of the year, with the Copepoda being the most abundant. Johnson (1965) showed that for Babine and Nilkitkwa Lakes Cyclops, Diaptomus and the nauplii were the most abundant in the early spring and Bosmina was the most numerous in the summer.

Ward (1964) identified four species of zooplankton for each of Copepoda and Cladocera in 1964 while only two species were present for each class in the spring of 1973. However, there

were a large number of nauplii present that were not identified to species. Species like Holopedium gibberum were reported to be the most abundant during the summer (Ward, 1964).

The greatest variety of lake phytoplankton species occurred at the Painted Bluff area. The least variety was noted at the West End near Savona. The significance of why one particular species of diatoms is more dominant than another still has not been determined. One would expect that the number of organisms for this time of year would be low. In comparison to a lake surface sample taken in November 1972 near Savona (unpublished data), the total number of phytoplankton was doubled. In November, Tabellaria fenestrata, Synedra species, Achnanthes sp and Fragilaria construens were the most abundant species. It is believed that there has always been a large number of diatoms in Kamloops Lake. Dr. J. Servizi (personal communication) of the International Pacific Salmon Fisheries Commission reports of instances where the Clarke-Bumpus sampling nets have been plugged with diatoms during the summer months.

4.2 Thompson Rivers

As stated earlier, there was no quantitative sampling done for algae in the river but there was by far more algae in the lower Thompson River than above the lake.*

*However, quantitative samples for algae and bottom fauna were collected by Fisheries Service and their results will be published at a future date.

The most dominant species of diatoms at Walhachin was Gomphonema olivaceum, Cymbella cistual, C. turgida, Fragilaria vaucheriae and F. crotonensis. It is also very interesting to note that there were also thick growths of benthic algae on the Chilko River this spring, with Cymbella cistual, being a dominant alga. There were also several varieties of Fragilaria and Cymbella that were also abundant. It was further reported that the same species have been found in the Mackenzie River in Oregon below the Weyerhaeuser Pulp Mill. Once again the significance of the presence of this algae is not know. Domestic and industrial pollution is not significant in the Chilko River.

From the samples collected for benthic fauna in the rivers, there would appear to be an abundance of organisms at all stations except Savona on the Thompson River and at Albreda on the North Thompson River. However, the Savona data is based on only one sample. The difference in the number of Diptera present between sampling sites could be due to different substrates but is probably due more to a difference in temperature. With the North Thompson being much colder, the larva would be later in hatching. It has also been found that one area of a stream or river can be very abundant in bottom organisms while on the opposite side they may be of a very low distribution. It is recommended that several samples be taken in the same area as well as the substrate content and current velocities be determined in order to have continuity of sample sites.

Patrick (1949) concluded after her study that under healthy conditions a great many species should be represented by a great number of individuals. Polluted conditions would eliminate many species and the ones that did survive would have less competition, and more chance for survival. Thus some groups would be more severely affected than other. An increase in toxicity causes a reduction of some groups, while severe toxicity would kill all organisms. Thus she concludes that pollution causes a reduction in species number with the most tolerant species surviving. The only situation where this might be occurring is at Savona, but this is based on only one sample. A few miles downstream of Savona at Walhachin the insect population would seem to be normal.

5. CONCLUSIONS

1. It would appear that the abundance of the species of plankton present in Kamloops Lake, for the time of year sampled, was normal.
2. The abundance of the algae in the North and South Thompson River was normal. However, in the Thompson River below Savona the algae was by far in excess of its normal growth.
3. The invertebrate populations in the Thompson River System also appeared to be normal with perhaps the exception at Savona.
4. Because these samples consist of only one set taken at one time of the year under specific environmental conditions further samples will have to be taken for at least one yearly cycle to either verify or confirm the above.

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