Environment Canada
Conservation & Protection

Environnement Canada
Conservation et Protection

CO 87-1
c1

AN ALGAL ASSAY STUDY ON THE EFFECTS OF METALS AND NUTRIENT DISCHARGES ON THE ALGAL GROWTH POTENTIAL IN THE COLUMBIA RIVER, BRITISH COLUMBIA

(Data Report)

T.M. Tuominen, G.L. Ennis, S.W. Sheehan

March, 1987

Inland Waters and Lands
Pacific and Yukon Region
Vancouver, B.C.

TD
227
.B74
C087-1
Algal assay study on the effects of metals and nutrient discharges on the algal growth potential in the

TD
227
.B74
C087-1
Algal assay study on the effects of metals and nutrient discharges on the algal growth potential in the

BVAE North Van. Env. Can. Lib./Bib.
36 002 299

Ev

ENVIRONMENT CANADA

CONSERVATION AND PROTECTION

AN ALGAL ASSAY STUDY ON THE EFFECTS OF METALS AND NUTRIENT DISCHARGES ON THE ALGAL GROWTH POTENTIAL IN THE COLUMBIA RIVER, BRITISH COLUMBIA

(Data Report)

LIBRARY
ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
PACIFIC REGION

T.M. Tuominen, G.L. Ennis[1],

S.W. Sheehan

Inland Waters and Lands

Pacific and Yukon Region

Vancouver, B.C.

March 1987

[1]Present address:
Water Use Unit
Habitat Management Division
Field Services Branch
Fisheries and Oceans
Pacific and Yukon Region

ABSTRACT

A lead-zinc smelter and fertilizer complex at Trail, British Columbia discharge effluents into the Columbia River which flows across the Canada-United States border. Water quality monitoring conducted in 1977-79 showed elevated levels of metals and nutrients in the Columbia River downstream of the discharges. Decreases in the concentrations of metals discharged into the river were expected with the modernization of the smelting operations planned for the late 1970's through to the early 1990's.

The *Selenastrum capricornutum* Algal Assay Bottle Test was used to investigate the following:

1. Can metal concentrations in Columbia River water downstream of Trail inhibit algal growth?
2. When the effects of metals are reduced in the future, is there greater potential for algal growth downstream than upstream of Trail?

This report presents the algal assay results with accompanying data on the concentrations of chemicals and indigenous algae in the river water. A description of the field and laboratory methods used in the study is included.

RESUME

Une fonderie de plomb et de zinc ainsi qu'un complexe de fertilisants sont situés à Trail, en Colombie-Britannique; ils déversent leurs eaux usées dans la rivière Columbia, qui traverse ensuite la frontière entre le Canada et les Etats-Unis. De 1977 à 1979, un programme de surveillance continue de la qualité des eaux a mis en évidence des concentrations accrues de métaux et de nutriments dans la rivière Columbia en aval des usines. La modernisation de la fonderie a débuté à la fin des années 70 et doit se terminer au début des années 90; suite à cette modernisation, on devrait observer une diminution de la concentration des métaux dans les eaux usées.

Un test en bouteille avec l'algue Selenastrum capricornutum a été utilisé pour répondre aux questions suivantes:

1. Les concentrations de métaux dans l'eau de la rivière Columbia en aval de Trail peuvent-elles inhiber la croissance des algues?
2. Quand l'influence des métaux aura été réduite lors des années subséquentes, y a-t-il possibilité plus grande en aval qu'en amont pour la croissance des algues?

Le présent rapport renferme les résultats des tests avec l'algue Selenastrum capricornutum ainsi que des données pertinentes sur les concentrations de diverses substances chimiques et d'algues indigènes dans l'eau de la rivière. Une description des méthodes utilisées sur le terrain et au laboratoire est incluse.

ACKNOWLEDGEMENTS

We would like to acknowledge the encouragement and support of Dr. W.E. Erlebach, Chief of the Water Quality Branch, Inland Waters and Lands, Pacific and Yukon Region throughout all phases of this study.

We are especially grateful to M. Bolin and S.G. Yee for providing technical expertise and advice in conducting the algal assays and for the analysis of algal samples. We would like to thank F.T.S. Mah and personnel of the Analytical Services Division for precise analysis of water samples. This study would not have been possible without the capability of our regional Water Quality Laboratory to analyse water samples for metals and nutrients immediately upon receipt at the laboratory. We are especially grateful to P.A. Thomson and N. Wade for these analyses.

We thank Cominco Inc. for providing access to one of their discharge sewers for collection of water samples. We are grateful to Dr. A.L. Smith for the compilation, manipulation and graphic display of the data. We are indebted to M. Lamb, Water Quality Branch, Ottawa and D. Burroughs, formerly of Water Quality Branch, Ottawa for input, formatting and reformatting of the water chemistry data. We are very grateful to M.L. Haines for her typing and revisions of the report. The comments provided by the reviewers, Dr. L.M. Churchland, P.H. Whitfield and R.E. Kwiatkowski were appreciated.

TABLE OF CONTENTS

	PAGE NO.
ABSTRACT	i
RESUME	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
I. Introduction	1
II. Rationale for the Selection of the Algal Assay Test for this Study	4
III. Description of the Algal Assay Test and its Application in this Study	7
IV. Study Sites	10
V. Methods	13
A. Sampling Dates	13
B. Chemical Methods	13
1. Field Sampling	13
2. Laboratory Analytical Methods	16
C. Biological Methods	16
1. Phytoplankton	16
2. Periphyton	23
a. Total Algal Abundance	23
b. Diatom Abundance	23
3. Algal Assays	24
a. Sample Collection and Preparation	25
i. TED sample preparation	27

TABLE OF CONTENTS

PAGE NO.

b. Assay Procedure 28
c. Determination of Dry Weight per Volume *S. capricornutum* 32
d. Concentrations of Metals and Nutrients in the Prepared Sample Water 33

V. Results 34

A. Algal Assay Results 34

B. Indigenous Phytoplankton and Periphyton collected from the Columbia River on early reconnaissance trips (1978-1979) and in conjunction with samples for algal assays (1980-1982). 229

C. Concentrations of metals and composition of phytoplankton in samples collected on August 11, 1980 and September 17, 1980 from Kootenay River and Columbia River downstream of Hugh Keenleyside Dam 322

REFERENCES 329

LIST OF FIGURES

		PAGE NO.
Figure 1	Sampling station locations and NAQUADAT station numbers in the Columbia River basin, British Columbia.	11
Figure 2	Flowchart outlining the events from water sample collection to the termination of algal assay.	26
Figure 3	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the July 1980 algal assay.	62
Figure 4	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the August 1980 algal assay.	85
Figure 5	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the September 1980 algal assay.	107
Figure 6	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the December 1980 algal assay.	124
Figure 7	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the Feburary 1981 algal assay.	140
Figure 8	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the June 1982 algal assay.	165
Figure 9	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the August 1982 algal assay.	192
Figure 10	Algal growth indicated by *in vivo* chlorophyll *a* (measured in relative fluorometer units) for the September 1982 algal assay.	217

LIST OF TABLES

		PAGE NO.
Table 1	Sampling dates, sites and types of samples collected.	14
Table 2	Field sampling procedures for chemical parameters.	17
Table 3	NAQUADAT code numbers and limits of detection for the chemical parameters measured in the field and in the laboratory.	19
Table 4	Composition of nutrient and EDTA spike solutions and the final concentration of the spikes in algal assay samples.	29
Table 5	Sample treatments used in algal assays including abbreviations for the treatments, as used in the data presentation.	30
Table 6	Concentrations of chemicals in the Columbia River on February 14, 1980.	36
Table 7a	Concentrations (mg/L) of orthophosphate and metals in water from Birchbank at various stages of preparation for the February 1980 algal assay.	39
Table 7b	Concentrations (mg/L) of orthophosphate and metals in water from Waneta at various stages of preparation for the February 1980 algal assay.	41
Table 8	Concentrations of chemicals in the Columbia River on March 26, 1980.	43
Table 9a	Concentrations (mg/L) of nutrients and dissolved metals in water from Birchbank at two stages of preparation for the March 1980 algal assay.	46
Table 9b	Concentrations (mg/L) of nutrients and dissolved metals in water from Waneta at two stages of preparation for the March 1980 algal assay.	47
Table 10	Concentrations of chemicals in the Columbia River on July 22, 1980.	48
Table 11	Concentrations (mg/L) of nutrients and dissolved metals in water used for the July 1980 algal assay.	52
Table 12	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the July 1980 algal assay.	54

LIST OF TABLES

		PAGE NO.
Table 13	Final yield of each algal assay treatment for the July 1980 assay.	67
Table 14	Concentrations of chemicals in the Columbia River on August 11, 1980.	71
Table 15	Concentrations (mg/L) of nutrients and dissolved metals in water used for the August 1980 algal assay.	75
Table 16	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the August 1980 algal assay.	77
Table 17	Final yield of each algal assay treatment for the August 1980 assay.	90
Table 18	Concentrations of chemicals in the Columbia River on September 17, 1980.	94
Table 19	Concentrations (mg/L) of nutrients and dissolved metals in water used for the September 1980 algal assay.	98
Table 20	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the September 1980 algal assay.	99
Table 21	Final yield of each algal assay treatment for the September 1980 assay.	112
Table 22	Concentrations of chemicals in the Columbia River on December 2, 1980.	116
Table 23	Concentrations (mg/L) of nutrients and dissolved metals in water used for the December 1980 algal assay.	119
Table 24	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the December 1980 algal assay.	120
Table 25	Final yield of each algal assay treatment for the December 1980 assay.	128

LIST OF TABLES

		PAGE NO.
Table 26	Concentrations of chemicals in the Columbia River on February 17, 1981.	131
Table 27	Concentrations (mg/L) of orthophosphate and dissolved metals in water used for the February 1981 algal assay.	134
Table 28	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the February 1981 algal assay.	135
Table 29	Final yield of each algal assay treatment for the February 1981 assay.	144
Table 30	Concentrations of chemicals in the Columbia River on June 22, 1982.	147
Table 31a	Concentrations (mg/L) of nutrients and metals in water from Birchbank at various stages of preparation for the June 1982 algal assay.	151
Table 31b	Concentrations (mg/L) of nutrients and metals in water from Waneta at various stages of preparation for the June 1982 algal assay.	153
Table 31c	Concentrations (mg/L) of nutrients and metals in water from Cominco Sewer #8 at various stages of preparation for the June 1982 algal assay.	155
Table 31d	Composition of the TED-70μg Zn/L dilution of Cominco effluent used for the June 1982 algal assay	156
Table 32	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the June 1982 algal assay.	157
Table 33	Final yield of each algal assay treatment for the June 1982 assay.	171
Table 34	Concentrations of chemicals in the Columbia River on August 17, 1982.	176
Table 35a	Concentrations (mg/L) of nutrients and dissolved metals in water from Birchbank used in the August 1982 algal assay.	180

LIST OF TABLES

		PAGE NO.
Table 35b	Concentrations (mg/L) of nutrients and dissolved metals in water from Waneta at two stages of preparation for the August 1982 algal assay.	181
Table 35c	Concentrations (mg/L) of nutrients and dissolved metals in water from Cominco Sewer #8 at two stages of preparation for the August 1982 algal assay.	182
Table 35d	Composition of the TED-40μg Zn/L dilution of Cominco effluent used in the August 1982 algal assay.	183
Table 36	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the August 1982 algal assay.	184
Table 37	Final yield of each algal assay treatment for the August 1982 assay.	198
Table 38	Concentrations of chemicals in the Columbia River on September 28, 1982.	203
Table 39	Concentrations (mg/L) of nutrients and dissolved metals in water used for the September 1982 algal assay.	207
Table 40	Daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units) for the September 1982 algal assay.	209
Table 41	Final yield of each algal assay treatment for the September 1982 assay.	223
Table 42	Data used to determine dry weight per volume ($\mu g/\mu m^3$) of *Selenastrum capricornutum*	228
Table 43	A list of all algal species collected from the Columbia River Basin, July 26, 1978 - September 28, 1982, indicating whether they were found in the periphyton or in the phytoplankton.	230
Table 44	Concentrations of phytoplankton species (cells/ml) collected from the Columbia and Pend d'Oreille Rivers, July 26, 1978 - September 28, 1982.	234
Table 45	Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River Basin in July, 1978.	316

LIST OF TABLES

		PAGE NO.
Table 46	Percent numeric compositon of periphytic diatoms collected from the Columbia River Basin in July, 1978.	317
Table 47	Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River on April 2, 1981.	319
Table 48	Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River at Waneta on June 22, 1982.	320
Table 49	Percent numeric compositon of periphytic diatoms collected from the Waneta Station on June 22, 1982.	321
Table 50a	Concentrations (mg/L) of metals in the Kootenay River on August 11, 1980.	323
Table 50b	Concentrations (mg/L) of metals in the Columbia River downstream from the Hugh Keenleyside Dam on August 11, 1980.	324
Table 50c	Concentrations (mg/L) of metals in the Kootenay River on September 17, 1980.	325
Table 50d	Concentrations (mg/L) of metals in the Columbia River downstream from the Hugh Keenleyside Dam on September 17, 1980.	326
Table 51a	Concentrations of phytoplankton species (cells/ml) collected from the Kootenay River on August 11, 1980	327
Table 51b	Concentrations of phytoplankton species (cells/ml) collected from the Columbia River downstream from the Hugh Keenleyside Dam on August 11, 1980.	328

I. INTRODUCTION

The Columbia is a major waterway which flows across the Canada-United States border near Trail, British Columbia into the State of Washington. Fifteen kilometres upstream of the international border a large lead-zinc smelter and fertilizer complex operated by Cominco Limited discharges effluent into the Columbia River.

Water quality monitoring conducted by Inland Waters and Lands in 1977-79 showed that elevated levels of metals and nutrients were intermittently present in the Columbia River downstream of Cominco (Sheehan and Lamb, in prep.). It was expected that the levels of metals in the river would decrease following modernization of the smelting operations planned by Cominco for the late 1970's through to the early 1990's.

Inland Waters and Lands and Environmental Protection were concerned that reductions in metal discharges, without accompanying reductions in nutrient discharges, could result in nuisance algal growth or blooms downstream of Trail. It was hypothesized that the elevated metal concentrations in the river may have been responsible for inhibiting algal growth in the past.

In response to these concerns, the following were investigated:

1. Can metal concentrations in Columbia River water downstream of Trail inhibit algal growth?
2. When the effects of metals are reduced in the future, is there greater potential for algal growth downstream than upstream of Trail?

The approach used to assess the present and predict the future algal growth potential of the river water was the Selenastrum capricornutum Printz Algal Assay Bottle Test (Miller et al., 1978). This laboratory algal assay measures the growth of an algal culture in sample water. To gain an understanding of indigenous algal flora present in the Columbia River, samples of Columbia River water were analysed for algal species composition and abundance.

This data report presents the results of eight algal assays conducted from 1980 to 1982 with supporting data on the concentrations of chemicals measured in the field and laboratory. The rationale for the use of the algal assay technique and its application to this study are presented. Also included is a detailed description of the field and laboratory methods used.

The results are arranged in three sections. Section A presents data associated directly with the algal assays. Sections B and C present additional data characterizing the aquatic quality of the river. Section B contains data on species composition and abundance of indigenous phytoplankton and periphyton of the Columbia River.

These samples were collected on early reconnaissance trips (1978-1979) and in conjunction with water samples for algal assays (1980-1982). Section C presents data on the concentrations of chemicals and the composition of phytoplankton in samples collected upstream of Birchbank at Kootenay River near its confluence with the Columbia River and at the Columbia River just downstream of Hugh Keenleyside Dam in an attempt to trace the source of elevated metal and phosphorus concentrations measured at Birchbank (the station upstream of Cominco discharges) in July 1980.

The interpretive report (in prep.) will present an analysis and discussion of the results of this study. There will be an analysis of the algal growth potential and limiting nutrients at stations upstream and downstream of Cominco effluents, an analysis of the effects of metal discharges on algal growth, and a prediction of future algal growth potential in the river when metal discharges are decreased. Also included will be an analysis of the effects of pre-assay laboratory preparation of sample water on the concentrations of chemicals in the water.

II. RATIONALE FOR THE SELECTION OF THE ALGAL ASSAY TEST FOR THIS STUDY

The approach selected to address the objectives of this study had to have the following capabilities:

1. the ability to predict algal growth in the future when metal levels in the river will be substantially decreased;
2. the ability to measure algal growth potential in river water during "worst case" conditions, that is, during random episodic peak metal discharges from Cominco;
3. the capability to contend with characteristics of the Columbia River in the Trail vicinity, such as;

   a) the short distance (15 km, approximately 5 hours travel time for a specific mass of water) from the discharge site to the international boundary which does not allow sufficient time for phytoplankton to reflect chemical changes in the water,

   b) the fluctuating water level in the river due to upstream dams on the Columbia and Kootenay Rivers which discourages the growth of periphytic algae. The major algal component in the river, therefore, is phytoplankton, which probably originates from upstream reservoirs.

A controlled experimental or bioassay approach using the *Selenastrum capricornutum* Printz Algal Assay Bottle Test was seen as a suitable

technique for meeting the study objectives under the conditions imposed by the study site. The algal assay bottle test has been used by various investigators to study (1) the algal growth potential of waters, (2) the identity of nutrients limiting algal growth, and (3) the presence of substances that are toxic or inhibitory to algal growth (Miller et al., 1974; Greene et al., 1975a; Miller et al., 1975; Gerhold, 1975; Gerhold and Otto, 1976; Miller et al., 1976; Parr and Smith, 1976; Greene et al., 1978; Davis and DeCosta, 1980; Grizzard et al., 1980; Dobolyi and Ördög, 1981; Olive and Higgins, 1981; Markee et al., 1982; Perry and Stanford, 1982; Ram and Plotkin, 1983; Turbak et al., 1986). Studies by Greene et al., (1975b) showed that algal growth potential predicted by the algal assay technique agreed favourably with indigenous phytoplankton standing stocks.

The algal assay bottle test was appropriate for this study because it allows for the containment of river water in the laboratory so that the algal growth response can be measured. An advantage of this technique is that the sample water can be manipulated to investigate factors affecting algal growth. With the addition of the chelating compound EDTA excess dissolved metals can be complexed to EDTA and made unavailable for algal uptake. Hence this would simulate future conditions when metals are present in lower concentrations in the river.

This technique also allowed for the simulation of "worst case" metal discharge conditions by the addition of effluent collected directly from Cominco sewers. The simulation was required because peak metal discharges were present in downstream waters at occasional and unpredictable times. When water collections were made it was not known if high metal levels were present in the downstream (Waneta) sample until the water was analysed at the laboratory. If the metals levels were considerably lower than those measured during previous intensive monitoring series (Sheehan and Lamb, in prep.), an appropriate volume of Cominco effluent could be added to some of the Waneta samples, so that the algal growth potential under high metal discharge conditions could be measured.

III. DESCRIPTION OF THE ALGAL ASSAY TEST AND ITS APPLICATION IN THIS STUDY

The *Selenastrum capricornutum* Printz Algal Assay Bottle test was developed by the U.S. Environmental Protection Agency and is described in detail in Miller et al. (1978).

For this test, the unicellular green alga, *Selenastrum capricornutum*, is grown in sample water under controlled laboratory conditions. When the culture ceases to increase in biomass, its final biomass is used as a measure of the algal growth potential in that particular water. Waters with higher concentrations of nutrients should result in greater biomass of *S. capricornutum* and hence have a greater growth potential.

The macronutrient limiting algal growth in water can be identified by growing the alga in water samples that have been spiked with the macronutrients, orthophosphate and nitrate. These two macronutrients are added individually to sample water. The final biomass of these "spiked" samples is compared to the final biomass of the control or unspiked sample. If, for example, greater growth is measured in the sample water spiked with orthophosphate, this indicates that orthophosphate is present in limited supply in the original sample water. Thus the availability of orthophosphate in the water is controlling the growth of algae. If greater growth results only when both macronutrients are added together this indicates that neither macronutrient, alone, is limiting the growth of algae.

When no increase in biomass (when compared to the biomass in the unspiked control sample) is evident with the addition of the macronutrients individually or together this indicates that some other factor is limiting algal growth. The growth-limiting factor could be the lack of a micronutrient or trace element that is required for algal growth. Alternatively, the growth could be limited by the presence of a substance that has a toxic or inhibitory effect on algal growth. The specific cause of the growth limitation can be narrowed down with further spikes to the water. For example, the water can be spiked with the chelating compound EDTA. EDTA acts as a complexing agent for metals and mediates the dissolved or biologically-available portion of trace metals in water (Miller et al., 1976). If greater growth results with the addition of EDTA this then indicates one of two possible conditions, either (1) trace metals are available to the algae in excessive concentrations and are therefore inhibiting the algal growth or (2) trace metals in the sample water are present but unavailable for algal uptake. An analysis of the concentrations of metals in the water will shed further light on which of the above two conditions is most likely.

The algal assays conducted on Columbia River water, generally, followed the experimental design described in Miller et al. (1978). The alga was grown in water samples collected upstream (Birchbank) and downstream (Waneta) of Cominco discharges to determine the effect of Cominco discharges on algal growth potential in the

water. Nutrient additions to these waters investigated the effect of Cominco discharges on limiting nutrients in the water. EDTA was added to ascertain if metals were affecting the growth of algae. This treatment also gave an indication of the algal growth potential of Waneta water when the growth-limiting or inhibitory effects, if any, of the metals are reduced in the future.

For some assays further spikes were added to test if metal deficiencies upstream of Cominco effluents may be limiting the growth of algae in the river. The effect of Cominco effluents on these deficiencies, if any, could then be ascertained. Note, if metals are not present in some form in the water the addition of EDTA would have no effect on metal availability. A spike of trace metals was added for some of the assays (August and September, 1982). A spike of iron alone was included as a treatment for most assays. Iron has been shown to limit the growth of S. capricornutum at some downstream Columbia River locations in the United States (Miller et al., 1976). Data on the concentrations of dissolved iron at Birchbank indicate low concentrations (1 to 2 μg Fe/L) (Sheehan and Lamb, in prep).

IV. STUDY SITES

Sampling sites are shown in Figure 1. For each algal assay, water samples were collected at Birchbank (NAQUADAT no. 00BC08NE0005) which is located upstream of Cominco discharges at Trail and at Waneta (NAQUADAT no. 00BC08NE0001) which is located downstream of these discharges.

On most sampling dates samples were collected from Cominco smelter's sewer #8 (NAQUADAT no. 20BC08NE0001) which discharges from the zinc roaster and sulphuric acid plant area to the Columbia River. This water was added to samples of Waneta water to simulate high Cominco metal discharge conditions at Waneta.

On September 17, 1980, water samples were also collected from the Pend d'Oreille River (NAQUADAT no. 00BC08NE0029) near its confluence with the Columbia. The Pend d'Oreille River is a major tributary of the Columbia River, contributing a significant input of water to the Columbia River, downsteam of the Waneta sampling station. It was considered important to determine the algal growth potential of this tributary to better predict the algal growth potential in downstream Columbia River water in the United States.

On August 11 and September 17, 1980 the following two locations upstream of Birchbank were sampled: Kootenay River near its confluence with the Columbia River and the Columbia River just

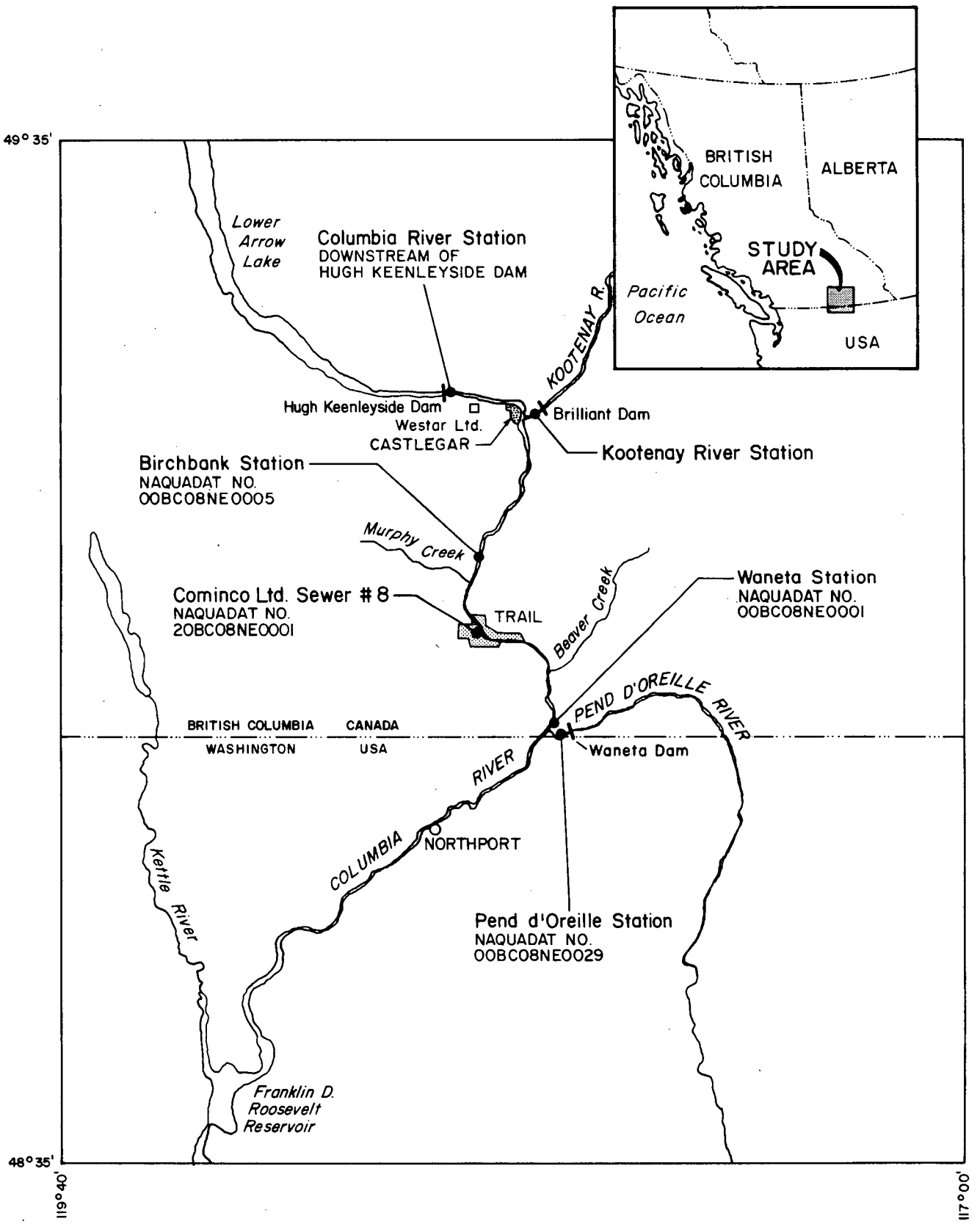


Figure 1 Sampling station locations and NAQUADAT station numbers in the Columbia River Basin, British Columbia

downstream of the Hugh Keenleyside Dam. These upstream sites were sampled to trace the source of elevated metals and nutrient concentrations measured at Birchbank in July 1980.

V. METHODS

A. Sampling Dates

Table 1 presents the sampling dates, sites and types of samples collected.

B. Chemical Methods

1. Field Sampling

Samples for determination of nutrients, metals, and major ions were collected, filtered and/or preserved in the field, and returned to Vancouver for analysis within 30 hours. Usually three replicates were collected. Samples were gathered by dipping appropriate collecting bottles at a wadable distance from the left (east) bank at the Waneta station and from the right (west) bank at the Birchbank station. Samples were collected in a similar fashion from the right (north) bank at the Pend d'Oreille station, from the left (south) bank at the Kootenay River station and from the right (south) bank at the station downstream of the Hugh Keenleyside Dam.

At Cominco, samples were dispensed into the appropriate sample bottles from a 2-L teflon bottle that had been lowered into sewer #8. The teflon bottle was held in a sampling iron (see Inland Waters Directorate, 1983b).

TABLE 1

SAMPLING DATES, SITES AND TYPES OF SAMPLES COLLECTED

Date	Site	Sample Type: Chemical Measurements	Phytoplankton	Algal Assay	Periphyton
July 16, 1978	Waneta	1	+		+
July 26, 1978	Birchbank	1	+		+
	Pend d'Oreille R.	1	+		+
October 23, 1979	Birchbank		+		
	Waneta		+		
	Cominco sewer #8		+		
February 14, 1980	Birchbank	+	+		
	Waneta	+	+		
March 26, 1980	Birchbank	+	+		
	Waneta	+	+		
July 22, 1980	Birchbank	+	+	+	
	Waneta	+	+	+	
	Cominco sewer #8	+	+	+	
August 11, 1980	Birchbank	+	+	+	
	Waneta	+	+	+	
	Cominco sewer #8	+	+	+	
	Mouth of Kootenay R.	+	+		
	Columbia R. downstream of Hugh Keenleyside Dam	+	+		

TABLE 1 (Continued)

Date	Site	Sample Type: Chemical Measurements	Phytoplankton	Algal Assay	Periphyton
September 17, 1980	Birchbank	+	+	+	
	Waneta	+	+	+	
	Pend d'Oreille R.	+	+	+	
	Mouth of Kootenay R.	+			
	Columbia R. downstream of Hugh Keenleyside Dam	+			
December 2, 1980	Birchbank	+	+	+	
	Waneta	+	+	+	
February 17, 1981	Birchbank	+	+	+	
	Waneta	+	+	+	
June 22, 1982	Birchbank	+	+	+	
	Waneta	+	+	+	+
	Cominco sewer #8	+		+	
August 17, 1982	Birchbank	+	+	+	
	Waneta	+	+	+	
	Cominco sewer #8	+		+	
September 28, 1982	Birchbank	+	+	+	
	Waneta	+	+	+	
	Cominco sewer #8	+		+	

[1] Chemical measurements that were made on this date are reported in Sheehan and Lamb (in prep.).

Details of sampling procedures for specific parameters are summarized in Table 2.

2. Laboratory Analytical Methods

Analyses for the concentrations of chemicals in water were performed at the Water Quality Laboratory in Vancouver according to methods described in the NAQUADAT Dictionary (Inland Waters Directorate, Water Quality Branch, 1983a) and the Analytical Methods Manual (Inland Waters Directorate, Water Quality Branch, 1979). All analyses used, with their identifying NAQUADAT code numbers and limits of detection, are listed in Table 3.

C. Biological Methods

1. Phytoplankton

Phytoplankton were collected by filling three 200-ml bottles with water from just below the water's surface at a wadable distance from the river bank. The samples were preserved with Lugol's solution. When collected with samples for chemical analyses, they were collected at the same locations.

The phytoplankton were enumerated using the Utermöhl technique (Utermöhl, 1958). Samples were shaken, and, depending on algal density, transferred to 5, 10 or 25 cc settling chambers. The samples were settled and then enumerated using an inverted phase contrast microscope. Microscope transects were examined at 625X

TABLE 2

FIELD SAMPLING PROCEDURES FOR CHEMICAL PARAMETERS

Parameter	Field Procedures and Sample Preservation
Total Phosphorus	Samples were collected in 50-ml sovirel glass bottles. The bakelite caps had teflon liner inserts to prevent phosphate contamination. Samples were packed in ice.
Dissolved Phosphorus and Orthophosphorus	Samples were collected in 100-ml sovirel glass bottles capped with teflon-lined bakelite caps. Each sample was filtered through a 47-mm Millipore HA (0.45μm pore diameter) filter which had been pre-soaked in distilled water. The filtering apparatus consisted of a Sartorius polycarbonate filter holder (47 mm diameter, Model SM 165 11). Positive pressure was provided by a hand pump. The filtrate was collected in a 50-ml sovirel glass bottle and packed in ice.
Nitrate and Nitrite, Ammonia, Total Dissolved Nitrogen, Particulate Carbon, Particulate Nitrogen	Samples were collected in 1-L polyethylene bottles. Each sample was filtered within 3 hours through a Whatman GF/F glass fibre filter which had been pre-cooked for 6 hours at 460 C. The filtering apparatus consisted of a glass filter holder coupled to a 1-L erlenmeyer flask, both of which had been prewashed in HCl. The vacuum was provided by a hand pump. The filtrate was collected in a 250-ml polyethylene bottle and packed in ice. The filter was transferred to a petri dish and placed in a cooler.
Dissolved Inorganic Carbon/ Dissolved Organic Carbon (DIC/DOC)	Samples were collected and filtered as above for the nitrogen samples. Samples were placed into 100-ml polyethylene bottles and packed in ice.
Total Inorganic Carbon/ Total Organic Carbon (TIC/TOC)	Samples were collected in 100-ml polyethylene bottles and packed in ice.
Total and extractable metals (Cd, Cu, Fe, Mn, Ni, Pb, Zn)	Samples were collected in 500-ml polyethylene bottles which had been pre-washed in chromic acid cleaning solution.* One millilitre of HNO_3 was added to each bottle no more than 2 hours after collection.

TABLE 2 (Continued)

Parameter	Field Procedures and Sample Preservation
Dissolved metals (Cd, Cu, Fe, Mn, Ni, Pb, Zn)	Samples were collected in 1-L polyethylene bottles. Each sample was filtered through a Millipore HA filter which had been pre-soaked in 0.25% HNO_3 for a minimum of 12 hours. The filtering apparatus consisted of a glass filter holder coupled to a 1-L erlenmeyer flask, both of which had been pre-washed in chromic acid cleaning solution.* The vacuum was provided by a handpump. The filtrate was collected in a 500-ml polyethylene bottle, and 1 ml of HNO_3 was added. A new filter was used for each sample.
Total, Extractable and Dissolved Cr	Samples were collected and filtered (for dissolved Cr) using the same procedures as were used above for the metals samples. The samples were placed into 500-ml polyethylene bottles which had been pre-washed with nitric acid.
Extractable Hg	Samples were collected in 100-ml teflon bottles which had been pre-washed with chromic acid cleaning solution.* Two millilitres of preservative (a solution of 50% HNO_3 and 2.5% $K_2Cr_2O_7$) was added to each bottle no more than 2 hours after collection.
Extractable As, Se	Samples were collected in 100-ml polyethylene bottles which were pre-washed in chromic acid cleaning solution.* The samples were packed in ice.
Major Ions, Residues Physical Parameters	Two 1-L polyethylene bottles were filled with sample water. In the laboratory, aliquots were taken for analyses.

*Chromic acid cleaning solution: Approximately 700 g of sodium dichromate ($Na_2Cr_2O_7$) was added to 8-L of distilled water. Then 4 X 2 1/2-L or 4 winchesters of technical or reagent grade sulphuric acid was stirred into solution.

TABLE 3

NAQUADAT CODE NUMBERS AND LIMITS OF DETECTION FOR THE CHEMICAL PARAMETERS MEASURED IN THE FIELD AND IN THE LABORATORY

Parameter	NAQUADAT Number	Detection Limit
Colour	02011	5.0 Relative units
Specific Conductance	02041	0.2 μ sie/cm
Water Temperature (Lab)	02061	
Water Temperature (Field)	02061	
Turbidity	02073	0 jtu
Total Organic Carbon	06001	Variable
Total Inorganic Carbon	06051	1.0 mg/L
Dissolved Organic Carbon	06101	0.5 mg/L
Dissolved Inorganic Carbon	06151	0.5 mg/L
Particulate Carbon	06903	Variable
NO_3/NO_2 (dissolved)	07110	0.002 mg/L
Ammonia (dissolved)	07557	0.002 mg/L
Total Dissolved Nitrogen (unfiltered)	07651	0.010 mg/L
Total Dissolved Nitrogen (filtered)	07655	0.010 mg/L
Particulate Nitrogen	07903	Variable
Fluoride (dissolved)	09106	0.050 mg/L
Alkalinity (total)	10101	0.5 mg/L $CaCO_3$
Alkalinity (phenolphthalein)	10151	0.5[1] mg/L $CaCO_3$
Acidity	10251	0.5 mg/L $CaCO_3$
pH (Lab)	10301	
Nonfilterable residue	10401	10.0 mg/L
Filterable residue	10451	10.0 mg/L
Nonfilterable residue (fixed)	10501	10.0 mg/L
Filterable residue (fixed)	10551	10.0 mg/L
Hardness (total)	10603	0.5 mg/L $CaCO_3$

[1]This limit of detection applies at pH greater than 8.3. At lower pH phenolphthalein alkalinity = 0

TABLE 3 (Continued)

Parameter	NAQUADAT Number	Detection Limit
Sodium (dissolved)	11103	0.2 mg/L
Magnesium (dissolved)	12101	Calculated
Silica (reactive)	14105	0.2 mg/L
Phosphorus (dissolved)	15102	0.002 mg/L[2]
Orthophosphate	15256	0.002 mg/L[2]
Phosphorus (total)	15406	0.002 mg/L[2]
Sulphate (dissolved)	16306	0.5 mg/L
Chloride (dissolved)	17206	0.2 mg/L
Potassium (dissolved)	19103	0.2 mg/L
Calcium (dissolved)	20101	0.5 mg/L
Chromium (dissolved)	24052	0.01 mg/L
Chromium (dissolved)	24053	0.001 mg/L
Chromium (extractable)	24302	0.01 mg/L
Chromium (extractable)	24303	0.001 mg/L
Manganese (total)	25004	0.01 mg/L
Manganese (dissolved)	25104	0.01 mg/L
Manganese (dissolved)	25105	0.001 mg/L
Manganese (extractable)	25304	0.01 mg/L
Manganese (extractable)	25305	0.001 mg/L
Iron (total)	26004	0.05 mg/L
Iron (dissolved)	26104	0.05 mg/L
Iron (dissolved)	26105	0.001 mg/L
Iron (extractable)	26304	0.05 mg/L
Iron (extractable)	26305	0.001 mg/L
Nickel (total)	28002	0.001 mg/L
Nickel (dissolved)	28102	0.001 mg/L
Nickel (extractable)	28301	0.01 mg/L
Nickel (extractable)	28302	0.001 mg/L

[2] In 1980, a detection limit of 0.001 mg/L was used for some samples.

TABLE 3 (Continued)

Parameter	NAQUADAT Number	Detection Limit
Copper (total)	29006	0.01 mg/L
Copper (total)	29005	0.001 mg/L
Copper (dissolved)	29106	0.01 mg/L
Copper (dissolved)	29105	0.001 mg/L
Copper (extractable)	29306	0.01 mg/L
Copper (extractable)	29305	0.001 mg/L
Zinc (total)	30004	0.01 mg/L
Zinc (total)	30005	0.001 mg/L
Zinc (dissolved)	30104	0.01 mg/L
Zinc (dissolved)	30105	0.001 mg/L
Zinc (extractable)	30304	0.01 mg/L
Zinc (extractable)	30305	0.001 mg/L
Arsenic (extractable)	33304	0.0001 mg/L
Selenium (extractable)	34302	0.0001 mg/L
Cadmium (total)	48002	0.0005 mg/L
Cadmium (dissolved)	48101	0.01 mg/L
Cadmium (dissolved)	48102	0.0005 mg/L
Cadmium (extractable)	48301	0.01 mg/L
Cadmium (extractable)	48302	0.0005 mg/L
Mercury (dissolved)[3]	80111	0.05 µg/L
Mercury (extractable)	80311	0.05 µg/L
Lead (total)	82001	0.01 mg/L
Lead (total)	82002	0.001 mg/L
Lead (dissolved)	82101	0.01 mg/L
Lead (dissolved)	82103	0.001 mg/L
Lead (extractable)	82301	0.01 mg/L
Lead (extractable)	82302	0.001 mg/L

[3] This parameter was measured in laboratory samples only.

magnification and all phytoplankton were identified and counted until a minimum of 100 cells of the dominant species and at least 300 cells in total were counted.

Filamentous species were enumerated as length of filament. Colonies of small cells were recorded as single cells. Species too small to be identified at a magnification of 625X were identified using phase contrast at 1250X magnification but enumerated at 625X magnification. Because high magnifications can produce errors in the counts of large phytoplankton species, the sample was re-examined at 200X magnification and only large phytoplankton were counted. Only live cells (ie., cells with chloroplasts) were counted. Microscopic counts were converted to cells/ml by the following calculation:

$$\text{cells/ml} = \frac{\text{(cells counted) x (settling area of chamber)}}{\text{(chamber volume) x (area of transects counted)}}$$

Planktonic diatoms in the samples were identified using the reference works of Patrick and Reimer (1966-1975), Cleve-Euler (1951-1955), Hustedt (1930, 1930-1966), Huber Pestalozzi (1942), Sreenivasa and Duthie (1973), and Weber (1966). The species classification scheme of Van Landingham (1967-1979) was followed for diatoms. The works of Bourrelly (1966, 1968, 1970), Prescott (1962) and Huber-Pestalozzi (1938-1972) were used to identify algae from other classes.

2. Periphyton

Periphytic algae were collected for the purpose of determining the dominant species present and not for the estimation of biomass per area of substrate. Algae were removed from rock substrates with a toothbrush or razor blade. The samples were preserved with Lugol's solution.

a. Total Algal Abundance

Each sample bottle was shaken to distribute the algae evenly in the sample. A subsample was transferred to a 5 or 10 ml settling chamber. The algae were settled and then examined with an inverted microscope at 625X or 200X magnification. The percent abundance (by volume) of each algal division was estimated in ten random fields. Non-diatom species abundances were estimated and the species were identified using Prescott (1962), Bourrelly (1966, 1968, 1970) and Huber-Pestalozzi (1938-1972).

b. Diatom Abundance

A subsample of the periphyton sample was prepared for diatom analysis. Prior to 1982, these sub-samples were cleaned in nitric acid as described in Patrick and Reimer (1966-1975). In 1982, samples were cleaned with sulphuric acid, potassium permanganate and oxalic acid as described in Hasle and Fryxell (1970). Following the cleaning, an aliquot was first diluted with distilled water and then poured into an

evaporation dish designed to support four circular coverslips (Battarbee, 1973). The liquid in the dish was allowed to evaporate. When dry, the coverslips were removed and mounted onto slides with Hyrax mounting media (refractive index 1.63). One slide from each sample was examined.

Microscope transects were examined using a phase contrast microscope at 1000X magnification and all diatoms in the sample were identified and counted until a minimum of 100 frustules of the dominant species were enumerated and at least 300 frustules in total were counted. Because this high magnification can produce errors in the counts of large diatoms the sample was re-examined at 200X magnification and only the large diatoms counted. Since the samples were not collected quantitatively, counts are tabulated in intervals of percent abundance of sample observed (i.e. <10%, 10-50%, >50%), rather than as absolute density per area of substrate.

The same keys were used to identify periphyton as were used for phytoplankton.

3. Algal Assays

The algal assays were conducted following the procedure of Miller et al. (1978) with some modifications.

A unialgal but xenic culture of *Selenastrum capricornutum* was obtained from the United States Environmental Protection Agency,

Corvallis, Oregon. The culture was grown in AAP medium (Miller et al., 1978) and harvested for algal assays when at late logarithmic or early stationary phase of growth.

In preparation for an algal assay, all glassware was washed with low-phosphate detergent in hot water and rinsed 3 times with distilled water. After that, the glassware was soaked in 10% HCl, rinsed in a saturated Na_2CO_3 solution, and then rinsed 10 times with distilled water. Finally, the glassware was dried in an oven at 50-65 C and autoclaved. Polycarbonate flasks were soaked in 10% HNO_3 instead of 10% HCl. Polycarbonate flasks were used in some bioassays as a control to check on possible leaching of metals from the walls of glass flasks (Miller et al., 1975).

Membrane filters used for filtering sample water and nutrient solutions were first soaked overnight in 0.2% HNO_3, then rinsed and soaked several times with distilled water. Prior to autoclaving, one litre of distilled water was passed through each filter.

a. Sample Collection and Preparation

A flowchart of events from sample collection to the termination of the algal assay is presented in Figure 2.

Water samples were collected in 1-L acid-washed teflon bottles from the same locations as the samples for chemical

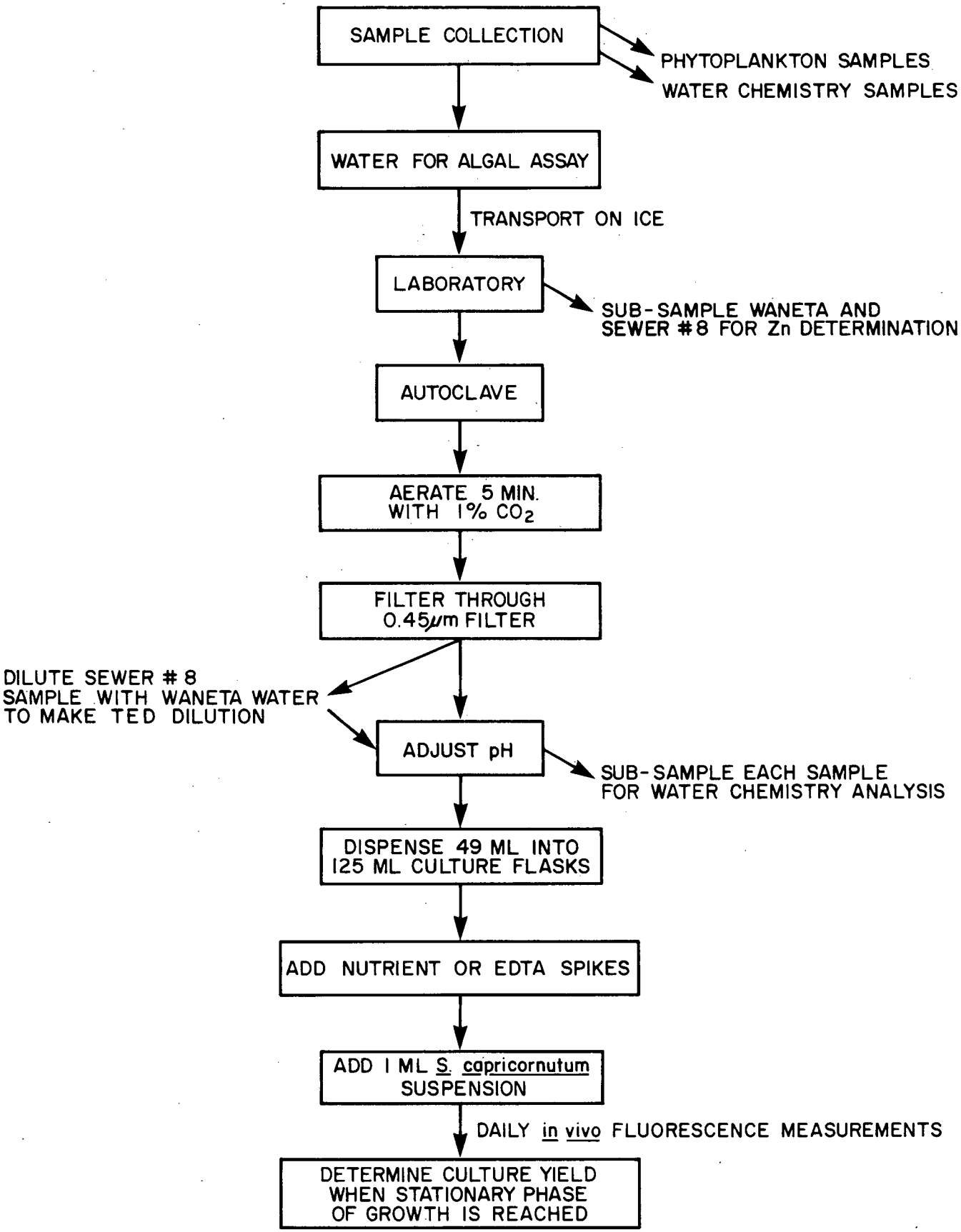


Figure 2 Flowchart outlining the events from water sample collection to the termination of algal assay

and algal species composition analyses were collected. The bottles were immediately packed in ice. The samples were delivered to the laboratory within 30 hours.

At the laboratory, samples were autoclaved (30 minutes per litre of water at 121 C, 1.1 kg/cm^2), aerated with 1% CO_2 and then filtered through Millipore HA membrane filters.

The pH was adjusted to 7.0 $\pm$ 0.5 with 0.1 N NaOH or HCl. The pH of samples collected in August and September of 1982 was adjusted to 8.0 $\pm$ 0.5 to more closely simulate the natural pH (8.0-8.1) of the water.

i. TED sample preparation

The TED (Total Effluent Dilution) sample designates the dilution of Cominco sewer #8 effluent with Waneta water to simulate a Waneta sample with high concentrations of metals.

Subsamples of Waneta and sewer #8 water were distributed to appropriate sample bottles immediately when the samples arrived at the laboratory. These subsamples were analysed for dissolved and/or extractable zinc concentration. Zinc was the trace metal usually measured in the highest concentration in the Cominco effluent.

The results of the zinc analyses were then used to

calculate the volume of sewer #8 water required to increase the zinc concentration of Waneta water to the appropriate level (usually 70μg Zn/L). Previous data showed that zinc concentrations at Waneta frequently reached or exceeded this level. The addition was made after both samples had been autoclaved, aerated with CO_2, and filtered. The pH was adjusted to pH 7 or 8 as described above in Section 3a after the dilution was made. The name of the sample refers to the final dissolved zinc concentration of the water. For example, TED-70 μg Zn/L has a concentration of 70 μg Zn/L.

b. Assay Procedure

The prepared sample water was distributed in 49-ml aliquots to 125-ml erlenmeyer flasks. Some flasks were then spiked with 10 μl of filter-sterilized nutrient and/or EDTA and/or iron solution(s). The trace metal solution was added as a 50 μl spike. Table 4 presents the composition of spike solutions and Table 5 lists all the spikes and combinations of spikes used. Unspiked sample water was referred to as the control, and spiked samples were named control + spike. All treatments were conducted in replicates of 3 or 5.

After the addition of spikes, 1 ml of algal suspension was dispensed to each flask. This resulted in a cell density of

TABLE 4

COMPOSITION OF NUTRIENT AND EDTA SPIKE SOLUTIONS AND THE FINAL CONCENTRATION OF THE SPIKES IN ALGAL ASSAY SAMPLES

Spike	Composition of Spike Stock Solution	Final Concentration of Spike in 50 ml[1] Algal Assay Sample
Phosphorus	0.250g P/L as K_2HPO_4	0.05 mg P/L
Nitrogen	5.000g N/L as $NaNO_3$	1.00 mg N/L
EDTA Chelator	5.000g EDTA/L as Disodium (Ethylenedinitrilo) tetraacetate	1.00 mg EDTA/L
Iron	1.000g Fe/L as $FeCl_3$	0.200 mg Fe/L
Trace Metals	Micronutrient stock solution in Miller et al., 1978:	Trace Metals Solution:
	32.460 mg B/L as H_3BO_3	32.460 µg B/L
	115.374 mg Mn/L as $MnCl_2 \cdot 4H_2O$	115.374 µg Mn/L
	1.570 mg Zn/L as $Zn\ Cl_2$	1.570 µg Zn/L
	0.354 mg Co/L as $CoCl_2 \cdot 6H_2O$	0.354 µg Co/L
	0.004 mg Cu/L as $CuCl_2 \cdot 2H_2O$	0.004 µg Cu/L
	2.878 mg Mo/L as $Na_2MoO_4 \cdot 2H_2O$	2.878 µg Mo/L
	33.051 mg Fe/L as $Fe\ Cl_3 \cdot 6H_2O$	33.051 µg Fe/L
	300.000 mg $Na_2EDTA \cdot 2H_2O$/L	300.000 µg $Na_2EDTA \cdot 2H_2O$

[1] 49 ml sample water + 1 ml algal inoculum

TABLE 5

SAMPLE TREATMENTS USED IN ALGAL ASSAYS INCLUDING ABBREVIATIONS FOR THE TREATMENTS, AS USED IN THE DATA PRESENTATION. NOTE ALL "SPIKE" COMBINATIONS WERE NOT USED FOR ALL EXPERIMENTS

Sample Treatment	Abbreviations in Tables	Abbreviations in Graphs
Control (no spikes added)	Control	Control
Control + 1.0 mg EDTA/L	Control + EDTA	+ EDTA
Control + 0.05 mg P/L	Control + P	+ P
Control + 1.0 mg N/L	Control + N	+ N
Control + 200 μg Fe/L	Control + 200 μg Fe/L	+ Fe
Control + 1.0 mg EDTA/L + 0.05 mg P/L	Control + EDTA + P	+ EDTA + P
Control + 1.0 mg EDTA/L + 1.0 mg N/L	Control + EDTA + N	+ EDTA + N
Control + 1.0 mg EDTA/L + 0.05 mg P/L + 1.0 mg N/L	Control + EDTA + P + N	+ EDTA + P + N
Control + 1.0 mg EDTA/L + 200 μg Fe/L	Control + EDTA + 200 μg Fe/L	+ EDTA + Fe
Control + 0.05 mg P/L + 1.0 mg N/L	Control + P + N	+ P + N
Control + 1.0 mg EDTA/L + 1.0 mg N/L + 200 μg Fe/L	Control + EDTA + N + 200 μg Fe/L	+ EDTA + N + Fe
Control + 1.0 mg EDTA/L + 0.05 mg P/L + 200 μg Fe/L	Control + EDTA + P + 200 μg Fe/L	+ EDTA + P + Fe
Control + 1.0 mg EDTA/L + 1.0 mg N/L + 0.05 mg P/L + Trace Metals *	Control + EDTA + N + P + Trace Metals	+ EDTA + N + P + T.M.

*Refer to Table 2 for the concentrations and identity of the trace metals

approximately 1000 cells/ml. The flasks were plugged with sterile foam plugs (Identi-plugs, Jaece Industries Inc.).

The cultures were incubated at 24 $\pm$ 2 C and continuously illuminated at 4306 $\pm$ 10% lm/m^2 (400 ft-c; lm=lumens) in a Lab-line Environ 3597 environmental chamber. Illumination was provided by Vita-Lite (Duro-Test Corp.) fluorescent tubes. The flasks were continuously shaken at 100 rpm.

The cultures were monitored daily by measuring the in vivo fluorescence with a Turner Fluorometer. The culture was shaken and a sub-sample was poured into a sterile cuvette. The fluorescence reading was measured and the sample was returned to the original culture. After 14 days or when the stationary phase of growth was reached (ie.: when the daily increase in chlorophyll content as measured in relative fluorescence units was $\leq$5%), the cell density was determined and the algal assay was terminated. For algal assays conducted prior to June 1982, the final cell density was determined using a haemocytometer. For algal assays conducted in June 1982 to September 1982, cell density was measured with a Model ZB1 Coulter Electronic Particle Counter. Isoton II electrolyte solution (Coulter Electronics) was used to dilute the culture for Coulter Counter measurements.

For algal assays conducted in June, August, and September of 1982, the mean cell volume of each culture was determined with the Coulter Model MHR. The Coulter Counter was calibrated with 4.91-μm latex microspheres. For these three algal assays, it was possible to calculate the dry weight yield of S. capricornutum in each culture by the following calculation (Miller et al., 1978):

$$\text{mg dry weight} = \text{cell counts (cells/ml)} \times \text{MCV} \times 3.61 \times 10^{-7}$$

where, MCV = mean cell volume (μm^3/cell)
3.61×10^{-7} = calculated dry wt ($\mu g/\mu m^3$) of S. capricornutum, as determined below.

c. Determination of Dry Weight per Volume S. capricornutum

Two cultures of S. capricornutum were grown in AAP medium to the late logarithmic phase of growth. The cultures were shaken and the cell densities (cells/ml) and mean cell volumes (μm^3/cell) were determined using the Coulter Counter.

Measured volumes of each culture were filtered onto pre-dried and pre-weighed Millipore HA filters. These filters were then dried at 60-65 C in an oven, cooled in a dessicator for 24 hours, and weighed. The following equation was used to calculate the dry weight of S. capricornutum per volume of algae ($\mu g/\mu m^3$):

$$\text{dry wt. } (\mu g/\mu m^3) = \frac{DW}{VF \times CD \times MCV}$$

where, DW = dry weight of algae on filter (μg)
VF = volume filtered (ml)
CD = cell density (cells/ml)
MCV = mean cell volume (μm^3/cell)

d. Concentrations of Metals and Nutrients in the Prepared Sample Water

For assays conducted prior to 1982, subsamples for chemical analysis were removed after the filtration step. For assays conducted in 1982, subsamples were removed from each sample just prior to their distribution into culture flasks (i.e., after pH adjustment of sample water). These subsamples were analysed for the following: orthophosphate, total dissolved phosphorus, nitrate/nitrite, ammonia, total dissolved nitrogen, dissolved Zn, Cu, Fe, Mn, Cd, Pb, Ni and Hg. The procedures used for the analyses are described in the chemical methods section.

In February 1980, March 1980, and June 1982, the concentrations of metals and nutrients in the water were measured at various stages of the laboratory procedures to test for possible changes at each stage. Samples were taken:

- before autoclaving
- after filtration without autoclaving
- after autoclaving
- after autoclaving and CO_2 aeration
- after autoclaving and filtration without CO_2 aeration
- after autoclaving, CO_2 aeration, and filtration
- after autoclaving, CO_2 aeration, filtration, and pH adjustment.

VI. RESULTS

A. Algal Assay Results

The algal assay data are presented in chronological order. The algal growth data for assays conducted in February 1980 and March 1980 are not presented in this report because the algal assay techniques had not been perfected and the growth data were suspect. Data on the concentrations of chemicals in the water, however, are presented. These chemical data are included because these data are used to evaluate the effect of the pre-assay treatment on the concentrations of chemicals in the water.

For each assay, the data are presented in the following order:

1) Table on the concentrations of chemcials in the water and Cominco effluent (this water has not been treated at the laboratory).
2) Table on the concentrations of chemicals in the water and Cominco effluent at various stages or one stage of pre-assay laboratory preparation.
3) Table on the daily *in vivo* chlorophyll *a* readings (expressed as relative fluorometer units).
4) Figures graphing the algal growth as daily *in vivo* chlorophyll *a* readings. These graphs are based on the data presented in the table described in item (3), above.
5) Table on the final yield of each algal assay treatment.

The analytical procedures and associated NAQUADAT method number for the parameters listed in the report are consistent for each parameter. For example, the orthophosphorus analytical procedure identified as 15256 (phosphorus dissolved ortho PO4) for the water samples at Birchbank and Waneta on February 14, 1980 (Table 6) is the same analytical procedure used for the analysis of orthophosphorus in Tables 7a and 7b.

When the concentration of a chemical was recorded as less than detection limit (L), the limit of detection was used as the value in the calculation of mean and standard deviation. In the tables, S.D. = standard deviation; G.F. = geometric factor or standard deviation of the geometric mean.

TABLE 6

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER
ON FEBRUARY 14, 1980. CONCENTRATIONS OF ALL
CHEMICALS EXCEPT HG ARE REPORTED IN mg/L;
HG IS IN μg/L. PARAMETERS ARE LISTED UNDER
THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-02-14

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.004	.003	.003	.003	.001	.003	1.1807
15102	PHOSPHORUS TOTAL DISSOLVED	.004	.003	.002	.003	.001	.003	1.4166
15406	PHOSPHORUS TOTAL	.005	.005	.005	.005	.000	.005	1.0000
07110	NITROGEN DISSOLVED NO3 & NO2	.140	.139	.139	.139	.001	.139	1.0041
07557	NITROGEN DISSOLVED AMMONIA	.010	.007	.008	.008	.002	.008	1.1975
07655	NITROGEN TOTAL DISSOLVED	.185	.180	.200	.188	.010	.188	1.0562
07903	NITROGEN PARTICULATE	.010	.014	.014	.013	.002	.013	1.2144
30105	ZINC DISSOLVED	.003	L.001	L.001	*.002	.001	*.001	1.8857
30305	ZINC EXTRBLE.	.001	.002	.001	.001	.001	.001	1.4921
29105	COPPER DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
29305	COPPER EXTRBLE.	.001	.002	L.001	*.001	.001	*.001	1.4921
26105	IRON DISSOLVED	.002	.001	.001	.001	.001	.001	1.4921
26305	IRON EXTRBLE.	.008	.008	.008	.008	.000	.008	1.0000
25105	MANGANESE DISSOLVED	.002	.002	.002	.002	.000	.002	1.0000
25305	MANGANESE EXTRBLE.	.005	.005	.005	.005	.000	.005	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0002	.0002	.0002	.0002	.0000	.0002	1.0000
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
02011	COLOUR APPARENT	5.			5.		5.	
02041	SPECIFIC CONDUCT.	140.0			140.0		140.0	
02061	TEMP. WATER ,LAB	19.4			19.4		19.4	
02073	TURBIDITY	1.00			1.00		1.00	
06001	CARBON TOTAL ORGANIC	L2.1			L2.1		L2.1	
06051	CARBON TOTAL INORGANIC	15.0			15.0		15.0	
06903	CARBON PARTICULATE	.120	.162	.167	.150	.026	.148	1.2004
09106	FLUORIDE DISSOLVED	.099			.099		.099	
10101	ALKALINITY TOTAL	59.4			59.4		59.4	
10151	ALKALINITY PHENOL PHTHALEIN	.0			.0			
10301	PH	7.9			7.9		7.9	
10401	RESIDUE NONFILTR.	L10.			L10.		L10.	
10451	RESIDUE FILTERABLE	91.			91.		91.	
10501	RESIDUE FIXED NONFILTR.	L10.			L10.		L10.	
10551	RESIDUE FIXED FILTERABLE	80.			80.		80.	
10603	HARDNESS TOTAL	68.5			68.5		68.5	
11103	SODIUM DISSOLVED	1.3			1.3		1.3	
12101	MAGNESIUM DISSOLVED (CALCD.)	11.7			11.7		11.7	
14105	SILICA REACTIVE	3.9			3.9		3.9	
16306	SULPHATE DISSOLVED	10.9			10.9		10.9	
17206	CHLORIDE DISSOLVED	.8			.8		.8	
19103	POTASSIUM DISSOLVED	.7			.7		.7	
20101	CALCIUM DISSOLVED	8.2			8.2		8.2	

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-02-14

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.033	.033	.033	.033	.000	.033	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.034	.036	.035	.035	.001	.035	1.0290
15406	PHOSPHORUS TOTAL	.040	.041	.040	.040	.001	.040	1.0144
07110	NITROGEN DISSOLVED NO3 & NO2	.168	.144	.142	.151	.014	.151	1.0978
07557	NITROGEN DISSOLVED AMMONIA	.033	.033	.032	.033	.001	.033	1.0179
07655	NITROGEN TOTAL DISSOLVED	.278	.218	.213	.236	.036	.235	1.1590
07903	NITROGEN PARTICULATE	.015	.015	.017	.016	.001	.016	1.0749
30105	ZINC DISSOLVED	.011	.006	.002	.006	.005	.005	2.3730
30305	ZINC EXTRBLE.	.029	.015	.020	.021	.007	.021	1.3917
29105	COPPER DISSOLVED	.003	.008	.003	.005	.003	.004	1.7617
29305	COPPER EXTRBLE.	.003	.002	.003	.003	.001	.003	1.2638
26105	IRON DISSOLVED	.003	.002	.001	.002	.001	.002	1.7429
26305	IRON EXTRBLE.	.032	.013	.016	.020	.010	.019	1.6027
25105	MANGANESE DISSOLVED	.004	.004	.003	.004	.001	.004	1.1807
25305	MANGANESE EXTRBLE.	.014	.008	.009	.010	.003	.010	1.3432
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	.008	.007	.007	.007	.001	.007	1.0801
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0004	.0004	.0004	.0004	.0000	.0004	1.0000
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
02011	COLOUR APPARENT	L5.			L5.		L5.	
02041	SPECIFIC CONDUCT.	153.0			153.0		153.0	
02061	TEMP. WATER ,LAB	19.5			19.5		19.5	
02073	TURBIDITY	1.00			1.00		1.00	
06001	CARBON TOTAL ORGANIC	L2.1			L2.1		L2.1	
06051	CARBON TOTAL INORGANIC	15.0			15.0		15.0	
06903	CARBON PARTICULATE	.149	.154	.187	.163	.021	.162	1.1306
09106	FLUORIDE DISSOLVED	.152			.152		.152	
10101	ALKALINITY TOTAL	59.4			59.4		59.4	
10151	ALKALINITY PHENOL PHTHALEIN	.0			.0			
10301	PH	7.8			7.8		7.8	
10401	RESIDUE NONFILTR.	L10.			L10.		L10.	
10451	RESIDUE FILTERABLE	102.			102.		102.	
10501	RESIDUE FIXED NONFILTR.	L10.			L10.		L10.	
10551	RESIDUE FIXED FILTERABLE	86.			86.		86.	
10603	HARDNESS TOTAL	73.0			73.0		73.0	
11103	SODIUM DISSOLVED	1.4			1.4		1.4	
12101	MAGNESIUM DISSOLVED (CALCD.)	4.2			4.2		4.2	
14105	SILICA REACTIVE	3.9			3.9		3.9	
16306	SULPHATE DISSOLVED	15.6			15.6		15.6	
17206	CHLORIDE DISSOLVED	.8			.8		.8	
19103	POTASSIUM DISSOLVED	.6			.6		.6	
20101	CALCIUM DISSOLVED	22.3			22.3		22.3	

TABLE 7a.

Concentrations (mg/L) of orthophosphate and metals in water from Birchbank at various stages of preparation for the February 1980 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Untreated							
Orthophosphate	0.003	0.003	0.003	0.003	0.0	0.003	1.0000
Extractable Zn	0.001	L0.001	0.002	0.001	0.001	0.001	1.4923
Extractable Cu	0.005	0.001	0.014	0.007	0.007	0.004	3.7815
Extractable Fe	0.007	0.011	0.005	0.008	0.003	0.007	1.4853
Extractable Mn	0.005	0.006	0.006	0.006	0.001	0.006	1.1109
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Filtered Only							
Orthophosphate	0.004	0.004	0.003	0.004	0.001	0.004	1.1810
Dissolved Zn	0.002	0.001	0.003	0.002	0.001	0.002	1.7430
Dissolved Cu	0.003	0.006	0.007	0.005	0.002	0.005	1.5704
Dissolved Fe	0.003	0.002	0.003	0.003	0.001	0.003	1.2639
Dissolved Mn	0.004	0.003	0.004	0.004	0.001	0.004	1.1810
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved							
Orthophosphate	0.005	0.004	0.004	0.004	0.001	0.004	1.1377
Extractable Zn	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Cu	0.004	0.004	0.001	0.003	0.002	0.002	2.2265
Extractable Fe	0.001	0.001	0.002	0.001	0.001	0.001	1.4923
Extractable Mn	0.003	0.004	0.003	0.003	0.001	0.003	1.1808
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 7a. (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Autoclaved and Aerated with CO_2							
Orthophosphate	0.005	0.005	0.005	0.005	0.0	0.005	1.0000
Extractable Zn	L0.001	0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Cu	0.002	0.001	0.002	0.002	0.001	0.002	1.4922
Extractable Fe	0.002	0.002	L0.001	0.002	0.001	0.002	1.4922
Extractable Mn	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved and Filtered, without CO_2 Aeration							
Orthophosphate	0.005	0.005	0.005	0.005	0.0	0.005	1.0000
Dissolved Zn	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.005	0.002	0.001	0.003	0.002	0.002	2.2419
Dissolved Fe	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Mn	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved, Aerated with CO_2, and Filtered							
Orthophosphate	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Dissolved Zn	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Fe	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Mn	0.002	0.001	0.002	0.002	0.001	0.002	1.4922
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 7b.

Concentrations (mg/L) of orthophosphate and metals in water from Waneta at various stages of preparation for the February 1980 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Untreated							
Orthophosphate	0.034	0.034	0.034	0.034	0.0	0.034	1.0000
Extractable Zn	0.012	0.013	0.018	0.014	0.003	0.014	1.2395
Extractable Cu	0.004	0.004	0.007	0.005	0.002	0.005	1.3814
Extractable Fe	0.006	0.006	0.006	0.006	0.0	0.006	1.0000
Extractable Mn	0.007	0.007	0.007	0.007	0.0	0.007	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	0.003	0.002	0.004	0.003	0.001	0.003	1.4166
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Filtered Only							
Orthophosphate	0.035	0.035	0.035	0.035	0.0	0.035	1.0000
Dissolved Zn	0.010	0.012	0.013	0.012	0.002	0.012	1.1439
Dissolved Cu	0.002	0.004	0.006	0.004	0.002	0.004	1.7430
Dissolved Fe	0.001	0.002	0.003	0.002	0.001	0.002	1.7430
Dissolved Mn	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Ni	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Autoclaved							
Orthophosphate	0.038	0.038	0.038	0.038	0.0	0.038	1.0000
Extractable Zn	0.009	0.013	0.010	0.011	0.002	0.010	1.2084
Extractable Cu	0.005	0.007	0.006	0.006	0.001	0.006	1.1834
Extractable Fe	0.002	0.009	0.003	0.005	0.004	0.004	2.1777
Extractable Mn	0.005	0.005	0.004	0.005	0.001	0.005	1.1375
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	0.004	0.006	0.004	0.005	0.001	0.005	1.2639
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 7b. (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Autoclaved and Aerated with CO_2							
Orthophosphate	0.037	0.037	0.037	0.037	0.0	0.037	1.0000
Extractable Zn	0.010	0.012	0.011	0.011	0.001	0.011	1.0954
Extractable Cu	0.003	0.004	0.004	0.004	0.001	0.004	1.1810
Extractable Fe	0.004	0.004	0.003	0.004	0.001	0.004	1.1810
Extractable Mn	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved and Filtered, without CO_2 Aeration							
Orthophosphate	0.038	0.038	0.038	0.038	0.0	0.038	1.0000
Dissolved Zn	0.005	0.010	0.007	0.007	0.002	0.007	1.4143
Dissolved Cu	0.004	0.004	0.002	0.003	0.001	0.003	1.4921
Dissolved Fe	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Dissolved Mn	0.003	0.003	0.003	0.003	0.0	0.003	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	0.002	0.003	0.002	0.001	0.002	1.7430
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved, Aerated with CO_2, and Filtered							
Orthophosphate	0.037	0.037	0.037	0.037	0.0	0.037	1.0000
Dissolved Zn	0.010	0.011	0.011	0.011	0.001	0.011	1.0565
Dissolved Cu	0.002	0.004	0.001	0.002	0.002	0.002	2.0001
Dissolved Fe	0.001	L0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Mn	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	0.002	0.003	0.002	0.001	0.002	1.2638
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 8

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON MARCH 26, 1980. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-03-26

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.006	.005	.005	.005	.001	.005	1.1110
15102	PHOSPHORUS TOTAL DISSOLVED	.003	.003	.003	.003	.000	.003	1.0000
15406	PHOSPHORUS TOTAL	.012	.007	.007	.009	.003	.008	1.3650
07110	NITROGEN DISSOLVED NO3 & NO2	.118	.117	.116	.117	.001	.117	1.0086
07557	NITROGEN DISSOLVED AMMONIA	.022	.016	.019	.019	.003	.019	1.1728
07655	NITROGEN TOTAL DISSOLVED	.192	.187	.204	.194	.009	.194	1.0456
07903	NITROGEN PARTICULATE	.014	.011	L.005	*.010	.005	*.009	1.7134
30105	ZINC DISSOLVED	.002	.003	.002	.002	.001	.002	1.2638
30305	ZINC EXTRBLE.	.001	.002	.003	.002	.001	.002	1.7429
29105	COPPER DISSOLVED	.005	.006	.003	.005	.002	.004	1.4323
29305	COPPER EXTRBLE.	L.001	L.001	.002	*.001	.001	*.001	1.4921
26105	IRON DISSOLVED	.005	.003	.003	.004	.001	.004	1.3430
26305	IRON EXTRBLE.	.010	.010	.010	.010	.000	.010	1.0000
25105	MANGANESE DISSOLVED	.004	.004	.004	.004	.000	.004	1.0000
25305	MANGANESE EXTRBLE.	.006	.006	.006	.006	.000	.006	1.0000
48102	CADMIUM DISSOLVED	L.0005	.0011	L.0005	*.0007	.0003	*.0007	1.5765
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0003	.0003	.0003	.0003	.0000	.0003	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
02011	COLOUR APPARENT	5.	5.	L5.	*5.	0.	*5.	1.0000
02041	SPECIFIC CONDUCT.	151.0	152.0	152.0	151.7	.6	151.7	1.0038
02061	TEMP. WATER ,LAB	21.9	21.9	21.9	21.9	.0	21.9	1.0000
02073	TURBIDITY	.7	.7	.6	.6	.1	.6	1.1013
06101	CARBON DISSOLVED ORGANIC	15.6	16.3	15.9	15.9	.4	15.9	1.0223
06151	CARBON DISSOLVED INORGANIC	L2.2	L2.3	L2.2	L2.2	.1	L2.2	1.0260
06903	CARBON PARTICULATE	.141	.138	.185	.155	.026	.153	1.1775
09106	FLUORIDE DISSOLVED	.096	.092	.092	.093	.002	.093	1.0249
10101	ALKALINITY TOTAL	63.3	63.7	63.4	63.5	.2	63.5	1.0033
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	8.0	8.0	8.0	8.0	.0	8.0	1.0000
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	78.	91.	82.	84.	7.	83.	1.0818
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	60.	75.	74.	70.	8.	69.	1.1333
10603	HARDNESS TOTAL	74.2	72.0	72.2	72.8	1.2	72.8	1.0168
11103	SODIUM DISSOLVED	2.2	2.1	2.1	2.1	.1	2.1	1.0272
12101	MAGNESIUM DISSOLVED (CALCD.)	4.7	4.4	4.3	4.5	.2	4.5	1.0473
14105	SILICA REACTIVE	4.2	4.2	4.2	4.2	.0	4.2	1.0000
16306	SULPHATE DISSOLVED	12.0	11.8	11.7	11.8	.2	11.8	1.0130
17206	CHLORIDE DISSOLVED	1.3	1.2	1.2	1.2	.1	1.2	1.0473
19103	POTASSIUM DISSOLVED	.7	.6	.6	.6	.1	.6	1.0931
20101	CALCIUM DISSOLVED	21.9	21.6	21.8	21.8	.2	21.8	1.0071

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-03-26

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.185	.186	.186	.186	.001	.186	1.0031
15102	PHOSPHORUS TOTAL DISSOLVED	.187	.183	.182	.184	.003	.184	1.0144
15406	PHOSPHORUS TOTAL	.186	.187	.188	.187	.001	.187	1.0054
07110	NITROGEN DISSOLVED NO3 & NO2	.132	.133	.133	.133	.001	.133	1.0044
07557	NITROGEN DISSOLVED AMMONIA	.162	.157	.161	.160	.003	.160	1.0167
07655	NITROGEN TOTAL DISSOLVED	.374	.371	.381	.375	.005	.375	1.0137
07903	NITROGEN PARTICULATE	.016	.018	.017	.017	.001	.017	1.0607
30104	ZINC DISSOLVED	.07	.07	.07	.07	.00	.07	1.0000
30304	ZINC EXTRBL.	.07	.07	.07	.07	.00	.07	1.0000
29105	COPPER DISSOLVED	.006	.006	.006	.006	.000	.006	1.0000
29305	COPPER EXTRBLE.	.007	.006	.005	.006	.001	.006	1.1834
26105	IRON DISSOLVED	.006	.008	.004	.006	.002	.006	1.4166
26305	IRON EXTRBLE.	.019	.018	.022	.020	.002	.020	1.1094
25105	MANGANESE DISSOLVED	.011	.011	.011	.011	.000	.011	1.0000
25305	MANGANESE EXTRBLE.	.012	.012	.013	.012	.001	.012	1.0473
48102	CADMIUM DISSOLVED	.0007	.0006	.0007	.0007	.0001	.0007	1.0931
48302	CADMIUM EXTRBLE.	.0007	.0006	.0006	.0006	.0001	.0006	1.0931
82103	LEAD DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
82302	LEAD EXTRBLE.	.009	.009	.009	.009	.000	.009	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	.10	.10	.10	.10	.00	.10	1.0000
33304	ARSENIC EXTRBLE.	.0009	.0009	.0009	.0009	.0000	.0009	1.0000
34302	SELENIUM EXTRBLE.	.0002	.0002	.0002	.0002	.0000	.0002	1.0000
02011	COLOUR APPARENT	5.	L5.	L5.	*5.	0.	*5.	1.0000
02041	SPECIFIC CONDUCT.	172.0	172.0	172.0	172.0	.0	172.0	1.0000
02061	TEMP. WATER ,LAB	21.9	21.7	21.8	21.8	.1	21.8	1.0046
02073	TURBIDITY	.9	.9	1.0	.9	.1	.9	1.0847
06101	CARBON DISSOLVED ORGANIC	15.2	15.6	15.6	15.5	.2	15.5	1.0151
06151	CARBON DISSOLVED INORGANIC	L2.3	L2.3	L2.1	L2.2	.1	L2.2	1.0539
06903	CARBON PARTICULATE	.171	.187	.172	.177	.009	.177	1.0513
09106	FLUORIDE DISSOLVED	.257	.250	.240	.249	.009	.249	1.0350
10101	ALKALINITY TOTAL	61.9	61.9	61.1	61.6	.5	61.6	1.0075
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.7	7.7	7.7	7.7	.0	7.7	1.0000
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	102.	114.	105.	107.	6.	107.	1.0594
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	73.	102.	98.	91.	16.	90.	1.2004
10603	HARDNESS TOTAL	61.6	82.7	83.2	75.8	12.3	75.1	1.1875
11103	SODIUM DISSOLVED	1.9	1.9	1.9	1.9	.0	1.9	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)		4.7	5.4	5.1	.5	5.0	1.1032
14105	SILICA REACTIVE	4.5	4.5	4.1	4.4	.2	4.4	1.0552
16306	SULPHATE DISSOLVED	21.0	21.0	21.0	21.0	.0	21.0	1.0000
17206	CHLORIDE DISSOLVED	1.5	1.5	1.4	1.5	.1	1.5	1.0406
19103	POTASSIUM DISSOLVED	.6	.6	.6	.6	.0	.6	1.0000
20101	CALCIUM DISSOLVED	25.4	25.3	24.4	25.0	.6	25.0	1.0224

TABLE 9a.

Concentrations (mg/L) of nutrients and dissolved metals in water from Birchbank at two stages of preparation for the March 1980 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Filtered Only							
Orthophosphate	0.006	0.005	0.005	0.005	0.001	0.005	1.1110
Nitrate plus Nitrite	0.113	0.113	0.113	0.113	0.0	0.113	1.0000
Ammonia	0.013	0.012	0.012	0.012	0.001	0.012	1.0472
Total Dissolved Nitrogen	0.176	0.171	0.171	0.173	0.003	0.173	1.0168
Dissolved Zn	0.001	0.001	0.002	0.001	0.001	0.001	1.4923
Dissolved Cu	0.001	0.002	0.009	0.004	0.004	0.003	3.0750
Dissolved Fe	0.005	0.004	0.008	0.006	0.002	0.005	1.4245
Dissolved Mn	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	0.002	0.001	0.001	0.001	1.4923
Dissolved Ni	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Autoclaved, Aerated with CO_2, and Filtered							
Orthophosphate	0.007	0.006	0.006	0.006	0.001	0.006	1.0930
Nitrate plus Nitrite	0.121	0.121	0.122	0.121	0.001	0.121	1.0045
Ammonia	0.015	0.014	0.016	0.015	0.001	0.015	1.0690
Total Dissolved Nitrogen	0.191	0.216	0.198	0.202	0.013	0.201	1.0653
Dissolved Zn	0.002	0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Cu	0.003	0.001	0.001	0.002	0.001	0.001	1.8857
Dissolved Fe	0.004	0.002	0.002	0.003	0.001	0.002	1.4922
Dissolved Mn	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 9b.

Concentrations (mg/L) of nutrients and dissolved metals in water from Waneta at two stages of preparation for the March 1980 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Filtered Only							
Orthophosphate	0.181	0.181	0.182	0.181	0.001	0.181	1.0032
Nitrate plus Nitrite	0.131	0.130	0.130	0.130	0.001	0.130	1.0042
Ammonia	0.150	0.152	0.156	0.153	0.004	0.153	1.0237
Total Dissolved Nitrogen	0.355	0.355	0.360	0.357	0.003	0.357	1.0081
Dissolved Zn	0.06	0.06	0.06	0.06	0.0	0.06	1.0000
Dissolved Cu	0.006	0.005	0.004	0.005	0.001	0.005	1.2251
Dissolved Fe	0.014	0.004	0.005	0.008	0.006	0.006	1.9508
Dissolved Mn	0.010	0.010	0.010	0.010	0.0	0.010	1.0000
Dissolved Cd	0.0006	0.0006	0.0007	0.0006	0.0001	0.0006	1.0937
Dissolved Pb	0.002	0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved, Aerated with CO_2, and Filtered							
Orthophosphate	0.190	0.191	0.192	0.191	0.001	0.191	1.0051
Nitrate plus Nitrite	0.136	0.136	0.136	0.136	0.0	0.136	1.0000
Ammonia	0.114	0.108	0.110	0.111	0.003	0.111	1.0279
Total Dissolved Nitrogen	0.310	0.310	0.316	0.312	0.004	0.312	1.0111
Dissolved Zn	0.06	0.06	0.06	0.06	0.00	0.06	1.0000
Dissolved Cu	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Fe	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Mn	0.010	0.010	0.010	0.010	0.0	0.010	1.0000
Dissolved Cd	0.0012	0.0006	0.0006	0.0008	0.0003	0.0008	1.4921
Dissolved Pb	0.004	0.001	0.001	0.002	0.002	0.002	2.2265
Dissolved Ni	0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 10

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER
ON JULY 22, 1980. CONCENTRATIONS OF ALL
CHEMICALS EXCEPT HG ARE REPORTED IN mg/L;
HG IS IN μg/L. PARAMETERS ARE LISTED UNDER
THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-07-22

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.001	L.001	L.001	*.001	.000	*.001	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.003	.003	.002	.003	.001	.003	1.2638
15406	PHOSPHORUS TOTAL	.005	.007	.009	.007	.002	.007	1.3430
07110	NITROGEN DISSOLVED NO3 & NO2	.105	.128	.136	.123	.016	.122	1.1449
07557	NITROGEN DISSOLVED AMMONIA	.006	.012	.010	.009	.003	.009	1.4323
07655	NITROGEN TOTAL DISSOLVED	.192	.218	.220	.210	.016	.210	1.0791
07903	NITROGEN PARTICULATE	.034	.035	.032	.034	.002	.034	1.0468
30104	ZINC DISSOLVED		.04	.04	.04	.00	.04	1.0000
30105	ZINC DISSOLVED	.005			.005		.005	
30305	ZINC EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29105	COPPER DISSOLVED	.001	.003	.004	.003	.002	.002	2.0784
29305	COPPER EXTRBLE.	.001	L.001	L.001	*.001	.000	*.001	1.0000
26105	IRON DISSOLVED	.004	.004	.004	.004	.000	.004	1.0000
26305	IRON EXTRBLE.	.014	.008	.007	.010	.004	.009	1.4445
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	.01	.01	.01	.01	.00	.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	L.0001	.0001	.0001	*.0001	.0000	*.0001	1.0000
34302	SELENIUM EXTRBLE.	.0001	L.0001	L.0001	*.0001	.0000	*.0001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	117.0	117.0	117.0	117.0	.0	117.0	1.0000
02061	TEMP. WATER ,LAB	21.0	21.1	21.9	21.3	.5	21.3	1.0232
02073	TURBIDITY	.41	.58	.53	.51	.09	.50	1.1972
06001	CARBON TOTAL ORGANIC	L1.7	L1.7	2.6	*2.0	.5	*2.0	1.2780
06051	CARBON TOTAL INORGANIC	12.0	13.0	12.0	12.3	.6	12.3	1.0473
06101	CARBON DISSOLVED ORGANIC	2.3	2.3	1.9	2.2	.2	2.2	1.1166
06151	CARBON DISSOLVED INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06903	CARBON PARTICULATE	.260	.270	.274	.268	.007	.268	1.0274
09106	FLUORIDE DISSOLVED	.082	.081	.081	.081	.001	.081	1.0071
10101	ALKALINITY TOTAL	47.3	47.3	47.4	47.3	.1	47.3	1.0012
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.9	7.9	7.9	7.9	.0	7.9	1.0000
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	73.	78.	78.	76.	3.	76.	1.0390
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	72.	59.	65.	65.	7.	65.	1.1047
10603	HARDNESS TOTAL	56.4	56.4	56.0	56.3	.2	56.3	1.0041
11103	SODIUM DISSOLVED	1.3	1.3	1.3	1.3	.0	1.3	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.2	2.9	2.8	3.0	.2	3.0	1.0717
14105	SILICA REACTIVE	4.1	4.1	4.1	4.1	.0	4.1	1.0000
16306	SULPHATE DISSOLVED	8.5	8.5	8.5	8.5	.0	8.5	1.0000
17206	CHLORIDE DISSOLVED	.7	.7	.7	.7	.0	.7	1.0000
19103	POTASSIUM DISSOLVED	.5	.5	.6	.5	.1	.5	1.1110
20101	CALCIUM DISSOLVED	17.3	17.8	17.8	17.6	.3	17.6	1.0166

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-07-22

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.002	.001	.001	.001	.000	.001	1.2638
15102	PHOSPHORUS TOTAL DISSOLVED	.004	.002	.001	.002	.001	.002	1.8950
15406	PHOSPHORUS TOTAL	.008	.009		.009	.001	.008	1.0869
07110	NITROGEN DISSOLVED NO3 & NO2	.092	.099	.108	.100	.008	.099	1.0836
07557	NITROGEN DISSOLVED AMMONIA	.021	.022	.023	.022	.001	.022	1.0465
07655	NITROGEN TOTAL DISSOLVED	.188	.192	.190	.190	.002	.190	1.0106
07903	NITROGEN PARTICULATE	.033	.038	.036	.036	.003	.036	1.0738
30104	ZINC DISSOLVED	.04	.04	.03	.04	.01	.04	1.1807
30304	ZINC EXTRBL.	.04	.04	.05	.04	.01	.04	1.1375
29105	COPPER DISSOLVED	.001	.003	.002	.002	.001	.002	1.7429
29305	COPPER EXTRBLE.	.002	.002	.002	.002	.000	.002	1.0000
26105	IRON DISSOLVED	.003	.002	.006	.004	.002	.003	1.7429
26305	IRON EXTRBLE.	.009	.015	.018	.014	.005	.013	1.4323
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	.02	.02	.01	.02	.01	.02	1.4921
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	.0006	L.0005	*.0005	.0001	*.0005	1.1110
82103	LEAD DISSOLVED	.001	.001	L.001	*.001	.000	*.001	1.0000
82302	LEAD EXTRBLE.	.003	.006	.007	.005	.002	.005	1.5704
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	.001	L.001	*.001	.000	*.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0001	.0002	.0001	.0001	.0001	.0001	1.4921
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	118.0	119.0	118.0	118.3	.6	118.3	1.0049
02061	TEMP. WATER ,LAB	21.5	21.7	21.4	21.5	.2	21.5	1.0071
02073	TURBIDITY	.52	.54	.52	.53	.01	.53	1.0220
06001	CARBON TOTAL ORGANIC	L1.6	L1.7	L1.8	L1.7	.1	L1.7	1.0607
06051	CARBON TOTAL INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06101	CARBON DISSOLVED ORGANIC	L1.7	L1.7	2.3	*1.9	.3	*1.9	1.1907
06151	CARBON DISSOLVED INORGANIC	11.0	12.0	12.0	11.7	.6	11.7	1.0515
06903	CARBON PARTICULATE	.250	.266	.255	.257	.008	.257	1.0322
09106	FLUORIDE DISSOLVED	.094	.092	.091	.092	.002	.092	1.0166
10101	ALKALINITY TOTAL	46.6	46.6	46.8	46.7	.1	46.7	1.0025
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.7	7.7	7.8	7.7	.1	7.7	1.0075
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	74.	77.	80.	77.	3.	77.	1.0398
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	74.	69.	58.	67.	8.	67.	1.1336
10603	HARDNESS TOTAL	56.4	57.4	57.2	57.0	.5	57.0	1.0093
11103	SODIUM DISSOLVED	1.3	1.3	1.3	1.3	.0	1.3	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.0	3.2	2.6	2.9	.3	2.9	1.1121
14105	SILICA REACTIVE	4.1	4.1	4.1	4.1	.0	4.1	1.0000
16306	SULPHATE DISSOLVED	11.0	10.0	9.5	10.2	.8	10.1	1.0772
17206	CHLORIDE DISSOLVED	.7	.7	.7	.7	.0	.7	1.0000
19103	POTASSIUM DISSOLVED	.5	.5	.5	.5	.0	.5	1.0000
20101	CALCIUM DISSOLVED	17.6	17.7	18.6	18.0	.6	18.0	1.0309

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-07-22

STATION NO.: 20BC08NE0001
COMINCO SEWER #8, TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.048	.053	.056	.052	.004	.052	1.0812
15102	PHOSPHORUS TOTAL DISSOLVED	.090	.061	.075	.075	.015	.074	1.2148
15406	PHOSPHORUS TOTAL	.160	.050	.050	.087	.064	.074	1.9573
07110	NITROGEN DISSOLVED NO3 & NO2	L.002	L.002	L.002	L.002	.000	L.002	1.0000
07557	NITROGEN DISSOLVED AMMONIA	51.500	45.000	46.500	47.667	3.403	47.587	1.0729
07655	NITROGEN TOTAL DISSOLVED	59.200	51.800	53.500	54.833	3.876	54.744	1.0722
07903	NITROGEN PARTICULATE	.040			.040		.040	
30104	ZINC DISSOLVED	110.00	120.00	150.00	126.67	20.82	125.57	1.1735
30304	ZINC EXTRBL.	140.00	120.00	170.00	143.33	25.17	141.88	1.1907
29106	COPPER DISSOLVED	.04	.04	.04	.04	.00	.04	1.0000
29306	COPPER EXTRBLE.	1.00	.92	.90	.94	.05	.94	1.0572
26104	IRON DISSOLVED	.54	.62	.59	.58	.04	.58	1.0725
26304	IRON EXTRBLE.	1.30	1.20	1.20	1.23	.06	1.23	1.0473
25104	MANGANESE DISSOLVED	23.00	21.00	27.00	23.67	3.06	23.54	1.1357
25304	MANGANESE EXTRBLE.	28.00	21.00	31.00	26.67	5.13	26.32	1.2238
48102	CADMIUM DISSOLVED	L.002	L.002	L.002	L.002	.000	L.002	1.0000
48302	CADMIUM EXTRBLE.	L.0005	.0006	L.0005	*.0005	.0001	*.0005	1.1110
82101	LEAD DISSOLVED	.22	.23	.25	.23	.02	.23	1.0670
82301	LEAD EXTRBLE.	.32	.26	.23	.27	.05	.27	1.1817
28102	NICKEL DISSOLVED	L.004	L.004	L.004	L.004	.000	L.004	1.0000
28301	NICKEL EXTRBLE.	.02	.03	.02	.02	.01	.02	1.2638
80311	MERCURY EXTRBLE.	.70	.75	.75	.73	.03	.73	1.0406
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	10200.0	12400.0	10500.0	11033.3	1193.0	10991.8	1.1111
02061	TEMP. WATER ,LAB	14.6	14.8	14.1	14.5	.4	14.5	1.0253
02073	TURBIDITY	2.70	2.00	2.20	2.30	.36	2.28	1.1657
06001	CARBON TOTAL ORGANIC	L1.4	3.7	3.2	*2.8	1.2	*2.5	1.6892
06051	CARBON TOTAL INORGANIC	4.8	3.4	3.4	3.9	.8	3.8	1.2203
06101	CARBON DISSOLVED ORGANIC	5.2			5.2		5.2	
06151	CARBON DISSOLVED INORGANIC	.7			.7		.7	
06903	CARBON PARTICULATE	.543			.543		.543	
09106	FLUORIDE DISSOLVED	1.640	.920	1.680	1.413	.428	1.363	1.4062
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10251	ACIDITY PH=8.3	1720.0	2200.0	1770.0	1896.7	263.9	1885.0	1.1441
10301	PH	1.9	1.8	1.8	1.8	.1	1.8	1.0317
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	2700.	3300.	2700.	2900.	346.	2887.	1.1228
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	580.	720.	600.	633.	76.	630.	1.1233
10603	HARDNESS TOTAL	384.0	454.0	384.0	407.3	40.4	406.0	1.1015
11103	SODIUM DISSOLVED	9.0	4.1	4.0	5.7	2.9	5.3	1.5860
12101	MAGNESIUM DISSOLVED (CALCD.)	53.6	100.0	82.7	78.8	23.4	76.2	1.3766
14105	SILICA REACTIVE	5.2	5.1	5.1	5.1	.1	5.1	1.0113
16306	SULPHATE DISSOLVED	2490.0	2225.0	2225.0	2313.3	153.0	2310.0	1.0671
17206	CHLORIDE DISSOLVED	9.1	5.5	5.7	6.8	2.0	6.6	1.3244
19103	POTASSIUM DISSOLVED	6.9	5.5	5.9	6.1	.7	6.1	1.1231
20101	CALCIUM DISSOLVED	65.5	17.0	17.4	33.3	27.9	26.9	2.1644

TABLE 11

Concentrations (mg/L) of nutrients and dissolved metals in water used for the July 1980 algal assay. Water from each site was autoclaved, aerated with CO_2, and filtered before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D. (=G.F.)
Birchbank							
Orthophosphate	0.010	0.010	0.010	0.010	0.000	0.010	1.0283
Nitrate plus Nitrite	0.066	0.067	0.065	0.066	0.001	0.066	1.0152
Ammonia	0.046	0.047	0.047	0.047	0.001	0.047	1.0120
Total Dissolved Nitrogen	0.180	0.185	0.180	0.182	0.003	0.182	1.0160
Dissolved Zn	0.07	0.04	0.28	0.13	0.13	0.092	2.7232
Dissolved Cu	0.002	0.001	0.003	0.002	0.001	0.002	1.7430
Dissolved Fe	0.002	0.002	0.001	0.002	0.001	0.002	1.4922
Dissolved Mn	0.01	0.03	0.05	0.03	0.02	0.02	2.2760
Dissolved Cd	0.0005	L0.0005	0.0034	0.0015	0.0017	0.0009	3.0246
Dissolved Pb	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	0.008	0.009	0.012	0.010	0.002	0.010	1.2319
Waneta							
Orthophosphate	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Nitrate plus Nitrite	0.072	0.072	0.073	0.072	0.001	0.072	1.0078
Ammonia	0.028	0.028	0.031	0.029	0.002	0.029	1.0605
Total Dissolved Nitrogen	0.163	0.163	0.168	0.165	0.003	0.165	1.0176
Dissolved Zn	0.04	0.04	0.04	0.04	0.0	0.04	1.0000
Dissolved Cu	0.006	0.005	0.010	0.007	0.003	0.007	1.4323
Dissolved Fe	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	0.0010	0.0005	0.0005	0.0007	0.0003	0.0006	1.4921
Dissolved Pb	0.005	0.004	0.003	0.004	0.001	0.004	1.2918
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 11 (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Cominco Effluent							
Orthophosphate	0.027	0.028	0.028	0.028	0.001	0.028	1.0210
Nitrate plus Nitrite	0.090	0.080	0.080	0.083	0.006	0.083	1.0703
Ammonia	46.0	42.0	46.0	44.7	2.31	44.6	1.0538
Total Dissolved Nitrogen	55.0	49.0	55.0	53.0	3.46	52.9	1.0689
Dissolved Zn	160.	140.	160.	153.	11.5	153.	1.0800
Dissolved Cu	0.55	0.46	0.58	0.53	0.06	0.53	1.1291
Dissolved Fe	1.2	1.2	1.2	1.2	0.0	1.2	1.0000
Dissolved Mn	30.	26.	30.	29.	2.3	29.	1.0861
Dissolved Cd	L0.002	L0.002	L0.002	L0.002	0.0	L0.002	1.0000
Dissolved Pb	0.38	0.36	0.37	0.37	0.01	0.37	1.0274
Dissolved Ni	0.02	0.02	0.02	0.02	0.0	0.02	1.0000
TED - 135µg Zn/L							
Orthophosphate	0.048	0.058	0.057	0.054	0.006	0.054	1.1135
Nitrate plus Nitrite	0.061			-	-	-	-
Ammonia	0.042			-	-	-	-
Total Dissolved Nitrogen	0.194			-	-	-	-
Dissolved Zn	0.14	0.13		0.14	0.01	0.13	1.0538
Dissolved Cu	0.003	0.003		0.003	0.0	0.003	1.0000
Dissolved Fe	0.005	0.005		0.005	0.0	0.005	1.0000
Dissolved Mn	0.02	0.02		0.02	0.0	0.02	1.0000
Dissolved Cd	0.0006	0.0006		0.0006	0.0	0.0006	1.0000
Dissolved Pb	0.003	0.003		0.003	0.0	0.003	1.0000
Dissolved Ni	0.005	0.006		0.006	0.001	0.00	1.1375

TABLE 12

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE JULY 1980 ALGAL ASSAY

These readings are graphed in Figure 3

Daily Relative Fluorometer Readings
July 24 - August 7, 1980

Birchbank

Control

	Replicates			Mean	S. D.
Day 1	.0026	.0025	.0024	.0025	.0001
Day 4	.0025	.0021	.0023	.0023	.0002
Day 5	.0027	.0021	.0022	.0023	.0003
Day 6	.0024	.0021	.0020	.0022	.0002
Day 7	.0022	.0022	.0020	.0021	.0001
Day 8	.0024	.0020	.0020	.0021	.0002
Day 12	.0019	.0019	.0019	.0019	.0000
Day 13	.0020	.0016	.0016	.0017	.0002
Day 14	.0020	.0016	.0016	.0017	.0002

Control + EDTA

Day 1	.0028	.0028	.0028	.0028	.0000
Day 4	.0049	.0066	.0055	.0057	.0009
Day 5	.0066	.0089	.0060	.0072	.0015
Day 6	.0074	.012	.0073	.0089	.0027
Day 7	.010	.015	.0088	.011	.003
Day 8	.011	.017	.011	.013	.003
Day 12	.013	.019	.014	.015	.003
Day 13	.012	.017	.014	.014	.003
Day 14	.014	.016	.014	.015	.001

Control + 200ug Fe/L

Day 1	.0025	.0025	.0024	.0025	.0001
Day 4	.0032	.0032	.0029	.0031	.0002
Day 5	.0032	.0029	.0028	.0030	.0002
Day 6	.0031	.0028	.0028	.0029	.0002
Day 7	.0032	.0026	.0026	.0028	.0004
Day 8	.0029	.0027	.0024	.0027	.0002
Day 12	.0021	.0022	.0019	.0021	.0002
Day 13	.0021	.0022	.0019	.0021	.0002
Day 14	.0020	.0022	.0018	.0020	.0002

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

Waneta

Control

	Replicates			Mean	S. D.
Day 1	.0028	.0028	.0029	.0028	.0001
Day 4	.0050	.0055	.0053	.0053	.0002
Day 5	.0046	.0059	.0056	.0054	.0007
Day 6	.0048	.0058	.0057	.0054	.0006
Day 7	.0051	.0059	.0056	.0055	.0004
Day 8	.0050	.0059	.0059	.0056	.0005
Day 12	.0026	.0052	.0046	.0041	.0014
Day 13	.0024	.0047	.0042	.0038	.0012
Day 14	.0022	.0040	.0036	.0033	.0010

Control + EDTA

Day 1	.0026	.0026	.0026	.0026	.0000
Day 4	.0093	.0080	.0087	.0087	.0006
Day 5	.010	.0085	.0096	.0094	.0008
Day 6	.011	.0091	.010	.010	.001
Day 7	.011	.0093	.010	.010	.001
Day 8	.012	.010	.010	.011	.001
Day 12	.013	.010	.010	.011	.002
Day 13	.012	.010	.010	.011	.001
Day 14	.013	.010	.010	.011	.002

Control + 200ug Fe/L

Day 1	.0028	.0028	.0027	.0028	.0001
Day 4	.0048	.0046	.0053	.0049	.0004
Day 5	.0045	.0045	.0051	.0047	.0004
Day 6	.0047	.0048	.0049	.0048	.0001
Day 7	.0049	.0049	.0050	.0049	.0001
Day 8	.0052	.0049	.0050	.0050	.0002
Day 12	.0031	.0035	.0030	.0032	.0003
Day 13	.0030	.0034	.0029	.0031	.0003
Day 14	.0026	.0029	.0027	.0027	.0002

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

Waneta

Control + P

	Replicates			Mean	S. D.
Day 1	.0029	.0028	.0029	.0029	.0001
Day 4	.0086	.0064	.0092	.0081	.0015
Day 5	.0089	.0077	.011	.0092	.0017
Day 6	.010	.0089	.012	.010	.002
Day 7	.011	.011	.013	.012	.001
Day 8	.013	.013	.016	.014	.002
Day 12	.023	.021	.028	.024	.004
Day 13	.026	.023	.030	.026	.004
Day 14	.030	.026	.032	.029	.003

Control + N

Day 1	.0028	.0028	.0028	.0028	.0000
Day 4	.0054	.0060	.0055	.0056	.0003
Day 5	.0059	.0066	.0055	.0060	.0006
Day 6	.0054	.0065	.0054	.0058	.0006
Day 7	.0056	.0065	.0058	.0060	.0005
Day 8	.0059	.0067	.0064	.0063	.0004
Day 12	.0059	.0059	.0057	.0058	.0001
Day 13	.0054	.0052	.0058	.0055	.0003
Day 14	.0046	.0046	.0054	.0049	.0005

Control + P + N

Day 1	.0030	.0029	.0029	.0029	.0001
Day 4	.0089	.0084	.0080	.0084	.0004
Day 5	.010	.0093	.0089	.0094	.0006
Day 6	.013	.010	.0095	.011	.002
Day 7	.017	.011	.012	.013	.003
Day 8	.022	.011	.013	.015	.006
Day 12	.077	.019	.024	.040	.032
Day 13	.11	.022	.029	.054	.049
Day 14	.17	.029	.039	.079	.079

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

Waneta

Control + EDTA + P + N

	Replicates			Mean	S. D.
Day 1	.0029	.0028	.0027	.0028	.0001
Day 4	.0082	.0069	.0090	.0080	.0011
Day 5	.012	.010	.016	.013	.003
Day 6	.019	.013	.027	.020	.007
Day 7	.029	.017	.040	.029	.012
Day 8	.044	.023	.056	.041	.017
Day 12	.10	.045	.12	.09	.04
Day 13	.12	.044	.13	.10	.05
Day 14	.12	.050	.13	.10	.04

Control + EDTA + P

Day 1	.0025	.0027	.0028	.0027	.0002
Day 4	.0039	.0040	.0083	.0054	.0025
Day 5	.0045	.0051	.012	.0072	.0042
Day 6	.0038	.0055	.022	.0104	.0100
Day 7	.0045	.0057	.035	.0151	.0173
Day 8	.0042	.0065	.052	.0209	.0270
Day 12	.0039	.0082	.080	.0307	.0428
Day 13	.0040	.0087	.083	.0319	.0443
Day 14	.0046	.0082	.081	.0313	.0431

Control + EDTA + N

Day 1	.0028	.0029	.0026	.0028	.0002
Day 4	.0089	.0075	.0061	.0075	.0014
Day 5	.013	.012	.0081	.011	.003
Day 6	.019	.017	.012	.016	.004
Day 7	.026	.019	.014	.020	.006
Day 8	.032	.022	.014	.023	.009
Day 12	.030	.026	.014	.023	.008
Day 13	.028	.029	.013	.023	.009
Day 14	.024	.028	.014	.022	.007

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

Waneta

Control (using polycarbonate culture flasks)

	Replicates			Mean	S. D.
Day 1	.0027	.0028	.0026	.0027	.0001
Day 4	.0030	.0032	.0033	.0032	.0002
Day 5	.0031	.0039	.0041	.0037	.0005
Day 6	.0030	.0036	.0035	.0034	.0003
Day 7	.0030	.0035	.0036	.0034	.0003
Day 8	.0032	.0035	.0037	.0035	.0002
Day 12	.0031	.0030	.0034	.0032	.0002
Day 13	.0031	.0029	.0038	.0033	.0005
Day 14	.0031	.0029	.0038	.0033	.0005

Control + EDTA (using polycarbonate culture flasks)

Day 1	.0029	.0028	.0029	.0029	.0001
Day 4	.0061	.0055	.0058	.0058	.0003
Day 5	.0076	.0067	.0067	.0070	.0005
Day 6	.0094	.0074	.0076	.0081	.0011
Day 7	.012	.0084	.0088	.0097	.0020
Day 8	.016	.009	.010	.012	.004
Day 12	.030	.013	.014	.019	.010
Day 13	.028	.013	.017	.019	.008
Day 14	.028	.014	.018	.020	.007

TED-135ug Zn/L

Control

Day 1	.0025	.0026	.0028	.0026	.0002
Day 4	.0044	.0042	.0045	.0044	.0002
Day 5	.0055	.0045	.0050	.0050	.0005
Day 6	.0065	.0046	.0055	.0055	.0010
Day 7	.0074	.0050	.0059	.0061	.0012
Day 8	.0078	.0048	.0072	.0066	.0016
Day 12	.0087	.0042	.0067	.0065	.0022
Day 13	.0086	.0049	.0074	.0070	.0019
Day 14	.0086	.0048	.0076	.0070	.0020

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

TED-135ug Zn/L

Control + EDTA

	Replicates			Mean	S. D.
Day 1	.0028	.0027	.0028	.0028	.0001
Day 4	.019	.036	.034	.030	.009
Day 5	.033	.046	.044	.041	.007
Day 6	.049	.053	.049	.050	.002
Day 7	.055	.058	.054	.056	.002
Day 8	.058	.063	.055	.059	.004
Day 12	.068	.057	.053	.059	.008
Day 13	.072	.060	.055	.062	.009
Day 14	.070	.057	.053	.060	.009

Control + 200ug Fe/L

Day 1	.0027	.0027	.0027	.0027	.0000
Day 4	.0044	.0056	.0060	.0053	.0008
Day 5	.0050	.0065	.0070	.0062	.0010
Day 6	.0053	.0065	.0078	.0065	.0012
Day 7	.0057	.0072	.0078	.0069	.0011
Day 8	.0057	.0075	.0080	.0071	.0012
Day 12	.0043	.0065	.0065	.0058	.0013
Day 13	.0040	.0067	.0065	.0057	.0015
Day 14	.0038	.0056	.0056	.0050	.0010

Control + P

Day 1	.0026	.0026	.0028	.0027	.0001
Day 4	.0046	.0046	.0047	.0046	.0001
Day 5	.0049	.0053	.0054	.0052	.0003
Day 6	.0056	.0060	.0061	.0059	.0003
Day 7	.0063	.0058	.0063	.0061	.0003
Day 8	.0071	.0065	.0066	.0067	.0003
Day 12	.0086	.0067	.0074	.0076	.0010
Day 13	.0094	.0070	.0072	.0079	.0013
Day 14	.0096	.0068	.0072	.0079	.0015

Daily Relative Fluorometer Readings
July 24 - August 7, 1980, Continued

TED-135ug Zn/L

Control + EDTA + P

	Replicates			Mean	S. D.
Day 1	.0029	.0027	.0027	.0028	.0001
Day 4	.044	.058	.029	.044	.014
Day 5	.073	.078	.068	.073	.005
Day 6	.076	.076	.071	.074	.003
Day 7	.077	.073	.071	.074	.003
Day 8	.075	.074	.066	.072	.005
Day 12	.074	.067	.058	.066	.008
Day 13	.066	.063	.054	.061	.006
Day 14	.064	.060	.052	.059	.006

FIGURE 3

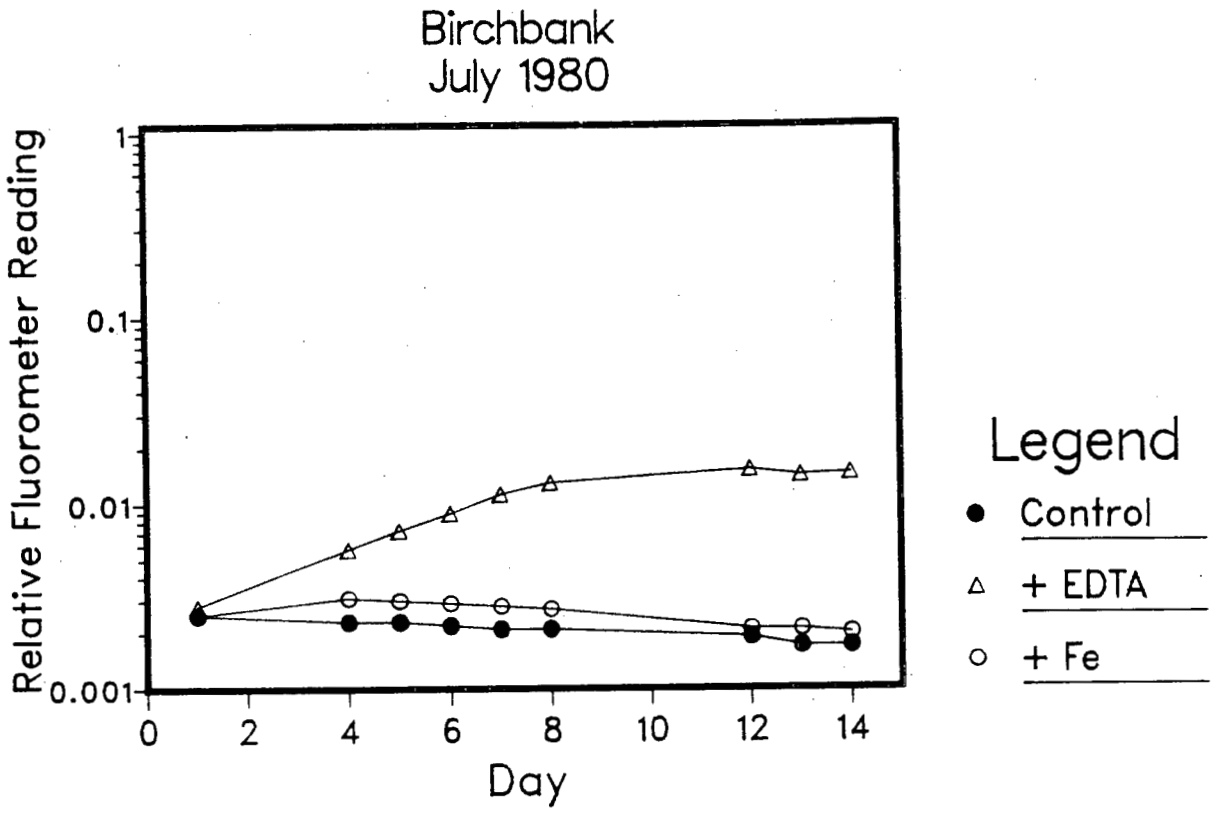
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

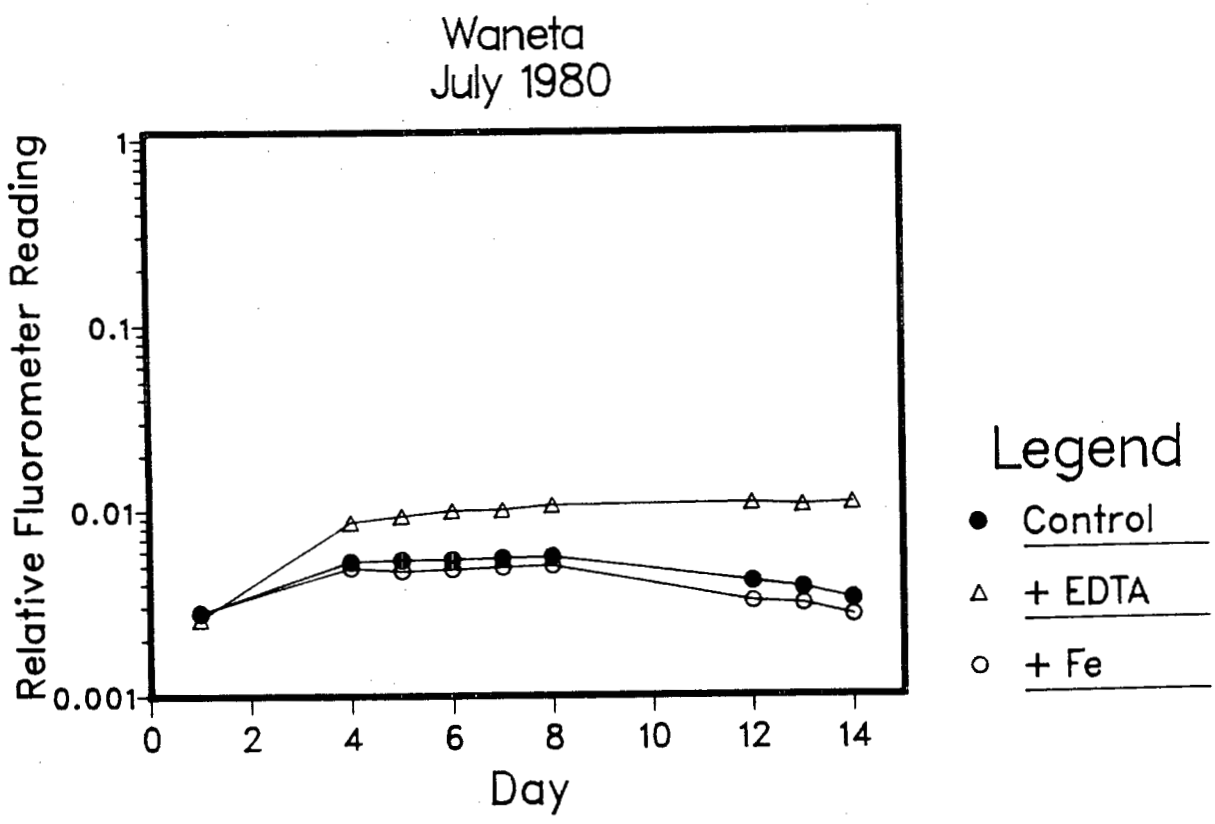
(MEASURED IN RELATIVE FLUOROMETER UNITS)

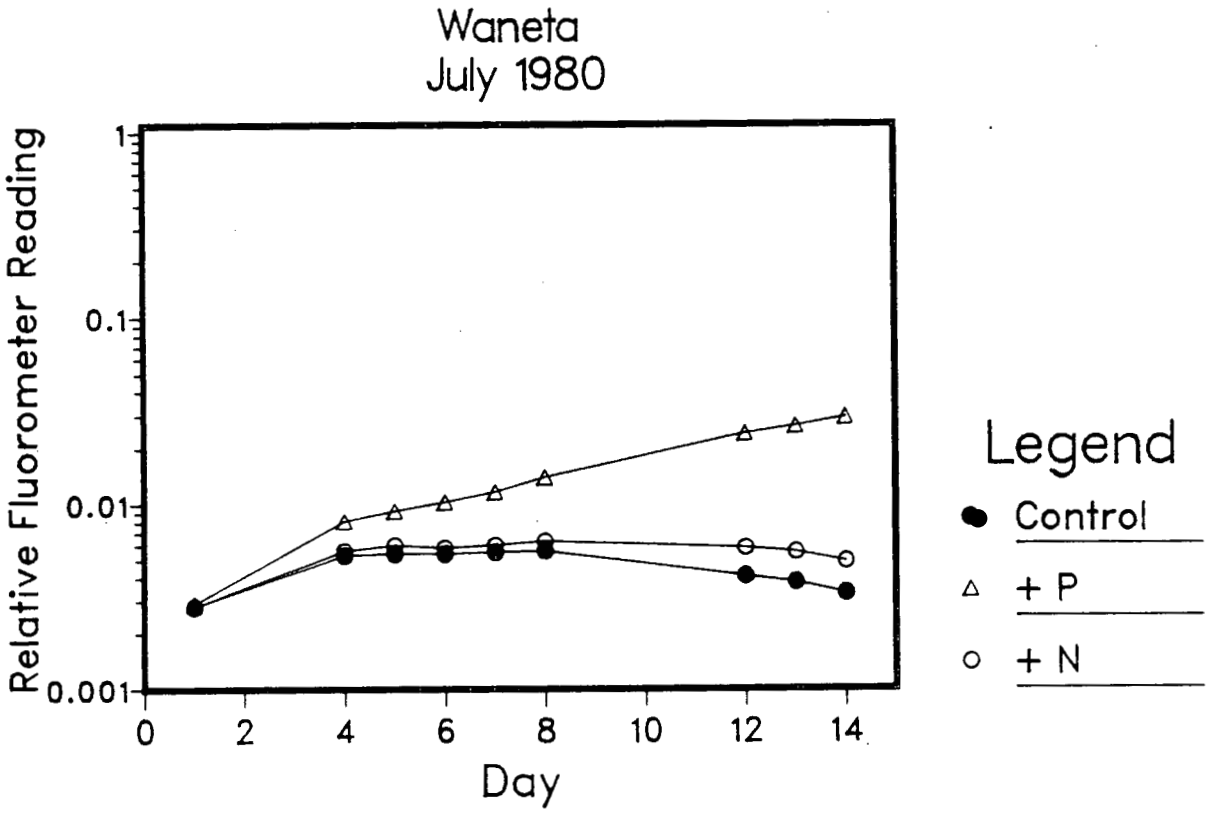
FOR THE JULY 1980 ALGAL ASSAY.

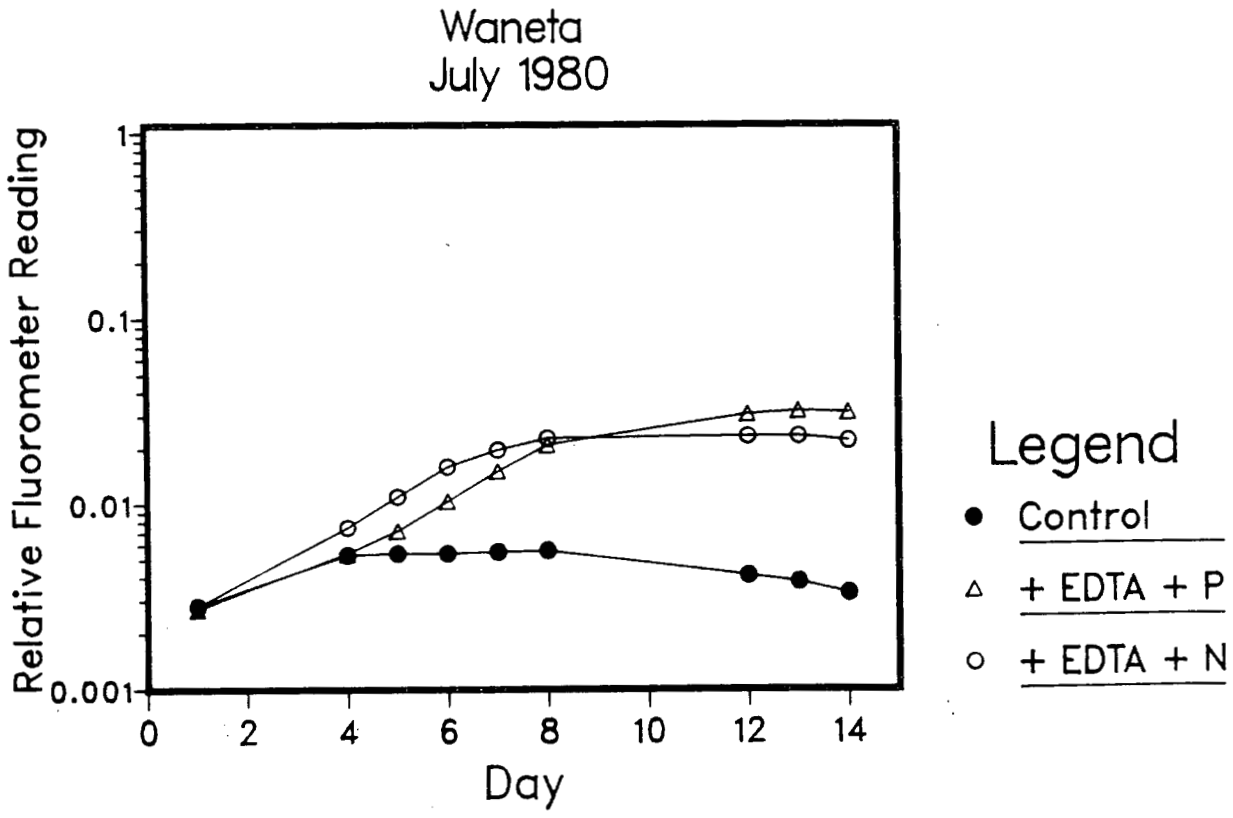
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

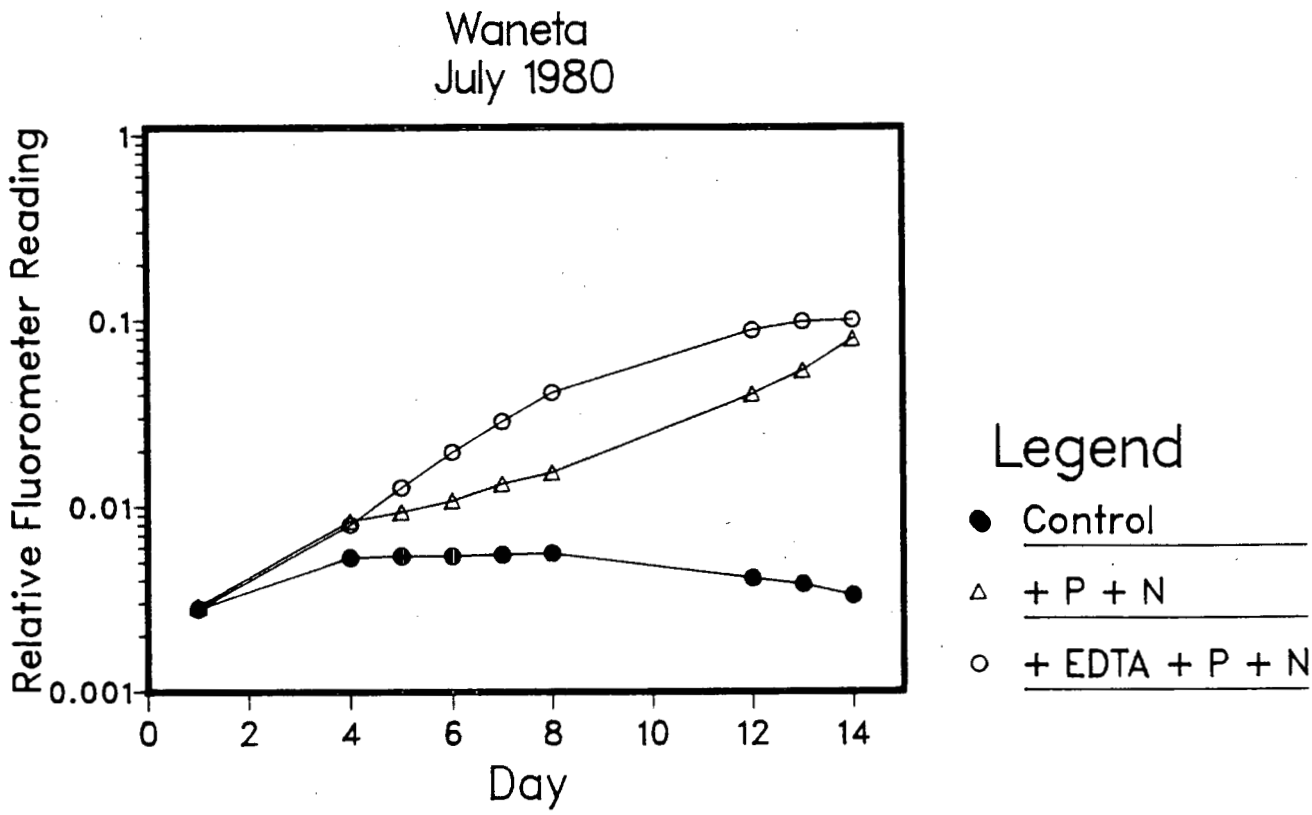
The readings used for these graphs are presented in Table 12

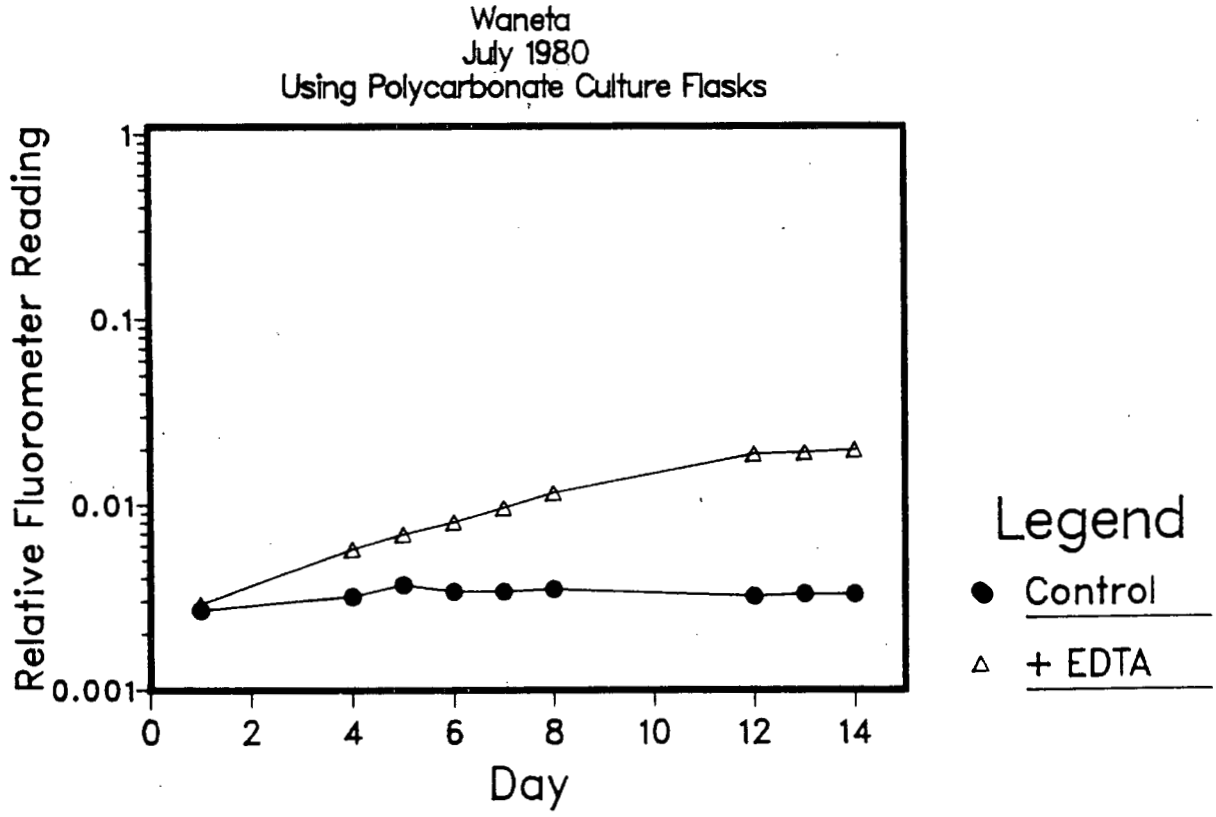

Birchbank
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe

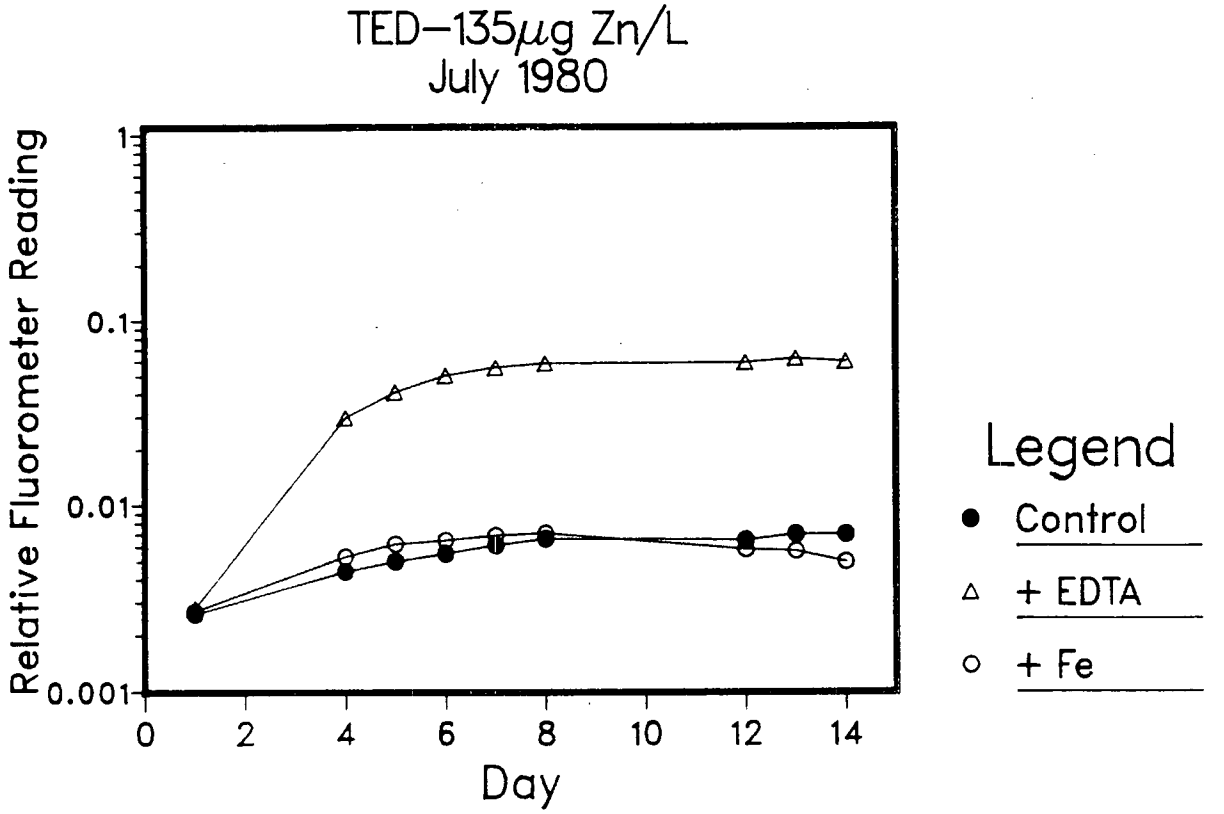

Waneta
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


Waneta
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ N


Waneta
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N


Waneta
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P + N
+ EDTA + P + N


Waneta
July 1980
Using Polycarbonate Culture Flasks
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA


TED–135μg Zn/L
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe

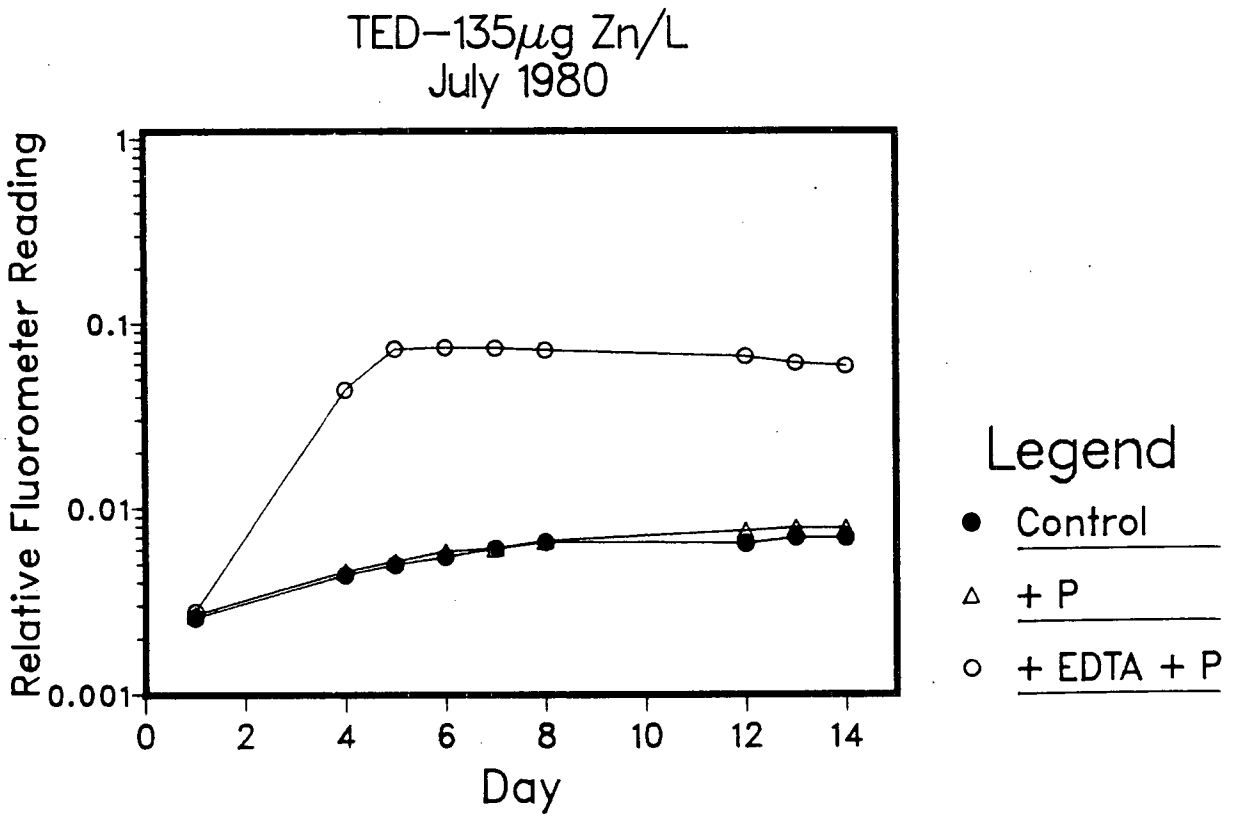

TED–135μg Zn/L
July 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ EDTA + P

TABLE 13

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE JULY 1980 ASSAY. THE YIELDS ARE EXPRESSED AS CELLS/ML AND WERE MEASURED WITH A HAEMOCYTOMETER

Cells/ml on Final Day
July 24 - August 7, 1980 Algal Assay

Birchbank

	Cells/ml	Mean Cells/ml	S.D.
Control	1000		
	1000	1000	0
	1000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	6000		
	8000	6333	1528
	5000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	1000		
	2000	1333	577
	1000		

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control	1000		
	3000	2000	1000
	2000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	15000		
	10000	13000	2646
	14000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	1000		
	2000	1333	577
	1000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P	49000		
	42000	45667	3512
	46000		

Cells/ml on Final Day
July 24 - August 7, 1980 Algal Assay, Continued

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control + N	1000		
	1000	1333	577
	2000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P + N	91000		
	36000	57667	29297
	46000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P + N	54000		
	9000	50667	40104
	89000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	1000		
	2000	34333	56871
	101000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	22000		
	29000	19333	11240
	7000		

	Cells/ml	Mean Cells/ml	S.D.
Control (using polycarbonate culture flasks)	3000		
	2000	2333	577
	2000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA (using polycarbonate culture flasks)	9000		
	10000	8000	2646
	5000		

Cells/ml on Final Day
July 24 - August 7, 1980 Algal Assay, Continued

TED-135ug Zn/L

	Cells/ml	Mean Cells/ml	S.D.
Control	2000		
	1000	1667	577
	2000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	67000		
	72000	74333	8737
	84000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	2000		
	5000	5000	3000
	8000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P	2000		
	7000	4667	2517
	5000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	150000		
	130000	143333	11547
	150000		

TABLE 14

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON AUGUST 11, 1980. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-08-11

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.004	.003	.003	.003	.001	.003	1.1834
15102	PHOSPHORUS TOTAL DISSOLVED	.003	.003	.006	.004	.001	.004	1.4190
15406	PHOSPHORUS TOTAL	.029	.005	.004	.012	.014	.008	3.1744
07110	NITROGEN DISSOLVED NO3 & NO2	.187	.130	.156	.158	.029	.156	1.1994
07557	NITROGEN DISSOLVED AMMONIA	.078	.008	.013	.033	.039	.020	3.3183
07655	NITROGEN TOTAL DISSOLVED	.330	.220	.221	.257	.063	.252	1.2621
07903	NITROGEN PARTICULATE	.037	.032	.018	.029	.010	.028	1.4639
30105	ZINC DISSOLVED	.002	.002	.002	.002	.000	.002	1.0000
30305	ZINC EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29105	COPPER DISSOLVED	.001	L.001	L.001	*.001	.000	*.001	1.0000
29305	COPPER EXTRBLE.	L.001	.001	L.001	*.001	.000	*.001	1.0000
26105	IRON DISSOLVED	.003	.002	.002	.002	.001	.002	1.2638
26305	IRON EXTRBLE.	.010	.009	.011	.010	.001	.010	1.1056
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	.001	*.001	.000	*.001	1.0000
28102	NICKEL DISSOLVED	L.001	.001	.001	*.001	.000	*.001	1.0000
28302	NICKEL EXTRBLE.	.001	L.001	.001	*.001	.000	*.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0002	.0002	.0001	.0002	.0001	.0002	1.4921
34302	SELENIUM EXTRBLE.	L.0001	.0001	L.0001	*.0001	.0000	*.0001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	105.0	107.0	108.0	106.7	1.5	106.7	1.0145
02061	TEMP. WATER ,LAB	21.3	21.5	21.4	21.4	.1	21.4	1.0047
02073	TURBIDITY	.27	.28	.24	.26	.02	.26	1.0839
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	10.0	10.0	10.0	10.0	.0	10.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	8.0	9.0	9.0	8.7	.6	8.7	1.0704
06903	CARBON PARTICULATE	.232	.174	.202	.203	.029	.201	1.1547
09106	FLUORIDE DISSOLVED	.074	.072	.068	.071	.003	.071	1.0441
10101	ALKALINITY TOTAL	44.6	44.4	44.0	44.3	.3	44.3	1.0069
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	8.2	7.7	7.7	7.9	.3	7.9	1.0370
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	74.	70.	88.	77.	9.	77.	1.1268
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	68.	70.	80.	73.	6.	72.	1.0906
10603	HARDNESS TOTAL	52.8	53.4	54.0	53.4	.6	53.4	1.0113
11103	SODIUM DISSOLVED	.9	.9	.9	.9	.0	.9	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.2	3.0	3.3	3.2	.2	3.2	1.0498
14105	SILICA REACTIVE	3.8	3.8	3.8	3.8	.0	3.8	1.0000
16306	SULPHATE DISSOLVED	7.6	7.6	7.5	7.6	.1	7.6	1.0077
17206	CHLORIDE DISSOLVED	.6	.6	.6	.6	.0	.6	1.0000
19103	POTASSIUM DISSOLVED	.6	.6	.6	.6	.0	.6	1.0000
20101	CALCIUM DISSOLVED	15.8	16.4	16.2	16.1	.3	16.1	1.0192

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-08-11

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.037	.040		.038	.002	.038	1.0574
15102	PHOSPHORUS TOTAL DISSOLVED	.044	.044	.042	.043	.001	.043	1.0343
15406	PHOSPHORUS TOTAL	.048	.049	.049	.049	.001	.048	1.0181
07110	NITROGEN DISSOLVED NO3 & NO2	.156	.161	.156	.158	.003	.158	1.0184
07557	NITROGEN DISSOLVED AMMONIA	.016	.017	.016	.016	.001	.016	1.0356
07655	NITROGEN TOTAL DISSOLVED	.246	.276	.241	.254	.019	.254	1.0758
07903	NITROGEN PARTICULATE	.021	.022	.018	.020	.002	.020	1.1108
30105	ZINC DISSOLVED	.008	.014	.018	.013	.005	.013	1.5145
30304	ZINC EXTRBL.	.05	.05	.05	.05	.00	.05	1.0000
29105	COPPER DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
29305	COPPER EXTRBLE.	.001	.001	.001	.001	.000	.001	1.0000
26105	IRON DISSOLVED	.003	.003	.003	.003	.000	.003	1.0000
26305	IRON EXTRBLE.	.009	.006	.010	.008	.002	.008	1.3096
25104	MANGANESE DISSOLVED	.01	.01	.01	.01	.00	.01	1.0000
25304	MANGANESE EXTRBLE.	.02	.01	.01	.01	.01	.01	1.4921
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	.001	L.001	*.001	.000	*.001	1.0000
82302	LEAD EXTRBLE.	.002	.002	.003	.002	.001	.002	1.2638
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0003	.0003	.0003	.0003	.0000	.0003	1.0000
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	118.0	118.0	116.0	117.3	1.2	117.3	1.0099
02061	TEMP. WATER ,LAB	21.0	21.4	21.2	21.2	.2	21.2	1.0095
02073	TURBIDITY	.53	.52	.52	.52	.01	.52	1.0111
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	10.0	10.0	10.0	10.0	.0	10.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	L1.0	*1.0	.0	*1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	9.0	9.0	9.0	9.0	.0	9.0	1.0000
06903	CARBON PARTICULATE	.263	.277	.252	.264	.013	.264	1.0485
09106	FLUORIDE DISSOLVED	.141	.142	.142	.142	.001	.142	1.0041
10101	ALKALINITY TOTAL	42.8	43.3	42.8	43.0	.3	43.0	1.0067
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.5	7.4	7.4	7.4	.1	7.4	1.0078
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	84.	73.	82.	80.	6.	80.	1.0779
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	69.	73.	68.	70.	3.	70.	1.0382
10603	HARDNESS TOTAL	57.8	58.2	57.2	57.7	.5	57.7	1.0088
11103	SODIUM DISSOLVED	1.0	1.2	1.1	1.1	.1	1.1	1.0955
12101	MAGNESIUM DISSOLVED (CALCD.)	3.3	2.9	4.1	3.4	.6	3.4	1.1912
14105	SILICA REACTIVE	3.8	3.8	3.8	3.8	.0	3.8	1.0000
16306	SULPHATE DISSOLVED	14.4	14.5	14.6	14.5	.1	14.5	1.0069
17206	CHLORIDE DISSOLVED	.6	.6	.6	.6	.0	.6	1.0000
19103	POTASSIUM DISSOLVED	.6	.7	.6	.6	.1	.6	1.0931
20101	CALCIUM DISSOLVED	17.7	18.5	16.2	17.5	1.2	17.4	1.0699

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-08-11

STATION NO.: 20BC08NE0001
COMINCO SEWER #8, TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.025	.036	.050	.037	.013	.036	1.4144
15102	PHOSPHORUS TOTAL DISSOLVED	.024	.043	.025	.031	.011	.029	1.3922
15406	PHOSPHORUS TOTAL	.029	.031	.035	.032	.003	.032	1.1000
07110	NITROGEN DISSOLVED NO3 & NO2	L.002	L.002	L.002	L.002	.000	L.002	1.0000
07557	NITROGEN DISSOLVED AMMONIA	23.600	24.600	25.000	24.400	.721	24.393	1.0302
07655	NITROGEN TOTAL DISSOLVED	24.200	27.200	29.200	26.867	2.517	26.787	1.0995
07903	NITROGEN PARTICULATE	.028	.030	.020	.026	.005	.026	1.2423
30104	ZINC DISSOLVED	49.00	68.00	83.00	66.67	17.04	65.15	1.3049
30304	ZINC EXTRBL.	36.00	34.00	78.00	49.33	24.85	45.70	1.5901
29105	COPPER DISSOLVED	.003	.002	.002	.002	.001	.002	1.2638
29305	COPPER EXTRBLE.	.005	.005	.004	.005	.001	.005	1.1375
26104	IRON DISSOLVED	.31	.53	.41	.42	.11	.41	1.3077
26304	IRON EXTRBLE.	.42	.52	.42	.45	.06	.45	1.1312
25104	MANGANESE DISSOLVED	7.70	12.00	15.00	11.57	3.67	11.15	1.4042
25304	MANGANESE EXTRBLE.	5.10	4.70	12.00	7.27	4.10	6.60	1.6807
48102	CADMIUM DISSOLVED	.0019	.0009	.0010	.0013	.0006	.0012	1.4985
48302	CADMIUM EXTRBLE.	.0039	.0039	.0018	.0032	.0012	.0030	1.5627
82101	LEAD DISSOLVED	.41	.43	.38	.41	.03	.41	1.0643
82301	LEAD EXTRBLE.	.47	.49	.62	.53	.08	.52	1.1611
80311	MERCURY EXTRBLE.	1.00	.95	.95	.97	.03	.97	1.0301
02011	COLOUR APPARENT	10.	10.	5.	8.	3.	8.	1.4921
02041	SPECIFIC CONDUCT.	3080.0	5570.0	6310.0	4986.7	1692.2	4765.9	1.4669
02061	TEMP. WATER ,LAB	21.4	21.4	21.5	21.4	.1	21.4	1.0027
02073	TURBIDITY	1.50	1.40	1.20	1.37	.15	1.36	1.1210
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	L1.0	1.0	L1.0	*1.0	.0	*1.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	L1.0	L1.0	L1.0	L1.0	.0	L1.0	1.0000
06903	CARBON PARTICULATE	.315	.295	.306	.305	.010	.305	1.0334
09106	FLUORIDE DISSOLVED	.540	.950	1.050	.847	.270	.814	1.4312
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10251	ACIDITY PH=8.3	470.0	910.0	1070.0	816.7	310.7	770.6	1.5462
10301	PH	2.4	2.0	2.0	2.1	.2	2.1	1.1110
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	879.	1150.	1530.	1186.	327.	1156.	1.3194
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	228.	335.	477.	347.	125.	332.	1.4466
10603	HARDNESS TOTAL	133.0	226.0	254.0	204.3	63.3	196.9	1.4117
11103	SODIUM DISSOLVED	2.2	1.9	1.6	1.9	.3	1.9	1.1728
14105	SILICA REACTIVE	4.3	4.2	4.2	4.2	.1	4.2	1.0137
16306	SULPHATE DISSOLVED	1010.0	820.0	545.0	791.7	233.8	767.1	1.3686
17206	CHLORIDE DISSOLVED	4.0	3.9	3.8	3.9	.1	3.9	1.0260
19103	POTASSIUM DISSOLVED	2.6	2.0	1.4	2.0	.6	1.9	1.3644
20101	CALCIUM DISSOLVED	28.6	35.0	39.5	34.4	5.5	34.1	1.1772

TABLE 15

Concentrations (mg/L) of nutrients and dissolved metals in water used for the August 1980 algal assay. Water from each site was autoclaved, aerated with CO_2, and filtered before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Birchbank							
Orthophosphate	0.004	0.004	0.003	0.003	0.000	0.003	1.0929
Nitrate plus Nitrite	0.090	0.092	0.090	0.091	0.001	0.091	1.0126
Ammonia	0.010	0.015	0.008	0.011	0.004	0.011	1.3753
Total Dissolved Nitrogen	0.161	0.151	0.151	0.154	0.006	0.154	1.0377
Dissolved Zn	0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.006	0.003	0.002	0.004	0.002	0.003	1.7430
Dissolved Fe	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Waneta							
Orthophosphate	0.044	0.044	0.042	0.043	0.001	0.043	1.0135
Nitrate plus Nitrite	0.101	0.101	0.102	0.101	0.001	0.101	1.0058
Ammonia	0.022	0.020	0.028	0.023	0.004	0.023	1.1893
Total Dissolved Nitrogen	0.202	0.182	0.188	0.191	0.010	0.190	1.0548
Dissolved Zn	0.05	0.03	0.05	0.04	0.01	0.04	1.3430
Dissolved Cu	0.005	0.003	0.002	0.003	0.002	0.003	1.5827
Dissolved Fe	0.002	0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Mn	0.01	0.01	0.01	0.01	0.0	0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 15 (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Cominco Effluent							
Orthophosphate	0.023	0.024	0.024	0.023	0.000	0.023	1.0120
Nitrate plus Nitrite	L0.002	L0.002	L0.002	L0.002	0.0	L0.002	1.0000
Ammonia	25.2	25.4	25.2	25.3	0.1	25.3	1.0032
Total Dissolved Nitrogen	26.3	28.3	27.3	27.3	1.0	27.3	1.0371
Dissolved Zn	83.	71.	66.	73.	9.	73.	1.1242
Dissolved Cu	0.003	0.003	0.004	0.003	0.001	0.003	1.1808
Dissolved Fe	0.25	0.27	0.30	0.27	0.02	0.27	1.0958
Dissolved Mn	11.	11.	11.	11.	0.0	11.	1.0000
Dissolved Cd	0.004	0.004	0.002	0.003	0.001	0.003	1.4921
Dissolved Pb	0.54	0.50	0.45	0.50	0.04	0.50	1.0958
TED - 80µg Zn/L							
Orthophosphate	0.042	0.042	0.042	0.042	0.000	0.042	1.0068
Nitrate plus Nitrite	0.095	0.095	0.098	0.096	0.002	0.096	1.0181
Ammonia	0.040	0.032	0.057	0.043	0.013	0.042	1.3379
Total Dissolved Nitrogen	0.224	0.208	0.246	0.226	0.019	0.226	1.0877
Dissolved Zn	0.08	0.08	0.08	0.08	0.0	0.08	1.0000
Dissolved Cu	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Fe	0.003	0.003	0.003	0.003	0.0	0.003	1.0000
Dissolved Mn	0.02	0.02	0.02	0.02	0.0	0.02	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	0.002	0.001	0.001	0.001	0.001	1.4923
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
TED - 160µg Zn/L							
Orthophosphate	0.042	0.043	0.043	0.043	0.000	0.043	1.0064
Nitrate plus Nitrite	0.098	0.098	0.097	0.098	0.001	0.098	1.0055
Ammonia	0.053	0.059	0.056	0.056	0.003	0.056	1.0550
Total Dissolved Nitrogen	0.230	0.246	0.240	0.239	0.008	0.239	1.0346
Dissolved Zn	0.16	0.16		0.16	0.0	0.16	1.0000
Dissolved Cu	0.002	0.003		0.002	0.001	0.002	1.3320
Dissolved Fe	0.002	0.003		0.002	0.001	0.002	1.3320
Dissolved Mn	0.03	0.03		0.03	0.0	0.03	1.0000
Dissolved Cd	L0.0005	L0.0005		L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	0.002		0.002	0.0	0.002	1.0000
Dissolved Ni	L0.001	L0.001		L0.001	0.0	L0.001	1.0000

TABLE 16

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE AUGUST 1980 ALGAL ASSAY

These readings are graphed in Figure 4

Daily Relative Fluorometer Readings
August 13 - 27, 1980

Birchbank

Control

	Replicates			Mean	S. D.
Day 1	.0025	.0024	.0024	.0024	.0001
Day 2	.0054	.0047	.0051	.0051	.0004
Day 5	.010	.0087	.011	.010	.001
Day 6	.010	.0093	.012	.010	.001
Day 7	.010	.010	.012	.011	.001
Day 8	.010	.011	.013	.011	.002
Day 9	.011	.011	.013	.012	.001
Day 12	.011	.011	.013	.012	.001
Day 13	.010	.013	.013	.012	.002
Day 14	.011	.011	.011	.011	.000

Control + EDTA

Day 1	.0025	.0026	.0025	.0025	.0001
Day 2	.0045	.0051	.0044	.0047	.0004
Day 5	.0094	.018	.0092	.0122	.0050
Day 6	.010	.018	.010	.013	.005
Day 7	.0098	.021	.010	.014	.006
Day 8	.010	.023	.0096	.014	.008
Day 9	.0092	.024	.010	.014	.008
Day 12	.010	.022	.010	.014	.007
Day 13	.010	.025	.011	.015	.008
Day 14	.010	.023	.010	.014	.008

Control + 200ug Fe/L

Day 1	.0024	.0024	.0024	.0024	.0000
Day 2	.0040	.0045	.0044	.0043	.0003
Day 5	.0066	.0059	.0062	.0062	.0004
Day 6	.0065	.0057	.0067	.0063	.0005
Day 7	.0074	.0064	.0071	.0070	.0005
Day 8	.0074	.0064	.0067	.0068	.0005
Day 9	.0075	.0066	.0073	.0071	.0005
Day 12	.0078	.0070	.0074	.0074	.0004
Day 13	.0085	.0068	.0070	.0074	.0009
Day 14	.0083	.0065	.0073	.0074	.0009

Daily Relative Fluorometer Readings
August 13 - 27, 1980, Continued

Waneta

Control

	Replicates			Mean	S. D.
Day 1	.0024	.0024	.0024	.0024	.0000
Day 2	.0039	.0040	.0036	.0038	.0002
Day 5	.035	.048	.028	.037	.010
Day 6	.055	.061	.050	.055	.006
Day 7	.072	.069	.073	.071	.002
Day 8	.076	.064	.076	.072	.007
Day 9	.072	.064	.073	.070	.005
Day 12	.072	.060	.066	.066	.006
Day 13	.070	.059	.064	.064	.006
Day 14	.068	.057	.063	.063	.006

Control + EDTA

Day 1	.0024	.0024	.0024	.0024	.0000
Day 2	.0048	.0050	.0043	.0047	.0004
Day 5	.090	.077	.074	.080	.008
Day 6	.10	.081	.080	.087	.011
Day 7	.11	.083	.086	.093	.015
Day 8	.11	.085	.086	.094	.014
Day 9	.11	.086	.086	.094	.014
Day 12	.096	.080	.083	.086	.008
Day 13	.090	.076	.080	.082	.007
Day 14	.085	.072	.073	.077	.007

Control + 200ug Fe/L

Day 1	.0024	.0022	.0024	.0023	.0001
Day 2	.0043	.0043	.0044	.0043	.0001
Day 5	.048	.060	.071	.060	.012
Day 6	.067	.076	.074	.072	.005
Day 7	.062	.077	.073	.071	.008
Day 8	.059	.074	.071	.068	.008
Day 9	.058	.072	.070	.067	.008
Day 12	.054	.072	.067	.064	.009
Day 13	.053	.071	.064	.063	.009
Day 14	.050	.067	.059	.059	.008

Daily Relative Fluorometer Readings
August 13 - 27, 1980, Continued

Waneta

Control + P

	Replicates			Mean	S. D.
Day 1	.0024	.0025	.0024	.0024	.0001
Day 2	.0040	.0042	.0043	.0042	.0002
Day 5	.022	.028	.023	.024	.003
Day 6	.044	.046	.043	.044	.002
Day 7	.060	.064	.068	.064	.004
Day 8	.070	.062	.068	.067	.004
Day 9	.063	.063	.067	.064	.002
Day 12	.056	.056	.065	.059	.005
Day 13	.054	.053	.064	.057	.006
Day 14	.052	.050	.060	.054	.005

Control + N

Day 1	.0025	.0024	.0025	.0025	.0001
Day 2	.0039	.004	.0044	.0041	.0003
Day 5	.022	.024	.021	.022	.002
Day 6	.041	.041	.042	.041	.001
Day 7	.070	.064	.077	.070	.007
Day 8	.10	.085	.13	.10	.02
Day 9	.16	.12	.20	.16	.04
Day 12	.29	.24	.34	.29	.05
Day 13	.30	.26	.37	.31	.06
Day 14	.29	.28	.34	.30	.03

Control + P + N

Day 1	.0025	.0025	.0024	.0025	.0001
Day 2	.0044	.0035	.0045	.0041	.0006
Day 5	.050	.024	.024	.033	.015
Day 6	.093	.036	.046	.058	.030
Day 7	.16	.060	.082	.101	.053
Day 8	.23	.074	.40	.23	.16
Day 9	.30	.097	.47	.29	.19
Day 12	.44	.16	.23	.28	.15
Day 13	.44	.18	.27	.30	.13
Day 14	.40	.19	.26	.28	.11

Daily Relative Fluorometer Readings
August 13 - 27, 1980, Continued

Waneta

Control + EDTA + P + N

	Replicates			Mean	S. D.
Day 1	.0025	.0026	.0024	.0025	.0001
Day 2	.0059	.0051	.0051	.0054	.0005
Day 5	.10	.18	.18	.15	.05
Day 6	*	*	*		
Day 7	.54	.61	.60	.58	.04
Day 8	.68	.74	.82	.75	.07
Day 9	.76	.81	.92	.83	.08
Day 12	.80	1.0	1.2	1.0	.2
Day 13	.78	1.1	1.2	1.0	.2
Day 14	.77	1.1	1.2	1.0	.2

Control + EDTA + P

Day 1	.0027	.0025	.0026	.0026	.0001
Day 2	.0054	.0049	.0049	.0051	.0003
Day 5	.082	.078	.11	.090	.017
Day 6	.091	.081	.11	.094	.015
Day 7	.10	.084	.12	.10	.02
Day 8	.11	.082	.12	.10	.02
Day 9	.11	.082	.12	.10	.02
Day 12	.10	.077	.12	.10	.02
Day 13	.10	.074	.13	.10	.03
Day 14	.096	.074	.12	.097	.023

Control + EDTA + N

Day 1	.0024	.0025	.0024	.0024	.0001
Day 2	.0046	.0048	.0044	.0046	.0002
Day 5	.10	.076	.10	.09	.01
Day 6	.26	.21	*	.24	.04
Day 7	.40	.36	.40	.39	.02
Day 8	.52	.43	.48	.48	.05
Day 9	.54	.50	.52	.52	.02
Day 12	.68	.64	.67	.66	.02
Day 13	.71	.64	.70	.68	.04
Day 14	.70	.65	.66	.67	.03

* designates that data were suspect and therefore not presented

Daily Relative Fluorometer Readings
August 13 - 27, 1980, Continued

Waneta

Control (using polycarbonate culture flasks)

	Replicates			Mean	S. D.
Day 1	.0026	.0025	.0024	.0025	.0001
Day 2	.0039	.0034	.0035	.0036	.0003
Day 5	.023	.016	.022	.020	.004
Day 6	.036	.030	.034	.033	.003
Day 7	.054	.041	.046	.047	.007
Day 8	.082	.062	.072	.072	.010
Day 9	.11	.081	.11	.10	.02
Day 12	.14	.14	.20	.16	.03
Day 13	.15	.16	.23	.18	.04
Day 14	.15	.16	.22	.18	.04

Control + EDTA (using polycarbonate culture flasks)

Day 1	.0024	.0024	.0024	.0024	.0000
Day 2	.0032	.0035	.0033	.0033	.0002
Day 5	.026	.025	.041	.031	.009
Day 6	.050	.050	.098	.066	.028
Day 7	.11	.10	.23	.15	.07
Day 8	.19	.16	.32	.22	.09
Day 9	.22	.20	.38	.27	.10
Day 12	.27	.26	.38	.30	.07
Day 13	.29	.27	.48	.35	.12
Day 14	.29	.26	.45	.33	.10

Control + 200ug Fe/L (using polycarbonate culture flasks)

Day 1	.0024	.0024	.0024	.0024	.0000
Day 2	.0034	.0035	.0035	.0035	.0001
Day 5	.016	.017	.013	.015	.002
Day 6	.028	.030	.023	.027	.004
Day 7	.052	.052	.042	.049	.006
Day 8	.082	.080	.072	.078	.005
Day 9	.13	.11	.11	.12	.01
Day 12	.20	.14	.15	.16	.03
Day 13	.22	.15	.15	.17	.04
Day 14	.21	.15	.15	.17	.03

Daily Relative Fluorometer Readings
August 13 - 27, 1980, Continued

TED-80ug Zn/L

Control

	Replicates			Mean	S. D.
Day 1	.0025	.0024	.0025	.0025	.0001
Day 2	.0029	.0029	.0028	.0029	.0001
Day 5	.0093	.0085	.010	.0093	.0008
Day 6	.012	.012	.015	.013	.002
Day 7	.012	.015	.023	.017	.006
Day 8	.020	.021	.028	.023	.004
Day 9	.023	.027	.032	.027	.005
Day 12	.036	.050	.048	.045	.008
Day 13	.045	.058	.055	.053	.007
Day 14	.049	.059	.058	.055	.006

Control + EDTA

Day 1	.0025	.0024	.0024	.0024	.0001
Day 2	.0047	.0038	.0045	.0043	.0005
Day 5	.094	.073	.081	.083	.011
Day 6	.10	.084	.092	.092	.008
Day 7	.10	.088	.10	.096	.007
Day 8	.11	.092	.093	.098	.010
Day 9	.11	.092	.097	.100	.009
Day 12	.11	.092	.10	.10	.01
Day 13	.11	.086	.10	.10	.01
Day 14	.10	.086	.092	.093	.007

TED-160ug Zn/L

Control

Day 1	.0022	.0022	.0024	.0023	.0001
Day 2	.0022	.0023	.0025	.0023	.0002
Day 5	.0030	.0033	.0038	.0034	.0004
Day 6	.0030	.0038	.0044	.0037	.0007
Day 7	.0029	.0045	.0057	.0044	.0014
Day 8	.0033	.0046	.0058	.0046	.0012
Day 9	.0037	.0050	.0058	.0048	.0011
Day 12	.0036	.0062	.0073	.0057	.0019
Day 13	.0038	.0062	.0065	.0055	.0015
Day 14	.0038	.0059	.0070	.0056	.0016

August 13 - 27, 1980, Continued

TED-160ug Zn/L

Control + EDTA

	Replicates			Mean	S. D.
Day 1	.0025	.0026	.0026	.0026	.0001
Day 2	.0055	.0051	.0045	.0050	.0005
Day 5	.10	.085	.10	.10	.01
Day 6	.11	.12	.12	.12	.01
Day 7	.12	.12	.12	.12	.00
Day 8	.12	.12	.12	.12	.00
Day 9	.12	.12	.12	.12	.00
Day 12	.12	.13	.12	.12	.01
Day 13	.11	.12	.11	.11	.01
Day 14	.11	.12	.11	.11	.01

FIGURE 4

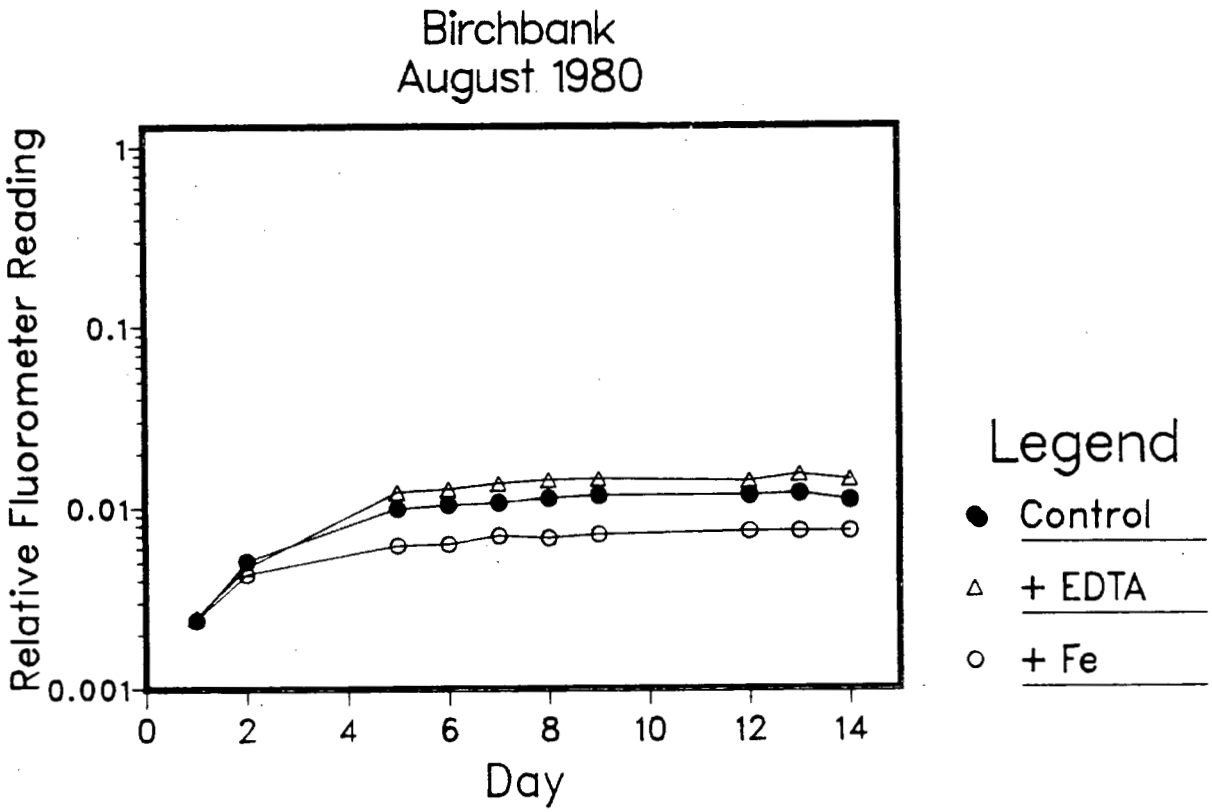
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

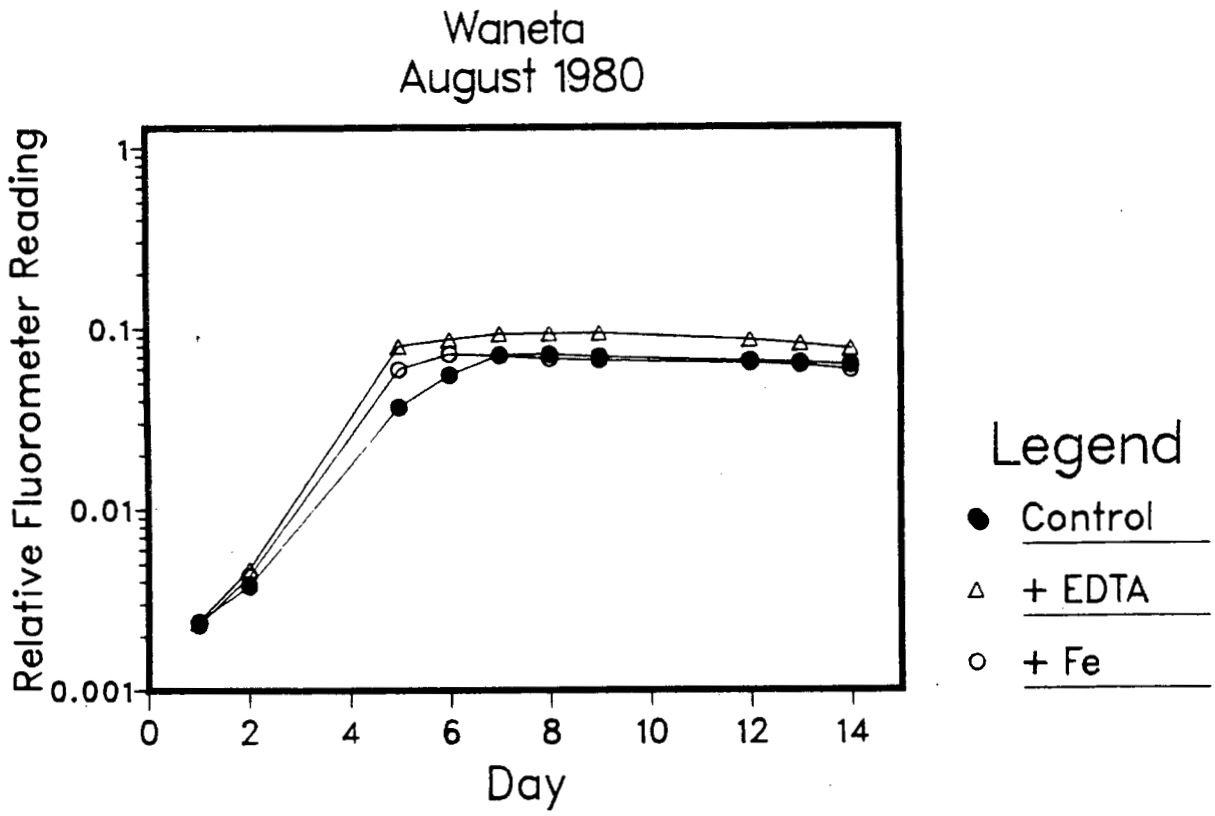
(MEASURED IN RELATIVE FLUOROMETER UNITS)

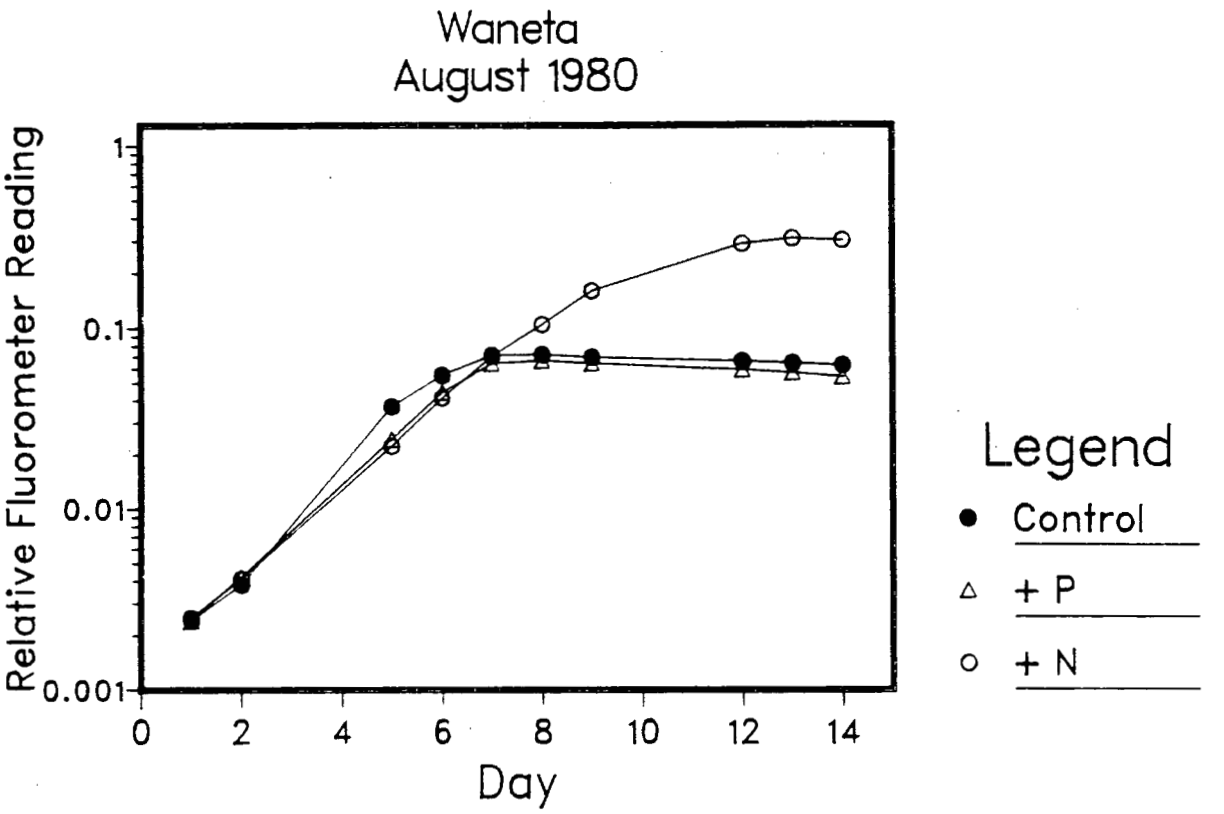
FOR THE AUGUST 1980 ALGAL ASSAY.

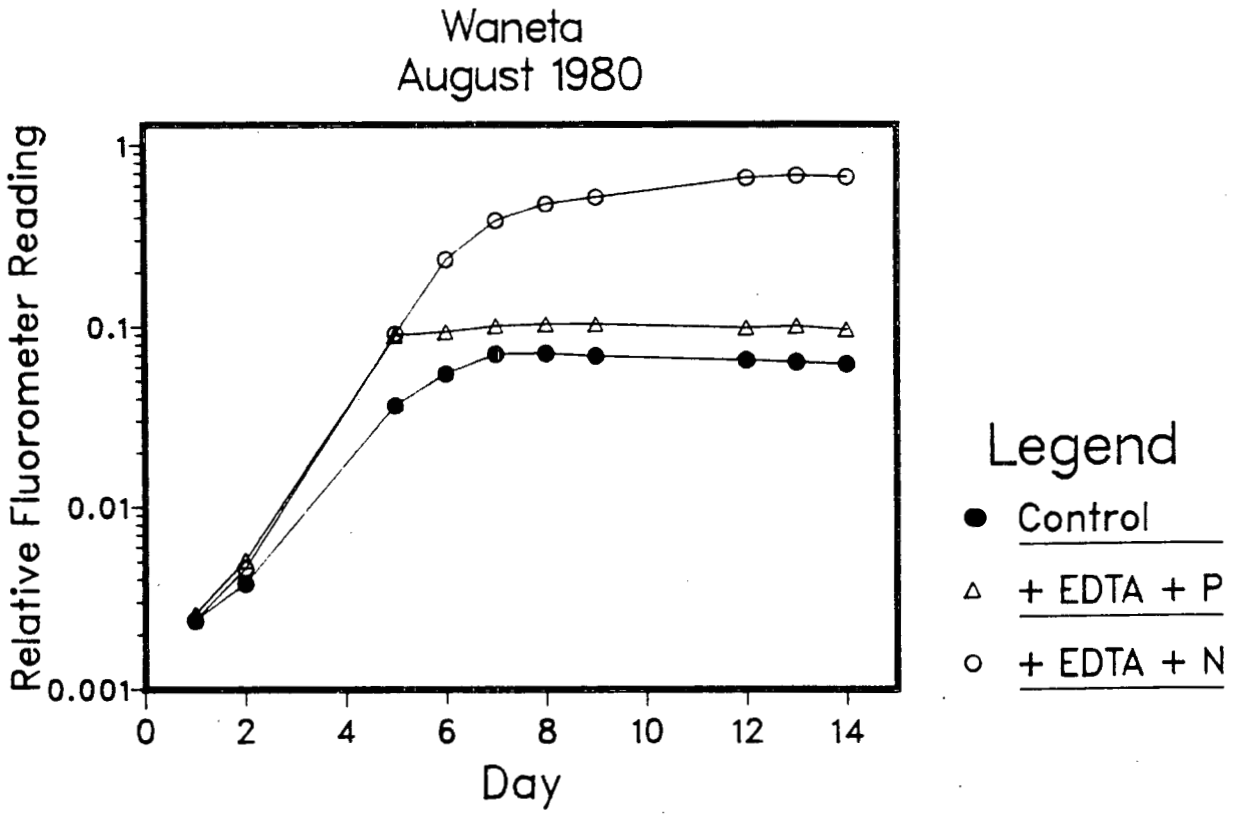
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

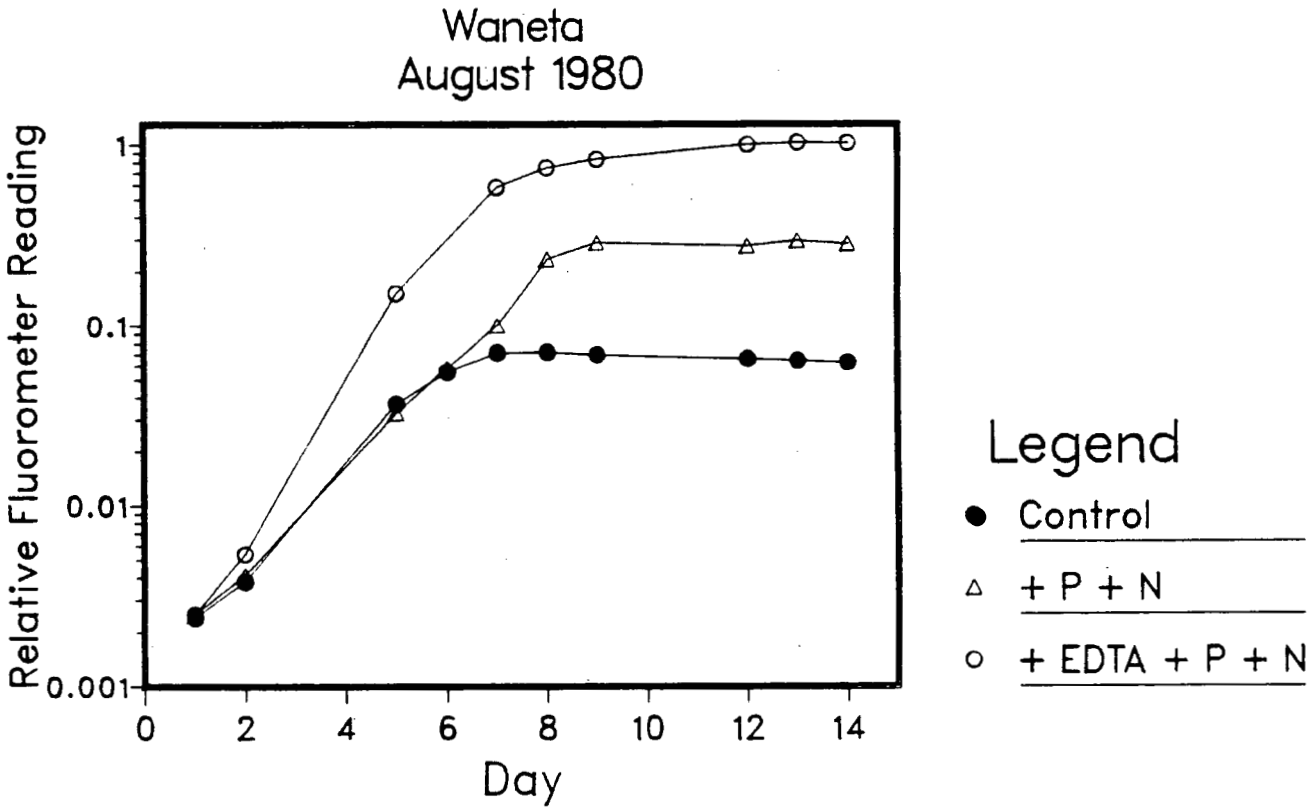
The readings used for these graphs are presented in Table 16

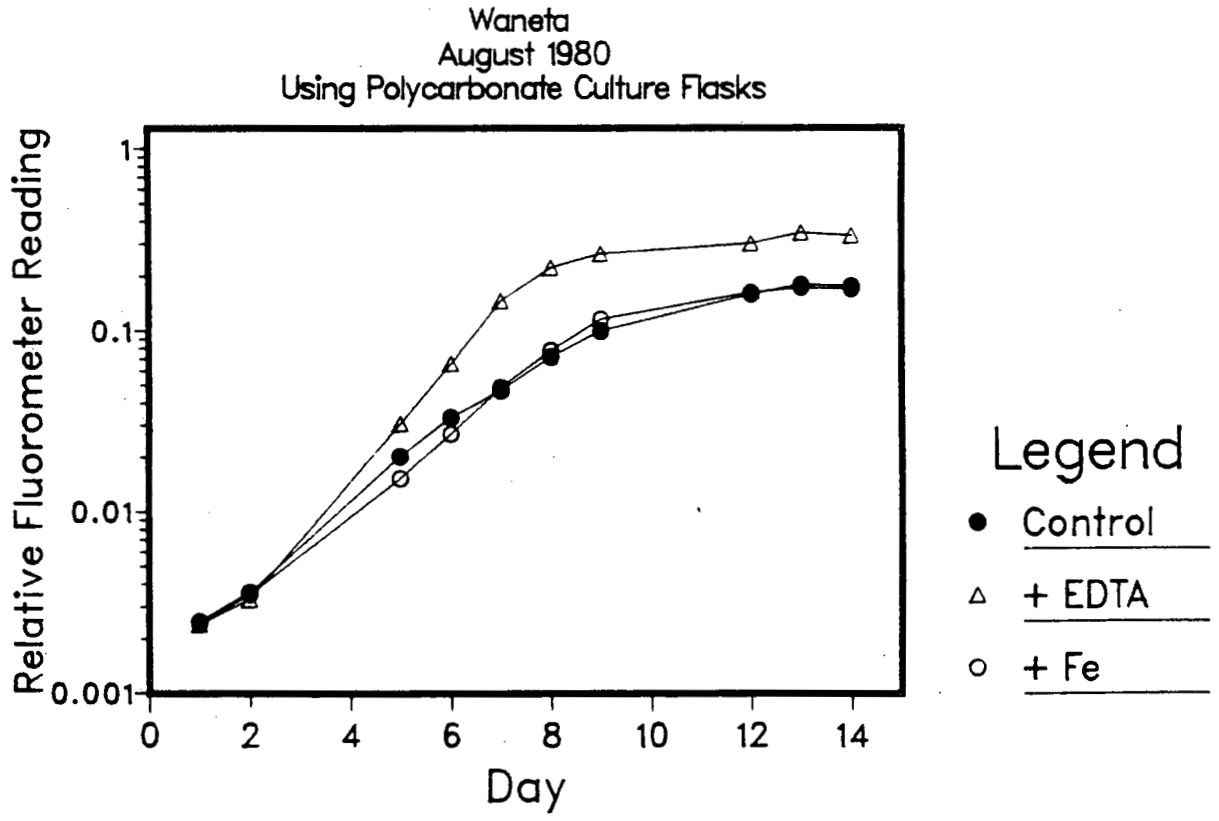

Birchbank
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe

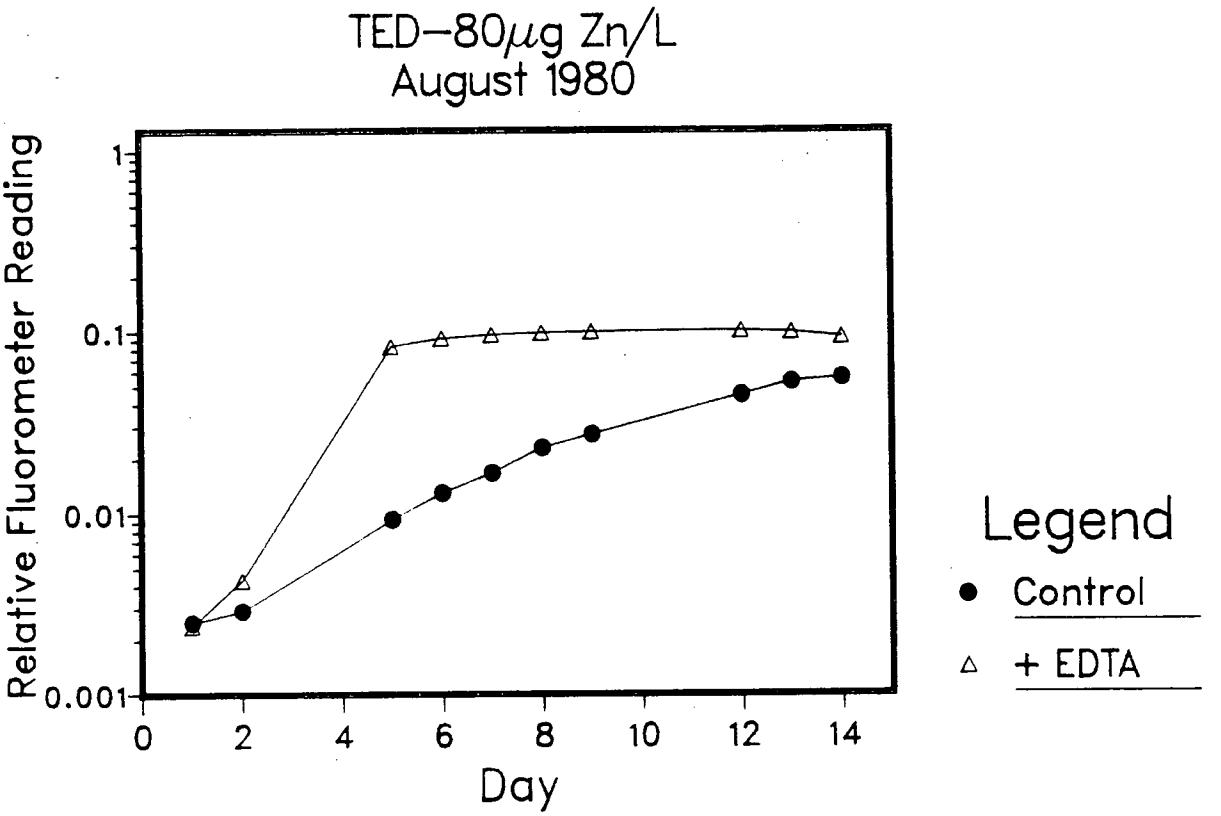

Waneta
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


Waneta
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ N


Waneta
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N


Waneta
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P + N
+ EDTA + P + N


Waneta
August 1980
Using Polycarbonate Culture Flasks
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


TED–80μg Zn/L
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA

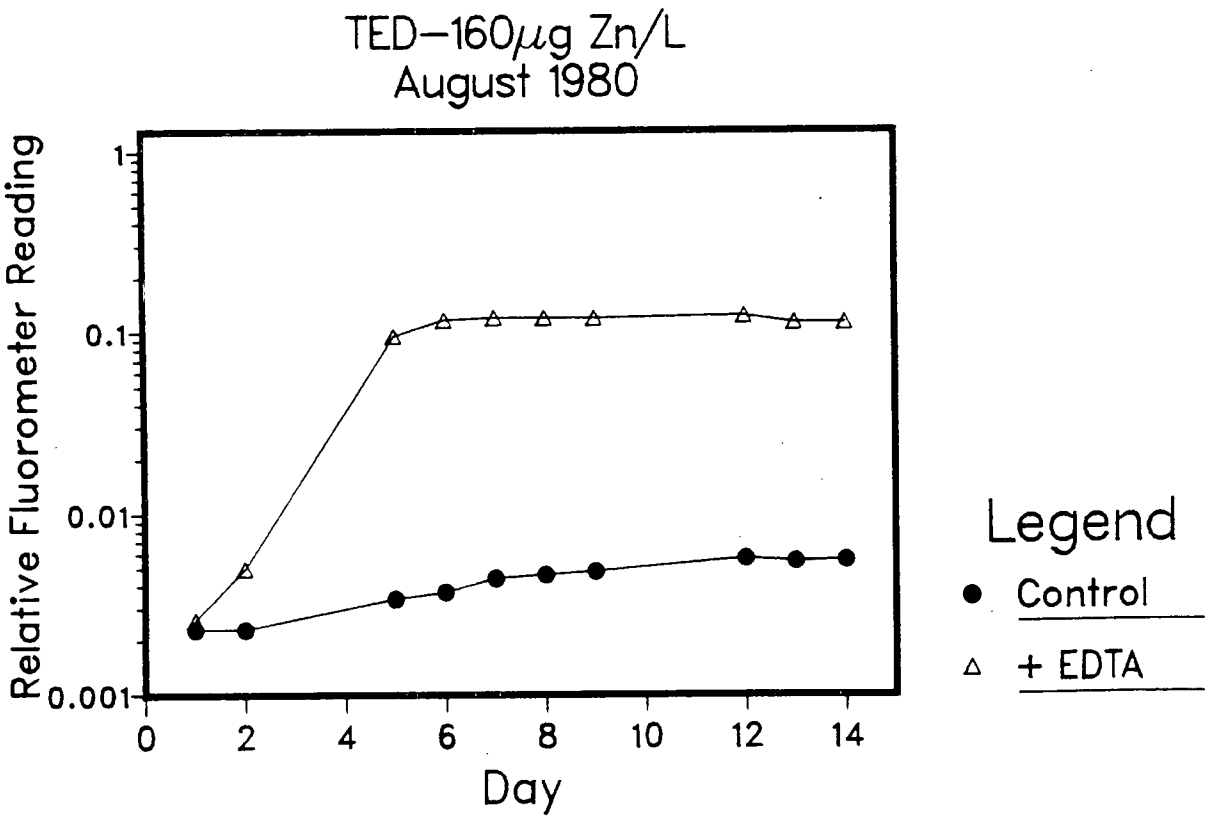

TED–160μg Zn/L
August 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA

TABLE 17

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE AUGUST 1980 ASSAY. THE YIELDS ARE EXPRESSED AS CELLS/ML AND WERE MEASURED WITH A HAEMOCYTOMETER

Cells/ml on Final Day
August 13 - 27, 1980 Algal Assay

Birchbank

	Cells/ml	Mean Cells/ml	S.D.
Control	10000		
	11000	10667	577
	11000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	8000		
	28000	15000	11269
	9000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	10000		
	6000	7667	2082
	7000		

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control	240000		
	200000	220000	20000
	220000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	270000		
	240000	250000	17321
	240000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	120000		
	220000	173333	50332
	180000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P	170000		
	170000	173333	5774
	180000		

Cells/ml on Final Day
August 13 - 27, 1980 Algal Assay, Continued

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control + N	320000		
	310000	330000	26458
	360000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P + N	580000		
	350000	463333	115036
	460000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P + N	1700000		
	2200000	2066667	321455
	2300000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	190000		
	180000	190000	10000
	200000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	760000		
	780000	773333	11547
	780000		

	Cells/ml	Mean Cells/ml	S.D.
Control (using polycarbonate culture flasks)	230000		
	240000	256667	37859
	300000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA (using polycarbonate culture flasks)	330000		
	320000	550000	389744
	1000000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L (using polycarbonate culture flasks)	290000		
	210000	233333	49329
	200000		

Cells/ml on Final Day
August 13 - 27, 1980 Algal Assay, Continued

TED-80ug Zn/L

	Cells/ml	Mean Cells/ml	S.D.
Control	26000		
	66000	53000	23388
	67000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	190000		
	230000	223333	30551
	250000		

TED-160ug Zn/L

	Cells/ml	Mean Cells/ml	S.D.
Control	2000		
	2000	2333	577
	3000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	200000		
	200000	203333	5774
	210000		

TABLE 18

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON SEPTEMBER 17, 1980. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-09-17

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.003	.002	.001	.002	.001	.002	1.5827
15102	PHOSPHORUS TOTAL DISSOLVED	.002	.003	.002	.002	.000	.002	1.1375
15406	PHOSPHORUS TOTAL	.010	.007	.011	.009	.002	.009	1.2593
07110	NITROGEN DISSOLVED NO3 & NO2	.042	.042	.041	.042	.001	.042	1.0140
07557	NITROGEN DISSOLVED AMMONIA	L.002	L.002	L.002	L.002	.000	L.002	1.0000
07655	NITROGEN TOTAL DISSOLVED	.085	.085	.080	.083	.003	.083	1.0356
07903	NITROGEN PARTICULATE	.030	.030	.032	.031	.001	.031	1.0380
30105	ZINC DISSOLVED	.009	.002	.002	.004	.004	.003	2.3830
30305	ZINC EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29105	COPPER DISSOLVED	.001	.002	.001	.001	.001	.001	1.4921
29305	COPPER EXTRBLE.	L.001	.001	L.001	*.001	.000	*.001	1.0000
26105	IRON DISSOLVED	.007	.008	.012	.009	.003	.009	1.3241
26305	IRON EXTRBLE.	.015	.017	.014	.015	.002	.015	1.1034
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	.001	L.001	*.001	.000	*.001	1.0000
82302	LEAD EXTRBLE.	L.001	.001	L.001	*.001	.000	*.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0001	.0002	.0002	.0002	.0001	.0002	1.4921
34302	SELENIUM EXTRBLE.	L.0001	L.0001	.0001	*.0001	.0000	*.0001	1.0000
02011	COLOUR APPARENT	5.	10.	10.	8.	3.	8.	1.4921
02041	SPECIFIC CONDUCT.	112.0	113.0	112.0	112.3	.6	112.3	1.0051
02061	TEMP. WATER ,FIELD	14.5			14.5		14.5	
02061	TEMP. WATER ,LAB	21.3	21.3	21.3	21.3	.0	21.3	1.0000
02073	TURBIDITY	.35	.17	.21	.24	.09	.23	1.4496
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	11.0	11.0	12.0	11.3	.6	11.3	1.0515
06903	CARBON PARTICULATE	.271	.271	.289	.277	.010	.277	1.0378
09106	FLUORIDE DISSOLVED	.075	.075	.076	.075	.001	.075	1.0077
10101	ALKALINITY TOTAL	50.0	49.2	49.1	49.4	.5	49.4	1.0100
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.7	7.7	7.7	7.7	.0	7.7	1.0000
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	80.	84.	77.	80.	4.	80.	1.0446
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	56.	49.	59.	55.	5.	55.	1.1005
10603	HARDNESS TOTAL	55.6	55.6	55.2	55.5	.2	55.5	1.0042
11103	SODIUM DISSOLVED	2.2	2.2	1.4	1.9	.5	1.9	1.2982
12101	MAGNESIUM DISSOLVED (CALCD.)	3.3	3.1	3.1	3.2	.1	3.2	1.0368
14105	SILICA REACTIVE	3.4	3.4	3.4	3.4	.0	3.4	1.0000
16306	SULPHATE DISSOLVED	7.0	7.0	7.0	7.0	.0	7.0	1.0000
17206	CHLORIDE DISSOLVED	.8	.8	1.1	.9	.2	.9	1.2018
19103	POTASSIUM DISSOLVED	.5	.5	.6	.5	.1	.5	1.1110
20101	CALCIUM DISSOLVED	16.9	17.1	17.0	17.0	.1	17.0	1.0059

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-09-17

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.002	.001	.001	.001	.000	.001	1.2638
15102	PHOSPHORUS TOTAL DISSOLVED	.002	.002	.003	.002	.000	.002	1.1375
15406	PHOSPHORUS TOTAL	.007	.009	.008	.008	.001	.008	1.1044
07110	NITROGEN DISSOLVED NO3 & NO2	.054	.054	.055	.054	.001	.054	1.0107
07557	NITROGEN DISSOLVED AMMONIA	.056	.055	.056	.056	.001	.056	1.0105
07655	NITROGEN TOTAL DISSOLVED	.158	.155	.155	.156	.002	.156	1.0111
07903	NITROGEN PARTICULATE	.030	.031	.031	.031	.001	.031	1.0191
30105	ZINC DISSOLVED	.060	.052	.072	.061	.010	.061	1.1772
30305	ZINC EXTRBLE.	.067	.070	.073	.070	.003	.070	1.0438
29105	COPPER DISSOLVED	.002	.002	.001	.002	.001	.002	1.4921
29305	COPPER EXTRBLE.	.002	.002	.002	.002	.000	.002	1.0000
26105	IRON DISSOLVED	.015	.002	.002	.006	.008	.004	3.2005
26305	IRON EXTRBLE.	.022	.018	.060	.033	.023	.029	1.9061
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	.003	.003	.002	.003	.001	.003	1.2638
82302	LEAD EXTRBLE.	.007	.007	.008	.007	.001	.007	1.0801
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0004	.0004	.0004	.0004	.0000	.0004	1.0000
34302	SELENIUM EXTRBLE.	.0002	.0001	L.0001	*.0001	.0001	*.0001	1.4921
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	116.0	125.0	129.0	123.3	6.7	123.2	1.0561
02061	TEMP. WATER ,FIELD	15.0			15.0		15.0	
02061	TEMP. WATER ,LAB	21.1	21.1	21.0	21.1	.1	21.1	1.0027
02073	TURBIDITY	.19	.21	.31	.24	.06	.23	1.2952
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	11.0	11.0	11.0	11.0	.0	11.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	10.0	10.0	10.0	10.0	.0	10.0	1.0000
06903	CARBON PARTICULATE	.285	.290	.284	.286	.003	.286	1.0113
09106	FLUORIDE DISSOLVED	.075	.076	.076	.076	.001	.076	1.0077
10101	ALKALINITY TOTAL	47.4	47.7	48.3	47.8	.5	47.8	1.0096
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.7	7.5	7.5	7.6	.1	7.6	1.0153
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	110.	106.	109.	108.	2.	108.	1.0195
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	80.	79.	71.	77.	5.	77.	1.0678
10603	HARDNESS TOTAL	56.2	58.4	58.8	57.8	1.4	57.8	1.0247
11103	SODIUM DISSOLVED	2.3	1.4	1.5	1.7	.5	1.7	1.3086
12101	MAGNESIUM DISSOLVED (CALCD.)	2.9	3.9	3.8	3.5	.6	3.5	1.1783
14105	SILICA REACTIVE	3.5	3.5	3.5	3.5	.0	3.5	1.0000
16306	SULPHATE DISSOLVED	9.0	11.5	12.4	11.0	1.8	10.9	1.1824
17206	CHLORIDE DISSOLVED	1.1	1.1	1.0	1.1	.1	1.1	1.0566
19103	POTASSIUM DISSOLVED	.5	.5	.5	.5	.0	.5	1.0000
20101	CALCIUM DISSOLVED	17.8	17.0	17.3	17.4	.4	17.4	1.0235

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-09-17

STATION NO.: 00BC08NE0029
PEND D'OREILLE RIVER BELOW WANETA POWER DAM AT RAILWAY BRIDGE

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.004	.003	.003	.003	.001	.003	1.1807
15102	PHOSPHORUS TOTAL DISSOLVED	.004	.006	.005	.005	.001	.005	1.2319
15406	PHOSPHORUS TOTAL	.011	.011	.011	.011	.000	.011	1.0000
07110	NITROGEN DISSOLVED NO3 & NO2	.013	.012	.012	.012	.001	.012	1.0473
07557	NITROGEN DISSOLVED AMMONIA	.013	.013	.014	.013	.001	.013	1.0437
07655	NITROGEN TOTAL DISSOLVED	.108	.115	.112	.112	.004	.112	1.0320
07903	NITROGEN PARTICULATE	.027	.027	.028	.027	.001	.027	1.0212
30105	ZINC DISSOLVED	.002	.001	L.001	*.001	.001	*.001	1.4921
30305	ZINC EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29105	COPPER DISSOLVED	.001	.002	.002	.002	.001	.002	1.4921
29305	COPPER EXTRBLE.	.001	.001	.002	.001	.001	.001	1.4921
26105	IRON DISSOLVED	.009	.007	.007	.008	.001	.008	1.1562
26305	IRON EXTRBLE.	.037	.041	.041	.040	.002	.040	1.0611
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	.001	*.001	.000	*.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	.001	*.001	.000	*.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0014	.0012	.0011	.0012	.0002	.0012	1.1299
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
02011	COLOUR APPARENT	5.	10.	10.	8.	3.	8.	1.4921
02041	SPECIFIC CONDUCT.	168.0	169.0	157.0	164.7	6.7	164.6	1.0418
02061	TEMP. WATER ,FIELD	17.0			17.0		17.0	
02061	TEMP. WATER ,LAB	20.8	20.7	20.8	20.8	.1	20.8	1.0028
02073	TURBIDITY	.35	.28	.34	.32	.04	.32	1.1290
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	17.0	17.0	17.0	17.0	.0	17.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	16.0	16.0	16.0	16.0	.0	16.0	1.0000
06903	CARBON PARTICULATE	.219	.226	.230	.225	.006	.225	1.0251
09106	FLUORIDE DISSOLVED	.075	.074	.075	.075	.001	.075	1.0078
10101	ALKALINITY TOTAL	76.6	75.0	76.1	75.9	.8	75.9	1.0109
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	8.2	8.1	8.2	8.2	.1	8.2	1.0071
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	129.	132.	124.	128.	4.	128.	1.0321
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	94.	90.	99.	94.	5.	94.	1.0489
10603	HARDNESS TOTAL	80.6	81.2	80.8	80.9	.3	80.9	1.0038
11103	SODIUM DISSOLVED	2.9	2.9	3.0	2.9	.1	2.9	1.0198
12101	MAGNESIUM DISSOLVED (CALCD.)	5.9	6.3	6.0	6.1	.2	6.1	1.0347
14105	SILICA REACTIVE	6.4	6.5	6.5	6.5	.1	6.5	1.0090
16306	SULPHATE DISSOLVED	7.5	7.0	7.0	7.2	.3	7.2	1.0406
17206	CHLORIDE DISSOLVED	1.0	1.0	.9	1.0	.1	1.0	1.0627
19103	POTASSIUM DISSOLVED	.7	.7	.7	.7	.0	.7	1.0000
20101	CALCIUM DISSOLVED	22.6	22.1	22.4	22.4	.3	22.4	1.0113

TABLE 19

Concentrations (mg/L) of nutrients and dissolved metals in water used for the September 1980 algal assay. Water from each site was autoclaved, aerated with CO_2, and filtered before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Birchbank							
Orthophosphate	0.004	0.004	0.004	0.004	0.0	0.004	1.0000
Nitrate plus Nitrite	0.044	0.043	0.044	0.044	0.001	0.044	1.0129
Ammonia	0.009	0.007	0.005	0.007	0.002	0.007	1.3430
Total Dissolved Nitrogen	0.090	0.085	0.080	0.085	0.005	0.085	1.0607
Dissolved Zn	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Cu	0.001	L0.001	0.002	0.001	0.001	0.001	1.4923
Dissolved Fe	0.007	0.002	0.002	0.004	0.003	0.003	2.0612
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	0.001	0.001	L0.001	0.001	0.0	0.001	1.0000
Waneta							
Orthophosphate	0.006	0.005	0.006	0.006	0.001	0.006	1.0954
Nitrate plus Nitrite	0.057	0.058	0.058	0.058	0.001	0.058	1.0097
Ammonia	0.039	0.040	0.039	0.039	0.001	0.039	1.0145
Total Dissolved Nitrogen	0.110	0.110	0.110	0.110	0.0	0.110	1.0000
Dissolved Zn	0.06	0.07	0.07	0.07	0.01	0.07	1.0931
Dissolved Cu	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Fe	0.001	0.011	0.003	0.005	0.005	0.003	3.3213
Dissolved Mn	0.01	0.02	0.01	0.01	0.01	0.01	1.4921
Dissolved Cd	L0.0005	0.0012	0.0005	0.0007	0.0004	0.0007	1.6578
Dissolved Pb	0.002	0.010	0.002	0.005	0.005	0.003	2.5326
Dissolved Ni	L0.001	0.009	L0.001	0.004	0.005	0.002	3.5558
Pend d'Oreille River							
Orthophosphate	0.006	0.006	0.006	0.006	0.000	0.006	1.0514
Nitrate plus Nitrite	0.015	0.017	0.015	0.016	0.001	0.016	1.0748
Ammonia	0.015	0.015	0.014	0.015	0.001	0.015	1.0404
Total Dissolved Nitrogen	0.105	0.110	0.105	0.107	0.003	0.107	1.0272
Dissolved Zn	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.001	0.001	L0.001	0.001	0.0	0.001	1.0000
Dissolved Fe	0.002	0.003	0.002	0.002	0.001	0.002	1.2638
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	0.001	0.001	0.001	0.0	0.001	1.0000

TABLE 20

DAILY IN VIVO CHLOROPHYLL A READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE SEPTEMBER 1980 ALGAL ASSAY

These readings are graphed in Figure 5

Daily Relative Fluorometer Readings
September 19 - October 3, 1980

Birchbank

Control

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0026	.0025	.0001
Day 3	.0039	.0046	.0044	.0043	.0004
Day 4	.0051	.0068	.0065	.0061	.0009
Day 5	.0066	.0086	.0075	.0076	.0010
Day 6	.0080	.012	.0091	.0097	.0021
Day 7	.010	.013	.014	.012	.002
Day 10	.014	.015	.024	.018	.006
Day 11	.015	.013	.024	.017	.006
Day 12	.016	.014	.027	.019	.007
Day 13	.017	.012	.030	.020	.009
Day 14	.018	.010	.029	.019	.010

Control + EDTA

Day 1	.0023	.0025	.0025	.0024	.0001
Day 3	.0050	.0043	.0048	.0047	.0004
Day 4	.0070	.0052	.0061	.0061	.0009
Day 5	.012	.0050	.0089	.0086	.0035
Day 6	.013	.0048	.016	.011	.006
Day 7	.017	.0050	.027	.016	.011
Day 10	.023	.0056	.030	.020	.013
Day 11	.022	.0052	.029	.019	.012
Day 12	.022	.0057	.029	.019	.012
Day 13	.021	.0054	.030	.019	.012
Day 14	.022	.0056	.029	.019	.012

Control + 200ug Fe/L

Day 1	.0024	.0023	.0025	.0024	.0001
Day 3	.0040	.0039	.0042	.0040	.0002
Day 4	.0058	.0050	.0061	.0056	.0006
Day 5	.0073	.0051	.0089	.0071	.0019
Day 6	.0085	.0052	.010	.0079	.0025
Day 7	.014	.0056	.014	.011	.005
Day 10	.027	.0060	.022	.018	.011
Day 11	.025	.0060	.022	.018	.010
Day 12	.023	.0055	.021	.016	.010
Day 13	.023	.0057	.020	.016	.009
Day 14	.023	.0057	.021	.017	.009

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Birchbank

Control + EDTA + N

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0023	.0024	.0001
Day 3	.0052	.0048	.0051	.0050	.0002
Day 4	.0074	.0068	.0077	.0073	.0005
Day 5	.010	.0090	.011	.010	.001
Day 6	.011	.0089	.012	.011	.002
Day 7	.012	.018	.013	.014	.003
Day 10	.016	.41	.016	.147	.227
Day 11	.013	.48	.015	.169	.269
Day 12	.013	.50	.015	.176	.281
Day 13	.016	.50	.015	.177	.280
Day 14	.015	.48	.016	.170	.268

Control + EDTA + P

Day 1	.0026	.0026	.0026	.0026	.0000
Day 3	.0073	.0073	.010	.0082	.0016
Day 4	.018	.018	.031	.022	.008
Day 5	.037	.037	.040	.038	.002
Day 6	.046	.041	.040	.042	.003
Day 7	.046	.043	.045	.045	.002
Day 10	.044	.043	.044	.044	.001
Day 11	.044	.043	.042	.043	.001
Day 12	.042	.041	.041	.041	.001
Day 13	.041	.041	.040	.041	.001
Day 14	.040	.039	.039	.039	.001

Waneta

Control

Day 1	.0023	.0024	.0023	.0023	.0001
Day 3	.0034	.0031	.0030	.0032	.0002
Day 4	.0046	.0044	.0044	.0045	.0001
Day 5	.0051	.0053	.0046	.0050	.0004
Day 6	.0058	.0055	.0061	.0058	.0003
Day 7	.0075	.0081	.0080	.0079	.0003
Day 10	.017	.021	.019	.019	.002
Day 11	.024	.032	.024	.027	.005
Day 12	.035	.044	.036	.038	.005
Day 13	.039	.052	.044	.045	.007
Day 14	.050	.060	.051	.054	.006

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Waneta

Control + EDTA

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0024	.0025	.0001
Day 3	.0047	.0052	.0050	.0050	.0002
Day 4	.0059	.0063	.0059	.0060	.0002
Day 5	.0061	.0063	.0065	.0063	.0002
Day 6	.0068	.0066	.0062	.0065	.0003
Day 7	.0070	.011	.011	.010	.002
Day 10	.0080	.071	.090	.056	.043
Day 11	.0076	.070	.086	.054	.041
Day 12	.0075	.068	.085	.054	.041
Day 13	.0082	.069	.085	.054	.041
Day 14	.0081	.070	.088	.055	.042

Control + 200ug Fe/L

Day 1	.0022	.0022	.0022	.0022	.0000
Day 3	.0026	.0027	.0026	.0026	.0001
Day 4	.0044	.0046	.0036	.0042	.0005
Day 5	.0052	.0053	.0043	.0049	.0006
Day 6	.0065	.0057	.0056	.0059	.0005
Day 7	.0083	.0077	.0070	.0077	.0006
Day 10	.037	.036	.029	.034	.004
Day 11	.046	.049	.040	.045	.005
Day 12	.052	.056	.050	.053	.003
Day 13	.052	.059	.056	.056	.004
Day 14	.051	.058	.058	.056	.004

Control + P

Day 1	.0023	.0024	.0024	.0024	.0001
Day 3	.0034	.0030	.0038	.0034	.0004
Day 4	.0050	.0040	.0063	.0051	.0012
Day 5	.0071	.0066	.0094	.0077	.0015
Day 6	.011	.0094	.017	.012	.004
Day 7	.014	.018	.025	.019	.006
Day 10	.022	.044	.057	.041	.018
Day 11	.026	.050	.060	.045	.017
Day 12	.032	.054	.060	.049	.015
Day 13	.035	.057	.061	.051	.014
Day 14	.040	.056	.054	.050	.009

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Waneta

Control + N

	Replicates			Mean	S. D.
Day 1	.0024	.0023	.0022	.0023	.0001
Day 3	.0032	.0025	.0026	.0028	.0004
Day 4	.0045	.0031	.0031	.0036	.0008
Day 5	.0053	.0042	.0043	.0046	.0006
Day 6	.0058	.0042	.0046	.0049	.0008
Day 7	.0082	.0055	.0050	.0062	.0017
Day 10	.029	.012	.0054	.016	.012
Day 11	.046	.015	.0046	.022	.022
Day 12	.060	.023	.0038	.029	.029
Day 13	.082	.028	.0038	.038	.040
Day 14	.12	.040	.0032	.054	.060

Control + P + N

Day 1	.0023	.0022	.0023	.0023	.0001
Day 3	.0040	.0040	.0030	.0037	.0006
Day 4	.0056	.0054	.0044	.0051	.0006
Day 5	.0086	.0083	.0055	.0075	.0017
Day 6	.013	.014	.0086	.012	.003
Day 7	.018	.018	.010	.015	.005
Day 10	.036	.042	.023	.034	.010
Day 11	.038	.046	.028	.037	.009
Day 12	.037	.050	.034	.040	.008
Day 13	.039	.049	.040	.043	.006
Day 14	.038	.049	.047	.045	.006

Control + EDTA + P + N

Day 1	.0028	.0026	.0027	.0027	.0001
Day 3	.0091	.012	.0086	.0099	.0018
Day 4	.024	.014	.024	.021	.006
Day 5	.075	.13	.070	.092	.033
Day 6	.23	.31	.19	.24	.06
Day 7	.45	.49	.42	.45	.04
Day 10	.96	.73	.86	.85	.12
Day 11	1.0	.76	.88	.88	.12
Day 12	1.0	.79	.89	.89	.11
Day 13	1.2	.83	.92	.98	.19
Day 14	1.2	.81	.90	.97	.20

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Waneta

Control + EDTA + P

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0026	.0025	.0001
Day 3	.010	.015	.0093	.011	.003
Day 4	.032	.044	.028	.035	.008
Day 5	.068	.075	.068	.070	.004
Day 6	.074	.082	.078	.078	.004
Day 7	.072	.078	.085	.078	.007
Day 10	.068	.074	.077	.073	.005
Day 11	.066	.072	.076	.071	.005
Day 12	.064	.070	.072	.069	.004
Day 13	.064	.068	.072	.068	.004
Day 14	.062	.067	.069	.066	.004

Control + EDTA + N

Day 1	.0026	.0025	.0023	.0025	.0002
Day 3	.0073	.014	.0064	.0092	.0042
Day 4	.012	.039	.010	.020	.016
Day 5	.014	.091	.011	.039	.045
Day 6	.016	.20	.021	.079	.105
Day 7	.030	.40	.081	.170	.201
Day 10	.47	.91	.47	.62	.25
Day 11	.52	1.0	.49	.67	.29
Day 12	.60	1.0	.52	.71	.26
Day 13	.66	1.1	.55	.77	.29
Day 14	.72	1.2	.56	.83	.33

Pend d'Oreille River

Control

Day 1	.0023	.0025	.0026	.0025	.0002
Day 3	.0044	.0049	.0044	.0046	.0003
Day 4	.0066	.0065	.0061	.0064	.0003
Day 5	.0091	.0068	.0081	.0080	.0012
Day 6	.010	.0070	.010	.0090	.0017
Day 7	.014	.0075	.014	.012	.004
Day 10	.020	.0075	.023	.017	.008
Day 11	.019	.0074	.023	.016	.008
Day 12	.020	.0074	.022	.016	.008
Day 13	.020	.0070	.023	.017	.008
Day 14	.022	.0072	.023	.017	.009

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Pend d'Oreille River

Control + EDTA

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0025	.0025	.0000
Day 3	.0055	.0048	.0051	.0051	.0004
Day 4	.0078	.0069	.0085	.0077	.0008
Day 5	.011	.010	.013	.011	.002
Day 6	.012	.010	.020	.014	.005
Day 7	.017	.015	.024	.019	.005
Day 10	.023	.020	.021	.021	.002
Day 11	.023	.020	.020	.021	.002
Day 12	.022	.019	.020	.020	.002
Day 13	.024	.019	.021	.021	.003
Day 14	.024	.019	.021	.021	.003

Control + 200ug Fe/L

Day 1	.0025	.0024	.0023	.0024	.0001
Day 3	.0039	.0044	.0037	.0040	.0004
Day 4	.0058	.0065	.0060	.0061	.0004
Day 5	.010	.010	.0078	.009	.001
Day 6	.013	.012	.0093	.011	.002
Day 7	.018	.018	.012	.016	.003
Day 10	.022	.020	.015	.019	.004
Day 11	.022	.019	.014	.018	.004
Day 12	.022	.019	.015	.019	.004
Day 13	.022	.019	.017	.019	.003
Day 14	.023	.019	.016	.019	.004

Control + EDTA + P

Day 1	.0023	.0026	.0024	.0024	.0002
Day 3	.011	.0096	.0070	.0092	.0020
Day 4	.024	.015	.024	.021	.005
Day 5	.029	.017	.030	.025	.007
Day 6	.030	.017	.030	.026	.008
Day 7	.030	.017	.030	.026	.008
Day 10	.029	.018	.032	.026	.007
Day 11	.029	.016	.031	.025	.008
Day 12	.027	.017	.030	.025	.007
Day 13	.027	.016	.031	.025	.008
Day 14	.026	.016	.031	.024	.008

Daily Relative Fluorometer Readings
September 19 - October 3, 1980, Continued

Pend d'Oreille River

Control + EDTA + N

	Replicates			Mean	S. D.
Day 1	.0025	.0025	.0026	.0025	.0001
Day 3	.0053	.0052	.0059	.0055	.0004
Day 4	.0069	.0077	.0096	.0081	.0014
Day 5	.0083	.014	.014	.012	.003
Day 6	.0092	.016	.018	.014	.005
Day 7	.011	.033	.036	.027	.014
Day 10	.015	.50	.56	.36	.30
Day 11	.014	.58	.66	.42	.35
Day 12	.016	.64	.73	.46	.39
Day 13	.015	.64	.74	.46	.39
Day 14	.017	.60	.68	.43	.36

FIGURE 5

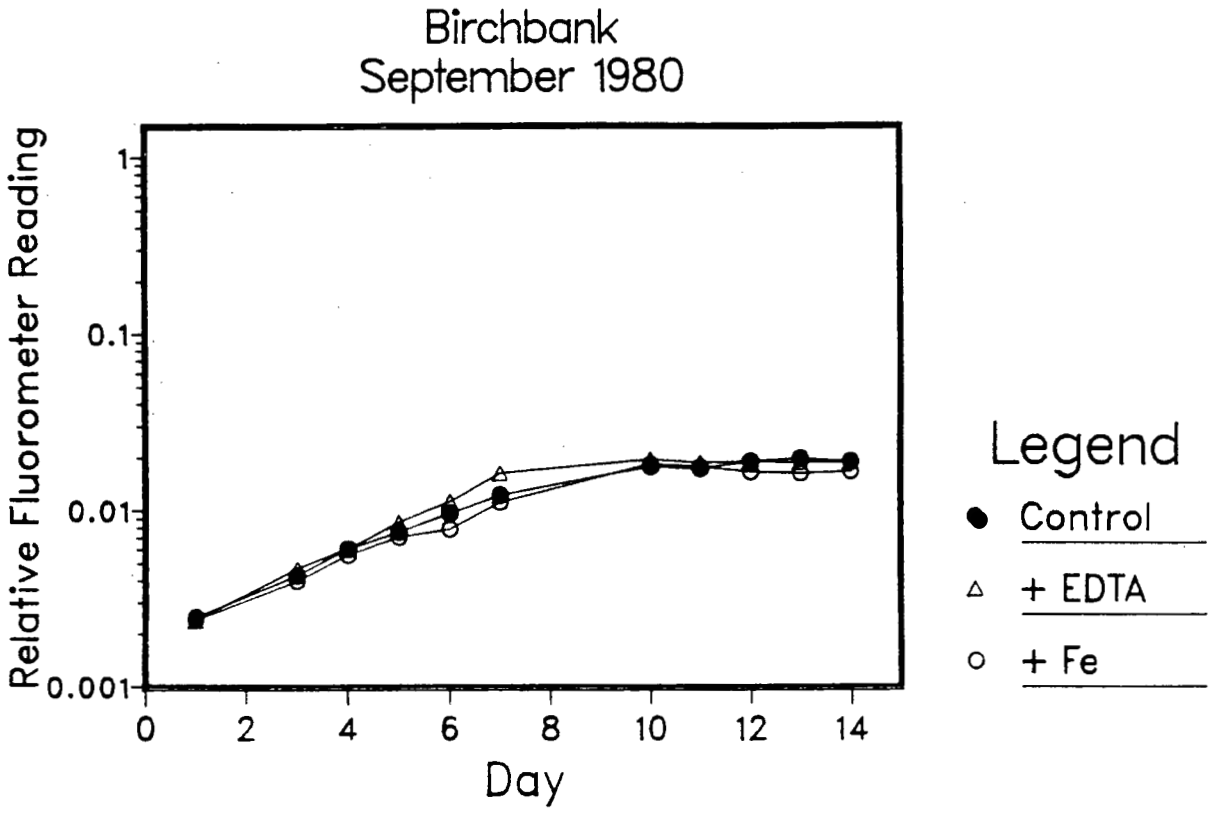
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

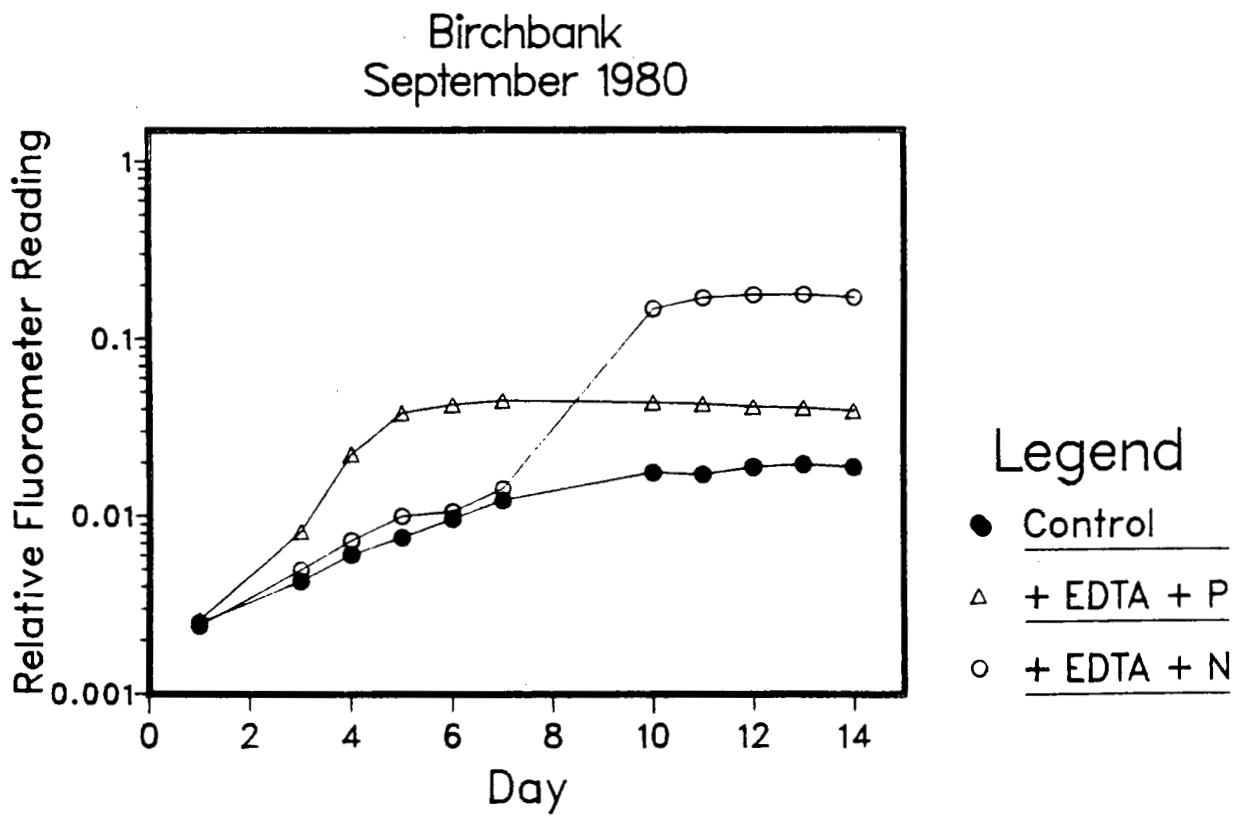
(MEASURED IN RELATIVE FLUOROMETER UNITS)

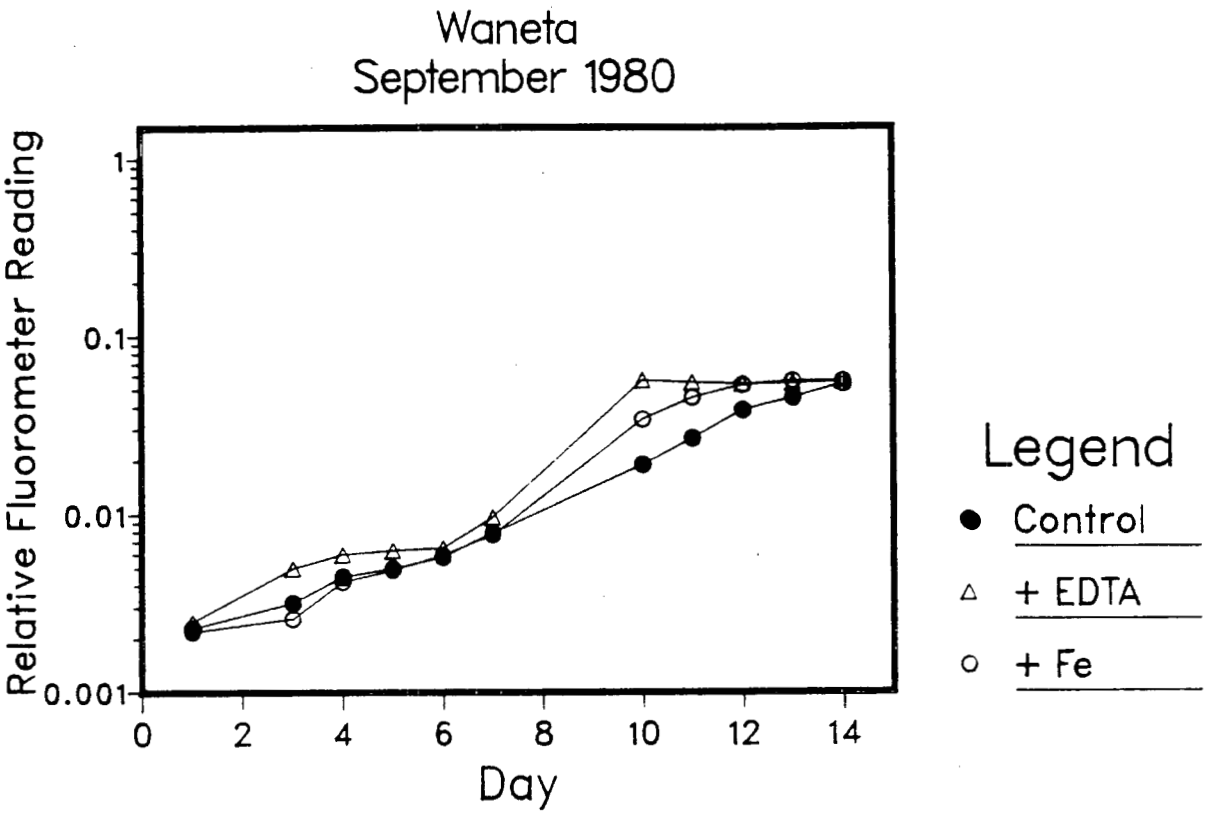
FOR THE SEPTEMBER 1980 ALGAL ASSAY.

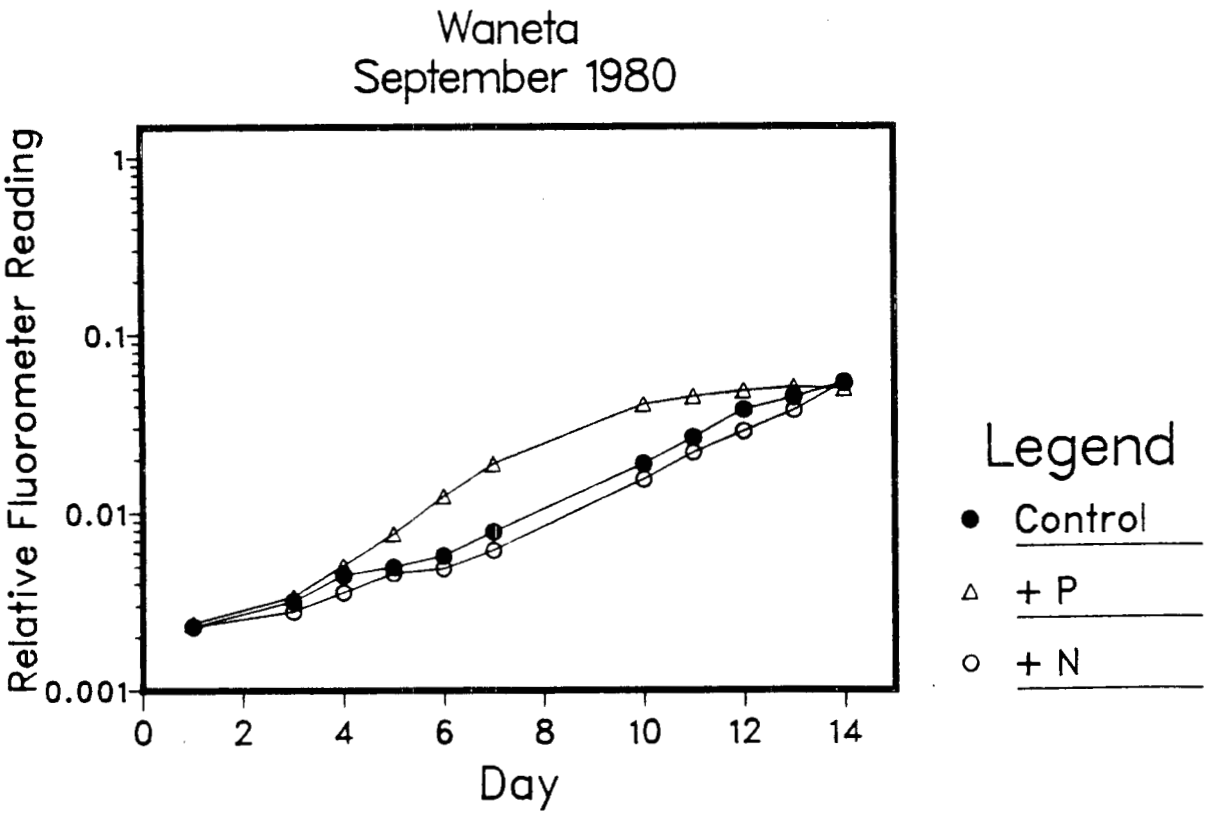
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

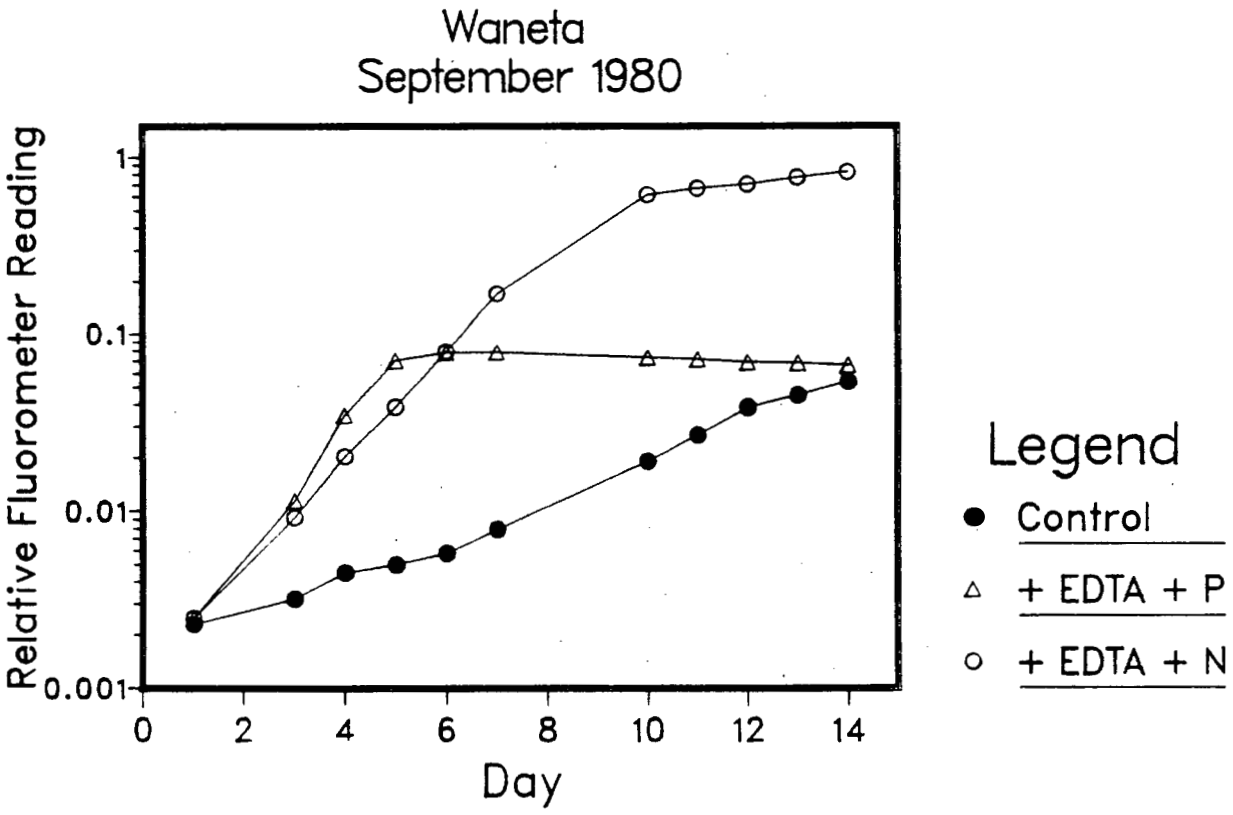
The readings used for these graphs are presented in Table 20

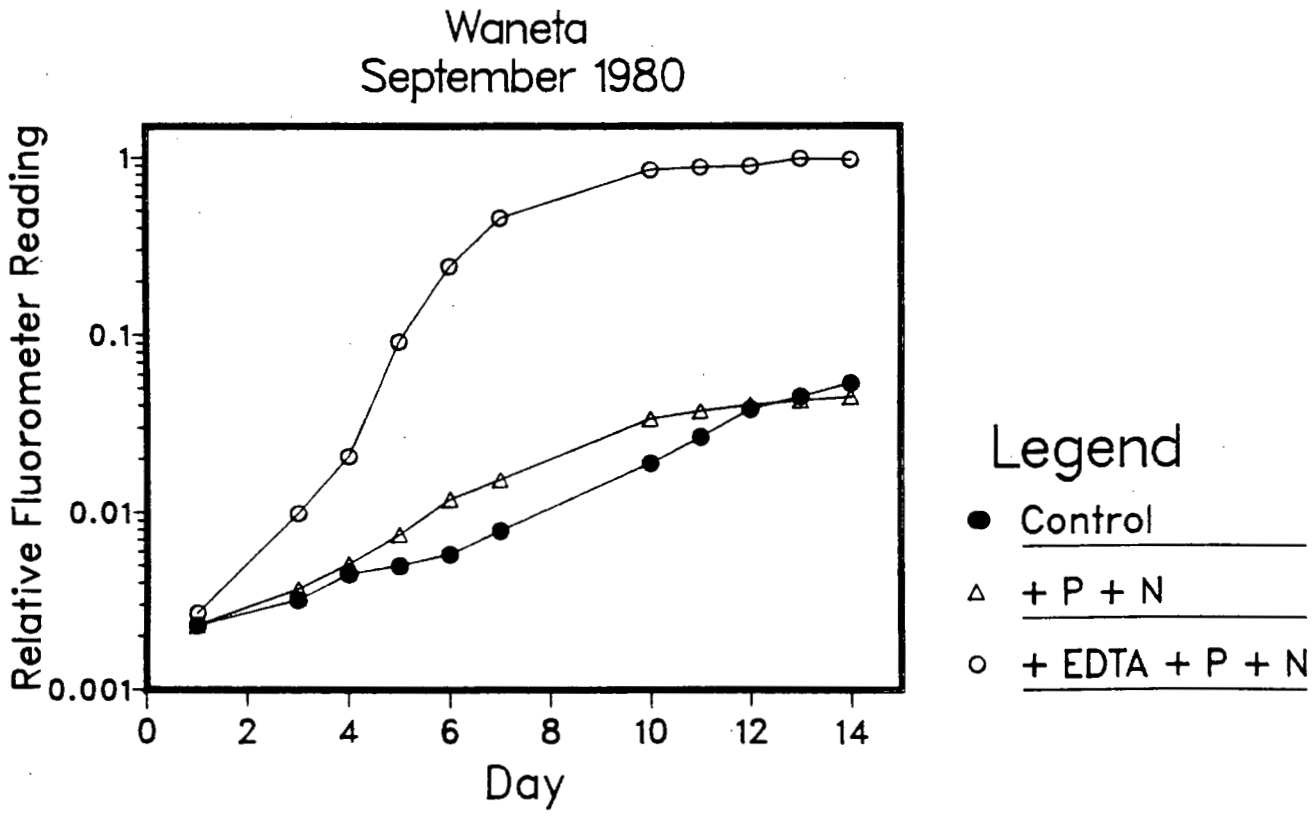

Birchbank
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe

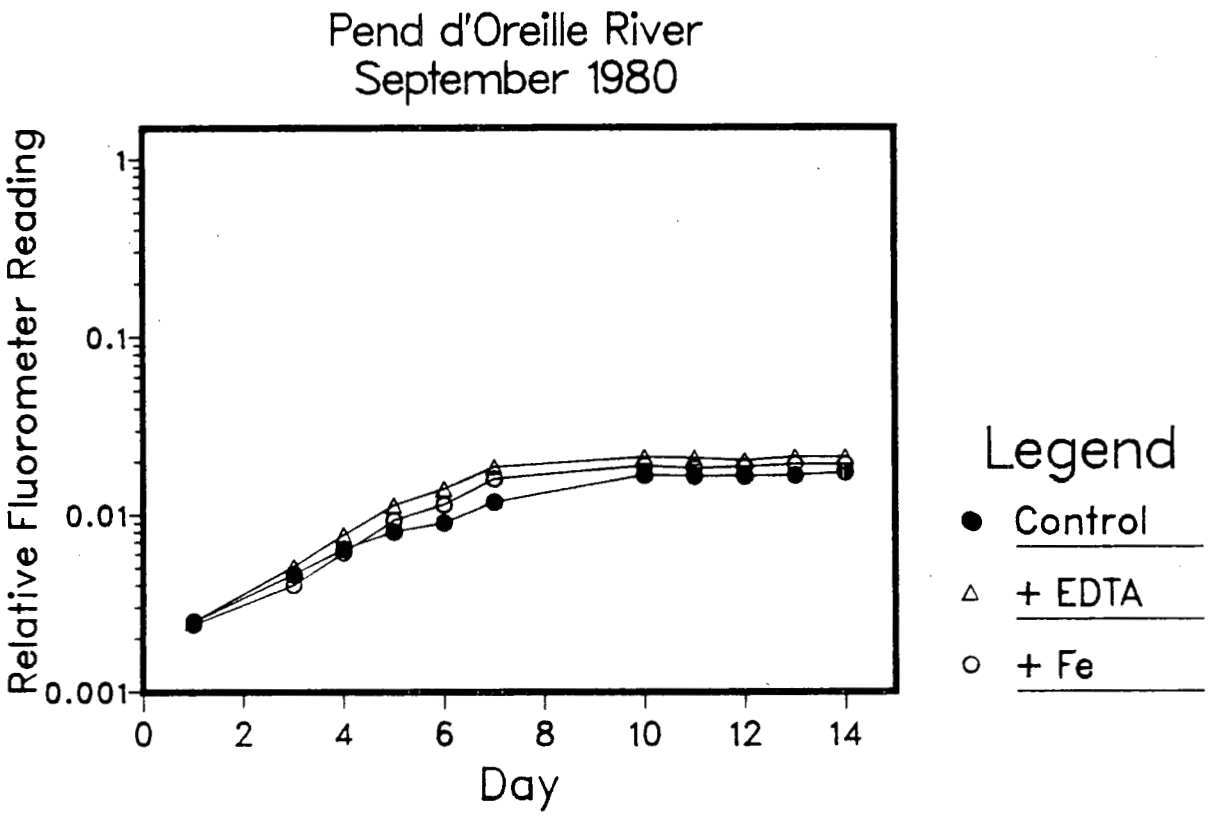

Birchbank
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N


Waneta
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


Waneta
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ N


Waneta
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N


Waneta
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P + N
+ EDTA + P + N


Pend d'Oreille River
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe

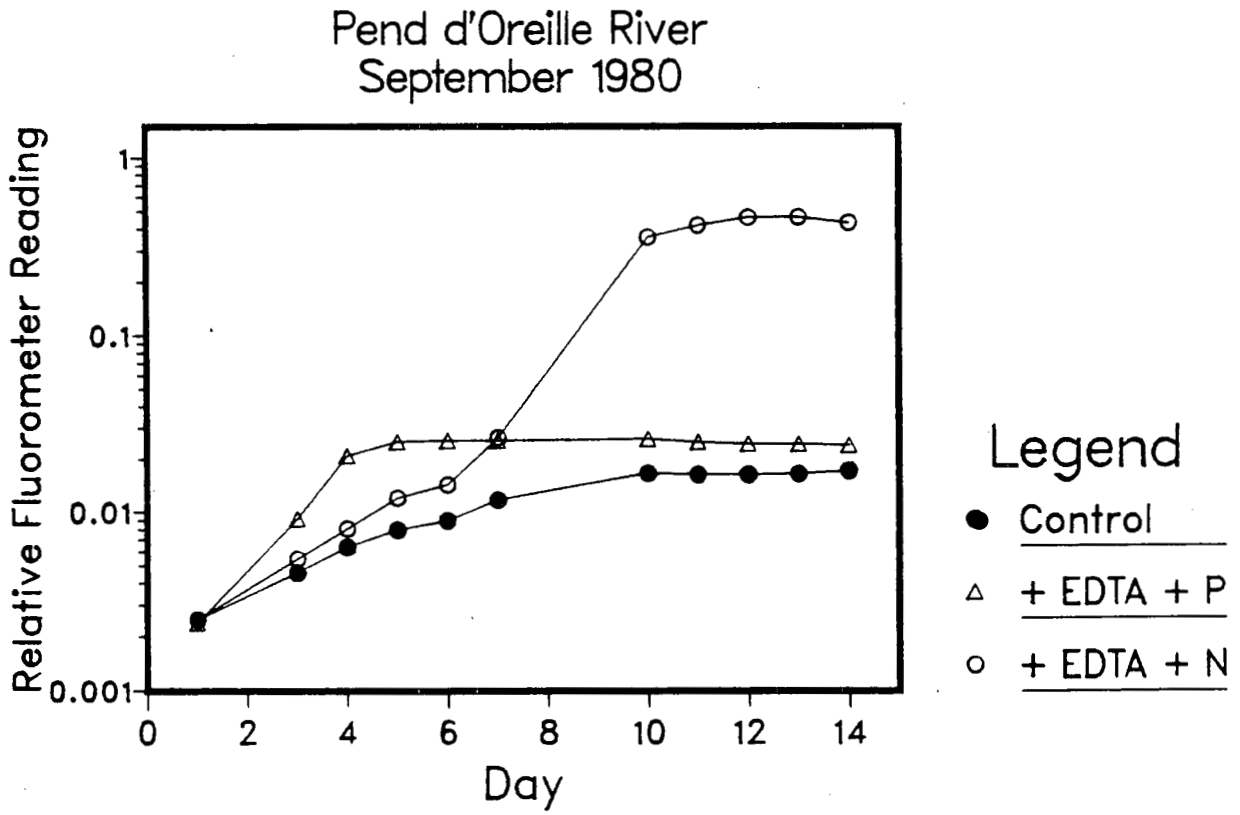

Pend d'Oreille River
September 1980
Relative Fluorometer Reading
1
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N

TABLE 21

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE SEPTEMBER 1980 ASSAY. THE YIELDS ARE EXPRESSED AS CELLS/ML AND WERE MEASURED WITH A HAEMOCYTOMETER

Cells/ml on Final Day
September 19 - October 3, 1980 Algal Assay

Birchbank

	Cells/ml	Mean Cells/ml	S.D.
Control	22000		
	22000	24000	3464
	28000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	44000		
	2000	42000	39038
	80000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	46000		
	2000	31000	25120
	45000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	23000		
	700000	247667	391735
	20000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	50000		
	51000	50667	577
	51000		

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control	72000		
	84000	75333	7572
	70000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	8000		
	230000	162667	134318
	250000		

Cells/ml on Final Day
September 19 - October 3, 1980 Algal Assay, Continued

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	98000		
	120000	112667	12702
	120000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P	58000		
	68000	64000	5292
	66000		

	Cells/ml	Mean Cells/ml	S.D.
Control + N	180000		
	28000	70000	96146
	2000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P + N	28000		
	54000	45667	15308
	55000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P + N	2000000		
	1700000	1833333	152753
	1800000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	170000		
	190000	186667	15275
	200000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	1000000		
	2000000	1303333	605007
	910000		

Cells/ml on Final Day
September 19 - October 3, 1980 Algal Assay, Continued

Pend d'Oreille River

	Cells/ml	Mean Cells/ml	S.D.
Control	55000		
	7000	40000	28618
	58000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	46000		
	36000	42000	5292
	44000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	53000		
	26000	34000	16523
	23000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	60000		
	26000	56667	29143
	84000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	26000		
	920000	632000	525026
	950000		

TABLE 22

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON DECEMBER 2, 1980. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-12-02

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.003	L.002	L.002	*.002	.000	*.002	1.1375
15102	PHOSPHORUS TOTAL DISSOLVED	.003	.003	.003	.003	.000	.003	1.1110
15406	PHOSPHORUS TOTAL	.005	.006	.005	.005	.001	.005	1.1110
07110	NITROGEN DISSOLVED NO3 & NO2	.096	.095	.096	.096	.001	.096	1.0061
07557	NITROGEN DISSOLVED AMMONIA	.007	.004	.003	.005	.002	.004	1.5386
07655	NITROGEN TOTAL DISSOLVED	.135	.130	.135	.133	.003	.133	1.0220
07903	NITROGEN PARTICULATE	.013	.010	.010	.011	.002	.011	1.1636
30105	ZINC DISSOLVED	.002	.002	.003	.002	.001	.002	1.2638
30305	ZINC EXTRBLE.	.002	.002	.002	.002	.000	.002	1.0000
29105	COPPER DISSOLVED	.015	.001	.002	.006	.008	.003	4.0827
29305	COPPER EXTRBLE.	.002	L.001	L.001	*.001	.001	*.001	1.4921
26105	IRON DISSOLVED	.020	.007	.005	.011	.008	.009	2.0608
26305	IRON EXTRBLE.	.033	.025	.024	.027	.005	.027	1.1892
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	.001	L.001	*.001	.000	*.001	1.0000
28102	NICKEL DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
28302	NICKEL EXTRBLE.	L.001	.001	.001	*.001	.000	*.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0002	.0002	.0001	.0002	.0001	.0002	1.4921
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
02011	COLOUR APPARENT	10.	5.	5.	7.	3.	6.	1.4921
02041	SPECIFIC CONDUCT.	134.0	134.0	135.0	134.3	.6	134.3	1.0043
02061	TEMP. WATER ,LAB	22.8	22.8	22.8	22.8	.0	22.8	1.0000
02073	TURBIDITY	.30	.30	.30	.30	.00	.30	1.0000
06001	CARBON TOTAL ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06051	CARBON TOTAL INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06903	CARBON PARTICULATE	.156	.144	.142	.147	.008	.147	1.0520
09106	FLUORIDE DISSOLVED	.070	.060	.060	.063	.006	.063	1.0931
10101	ALKALINITY TOTAL	54.2	56.2	56.2	55.5	1.2	55.5	1.0211
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.9	7.9	7.9	7.9	.0	7.9	1.0000
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	80.	79.	77.	79.	2.	79.	1.0197
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	66.	68.	70.	68.	2.	68.	1.0299
10603	HARDNESS TOTAL	64.7	63.7	64.5	64.3	.5	64.3	1.0083
11103	SODIUM DISSOLVED	1.2	1.2	1.2	1.2	.0	1.2	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.6	3.3	3.5	3.5	.2	3.5	1.0454
14105	SILICA REACTIVE	3.6	3.6	3.6	3.6	.0	3.6	1.0000
16306	SULPHATE DISSOLVED	9.8	9.9	9.7	9.8	.1	9.8	1.0103
17206	CHLORIDE DISSOLVED	.9	.9	.9	.9	.0	.9	1.0000
19103	POTASSIUM DISSOLVED	.5	.5	.5	.5	.0	.5	1.0000
20101	CALCIUM DISSOLVED	20.0	20.1	20.0	20.0	.1	20.0	1.0029

COLUMBIA RIVER BIOASSAY DATA

DATE: 80-12-02

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.022	.022	.020	.021	.001	.021	1.0426
15102	PHOSPHORUS TOTAL DISSOLVED	.023	.023	.023	.023	.000	.023	1.0000
15406	PHOSPHORUS TOTAL	.050	.037	.032	.040	.009	.039	1.2556
07110	NITROGEN DISSOLVED NO3 & NO2	.095	.096	.096	.096	.001	.096	1.0061
07557	NITROGEN DISSOLVED AMMONIA	.013	.013	.013	.013	.000	.013	1.0000
07655	NITROGEN TOTAL DISSOLVED	.150	.145	.145	.147	.003	.147	1.0198
07903	NITROGEN PARTICULATE	.013	.012	.011	.012	.001	.012	1.0871
30105	ZINC DISSOLVED	.039	.041	.040	.040	.001	.040	1.0253
30305	ZINC EXTRBLE.	.046	.047	.046	.046	.001	.046	1.0125
29105	COPPER DISSOLVED	.003	.005	.007	.005	.002	.005	1.5321
29305	COPPER EXTRBLE.	.002	.004	.003	.003	.001	.003	1.4166
26105	IRON DISSOLVED	.009	.030	.007	.015	.013	.012	2.1768
26304	IRON EXTRBLE.	.09	.09	.08	.09	.01	.09	1.0704
25104	MANGANESE DISSOLVED	.01	.01	.01	.01	.00	.01	1.0000
25304	MANGANESE EXTRBLE.	.01	.01	.01	.01	.00	.01	1.0000
48102	CADMIUM DISSOLVED	.0006	.0006	L.0005	*.0006	.0001	*.0006	1.1110
48302	CADMIUM EXTRBLE.	L.0005	.0005	.0006	*.0005	.0001	*.0005	1.1110
82103	LEAD DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
82302	LEAD EXTRBLE.	.005	.005	.005	.005	.000	.005	1.0000
28102	NICKEL DISSOLVED	L.001	.001	L.001	*.001	.000	*.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0003	.0005	.0003	.0004	.0001	.0004	1.3430
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	137.0	139.0	138.0	138.0	1.0	138.0	1.0073
02061	TEMP. WATER ,LAB	22.7	22.7	22.7	22.7	.0	22.7	1.0000
02073	TURBIDITY	.50	.50	.60	.53	.06	.53	1.1110
06001	CARBON TOTAL ORGANIC	1.0	1.0	4.0	2.0	1.7	1.6	2.2264
06051	CARBON TOTAL INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.0	1.0	1.0	1.0	.0	1.0	1.0000
06151	CARBON DISSOLVED INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06903	CARBON PARTICULATE	.157	.141	.139	.146	.010	.145	1.0688
09106	FLUORIDE DISSOLVED	.120	.120	.120	.120	.000	.120	1.0000
10101	ALKALINITY TOTAL	54.2	55.5	54.8	54.8	.7	54.8	1.0119
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.9	7.9	8.0	7.9	.1	7.9	1.0073
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	81.	80.	82.	81.	1.	81.	1.0124
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	70.	74.	74.	73.	2.	73.	1.0326
10603	HARDNESS TOTAL	67.2	67.6	68.6	67.8	.7	67.8	1.0107
11103	SODIUM DISSOLVED	1.3	1.3	1.3	1.3	.0	1.3	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.7	3.9	3.6	3.7	.2	3.7	1.0415
14105	SILICA REACTIVE	3.8	3.7	3.7	3.7	.1	3.7	1.0155
16306	SULPHATE DISSOLVED	14.3	13.8	13.7	13.9	.3	13.9	1.0232
17206	CHLORIDE DISSOLVED	1.0	1.0	1.0	1.0	.0	1.0	1.0000
19103	POTASSIUM DISSOLVED	.5	.5	.6	.5	.1	.5	1.1110
20101	CALCIUM DISSOLVED	20.8	20.6	21.5	21.0	.5	21.0	1.0227

TABLE 23

Concentrations (mg/L) of nutrients and dissolved metals in water used for the December 1980 algal assay. Water from each site was autoclaved, aerated with CO_2, and filtered before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Birchbank							
Orthophosphate	0.003	0.002	0.003	0.003	0.001	0.003	1.2639
Nitrate plus Nitrite	0.100	0.100	0.101	0.100	0.001	0.100	1.0058
Ammonia	0.008	0.009	0.014	0.010	0.003	0.010	1.3431
Total Dissolved Nitrogen	0.160	0.160	0.160	0.160	0.0	0.160	1.0000
Dissolved Zn	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.002	0.001	L0.001	0.001	0.001	0.001	1.4923
Dissolved Fe	0.008	0.004	L0.001	0.004	0.004	0.003	2.8830
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Waneta							
Orthophosphate	0.026	0.026	0.026	0.026	0.0	0.026	1.0000
Nitrate plus Nitrite	0.102	0.101	0.101	0.101	0.001	0.101	1.0058
Ammonia	0.016	0.017	0.014	0.016	0.002	0.016	1.1044
Total Dissolved Nitrogen	0.170	0.165	0.160	0.165	0.005	0.165	1.0308
Dissolved Zn	0.022	0.022	0.022	0.022	0.0	0.022	1.0000
Dissolved Cu	0.001	0.004	0.002	0.002	0.002	0.002	2.0001
Dissolved Fe	0.001	0.001	0.003	0.002	0.001	0.001	1.8857
Dissolved Mn	L0.01	0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 24

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE DECEMBER 1980 ALGAL ASSAY

These readings are graphed in Figure 6

Daily Relative Fluorometer Readings
December 4 - 16, 1980

Birchbank

Control

	Replicates					Mean	S. D.
Day 1	.0024	.0025	.0026	.0023	.0024	.0024	.0001
Day 4	.0050	.0035	.0044	.0038	.0038	.0041	.0006
Day 5	.0060	.0038	.0055	.0042	.0041	.0047	.0009
Day 6	.0068	.0043	.0061	.0045	.0042	.0052	.0011
Day 7	.0068	.0038	.0062	.0039	.0040	.0049	.0014
Day 8	.0073	.0038	.0065	.0041	.0039	.0051	.0015
Day 11	.0062	.0033	.0062	.0040	.0032	.0046	.0013
Day 12	.0065	.0032	.0063	.0032	.0032	.0045	.0016

Control + EDTA

Day 1	.0024	.0024	.0025	.0025	.0024	.0024	.0000
Day 4	.0038	.0039	.0038	.0037	.0041	.0039	.0001
Day 5	.0042	.0041	.0043	.0038	.0040	.0041	.0002
Day 6	.0045	.0045	.0049	.0044	.0047	.0046	.0002
Day 7	.0043	.0037	.0047	.0037	.0044	.0042	.0004
Day 8	.0046	.0042	.0050	.0040	.0043	.0044	.0004
Day 11	.0038	.0037	.0046	.0036	.0040	.0039	.0004
Day 12	.0039	.0038	.0046	.0036	.0047	.0041	.0004

Waneta

Control

Day 1	.0024	.0023	.0022	.0023	.0026	.0024	.0001
Day 4	.022	.0092	.0070	.014	.021	.015	.006
Day 5	.058	.021	.015	.038	.058	.038	.017
Day 6	.087	.052	.040	.070	.087	.067	.019
Day 7	.10	.085	.091	.070	.093	.088	.011
Day 8	.080	.081	.084	.066	.086	.079	.007
Day 11	.070	.069	.084	.058	.080	.072	.009
Day 12	.067	.066	.080	.055	.073	.068	.009

Daily Relative Fluorometer Readings
December 4 - 16, 1980, Continued

Waneta

Control + EDTA

	Replicates					Mean	S. D.
Day 1	.0024	.0024	.0025	.0025	.0024	.0024	.0000
Day 4	.038	.036	.022	.034	.028	.032	.006
Day 5	.068	.074	.063	.073	.073	.070	.004
Day 6	.064	.068	.080	.074	.090	.075	.007
Day 7	.061	.069	.080	.069	.085	.073	.007
Day 8	.060	.065	.079	.066	.085	.071	.008
Day 11	.051	.061	.070	.068	.082	.066	.008
Day 12	.049	.049	.068	.065	.080	.062	.010

Control + 200ug Fe/L

Day 1	.0027	.0027	.0024	.0024	.0023	.0025	.0002
Day 4	.019	.019	.012	.014	.023	.017	.003
Day 5	.056	.046	.030	.042	.052	.045	.009
Day 6	.078	.089	.074	.083	.077	.080	.006
Day 7	.087	.095	.087	.083	.077	.086	.005
Day 8	.082	.088	.081	.082	.074	.081	.003
Day 11	.074	.084	.078	.081	.068	.077	.004
Day 12	.070	.084	.078	.080	.067	.076	.006

Control + P

Day 1	.0026	.0026	.0024	.0024	.0025	.0025	.0001
Day 4	.016	.011	.014	.014	.013	.014	.002
Day 5	.040	.024	.034	.028	.035	.032	.006
Day 6	.067	.052	.059	.051	.067	.059	.007
Day 7	.080	.074	.075	.072	.076	.075	.003
Day 8	.065	.073	.066	.070	.070	.069	.003
Day 11	.062	.058	.063	.059	.063	.061	.002
Day 12	.059	.055	.058	.054	.060	.057	.002

Control + N

Day 1	.0024	.0024	.0027	.0024	.0025	.0025	.0001
Day 4	.016	.018	.024	.010	.013	.016	.005
Day 5	.040	.046	.056	.023	.034	.040	.012
Day 6	.095	.11	.13	.054	.077	.093	.028
Day 7	.19	.19	.19	.13	.14	.17	.03
Day 8	.22	.22	.24	.18	.20	.21	.02
Day 11	.29	.30	.29	.29	.29	.29	.00
Day 12	.30	.29	.28	.30	.27	.29	.01

Daily Relative Fluorometer Readings
December 4 - 16, 1980, Continued

Waneta

Control + P + N

	Replicates					Mean	S. D.
Day 1	.0024	.0022	.0026	.0028	.0022	.0024	.0002
Day 4	.013	.0086	.018	.016	.006	.012	.004
Day 5	.028	.044	.044	.037	.015	.034	.008
Day 6	.058	.025	.10	.089	.024	.059	.031
Day 7	.11	.043	.20	.18	.042	.12	.06
Day 8	.18	.068	.25	.28	.072	.17	.09
Day 11	.29	.17	.29	.44	.21	.28	.10
Day 12	.27	.19	.29	.44	.21	.28	.09

Control + EDTA + P + N

Day 1	.0025	.0023	.0025	.0025	.0025	.0025	.0001
Day 4	.024	.020	.025	.018	.029	.023	.003
Day 5	.066	.054	.077	.051	.08	.066	.011
Day 6	.17	.13	.19	.15	.17	.16	.02
Day 7	.24	.26	.24	.25	.20	.24	.01
Day 8	.23	.27	.24	.23	.19	.23	.02
Day 11	.20	.24	.20	.21	.17	.20	.02
Day 12	.19	.24	.20	.20	.16	.20	.02

Control + EDTA + P

Day 1	.0024	.0025	.0024	.0025	.0025	.0025	.0000
Day 4	.027	.018	.016	.025	.028	.023	.005
Day 5	.058	.051	.045	.055	.064	.055	.005
Day 6	.063	.071	.069	.063	.072	.068	.004
Day 7	.058	.070	*	.058	.065	.063	.006
Day 8	.054	.067	.064	.055	.057	.059	.006
Day 11	.048	.062	.059	.054	.058	.056	.005
Day 12	.046	.061	.055	.051	.055	.054	.006

Control + EDTA + N

Day 1	.0025	.0023	.0023	.0023	.0027	.0024	.0001
Day 4	.048	.032	.029	.020	.042	.034	.010
Day 5	.15	.082	.078	.066	.13	.101	.034
Day 6	.23	.18	.17	.17	.24	.20	.03
Day 7	.27	.26	.27	.22	.29	.26	.02
Day 8	.25	.26	.27	.24	.29	.26	.01
Day 11	.24	.23	.24	.23	.27	.24	.01
Day 12	.25	.22	.23	.22	.26	.24	.01

* designates that data were suspect and therefore not presented

FIGURE 6

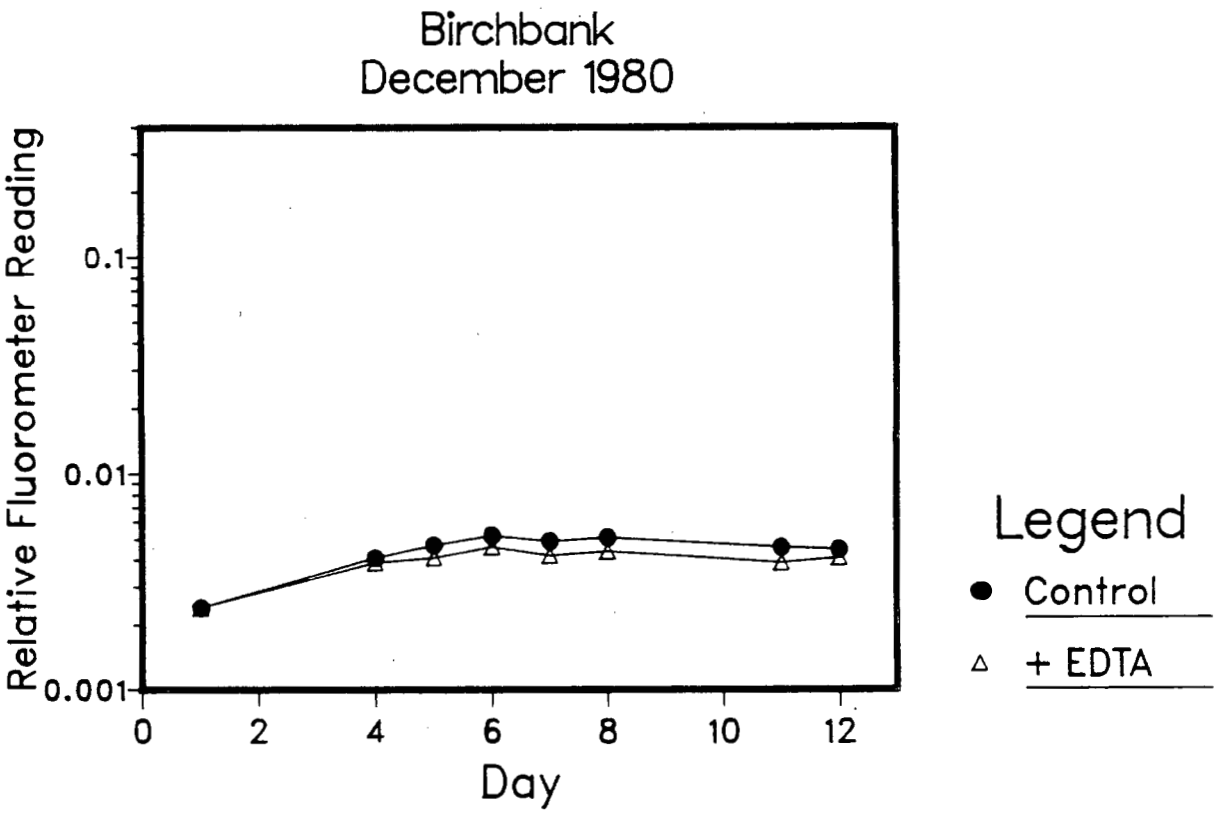
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

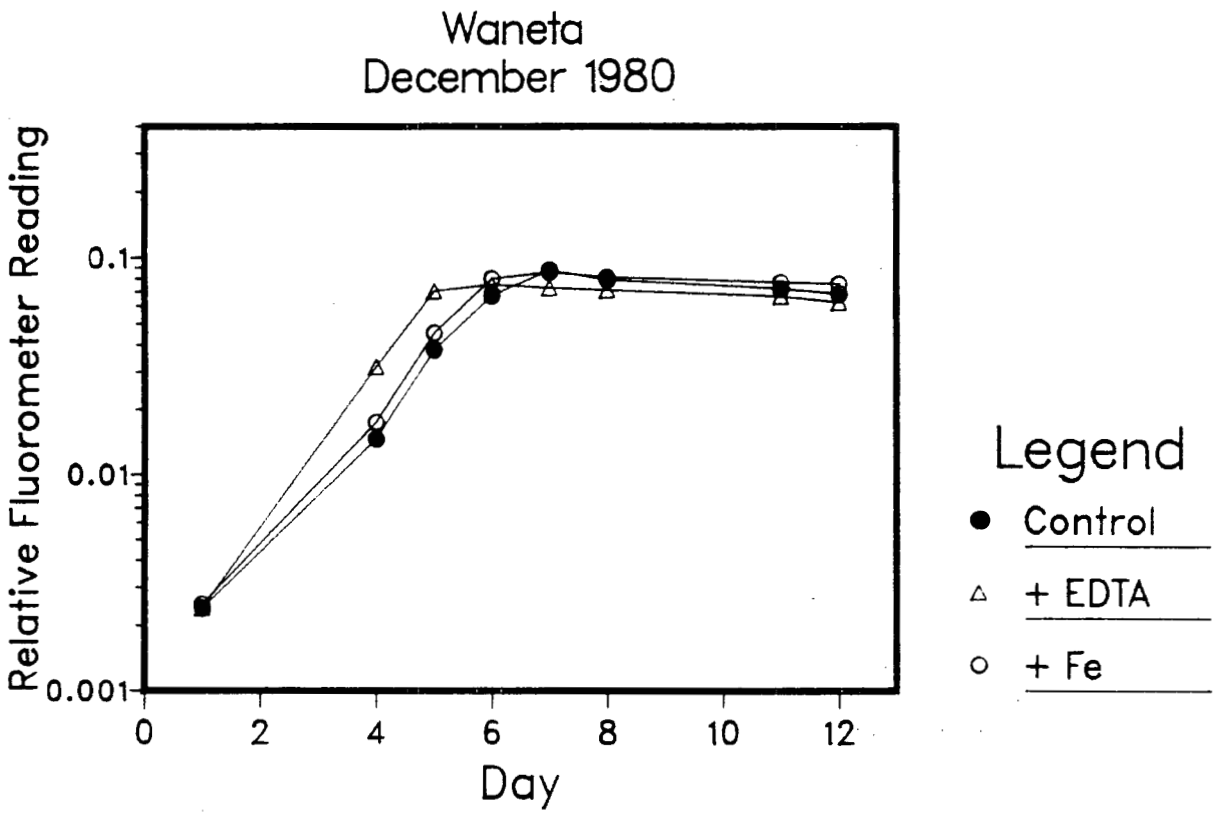
(MEASURED IN RELATIVE FLUOROMETER UNITS)

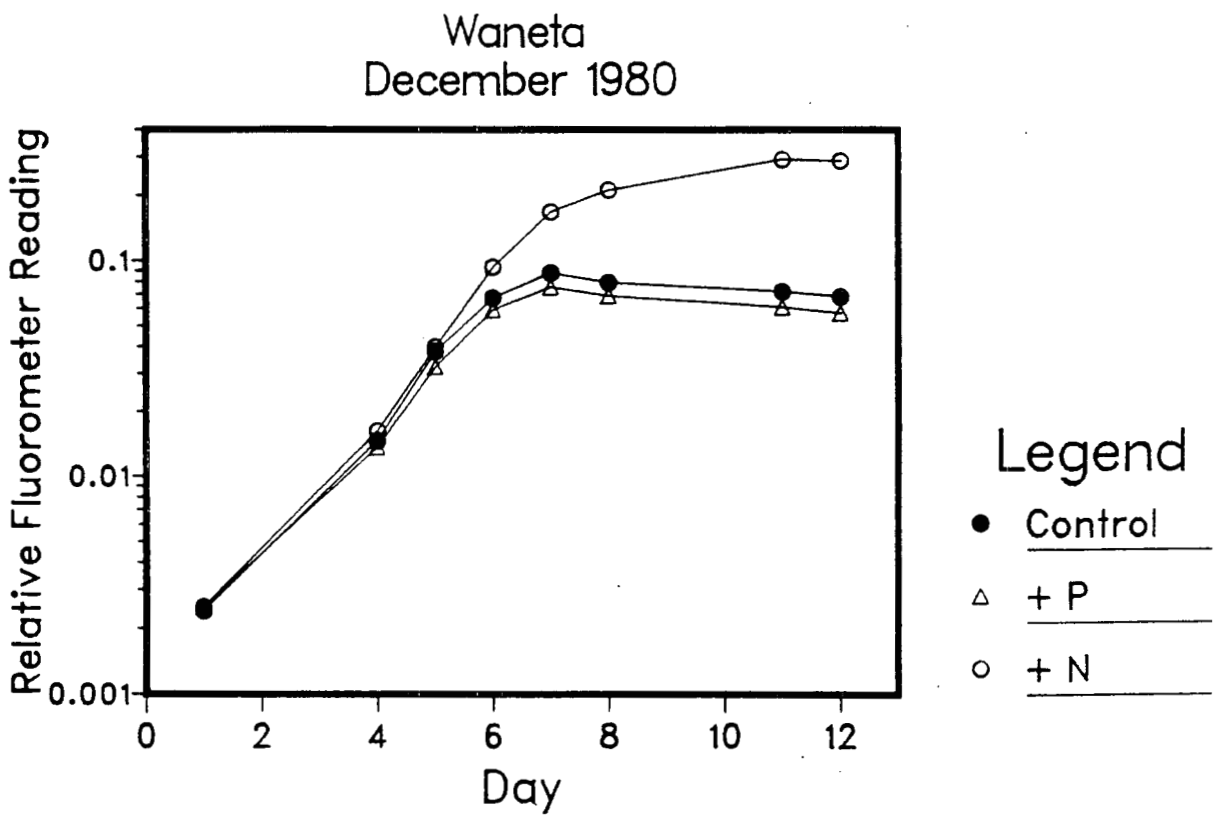
FOR THE DECEMBER 1980 ALGAL ASSAY.

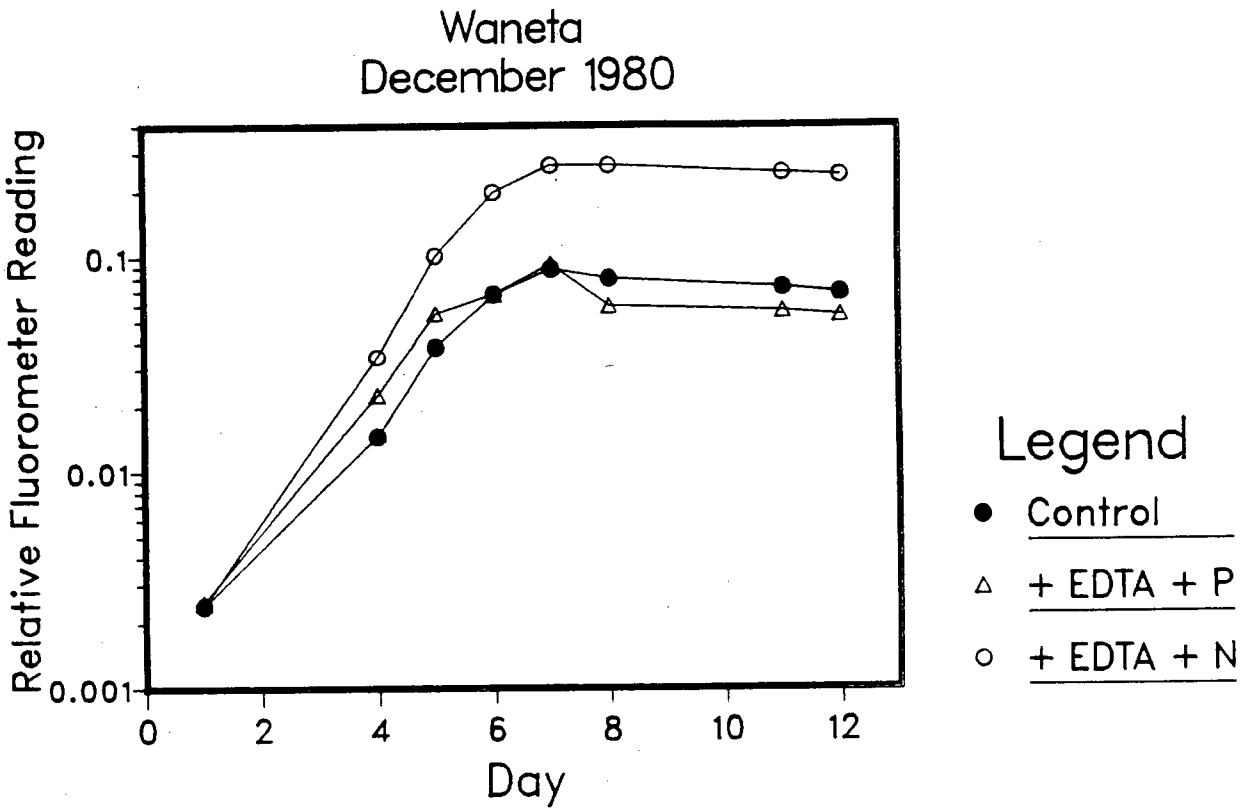
POINTS PLOTTED ARE THE MEANS OF 5 REPLICATES

The readings used for these graphs are presented in Table 24


Birchbank
December 1980
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
Day
Legend
Control
+ EDTA


Waneta
December 1980
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
Day
Legend
Control
+ EDTA
+ Fe


Waneta
December 1980
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
Day
Legend
Control
+ P
+ N


Waneta
December 1980
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
Day
Legend
Control
+ EDTA + P
+ EDTA + N

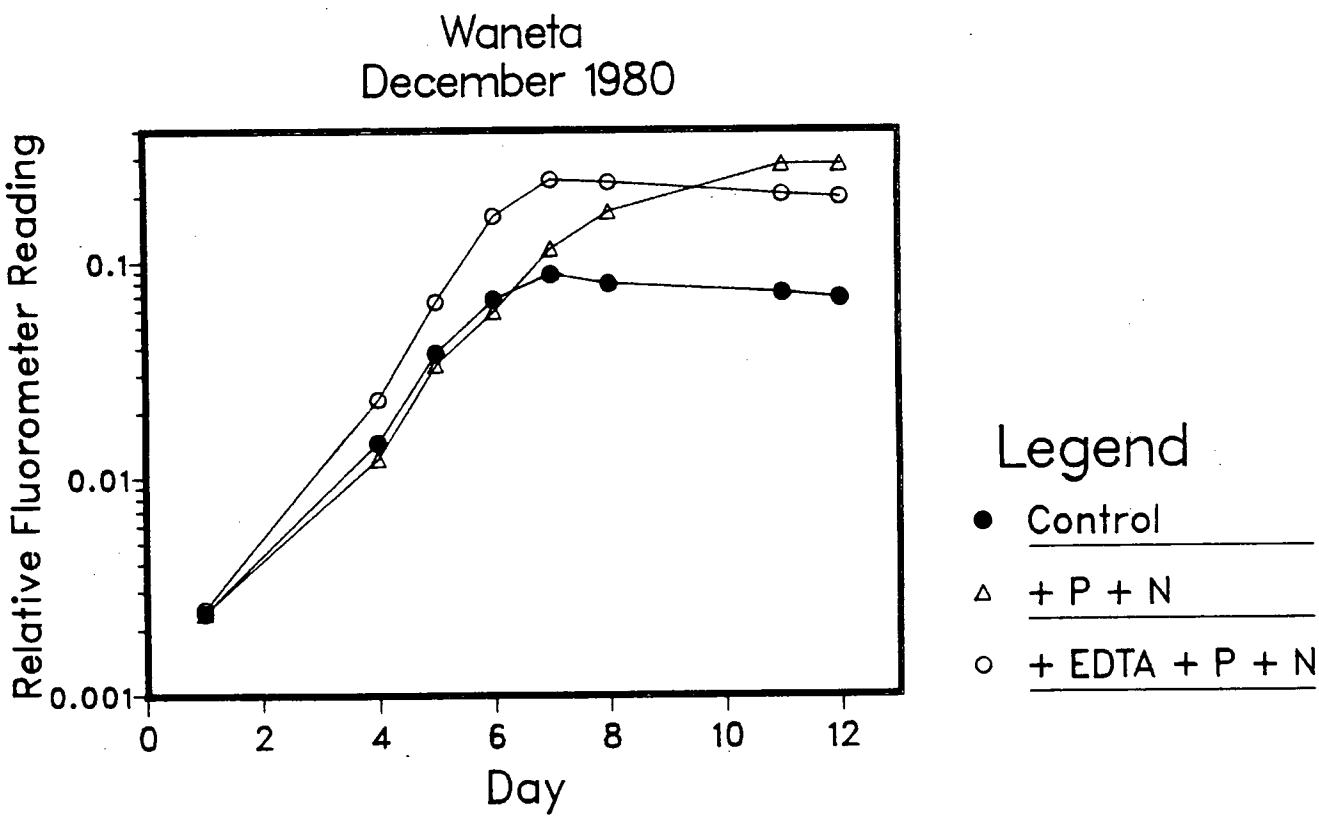

Waneta
December 1980
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
Day
Legend
Control
+ P + N
+ EDTA + P + N

TABLE 25

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE DECEMBER 1980 ASSAY. THE YIELDS ARE EXPRESSED AS CELLS/ML AND WERE MEASURED WITH A HAEMOCYTOMETER

Cells/ml on Final Day
December 4 - 16, 1980 Algal Assay

Birchbank

	Cells/ml	Mean Cells/ml	S.D.
Control	10000		
	5900	7860	2443
	11000		
	6400		
	6000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	8000		
	6000	8600	2408
	12000		
	7000		
	10000		

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control	150000		
	180000	160000	24495
	190000		
	130000		
	150000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	220000		
	100000	170000	43589
	180000		
	170000		
	180000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	180000		
	250000	198000	29496
	190000		
	190000		
	180000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P	150000		
	130000	144000	8944
	150000		
	140000		
	150000		

Cells/ml on Final Day
December 4 - 16, 1980 Algal Assay, Continued

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control + N	600000		
	580000	576000	30496
	550000		
	610000		
	540000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P + N	560000		
	300000	512000	207171
	580000		
	800000		
	320000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P + N	300000		
	360000	318000	30332
	330000		
	320000		
	280000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	90000		
	180000	130000	33912
	130000		
	110000		
	140000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	480000		
	350000	408000	75299
	360000		
	350000		
	500000		

TABLE 26

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER
ON FEBRUARY 17, 1981. CONCENTRATIONS OF ALL
CHEMICALS EXCEPT HG ARE REPORTED IN mg/L;
HG IS IN μg/L. PARAMETERS ARE LISTED UNDER
THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 81-02-17

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.005	.005	.005	.005	.000	.005	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.004	.003	.004	.004	.001	.004	1.1807
15406	PHOSPHORUS TOTAL	.007	.006	.006	.006	.001	.006	1.0931
07110	NITROGEN DISSOLVED NO3 & NO2	.134	.136	.136	.135	.001	.135	1.0086
07557	NITROGEN DISSOLVED AMMONIA	.018	.018	.017	.018	.001	.018	1.0336
07651	NITROGEN DISSOLVED	.180	.180	.180	.180	.000	.180	1.0000
30105	ZINC DISSOLVED	L.001	.002	.001	*.001	.001	*.001	1.4921
30305	ZINC EXTRBLE.	.001	.001	.001	.001	.000	.001	1.0000
29105	COPPER DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29305	COPPER EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
26105	IRON DISSOLVED	.003	.003	.003	.003	.000	.003	1.0000
26305	IRON EXTRBLE.	.018	.023	.017	.019	.003	.019	1.1742
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	.003	.001	*.002	.001	*.001	1.8857
82302	LEAD EXTRBLE.	.001	.002	.002	.002	.001	.002	1.4921
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0002	.0002	.0002	.0002	.0000	.0002	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
24053	CHROMIUM DISSOLVED	.003	.003	.003	.003	.000	.003	1.0000
24303	CHROMIUM EXTRBLE.	.005	.003	.003	.004	.001	.004	1.3430
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	141.0	141.0	140.0	140.7	.6	140.7	1.0041
02061	TEMP. WATER ,FIELD	4.0			4.0		4.0	
02061	TEMP. WATER ,LAB	20.5	20.5	20.7	20.6	.1	20.6	1.0056
02073	TURBIDITY	.21	.22	.24	.22	.02	.22	1.0701
06001	CARBON TOTAL ORGANIC	L.8	L.8	L.8	L.8	.0	L.8	1.0000
06051	CARBON TOTAL INORGANIC	14.0	14.5	14.5	14.3	.3	14.3	1.0205
09106	FLUORIDE DISSOLVED	.060	.060	.070	.063	.006	.063	1.0931
10101	ALKALINITY TOTAL	57.5	58.5	57.4	57.8	.6	57.8	1.0105
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.5	7.6	7.5	7.5	.1	7.5	1.0077
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	75.	108.	99.	94.	17.	93.	1.2098
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	53.	49.	51.	51.	2.	51.	1.0400
10603	HARDNESS TOTAL	71.3	68.5	67.5	69.1	2.0	69.1	1.0288
11103	SODIUM DISSOLVED	1.4	1.4	1.4	1.4	.0	1.4	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	5.1	4.6	4.4	4.7	.4	4.7	1.0787
14105	SILICA REACTIVE	4.0	4.0	4.0	4.0	.0	4.0	1.0000
16306	SULPHATE DISSOLVED	10.1	10.0	10.1	10.1	.1	10.1	1.0058
17206	CHLORIDE DISSOLVED	.8	.8	.8	.8	.0	.8	1.0000
19103	POTASSIUM DISSOLVED	.6	.6	.6	.6	.0	.6	1.0000
20101	CALCIUM DISSOLVED	20.1	19.8	19.8	19.9	.2	19.9	1.0087

COLUMBIA RIVER BIOASSAY DATA

DATE: 81-02-17

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.011	.011	.011	.011	.000	.011	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.011	.012	.010	.011	.001	.011	1.0955
15406	PHOSPHORUS TOTAL	.015	.015	.016	.015	.001	.015	1.0380
07110	NITROGEN DISSOLVED NO3 & NO2	.130	.127	.126	.128	.002	.128	1.0164
07557	NITROGEN DISSOLVED AMMONIA	L.002	L.002	L.002	L.002	.000	L.002	1.0000
07651	NITROGEN DISSOLVED	.180	.155	.155	.163	.014	.163	1.0902
30105	ZINC DISSOLVED	.018	.020	.017	.018	.002	.018	1.0859
30305	ZINC EXTRBLE.	.022	.022	.021	.022	.001	.022	1.0272
29105	COPPER DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
29305	COPPER EXTRBLE.	.001	.001	.001	.001	.000	.001	1.0000
26105	IRON DISSOLVED	.003	.005	.002	.003	.002	.003	1.5827
26305	IRON EXTRBLE.	.049	.065	.055	.056	.008	.056	1.1527
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	.001	.005	.001	.002	.002	.002	2.5325
82302	LEAD EXTRBLE.	.009	.008	.007	.008	.001	.008	1.1340
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0004	.0004	.0004	.0004	.0000	.0004	1.0000
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
24053	CHROMIUM DISSOLVED	.003	.003	.003	.003	.000	.003	1.0000
24303	CHROMIUM EXTRBLE.	.005	.004	.004	.004	.001	.004	1.1375
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	141.0	140.0	141.0	140.7	.6	140.7	1.0041
02061	TEMP. WATER ,FIELD	2.0			2.0		2.0	
02061	TEMP. WATER ,LAB	20.5	20.5	20.5	20.5	.0	20.5	1.0000
02073	TURBIDITY	.29	.34	.30	.31	.03	.31	1.0874
06001	CARBON TOTAL ORGANIC	1.3	.9	.9	1.0	.2	1.0	1.2365
06051	CARBON TOTAL INORGANIC	14.0	14.0	14.0	14.0	.0	14.0	1.0000
09106	FLUORIDE DISSOLVED	.110	.100	.100	.103	.006	.103	1.0566
10101	ALKALINITY TOTAL	58.4	57.5	55.8	57.2	1.3	57.2	1.0234
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.5	6.8	7.5	7.3	.4	7.3	1.0582
10401	RESIDUE NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10451	RESIDUE FILTERABLE	94.	76.	81.	84.	9.	83.	1.1153
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	60.	50.	55.	55.	5.	55.	1.0955
10603	HARDNESS TOTAL	67.9	68.7	70.5	69.0	1.3	69.0	1.0194
11103	SODIUM DISSOLVED	1.4	1.4	1.4	1.4	.0	1.4	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	4.8	4.9	5.5	5.1	.4	5.1	1.0761
14105	SILICA REACTIVE	4.0	4.0	4.0	4.0	.0	4.0	1.0000
16306	SULPHATE DISSOLVED	10.5	10.1	10.3	10.3	.2	10.3	1.0196
17206	CHLORIDE DISSOLVED	.9	.8	.8	.8	.1	.8	1.0704
19103	POTASSIUM DISSOLVED	.7	.6	.6	.6	.1	.6	1.0931
20101	CALCIUM DISSOLVED	19.2	19.5	19.2	19.3	.2	19.3	1.0090

TABLE 27

Concentrations (mg/L) of orthophosphate and dissolved metals in water used for the February 1981 algal assay. Water from each site was autoclaved, aerated with CO_2, and filtered before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Birchbank							
Orthophosphate	0.006	0.006	0.006	0.006	0.0	0.006	1.0000
Dissolved Zn	0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Cu	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Fe	0.017	L0.001	0.009	0.009	0.008	0.005	4.4219
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Waneta							
Orthophosphate	0.013	0.012	0.013	0.013	0.001	0.013	1.0473
Dissolved Zn	0.008	0.009	0.009	0.009	0.001	0.009	1.0703
Dissolved Cu	0.003	0.001	L0.001	0.002	0.001	0.001	1.8857
Dissolved Fe	0.030	0.002	0.001	0.011	0.016	0.004	6.0334
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	0.003	0.003	0.003	0.001	0.003	1.2639
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 28

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE FEBRUARY 1981 ALGAL ASSAY

These readings are graphed in Figure 7

Daily Relative Fluorometer Readings
February 19 - March 5, 1981

Birchbank

Control

	Replicates					Mean	S. D.
Day 1	.0025	.0024	.0025	.0026	.0026	.0025	.0001
Day 4	.011	.010	.012	.012	.012	.011	.001
Day 5	.010	.011	.011	.012	.012	.011	.001
Day 6	.011	.012	.012	.013	.015	.013	.001
Day 7	.011	.012	.012	.013	.013	.012	.001
Day 8	.013	.012	.012	.014	.012	.013	.001
Day 11	.012	.011	.011	.011	.011	.011	.000
Day 12	.013	.012	.010	.011	.010	.011	.001
Day 13	.012	.012	.011	.012	.011	.012	.000
Day 14	.012	.012	.010	.011	.011	.011	.001

Control + EDTA

Day 1	.0026	.0027	.0024	.0026	.0025	.0026	.0001
Day 4	.011	.010	.015	.013	.014	.013	.002
Day 5	.010	.011	.016	.012	.014	.013	.002
Day 6	.013	.012	.018	.014	.016	.015	.002
Day 7	.013	.012	.018	.015	.017	.015	.002
Day 8	.012	.012	.019	.013	.016	.014	.003
Day 11	.012	.011	.018	.014	.018	.015	.003
Day 12	.013	.012	.020	.015	.019	.016	.003
Day 13	.012	.012	.018	.015	.016	.015	.003
Day 14	.012	.013	.017	.015	.017	.015	.002

Control + 200ug Fe/L

Day 1	.0025	.0024	.0025	.0025	.0001
Day 4	.0075	.0087	.0092	.0085	.0009
Day 5	.0079	.0086	.0094	.0086	.0008
Day 6	.0088	.010	.011	.0099	.0011
Day 7	.0089	.0096	.010	.0095	.0006
Day 8	.0089	.0093	.010	.0094	.0006
Day 11	.0086	.0095	.010	.0094	.0007
Day 12	.0089	.0094	.010	.0094	.0006
Day 13	.0087	.0096	.010	.0094	.0007
Day 14	.0089	.0096	.010	.0095	.0006

Daily Relative Fluorometer Readings
February 19 - March 5, 1981, Continued

Waneta

Control

	Replicates					Mean	S. D.
Day 1	.0026	.0025	.0025	.0025	.0027	.0026	.0001
Day 4	.012	.020	.014	.029	.023	.020	.007
Day 5	.027	.041	.029	.058	.042	.039	.012
Day 6	.046	.061	.052	.080	.071	.062	.013
Day 7	.068	.076	.075	.096	.093	.082	.011
Day 8	.073	.075	.082	.096	.093	.084	.009
Day 11	.099	.087	.093	.10	.10	.096	.005
Day 12	.10	.085	.090	.11	.12	.10	.01
Day 13	.10	.083	.096	.10	.10	.10	.01
Day 14	.094	.081	.092	.11	.10	.095	.010

Control + EDTA

Day 1	.0025	.0026	.0027	.0025	.0027	.0026	.0001
Day 4	.021	.025	.040	.033	.033	.030	.007
Day 5	.056	.064	.080	.075	.084	.072	.010
Day 6	.10	.11	.10	.11	.12	.11	.01
Day 7	.12	.13	.11	.12	.14	.12	.01
Day 8	.13	.14	.10	.11	.14	.12	.02
Day 11	.14	.14	.12	.12	.15	.13	.01
Day 12	.14	.15	.12	.14	.14	.14	.01
Day 13	.15	.14	.11	.12	.14	.13	.02
Day 14	.15	.15	.11	.13	.14	.14	.02

Control + 200ug Fe/L

Day 1	.0025	.0025	.0031	.0025	.0025	.0026	.0003
Day 4	.034	.031	.038	.026	.030	.032	.004
Day 5	.065	.061	.074	.057	.046	.061	.007
Day 6	.080	.076	.10	.10	.055	.082	.013
Day 7	.086	.084	.11	.11	.060	.090	.015
Day 8	.084	.079	.12	.11	.056	.090	.019
Day 11	.086	.075	.12	.10	.060	.088	.018
Day 12	.086	.077	.12	.12	.060	.093	.021
Day 13	.081	.073	.12	.10	.060	.087	.019
Day 14	.085	.071	.12	.10	.060	.087	.019

Daily Relative Fluorometer Readings
February 19 - March 5, 1981, Continued

Waneta

Control + P

	Replicates					Mean	S. D.
Day 1	.0025	.0025	.0026	.0025	.0025	.0025	.0000
Day 4	.027	.026	.029	.031	.017	.026	.003
Day 5	.056	.060	.063	.077	.038	.059	.009
Day 6	.11	.11	.12	.12	.075	.11	.01
Day 7	.14	.14	.14	.13	.12	.13	.01
Day 8	.14	.13	.14	.12	.14	.13	.01
Day 11	.13	.13	.13	.11	.15	.13	.01
Day 12	.12	.13	.13	.11	.15	.13	.01
Day 13	.12	.13	.12	.11	.13	.12	.01
Day 14	.12	.12	.12	.11	.14	.12	.01

Control + N

Day 1	.0026	.0028	.0026	.0026	.0024	.0026	.0001
Day 4	.026	.032	.026	.022	.027	.027	.004
Day 5	.044	.061	.053	.046	.051	.051	.007
Day 6	.069	.12	.10	.088	.081	.092	.019
Day 7	.083	.15	.14	.13	.11	.12	.03
Day 8	.089	.15	.14	.13	.11	.12	.02
Day 11	.10	.16	.18	.17	.13	.15	.03
Day 12	.11	.20	.20	.19	.15	.17	.04
Day 13	.10	.18	.18	.17	.13	.15	.03
Day 14	.10	.18	.18	.18	.12	.15	.04

Control + P + N

Day 1	.0025	.0026	.0027	.0025	.0024	.0025	.0001
Day 4	.024	.019	.020	.019	.028	.022	.003
Day 5	.056	.044	.041	.044	.062	.049	.007
Day 6	.11	.11	.079	.090	.14	.11	.02
Day 7	.16	.17	.14	.16	.23	.17	.02
Day 8	.20	.23	.19	.21	.26	.22	.02
Day 11	.27	.28	.28	.34	.32	.30	.03
Day 12	.28	.30	.32	.33	.36	.32	.02
Day 13	.26	.29	.30	.33	.36	.31	.03
Day 14	.25	.29	.31	.35	.35	.31	.04

Daily Relative Fluorometer Readings
February 19 - March 5, 1981, Continued

Waneta

Control + EDTA + P + N

	Replicates					Mean	S. D.
Day 1	.0026	.0025	.0027	.0026	.0025	.0026	.0001
Day 4	.042	.041	.048	.062	.054	.049	.008
Day 5	.13	.12	.12	.15	.14	.13	.01
Day 6	.22	.22	.22	.23	.23	.22	.00
Day 7	.26	.27	.29	.29	.29	.28	.01
Day 8	.25	.30	.30	.29	.30	.29	.02
Day 11	.29	.30	.33	.31	.37	.32	.02
Day 12	.30	.35	.37	.38	.39	.36	.03
Day 13	.28	.31	.34	.31	.38	.32	.03
Day 14	.30	.36	.33	.35	.36	.34	.02

Control + EDTA + P

Day 1	.0027	.0025	.0024	.0026	.0026	.0026	.0001
Day 4	.036	.032	.031	.043	.040	.036	.005
Day 5	.088	.081	.081	.11	.095	.091	.012
Day 6	.13	.14	.13	.13	.13	.13	.00
Day 7	.14	.15	.15	.14	.14	.14	.01
Day 8	.14	.15	.15	.14	.14	.14	.01
Day 11	.14	.15	.14	.13	.13	.14	.01
Day 12	.14	.15	.13	.14	.13	.14	.01
Day 13	.13	.15	.13	.13	.12	.13	.01
Day 14	.13	.15	.13	.13	.13	.13	.01

Control + EDTA + N

Day 1	.0026	.0025	.0026	.0025	.0027	.0026	.0001
Day 4	.024	.031	.036	.036	.027	.031	.005
Day 5	.063	.076	.083	.087	.067	.075	.009
Day 6	.11	.12	.12	.13	.12	.12	.01
Day 7	.14	.13	.14	.16	.15	.14	.01
Day 8	.13	.13	.13	.15	.14	.14	.01
Day 11	.15	.14	.12	.18	.15	.15	.02
Day 12	.18	.18	.16	.20	.18	.18	.01
Day 13	.16	.17	.15	.17	.16	.16	.01
Day 14	.15	.15	.16	.19	.17	.16	.02

FIGURE 7

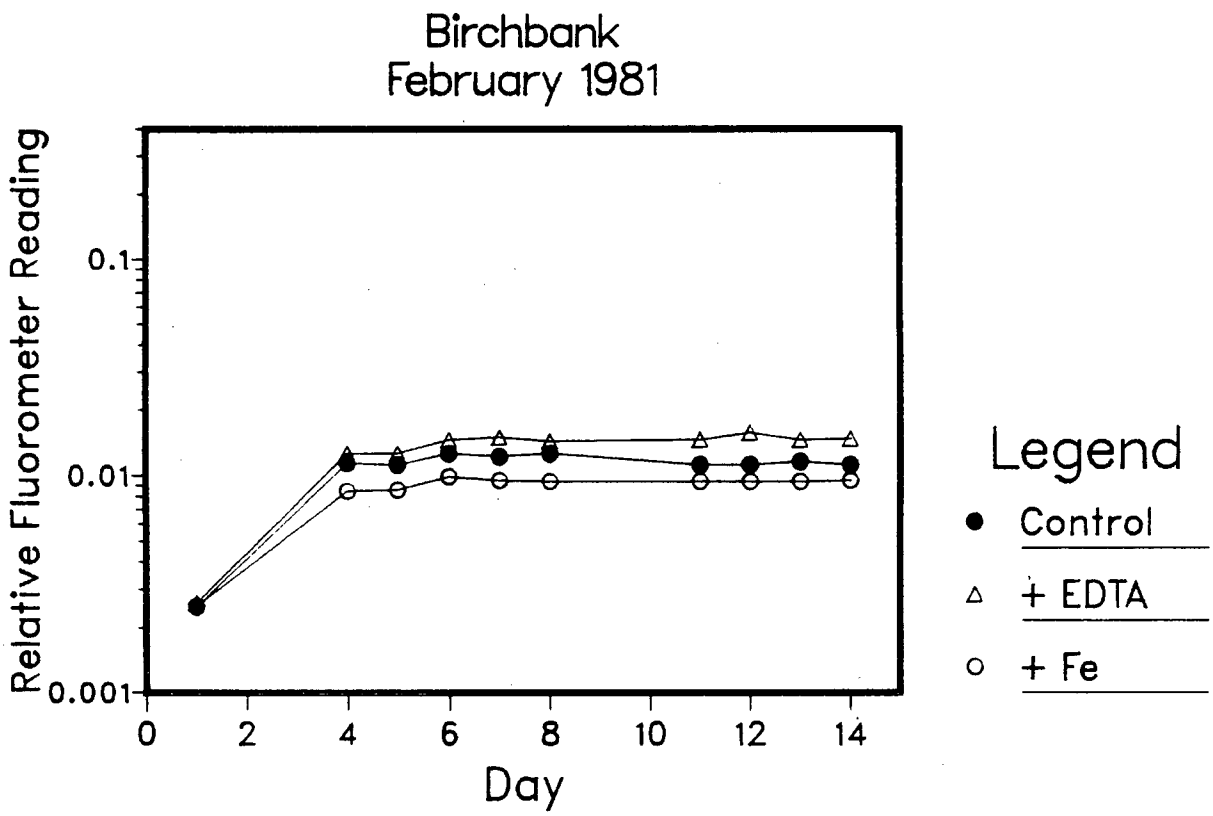
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

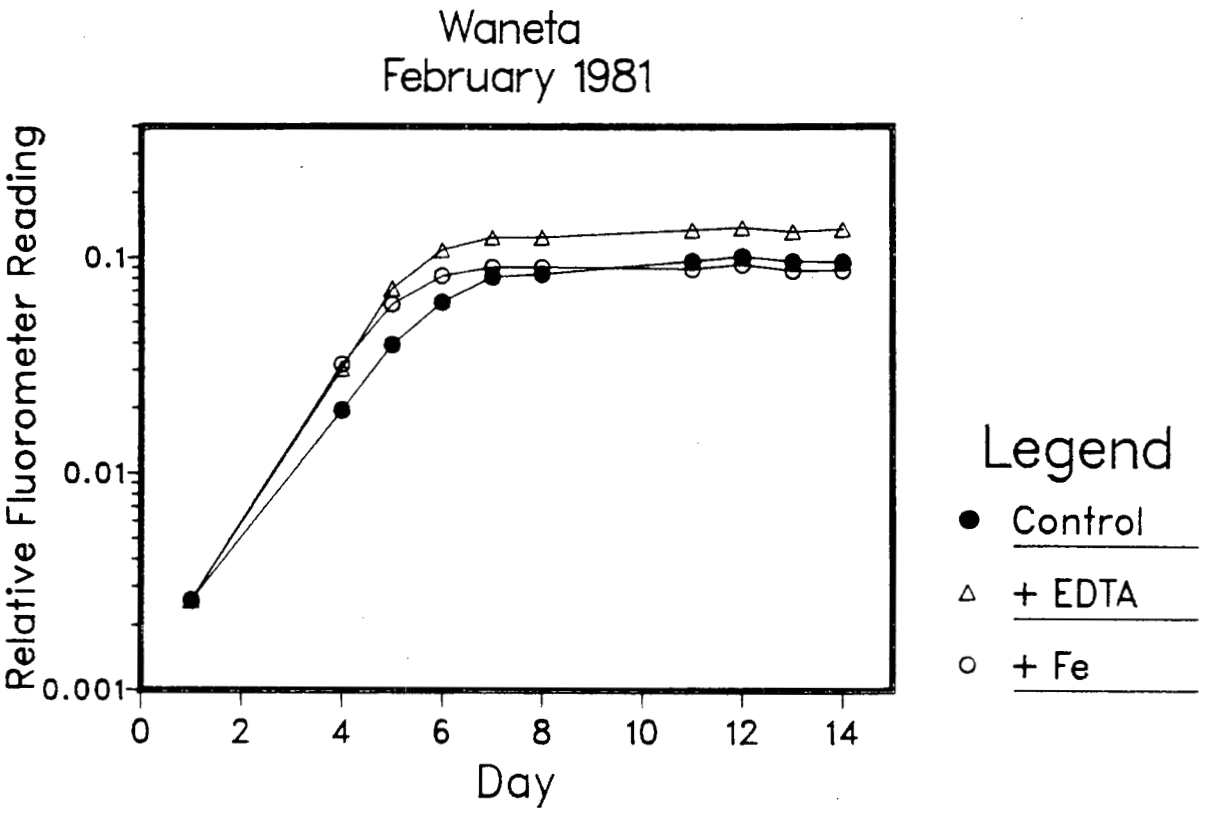
(MEASURED IN RELATIVE FLUOROMETER UNITS)

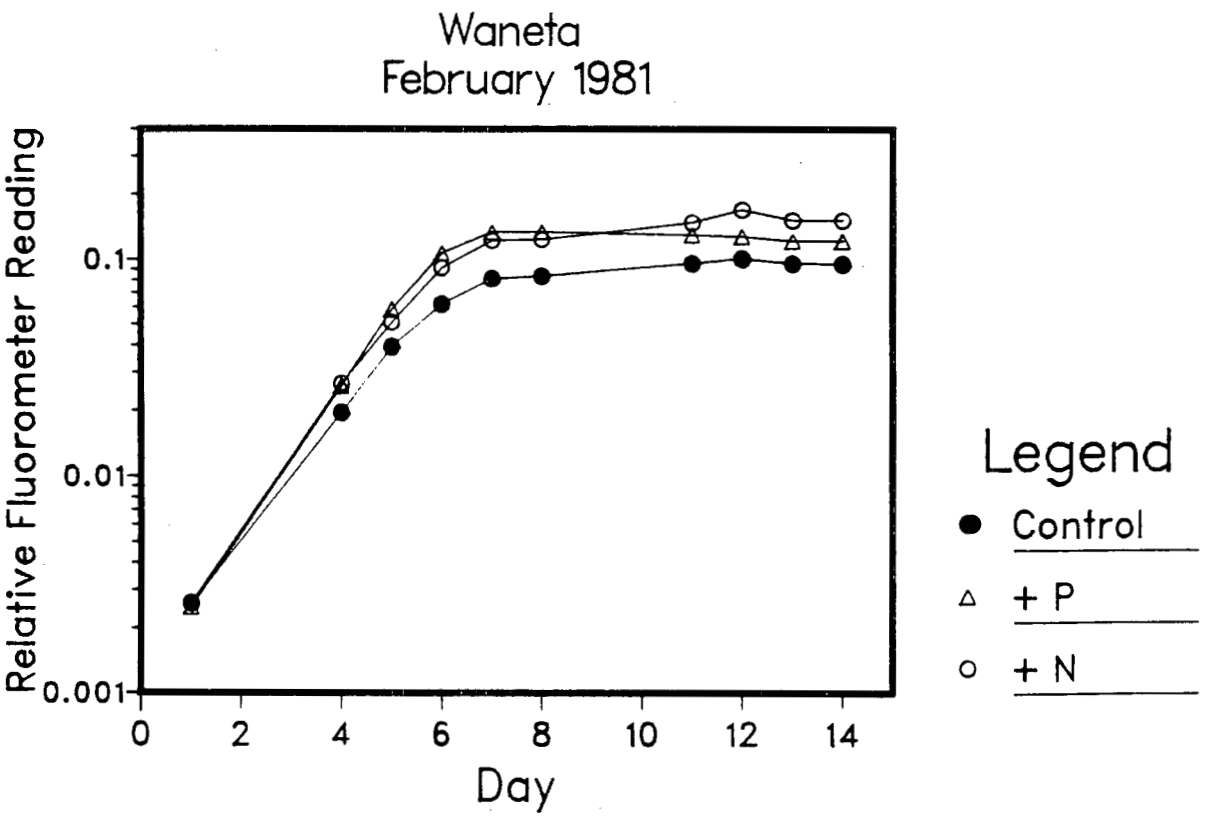
FOR THE FEBRUARY 1981 ALGAL ASSAY.

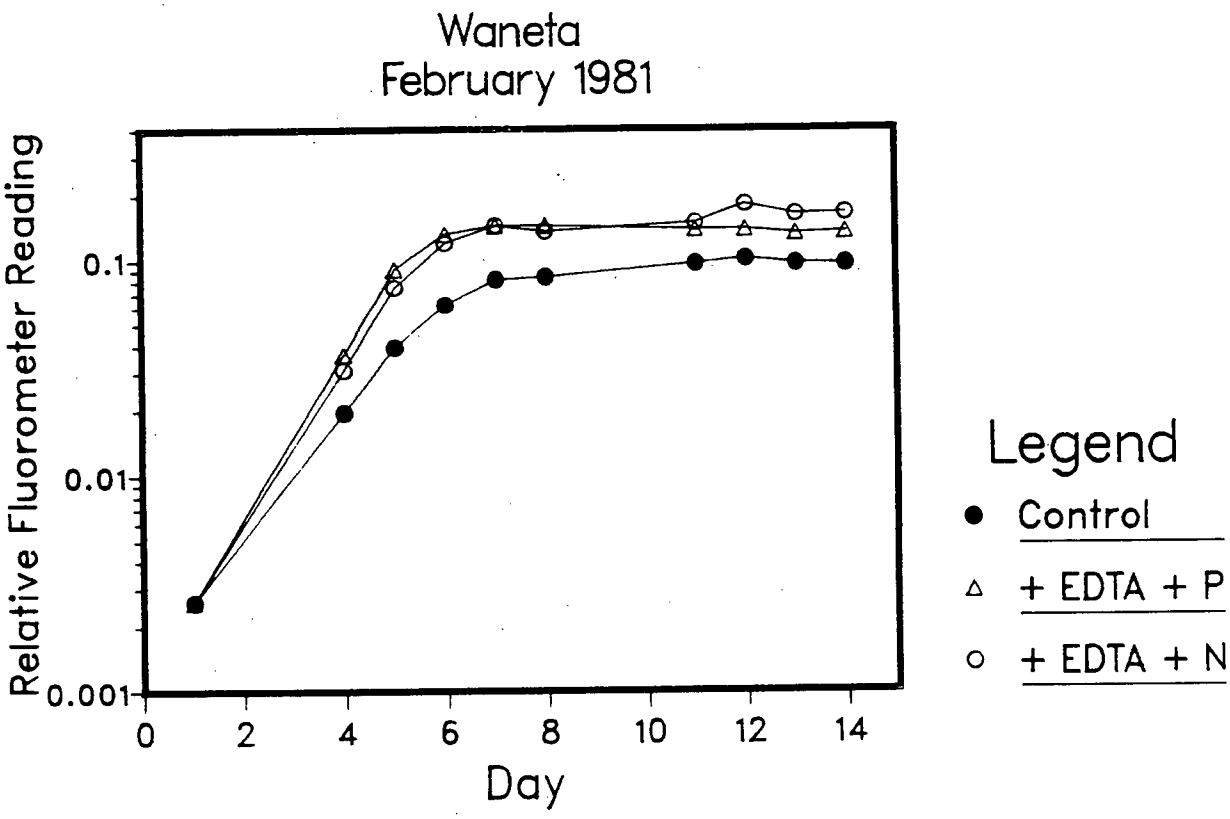
FOR ALL TREATMENTS, EXCEPT CONTROL + 200μg Fe/L FROM BIRCHBANK, THE POINTS PLOTTED ARE THE MEANS OF 5 REPLICATES. THE POINTS PLOTTED FOR CONTROL + 200μg Fe/L FROM BIRCHBANK ARE THE MEANS OF 3 REPLICATES

The readings used for these graphs are presented in Table 28


Birchbank
February 1981
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


Waneta
February 1981
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ Fe


Waneta
February 1981
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ N


Waneta
February 1981
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N

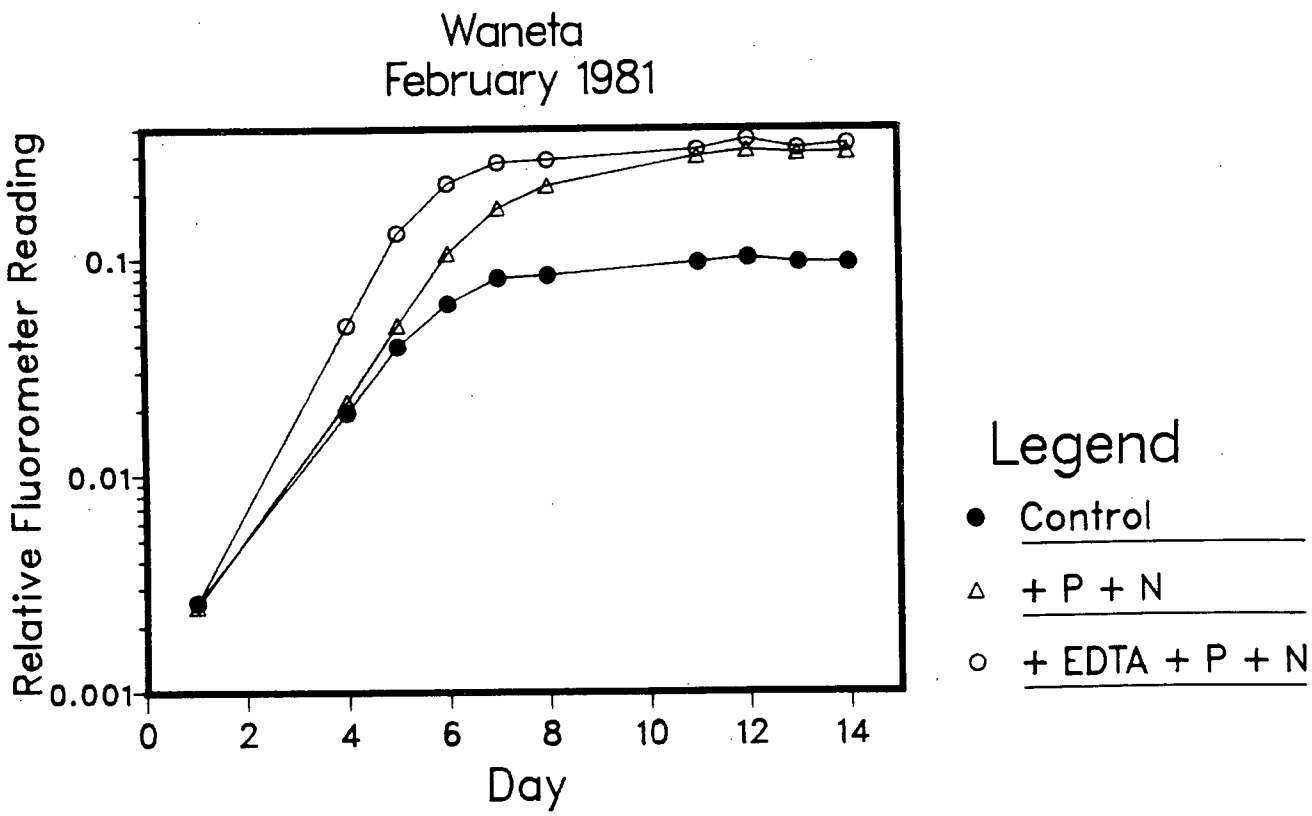

Waneta
February 1981
Relative Fluorometer Reading
0.1
0.01
0.001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P + N
+ EDTA + P + N

TABLE 29

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE FEBRUARY 1981 ASSAY. THE YIELDS ARE EXPRESSED AS CELLS/ML AND WERE MEASURED WITH A HAEMOCYTOMETER

Cells/ml on Final Day
February 19 - March 5, 1981 Algal Assay

Birchbank

	Cells/ml	Mean Cells/ml	S.D.
Control	10000		
	11000	10320	642
	9600		
	10000		
	11000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	10000		
	10000	14600	5079
	20000		
	13000		
	20000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	8000		
	8600	8600	600
	9200		

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control	120000		
	110000	126000	11402
	130000		
	140000		
	130000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA	190000		
	200000	184000	27019
	140000		
	180000		
	210000		

	Cells/ml	Mean Cells/ml	S.D.
Control + 200ug Fe/L	100000		
	95000	143200	66473
	230000		
	200000		
	91000		

Cells/ml on Final Day
February 19 - March 5, 1981 Algal Assay, Continued

Waneta

	Cells/ml	Mean Cells/ml	S.D.
Control + P	210000		
	200000	210000	22361
	220000		
	180000		
	240000		

	Cells/ml	Mean Cells/ml	S.D.
Control + N	230000		
	260000	236000	23022
	250000		
	240000		
	200000		

	Cells/ml	Mean Cells/ml	S.D.
Control + P + N	350000		
	370000	438000	73959
	460000		
	510000		
	500000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P + N	360000		
	510000	462000	69426
	420000		
	500000		
	520000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + P	230000		
	240000	234000	5477
	240000		
	230000		
	230000		

	Cells/ml	Mean Cells/ml	S.D.
Control + EDTA + N	240000		
	250000	256000	24083
	230000		
	270000		
	290000		

TABLE 30

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON JUNE 22, 1982. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-06-22

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.002	.002	.002	.002	.000	.002	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.004	.002	.002	.003	.001	.003	1.4921
15406	PHOSPHORUS TOTAL	.013	.013	.012	.013	.001	.013	1.0473
07110	NITROGEN DISSOLVED NO3 & NO2	.033	.032	.032	.032	.001	.032	1.0179
07557	NITROGEN DISSOLVED AMMONIA	.012	.008	.019	.013	.006	.012	1.5415
07655	NITROGEN TOTAL DISSOLVED	.088	.087	.107	.094	.011	.094	1.1233
07903	NITROGEN PARTICULATE	.039	.024	.028	.030	.008	.030	1.2816
30005	ZINC TOTAL	.004	.005	.009	.006	.003	.006	1.5203
30105	ZINC DISSOLVED	.003	.002	.002	.002	.001	.002	1.2638
30305	ZINC EXTRBLE.	.003	.003	.003	.003	.000	.003	1.0000
29005	COPPER TOTAL	.009	.003	.006	.006	.003	.005	1.7429
29105	COPPER DISSOLVED	.004	.002	.003	.003	.001	.003	1.4166
29305	COPPER EXTRBLE.	.001	.001	.007	.003	.003	.002	3.0755
26004	IRON TOTAL	.09	.23	.30	.21	.11	.18	1.8824
26105	IRON DISSOLVED	.009	.007	.007	.008	.001	.008	1.1562
26304	IRON EXTRBLE.	.12	.12	.13	.12	.01	.12	1.0473
25004	MANGANESE TOTAL	.01	.01	.02	.01	.01	.01	1.4921
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	.02	*.01	.01	*.01	1.4921
48002	CADMIUM TOTAL	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82002	LEAD TOTAL	L.001	L.001	.001	*.001	.000	*.001	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28002	NICKEL TOTAL	.002	.001	.003	.002	.001	.002	1.7429
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0002	.0002	.0002	.0002	.0000	.0002	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	117.0	116.0	117.0	116.7	.6	116.7	1.0050
02061	TEMP. WATER ,FIELD	14.0			14.0		14.0	
02061	TEMP. WATER ,LAB	23.4	23.0	22.8	23.1	.3	23.1	1.0133
02073	TURBIDITY	2.10	2.60	2.90	2.53	.40	2.51	1.1784
06001	CARBON TOTAL ORGANIC	2.6	2.0	2.0	2.2	.3	2.2	1.1636
06051	CARBON TOTAL INORGANIC	13.0	13.0	14.0	13.3	.6	13.3	1.0437
06101	CARBON DISSOLVED ORGANIC	2.0	2.0	1.8	1.9	.1	1.9	1.0627
06151	CARBON DISSOLVED INORGANIC	14.0	13.0	14.0	13.7	.6	13.7	1.0437
06903	CARBON PARTICULATE	.233	.263	.086	.194	.095	.174	1.8467
09106	FLUORIDE DISSOLVED	.060	.050	L.050	*.053	.006	*.053	1.1110
10101	ALKALINITY TOTAL	48.9	49.3	49.3	49.2	.2	49.2	1.0047
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.8	7.7	7.8	7.8	.1	7.8	1.0075
10603	HARDNESS TOTAL	57.9	58.1	58.1	58.0	.1	58.0	1.0020
11103	SODIUM DISSOLVED	1.4	1.5	1.4	1.4	.1	1.4	1.0406
12101	MAGNESIUM DISSOLVED (CALCD.)	3.9	4.0	4.0	4.0	.1	4.0	1.0161
14105	SILICA REACTIVE	4.6	4.6	4.6	4.6	.0	4.6	1.0000
16306	SULPHATE DISSOLVED	7.8	7.9	7.8	7.8	.1	7.8	1.0074
17206	CHLORIDE DISSOLVED	.9	.9	.9	.9	.0	.9	1.0000
19103	POTASSIUM DISSOLVED	.4	.4	.4	.4	.0	.4	1.0000
20101	CALCIUM DISSOLVED	16.7	16.6	16.6	16.6	.1	16.6	1.0035

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-06-22

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.006	.005	.006	.006	.001	.006	1.1110
15102	PHOSPHORUS TOTAL DISSOLVED	.005	.005	.006	.005	.001	.005	1.1110
15406	PHOSPHORUS TOTAL	.020	.018	.019	.019	.001	.019	1.0541
07110	NITROGEN DISSOLVED NO3 & NO2	.037	.037	.032	.035	.003	.035	1.0874
07557	NITROGEN DISSOLVED AMMONIA	.030	.045	.035	.037	.008	.036	1.2271
07655	NITROGEN TOTAL DISSOLVED	.134	.097	.117	.116	.019	.115	1.1762
07903	NITROGEN PARTICULATE	.028	.032	.023	.028	.005	.027	1.1807
30004	ZINC TOTAL	.05	.06	.04	.05	.01	.05	1.2252
30105	ZINC DISSOLVED	.013	.016	.012	.014	.002	.014	1.1601
30305	ZINC EXTRBLE.	.016	.019	.020	.018	.002	.018	1.1240
29005	COPPER TOTAL	.003	.002	.002	.002	.001	.002	1.2638
29105	COPPER DISSOLVED	.006	.005	.004	.005	.001	.005	1.2252
29305	COPPER EXTRBLE.	.002	.002	.002	.002	.000	.002	1.0000
26004	IRON TOTAL	.26	.14	.48	.29	.17	.26	1.8516
26105	IRON DISSOLVED	.006	.006	.006	.006	.000	.006	1.0000
26304	IRON EXTRBLE.	.14	.14	.13	.14	.01	.14	1.0437
25004	MANGANESE TOTAL	.02	.04	.03	.03	.01	.03	1.4166
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48002	CADMIUM TOTAL	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82002	LEAD TOTAL	.004	.003	.003	.003	.001	.003	1.1807
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	.002	.002	.001	.002	.001	.002	1.4921
28002	NICKEL TOTAL	.002	.002	.002	.002	.000	.002	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0004	.0003	.0002	.0003	.0001	.0003	1.4166
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	120.0	117.0	117.0	118.0	1.7	118.0	1.0147
02061	TEMP. WATER ,FIELD	14.0			14.0		14.0	
02061	TEMP. WATER ,LAB	23.2	23.4	23.7	23.4	.3	23.4	1.0108
02073	TURBIDITY	.90	1.80	1.30	1.33	.45	1.28	1.4145
06001	CARBON TOTAL ORGANIC	2.4	2.6	3.5	2.8	.6	2.8	1.2199
06051	CARBON TOTAL INORGANIC	13.0	13.0	13.0	13.0	.0	13.0	1.0000
06101	CARBON DISSOLVED ORGANIC	2.6	3.3	2.6	2.8	.4	2.8	1.1476
06151	CARBON DISSOLVED INORGANIC	13.0	12.0	13.0	12.7	.6	12.7	1.0473
06903	CARBON PARTICULATE	.253	.281	.298	.277	.023	.277	1.0865
09106	FLUORIDE DISSOLVED	.100	.080	.070	.083	.015	.082	1.1975
10101	ALKALINITY TOTAL	48.6	49.2	48.4	48.7	.4	48.7	1.0086
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.7	7.7	7.8	7.7	.1	7.7	1.0075
10603	HARDNESS TOTAL	57.1	58.4	58.1	57.9	.7	57.9	1.0119
11103	SODIUM DISSOLVED	1.4	1.5	1.4	1.4	.1	1.4	1.0406
12101	MAGNESIUM DISSOLVED (CALCD.)	3.7	4.1	3.9	3.9	.2	3.9	1.0423
14105	SILICA REACTIVE	4.7	4.7	4.7	4.7	.0	4.7	1.0000
16306	SULPHATE DISSOLVED	8.6	8.5	8.6	8.6	.1	8.6	1.0068
17206	CHLORIDE DISSOLVED	.9	.9	.9	.9	.0	.9	1.0000
19103	POTASSIUM DISSOLVED	.3	.6	.5	.5	.2	.4	1.4323
20101	CALCIUM DISSOLVED	16.7	16.7	16.8	16.7	.1	16.7	1.0035

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-06-22

STATION NO.: 20BC08NE0001
COMINCO SEWER #8, TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15406	PHOSPHORUS TOTAL	.027	.025	.027	.026	.001	.026	1.0454
07110	NITROGEN DISSOLVED NO3 & NO2	.089	.035	.047	.057	.028	.053	1.6114
07557	NITROGEN DISSOLVED AMMONIA	24.300	27.300	26.500	26.033	1.553	26.002	1.0623
07655	NITROGEN TOTAL DISSOLVED	25.000	29.300	30.000	28.100	2.707	28.010	1.1042
07903	NITROGEN PARTICULATE	.040	.034	.032	.035	.004	.035	1.1223
30004	ZINC TOTAL	39.00	38.00	38.00	38.33	.58	38.33	1.0271
30104	ZINC DISSOLVED	23.00	24.00	23.00	23.33	.58	23.33	1.0249
30304	ZINC EXTRBL.	32.00	32.00	33.00	32.33	.58	32.33	1.0179
29006	COPPER TOTAL	.05	.04	.03	.04	.01	.04	1.2919
29106	COPPER DISSOLVED	.04	.07	.03	.05	.02	.04	1.5386
29306	COPPER EXTRBLE.	.05	.05	.05	.05	.00	.05	1.0000
26004	IRON TOTAL	.20	.29	.29	.26	.05	.26	1.2393
26104	IRON DISSOLVED	.29	.41	.30	.33	.07	.33	1.2103
26304	IRON EXTRBLE.	.30	.36	.32	.33	.03	.33	1.0969
25004	MANGANESE TOTAL	24.00	24.00	24.00	24.00	0.00	24.00	1.0000
25104	MANGANESE DISSOLVED	6.30	6.80	6.30	6.47	.29	6.46	1.0451
25304	MANGANESE EXTRBLE.	9.30	9.30	9.30	9.30	.00	9.30	1.0000
48002	CADMIUM TOTAL	.0021	.0026	.0024	.0024	.0003	.0024	1.1139
48102	CADMIUM DISSOLVED	.0056	.0048	.0055	.0053	.0004	.0053	1.0879
48302	CADMIUM EXTRBLE.	.0032	.0028	.0042	.0034	.0007	.0034	1.2295
82001	LEAD TOTAL	.16	.23	.14	.18	.05	.17	1.2929
82101	LEAD DISSOLVED	.15	.16	.17	.16	.01	.16	1.0646
82301	LEAD EXTRBLE.	.16	.15	.16	.16	.01	.16	1.0380
28002	NICKEL TOTAL	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	7.20	7.00	7.10	7.10	.10	7.10	1.0142
33304	ARSENIC EXTRBLE.	.0073	.0072	.0072	.0072	.0001	.0072	1.0080
34302	SELENIUM EXTRBLE.	.0014	.0014	.0016	.0015	.0001	.0015	1.0801
02011	COLOUR APPARENT	5.	5.	5.	5.	0.	5.	1.0000
02041	SPECIFIC CONDUCT.	3667.0	3377.0	3612.0	3552.0	154.0	3549.7	1.0448
02061	TEMP. WATER ,LAB	23.5	23.2	23.1	23.3	.2	23.3	1.0090
02073	TURBIDITY	2.80	2.30	2.20	2.43	.32	2.42	1.1369
06001	CARBON TOTAL ORGANIC	1.3	1.3	.9	1.2	.2	1.2	1.2365
06051	CARBON TOTAL INORGANIC	6.9	6.9	6.5	6.8	.2	6.8	1.0351
06101	CARBON DISSOLVED ORGANIC	2.2	1.8	2.0	2.0	.2	2.0	1.1056
06151	CARBON DISSOLVED INORGANIC	2.1	2.5	2.5	2.4	.2	2.4	1.1059
06903	CARBON PARTICULATE	.478	.404	.402	.428	.043	.427	1.1036
09106	FLUORIDE DISSOLVED	.900	.850	.920	.890	.036	.890	1.0417
10101	ALKALINITY TOTAL	L.5	L.5	L.5	L.5	.0	L.5	1.0000
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	2.5	2.5	2.4	2.5	.1	2.5	1.0238
11103	SODIUM DISSOLVED	2.0	2.0	2.0	2.0	.0	2.0	1.0000
14105	SILICA REACTIVE	5.3	5.2	5.3	5.3	.1	5.3	1.0111
16306	SULPHATE DISSOLVED	730.0	680.0	730.0	713.3	28.9	712.9	1.0418
17206	CHLORIDE DISSOLVED	5.6	5.5	5.6	5.6	.1	5.6	1.0105
19103	POTASSIUM DISSOLVED	2.2	2.0	2.0	2.1	.1	2.1	1.0566

TABLE 31a.

Concentrations (mg/L) of nutrients and metals in water from Birchbank at various stages of preparation for the June 1982 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Untreated							
Total Phosphorus	0.010	0.010	0.009	0.010	0.001	0.010	1.0627
Extractable Zn	0.001	0.001	0.002	0.001	0.001	0.001	1.4923
Extractable Cu	0.004	0.005	0.005	0.005	0.001	0.005	1.1375
Extractable Fe	0.05	0.07	0.08	0.07	0.02	0.06	1.2740
Extractable Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Filtered Only							
Orthophosphate	0.003	0.003	0.003	0.003	0.0	0.003	1.0000
Nitrate plus Nitrite	0.029	0.032	0.033	0.031	0.002	0.031	1.0697
Ammonia	0.004	0.005	0.007	0.005	0.002	0.005	1.3254
Total Dissolved Nitrogen	0.068	0.076	0.078	0.074	0.005	0.074	1.0756
Dissolved Zn	0.002	L0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Cu	0.009	0.004	0.003	0.005	0.003	0.005	1.7678
Dissolved Fe	0.005	0.025	0.006	0.012	0.011	0.009	2.4140
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved							
Extractable Zn	0.002	0.002	0.003	0.002	0.001	0.002	1.2638
Extractable Cu	0.006	0.006	0.005	0.006	0.001	0.006	1.1109
Extractable Fe	0.05	0.05	0.06	0.05	0.01	0.05	1.1110
Extractable Mn	L0.01	L0.01	0.01	L0.01	0.0	L0.01	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 31a. (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Autoclaved, Aerated with CO_2, Filtered, and pH adjusted							
Orthophosphate	0.005	0.005	0.005	0.005	0.0	0.005	1.0000
Nitrate plus Nitrite	0.031	0.031	0.031	0.031	0.0	0.031	1.0000
Ammonia	0.009	0.010	0.010	0.010	0.001	0.010	1.0626
Total Dissolved Nitrogen	0.088	0.085	0.086	0.086	0.002	0.086	1.0177
Dissolved Zn	0.001	L0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Cu	0.003	0.003	0.003	0.003	0.0	0.003	1.0000
Dissolved Fe	0.004	0.002	0.003	0.003	0.001	0.003	1.4166
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

*Hg measured in µg/L

TABLE 31b.

Concentrations (mg/L) of nutrients and metals in water from Waneta at various stages of preparation for the June 1982 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Untreated							
Total Phosphorus	0.012	0.012	0.013	0.012	0.001	0.012	1.0473
Extractable Zn	0.019	0.020	0.022	0.020	0.002	0.020	1.0772
Extractable Cu	0.004	0.004	0.006	0.005	0.001	0.005	1.2639
Extractable Fe	0.025	0.025	0.041	0.030	0.009	0.029	1.3306
Extractable Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Filtered Only							
Orthophosphate	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Nitrate plus Nitrite	0.038	0.032	0.032	0.034	0.004	0.034	1.1043
Ammonia	0.022	0.021	0.035	0.026	0.008	0.025	1.3264
Total Dissolved Nitrogen	0.089	0.088	0.092	0.090	0.002	0.090	1.0233
Dissolved Zn	0.017	0.018		0.018	0.001	0.018	1.0410
Dissolved Cu	0.010	0.002		0.006	0.006	0.004	3.1206
Dissolved Fe	0.003	0.003		0.003	0.0	0.003	1.0000
Dissolved Mn	L0.01	L0.01		L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005		L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	L0.001		0.002	0.001	0.001	1.6325
Dissolved Ni	L0.001	L0.001		L0.001	0.0	L0.001	1.0000
Autoclaved							
Extractable Zn	0.013	0.020	0.011	0.015	0.005	0.014	1.3613
Extractable Cu	0.005	0.005	0.005	0.005	0.0	0.005	1.0000
Extractable Fe	0.05	0.33	0.05	0.14	0.16	0.09	2.9728
Extractable Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Extractable Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Extractable Pb	0.002	0.005	0.002	0.003	0.002	0.003	1.6974
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 31b. (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Autoclaved, Aerated with CO_2, Filtered, and pH adjusted							
Orthophosphate	0.007	0.007	0.008	0.007	0.001	0.007	1.0801
Nitrate plus Nitrite	0.035	0.036	0.034	0.035	0.001	0.035	1.0288
Ammonia	0.019	0.020	0.020	0.020	0.001	0.020	1.0298
Total Dissolved Nitrogen	0.106	0.106	0.101	0.104	0.003	0.104	1.0283
Dissolved Zn	0.015	0.016	0.017	0.016	0.001	0.016	1.0645
Dissolved Cu	0.004	0.005	0.006	0.005	0.001	0.005	1.2251
Dissolved Fe	0.016	0.020	0.032	0.023	0.008	0.022	1.4245
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

*Hg measured in µg/L

TABLE 31c.

Concentrations (mg/L) of nutrients and metals in water from Cominco sewer #8 at various stages of preparation for the June 1982 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Untreated							
Total Phosphorus	0.044	0.044	0.045	0.044	0.001	0.044	1.0131
Extractable Zn	36.	36.	36.	36.	0.0	36.	1.0000
Extractable Cu	0.07	0.08	0.07	0.07	0.01	0.07	1.0801
Extractable Fe	1.4	1.4	1.4	1.4	0.0	1.4	1.0000
Extractable Mn	9.4	9.3	9.2	9.3	0.10	9.3	1.0108
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Filtered							
Orthophosphate	0.015	0.015	0.015	0.015	0.0	0.015	1.0000
Nitrate plus Nitrite	0.039	0.035	0.035	0.036	0.002	0.036	1.0644
Ammonia	24.1	24.5	22.8	23.8	0.9	23.8	1.0383
Total Dissolved Nitrogen	24.8	24.7	24.8	24.8	0.1	24.8	1.0000
Dissolved Zn	30.	30.	28.	29.	1.	29.	1.0405
Dissolved Cu	0.09	0.08	0.09	0.09	0.01	0.09	1.0703
Dissolved Fe	0.80	0.80	0.66	0.75	0.08	0.75	1.1175
Dissolved Mn	7.3	7.4	6.7	7.1	0.38	7.1	1.0553
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved							
Extractable Zn	34.	35.	29.	33.	3.	33.	1.1065
Extractable Cu	0.08	0.06	0.07	0.07	0.01	0.07	1.1548
Extractable Fe	1.2	1.2	0.92	1.1	0.16	1.1	1.1658
Extractable Mn	9.6	9.6	8.0	9.1	0.92	9.0	1.1110
Extractable Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Autoclaved, Aerated with CO_2, Filtered, and pH adjusted							
Orthophosphate	0.037	0.037	0.037	0.037	0.0	0.037	1.0000
Nitrate plus Nitrite	0.022	0.016	0.016	0.018	0.004	0.018	1.2018
Ammonia	25.8	25.5	26.3	25.9	0.4	25.9	1.0155
Total Dissolved Nitrogen	27.5	27.9	28.3	27.9	0.4	27.9	1.0142
Dissolved Zn	29.	29.	34.	31.	3.	31.	1.0962
Dissolved Cu	0.07	0.07	0.07	0.07	0.0	0.07	1.0000
Dissolved Fe	0.80	0.95	1.4	1.0	0.31	1.0	1.3320
Dissolved Mn	8.0	9.0	9.5	8.8	0.76	8.8	1.0918
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000

TABLE 31d.

Composition of the TED-70µg Zn/L dilution of Cominco effluent used for the June 1982 algal assay. Concentrations of all chemicals except Hg are reported in mg/L; Hg is in µg/L

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Orthophosphate	0.007	0.007		0.007	0.0	0.007	1.0000
Nitrate plus Nitrite	0.034	0.035	0.034	0.034	0.001	0.034	1.0167
Ammonia	0.067	0.084	0.074	0.075	0.008	0.075	1.1200
Total Dissolved Nitrogen	0.195	0.214	0.182	0.197	0.016	0.197	1.0847
Dissolved Zn	0.07	0.07	0.07	0.07	0.0	0.07	1.0000
Dissolved Cu	0.006	0.006	0.005	0.006	0.001	0.006	1.1109
Dissolved Fe	0.005	0.008	0.008	0.007	0.002	0.007	1.3117
Dissolved Mn	0.02	0.02	0.02	0.02	0.0	0.02	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.003	0.002	0.002	0.002	0.001	0.002	1.2638
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg	0.05	0.05		0.05	0.0	0.05	1.0000

TABLE 32

DAILY IN VIVO CHLOROPHYLL A READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE JUNE 1982 ALGAL ASSAY

These readings are graphed in Figure 8

Daily Relative Fluorometer Readings
June 23 - July 7, 1982

Birchbank

Control

	Replicates			Mean	S. D.
Day 1	.0004	.0005	.0005	.0005	.0001
Day 2	.0011	.0011	.0012	.0011	.0001
Day 4	.0058	.0075	.014	.0091	.0043
Day 5	.0059	.0082	.016	.0100	.0053
Day 6	.0062	.0080	.016	.0101	.0052
Day 8	.0077	.010	.021	.013	.007
Day 11	.0073	.013	.025	.015	.009
Day 12	.0077	.016	.025	.016	.009
Day 13	.0087	.012	.025	.015	.009
Day 14	.0070	.011	.022	.013	.008

Control + EDTA

Day 1	.0005	.0010	.0005	.0007	.0003
Day 2	.0011	.0013	.0012	.0012	.0001
Day 4	.0059	.010	.0090	.0083	.0021
Day 5	.0054	.012	.021	.013	.008
Day 6	.0054	.012	.027	.015	.011
Day 8	.0069	.0092	.032	.0160	.0139
Day 11	.0077	.016	.034	.019	.013
Day 12	.0073	.015	.033	.018	.013
Day 13	.0077	.015	.034	.019	.014
Day 14	.0069	.015	.032	.018	.013

Control + EDTA + 200ug Fe/L

Day 1	.0004	.0006	.0008	.0006	.0002
Day 2	.0013	.0012	.0011	.0012	.0001
Day 4	.0045	.0035	.0046	.0042	.0006
Day 5	.0041	.0032	.0034	.0036	.0005
Day 6	.0045	.0031	.0035	.0037	.0007
Day 8	.0058	.0043	.0043	.0048	.0009
Day 11	.0058	.0044	.0049	.0050	.0007
Day 12	.0049	.0042	.0049	.0047	.0004
Day 13	.0051	.0041	.0045	.0046	.0005
Day 14	.0050	.0040	.0042	.0044	.0005

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

Birchbank

Control + 200ug Fe/L

	Replicates			Mean	S. D.
Day 1	.0004	.0004	.0006	.0005	.0001
Day 2	.0006	.0010	.0011	.0009	.0003
Day 4	.0032	.0092	.0037	.0054	.0033
Day 5	.0034	.014	.0036	.0070	.0061
Day 6	.0031	.018	.0038	.0083	.0084
Day 8	.0039	.022	.0042	.0100	.0104
Day 11	.0046	.024	.0049	.0112	.0111
Day 12	.0047	.020	.0046	.0098	.0089
Day 13	.0043	.021	.0044	.0099	.0096
Day 14	.0038	.022	.0040	.0099	.0104

Control + EDTA + N + 200ug Fe/L

Day 1	.0004	.0004	.0004	.0004	.0000
Day 2	.0012	.0010	.0010	.0011	.0001
Day 4	.0040	.0032	.0037	.0036	.0004
Day 5	.0037	.0031	.0040	.0036	.0005
Day 6	.0041	.0032	.0040	.0038	.0005
Day 8	.0045	.0034	.0042	.0040	.0006
Day 11	.0046	.0043	.0049	.0046	.0003
Day 12	.0051	.0037	.0051	.0046	.0008
Day 13	.0047	.0038	.0048	.0044	.0006
Day 14	.0045	.0038	.0046	.0043	.0004

Control + EDTA + P + 200ug Fe/L

Day 1	.0004	.0005	.0003	.0004	.0001
Day 2	.0010	.0013	.0018	.0014	.0004
Day 4	.015	.011	.016	.014	.003
Day 5	.031	.026	.033	.030	.004
Day 6	.036	.032	.033	.034	.002
Day 8	.038	.033	.035	.035	.003
Day 11	.039	.039	.042	.040	.002
Day 12	.037	.040	.035	.037	.003
Day 13	.037	.040	.036	.038	.002
Day 14	.035	.039	.035	.036	.002

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

Waneta

Control

	Replicates			Mean	S. D.
Day 1	.0000	.0001	.0001	.0001	.0000
Day 2	.0011	.0016	.0021	.0016	.0005
Day 4	.015	.014	.020	.016	.003
Day 5	.023	.019	.025	.022	.003
Day 6	.024	.022	.030	.025	.004
Day 8	.027	.025	.039	.030	.008
Day 11	.026	.020	.042	.029	.011
Day 12	.025	.029	.041	.032	.008
Day 13	.027	.026	.040	.031	.008
Day 14	.026	.025	.036	.029	.006

Control + EDTA

Day 1	.0002	.0004	.0001	.0002	.0002
Day 2	.0021	.0027	.0018	.0022	.0005
Day 4	.027	.021	.026	.025	.003
Day 5	.036	.024	.034	.031	.006
Day 6	.040	.030	.036	.035	.005
Day 8	.044	.034	.040	.039	.005
Day 11	.054	.038	.044	.045	.008
Day 12	.061	.033	.041	.045	.014
Day 13	.051	.038	.045	.045	.007
Day 14	.048	.035	.042	.042	.007

Control + EDTA + 200ug Fe/L

Day 1	.0001	.0002	.0000	.0001	.0001
Day 2	.0014	.0018	.0018	.0017	.0002
Day 4	.0096	.0099	.0099	.0098	.0002
Day 5	.0091	.010	.011	.010	.001
Day 6	.011	.012	.011	.011	.001
Day 8	.013	.013	.014	.013	.001
Day 11	.016	.016	.016	.016	.000
Day 12	.013	.015	.014	.014	.001
Day 13	.014	.014	.014	.014	.000
Day 14	.013	.013	.014	.013	.001

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

Waneta

Control + N

	Replicates			Mean	S. D.
Day 1	.0000	.0000	.0001	.0000	.0001
Day 2	.0019	.0016	.0023	.0019	.0004
Day 4	.023	.021	.019	.021	.002
Day 5	.029	.024	.024	.026	.003
Day 6	.038	.030	.028	.032	.005
Day 8	.044	.034	.033	.037	.006
Day 11	.034	.031	.022	.029	.006
Day 12	.040	.035	.024	.033	.008
Day 13	.044	.036	.031	.037	.007
Day 14	.042	.033	.025	.033	.008

Control + P

Day 1	.0001	.0001	.0001	.0001	.0000
Day 2	.0017	.0027	.0026	.0023	.0006
Day 4	.026	.032	.036	.031	.005
Day 5	.035	.037	.041	.038	.003
Day 6	.035	.032	.036	.034	.002
Day 8	.035	.032	.035	.034	.002
Day 11	.036	.034	.037	.036	.002
Day 12	.035	.032	.035	.034	.002
Day 13	.034	.032	.035	.034	.002
Day 14	.034	.031	.032	.032	.002

Control + EDTA + N

Day 1	.0001	.0003	.0001	.0002	.0001
Day 2	.0026	.0026	.0024	.0025	.0001
Day 4	.059	.030	.030	.040	.017
Day 5	.11	.037	.037	.061	.042
Day 6	.15	.041	.040	.077	.063
Day 8	.18	.047	.049	.092	.076
Day 11	.19	.049	.048	.096	.082
Day 12	.16	.047	.046	.084	.066
Day 13	.18	.047	.049	.092	.076
Day 14	.17	.047	.046	.088	.071

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

Waneta

Control + EDTA + P

	Replicates			Mean	S. D.
Day 1	.0000	.0000	.0000	.0000	.0000
Day 2	.0017	.0021	.0023	.0020	.0003
Day 4	.030	.031	.036	.032	.003
Day 5	.039	.035	.035	.036	.002
Day 6	.044	.040	.045	.043	.003
Day 8	.045	.041	.043	.043	.002
Day 11	.052	.047	.043	.047	.005
Day 12	.045	.032	.042	.040	.007
Day 13	.048	.042	.041	.044	.004
Day 14	.045	.042	.041	.043	.002

Control + EDTA + P + N

Day 1	.0002	.0002	.0001	.0002	.0001
Day 2	.0021	.0025	.0026	.0024	.0003
Day 4	.056	.045	.043	.048	.007
Day 5	.14	.12	.12	.13	.01
Day 6	.34	.34	.30	.33	.02
Day 8	.66	.69	.65	.67	.02
Day 11	.92	.90	.84	.89	.04
Day 12	.84	.91	.75	.83	.08
Day 13	.95	1.0	.79	.91	.11
Day 14	.98	1.0	.82	.94	.10

TED-70ug Zn/L

Control

Day 1	.0001	.0001	.0004	.0002	.0002
Day 2	.0008	.0008	.0007	.0008	.0001
Day 4	.0042	.0042	.0050	.0045	.0005
Day 5	.0058	.0058	.0065	.0060	.0004
Day 6	.0086	.0079	.0084	.0083	.0004
Day 8	.0081	.0096	.0091	.0089	.0008
Day 11	.0025	.0026	.0028	.0026	.0002
Day 12	.0028	.0032	.0036	.0032	.0004
Day 13	.0027	.0031	.0035	.0031	.0004
Day 14	.0023	.0023	.0027	.0024	.0002

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

TED-70ug Zn/L

Control + EDTA

	Replicates			Mean	S. D.
Day 1	.0004	.0002	.0003	.0003	.0001
Day 2	.0021	.0018	.0023	.0021	.0002
Day 4	.025	.021	.024	.023	.002
Day 5	.023	.021	.025	.023	.002
Day 6	.027	.025	.029	.027	.002
Day 8	.034	.029	.037	.033	.004
Day 11	.033	.031	.034	.033	.002
Day 12	.032	.029	.035	.032	.003
Day 13	.032	.028	.034	.031	.003
Day 14	.031	.028	.038	.032	.005

Control + EDTA + 200ug Fe/L

Day 1	.0001	.0002	.0002	.0002	.0001
Day 2	.0013	.0010	.0010	.0011	.0002
Day 4	.0050	.0071	.0066	.0062	.0011
Day 5	.0044	.0068	.0065	.0059	.0013
Day 6	.0057	.0090	.0083	.0077	.0017
Day 8	.0066	.011	.0096	.0091	.0022
Day 11	.0062	.012	.011	.010	.003
Day 12	.0060	.010	.010	.009	.002
Day 13	.0062	.011	.010	.009	.003
Day 14	.0053	.0096	.0096	.0082	.0025

Control + N

Day 1	.0002	.0003	.0002	.0002	.0001
Day 2	.0012	.0010	.0010	.0011	.0001
Day 4	.0045	.0045	.0047	.0046	.0001
Day 5	.0050	.0053	.0056	.0053	.0003
Day 6	.0064	.0067	.0074	.0068	.0005
Day 8	.0073	.0076	.0086	.0078	.0007
Day 11	.0033	.0029	.0035	.0032	.0003
Day 12	.0036	.0034	.0040	.0037	.0003
Day 13	.0037	.0033	.0035	.0035	.0002
Day 14	.0032	.0023	.0023	.0026	.0005

Daily Relative Fluorometer Readings
June 23 - July 7, 1982, Continued

TED-70ug Zn/L

Control + EDTA + N

	Replicates			Mean	S. D.
Day 1	.0002	.0002	.0002	.0002	.0000
Day 2	.0016	.0013	.0013	.0014	.0002
Day 4	.012	.013	.014	.013	.001
Day 5	.010	.011	.014	.012	.002
Day 6	.014	.015	.018	.016	.002
Day 8	.018	.019	.021	.019	.002
Day 11	.016	.016	.019	.017	.002
Day 12	.015	.015	.019	.016	.002
Day 13	.017	.017	.020	.018	.002
Day 14	.014	.015	.019	.016	.003

Control + EDTA + P + N

Day 1	.0002	.0001	.0006	.0003	.0003
Day 2	.0011	.0009	.0015	.0012	.0003
Day 4	.018	.015	.019	.017	.002
Day 5	.042	.028	.035	.035	.007
Day 6	.083	.074	.071	.076	.006
Day 8	.096	.11	.098	.101	.008
Day 11	.11	.11	.10	.11	.01
Day 12	.11	.11	.10	.11	.01
Day 13	.13	.12	.11	.12	.01
Day 14	.12	.13	.11	.12	.01

FIGURE 8

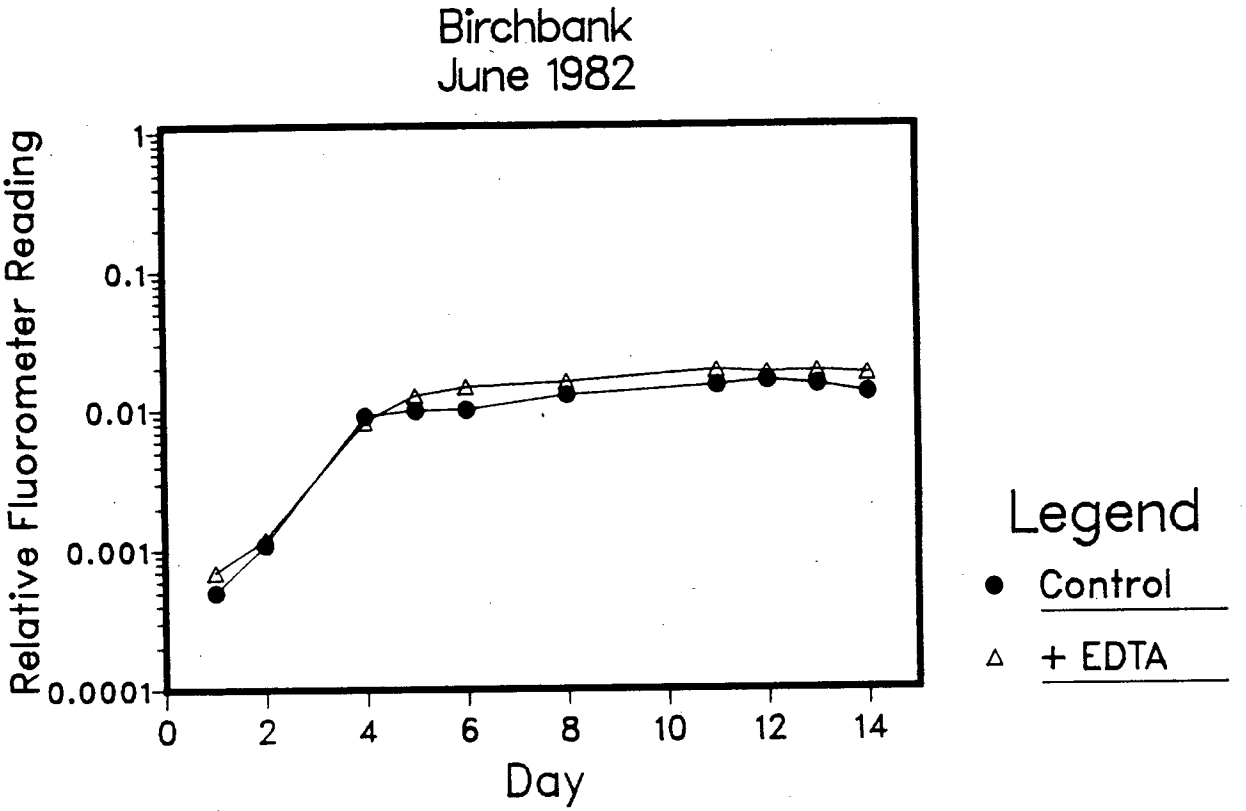
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

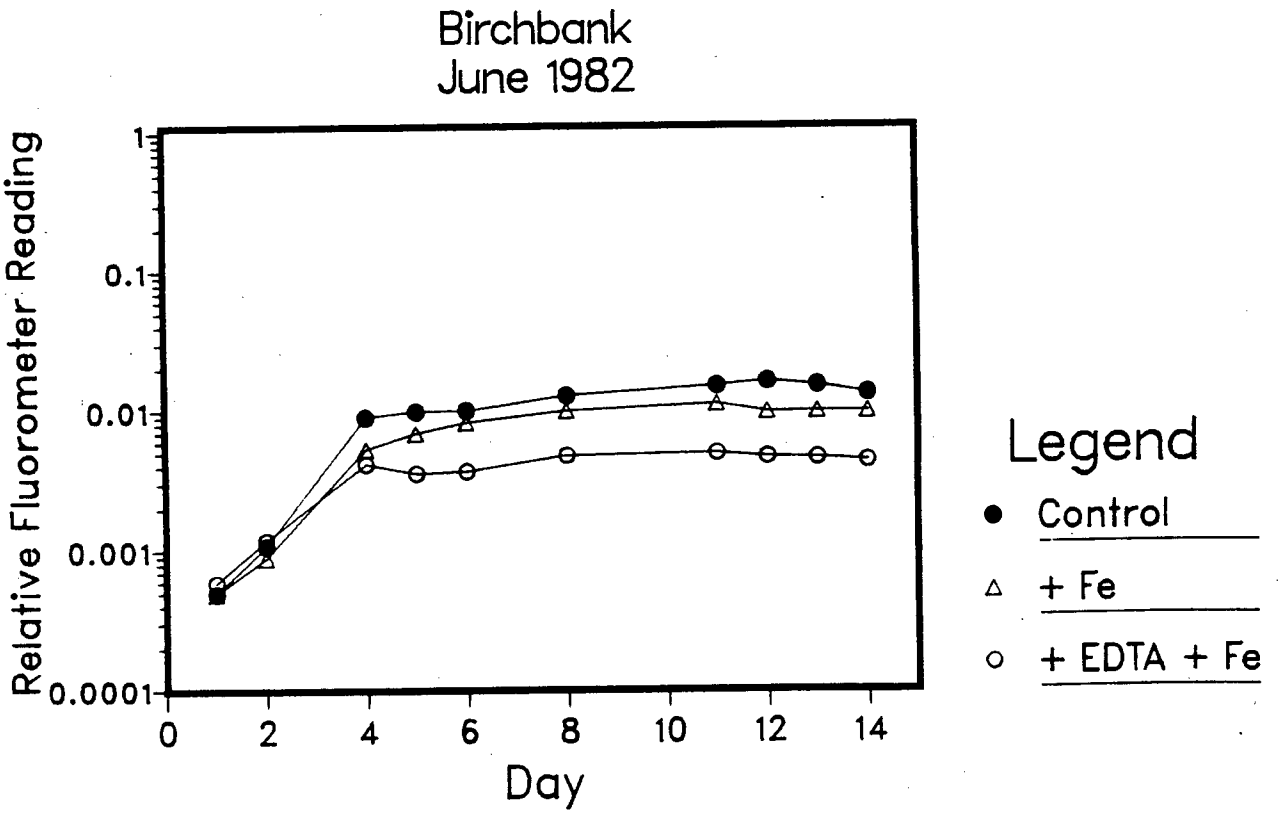
(MEASURED IN RELATIVE FLUOROMETER UNITS)

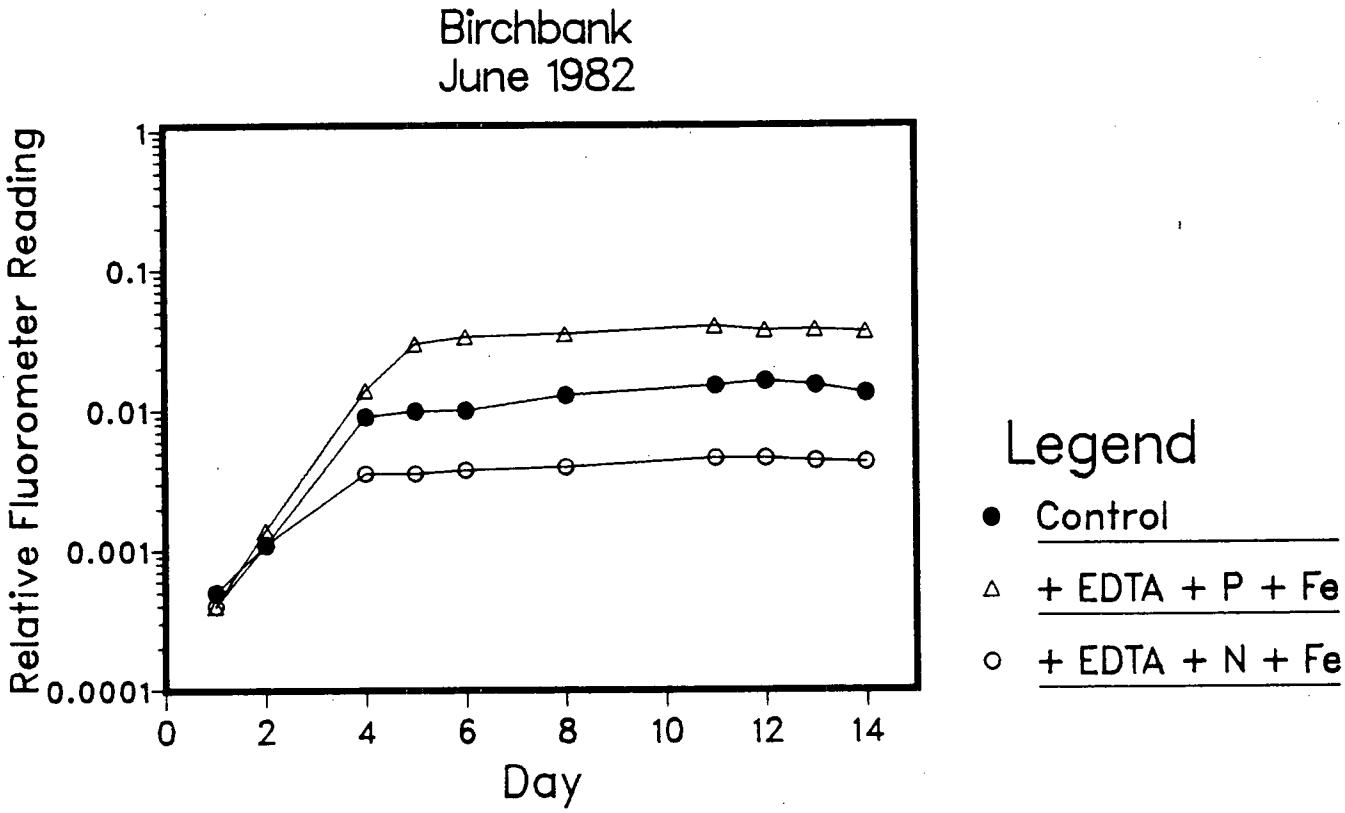
FOR THE JUNE 1982 ALGAL ASSAY.

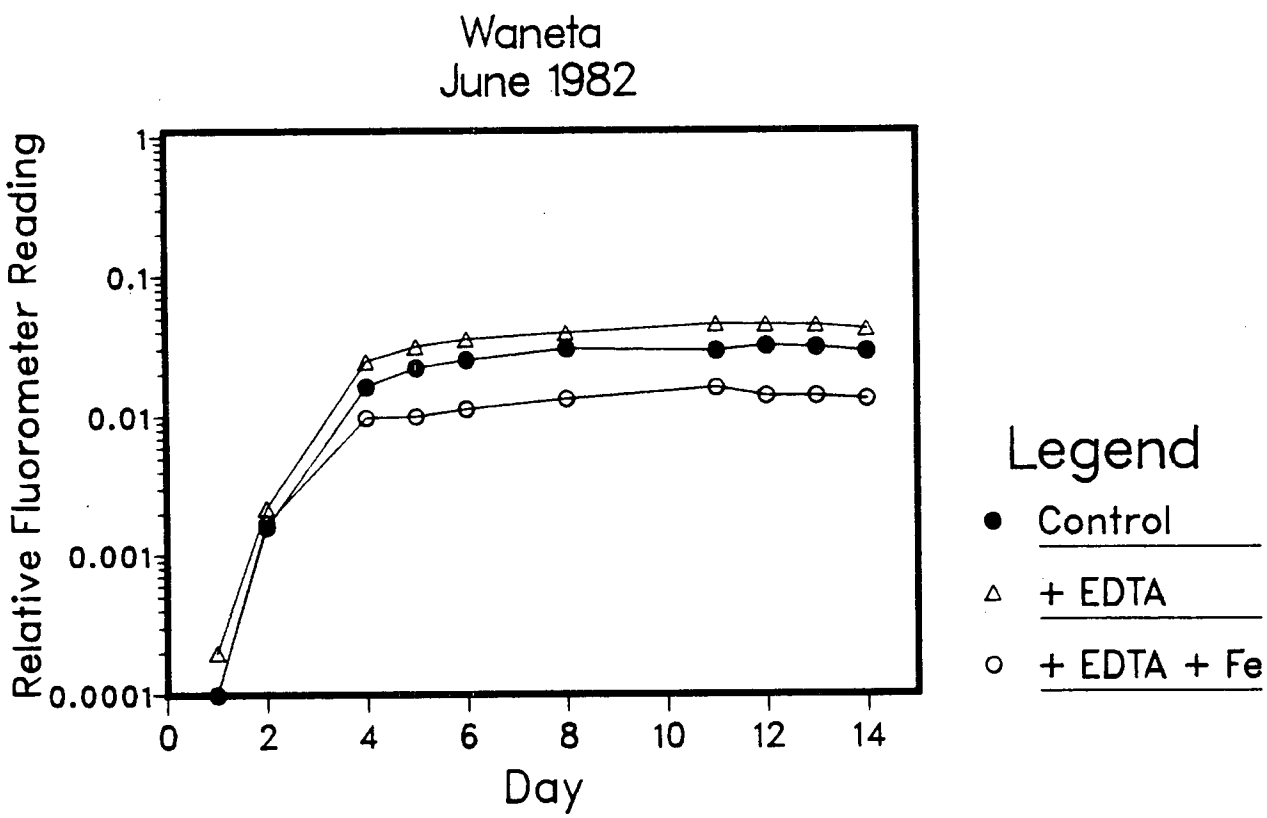
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

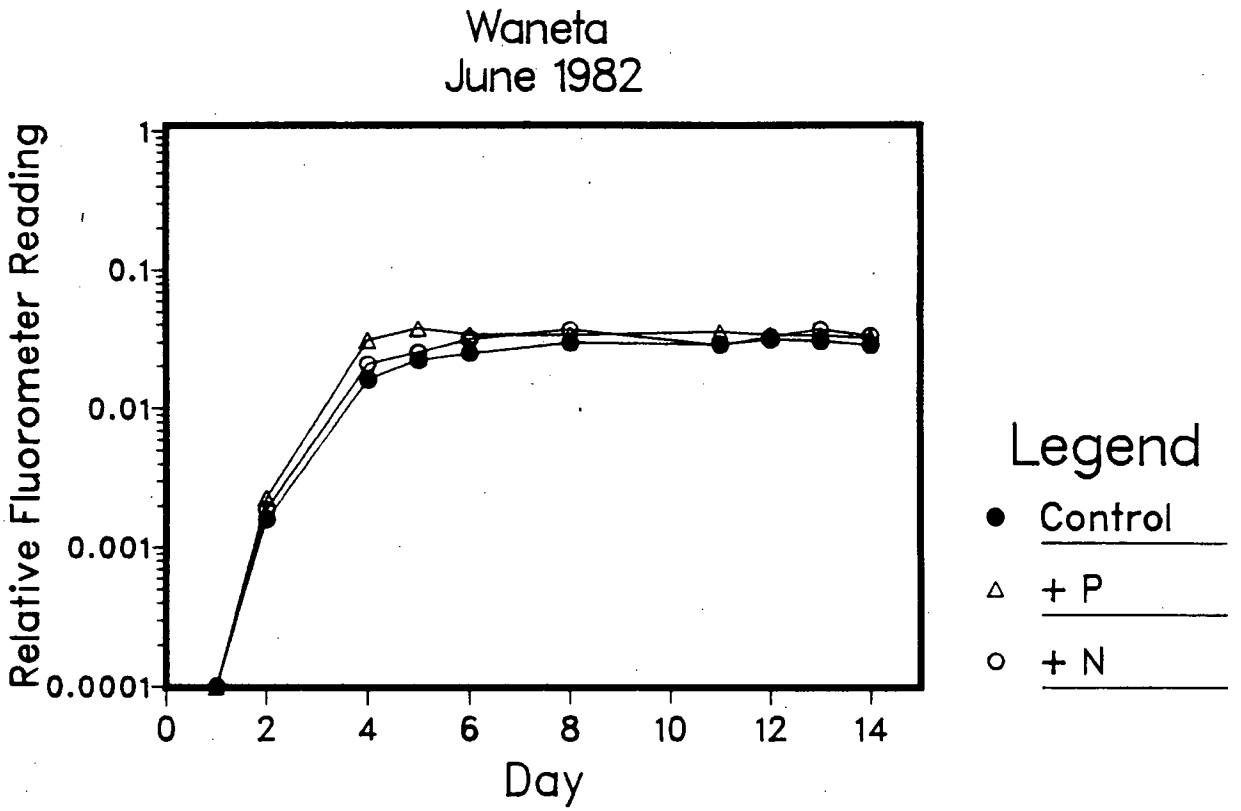
The readings used for these graphs are presented in Table 32

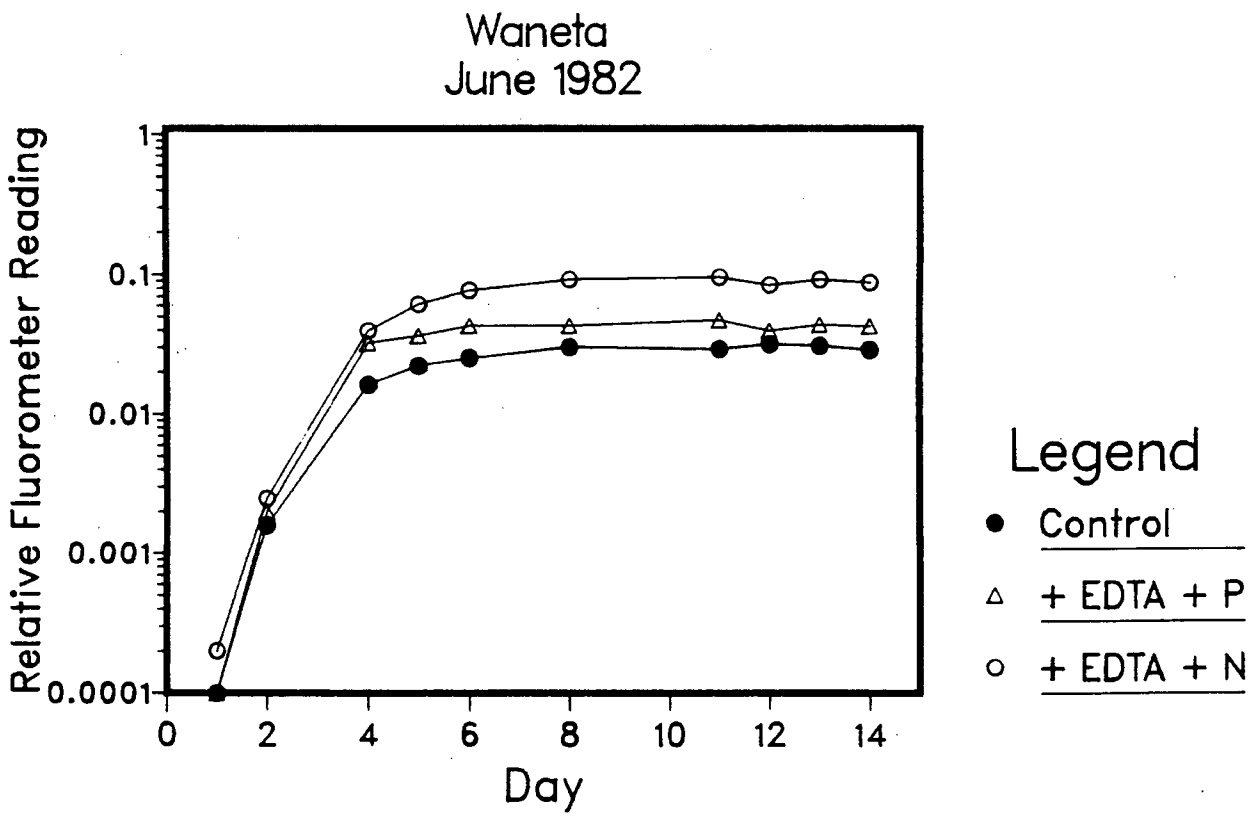

Birchbank
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA

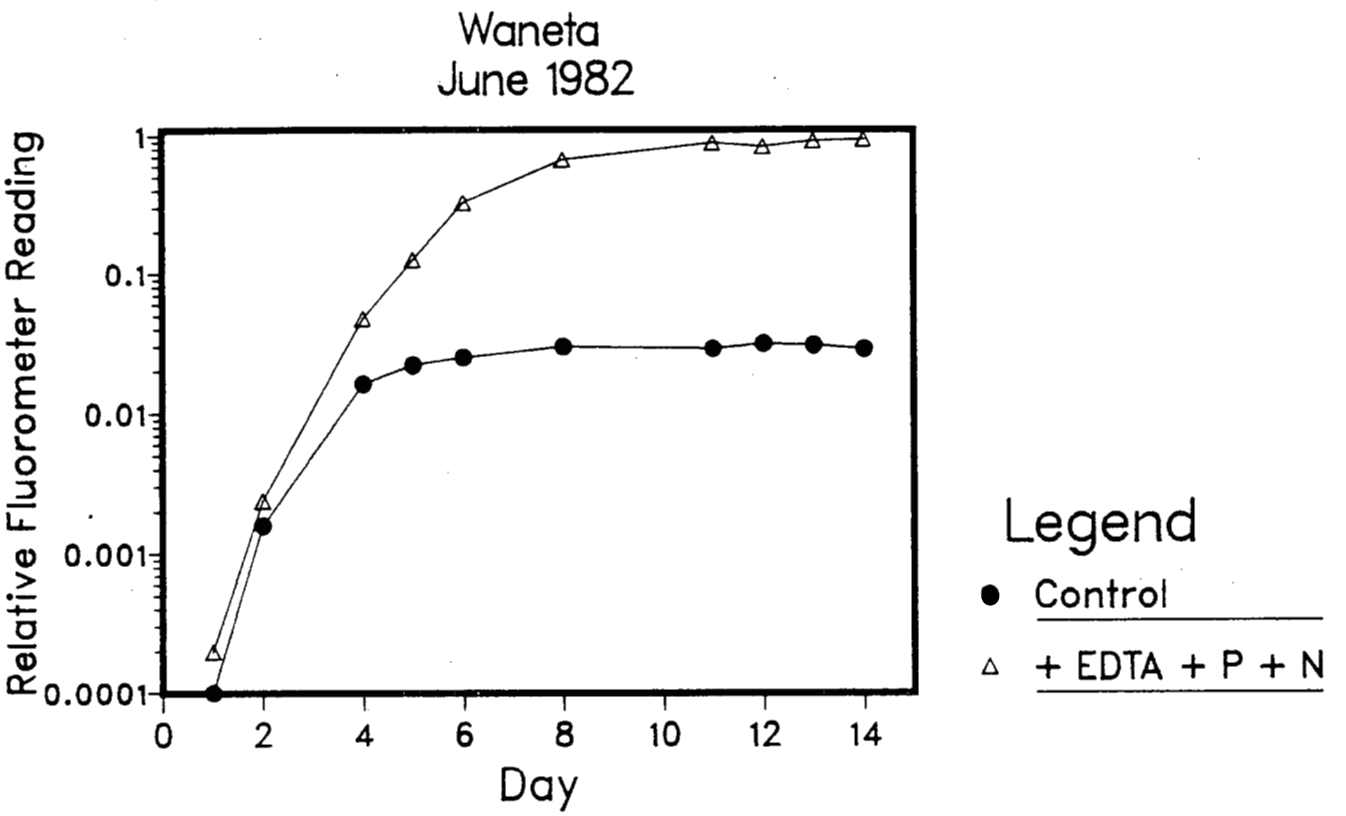

Birchbank
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ Fe
+ EDTA + Fe

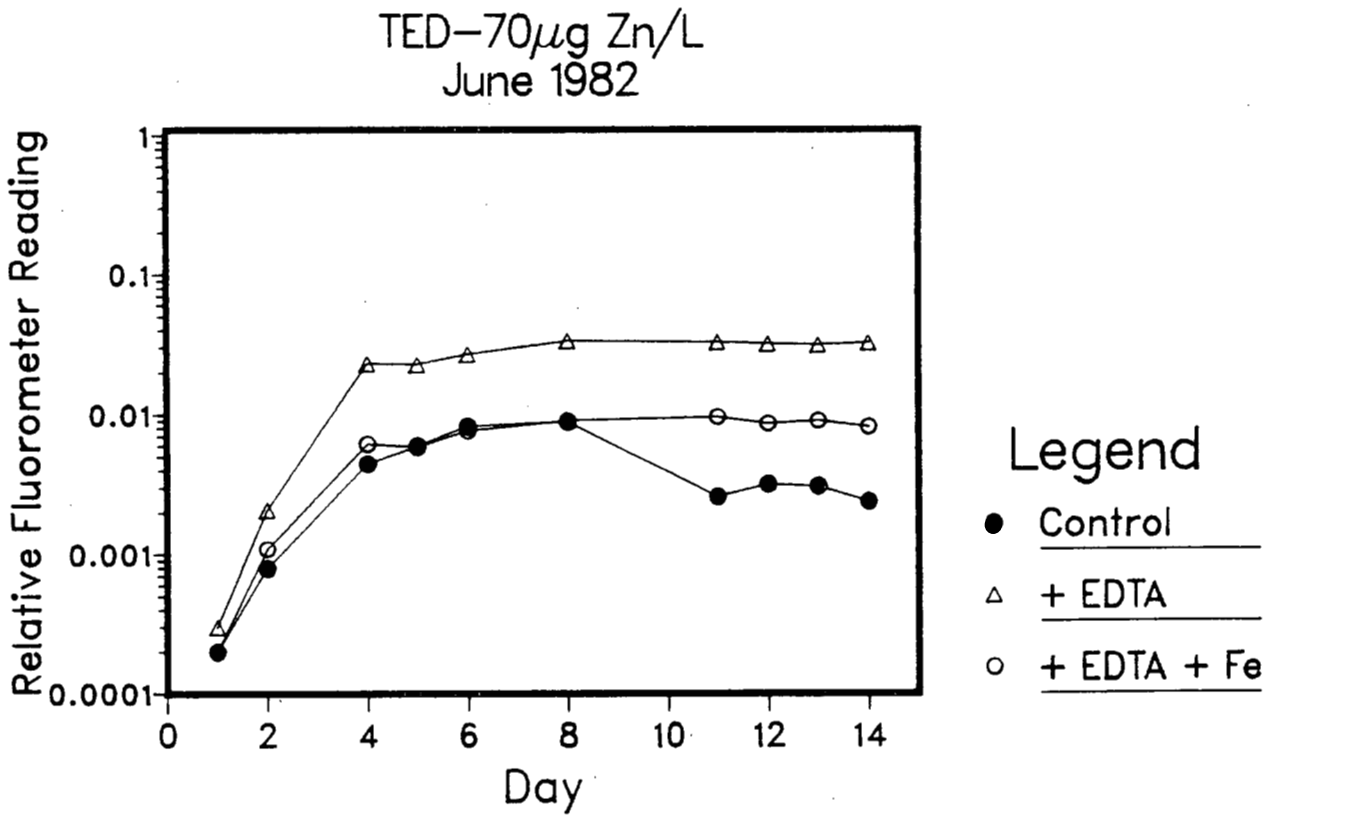

Birchbank
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P + Fe
+ EDTA + N + Fe

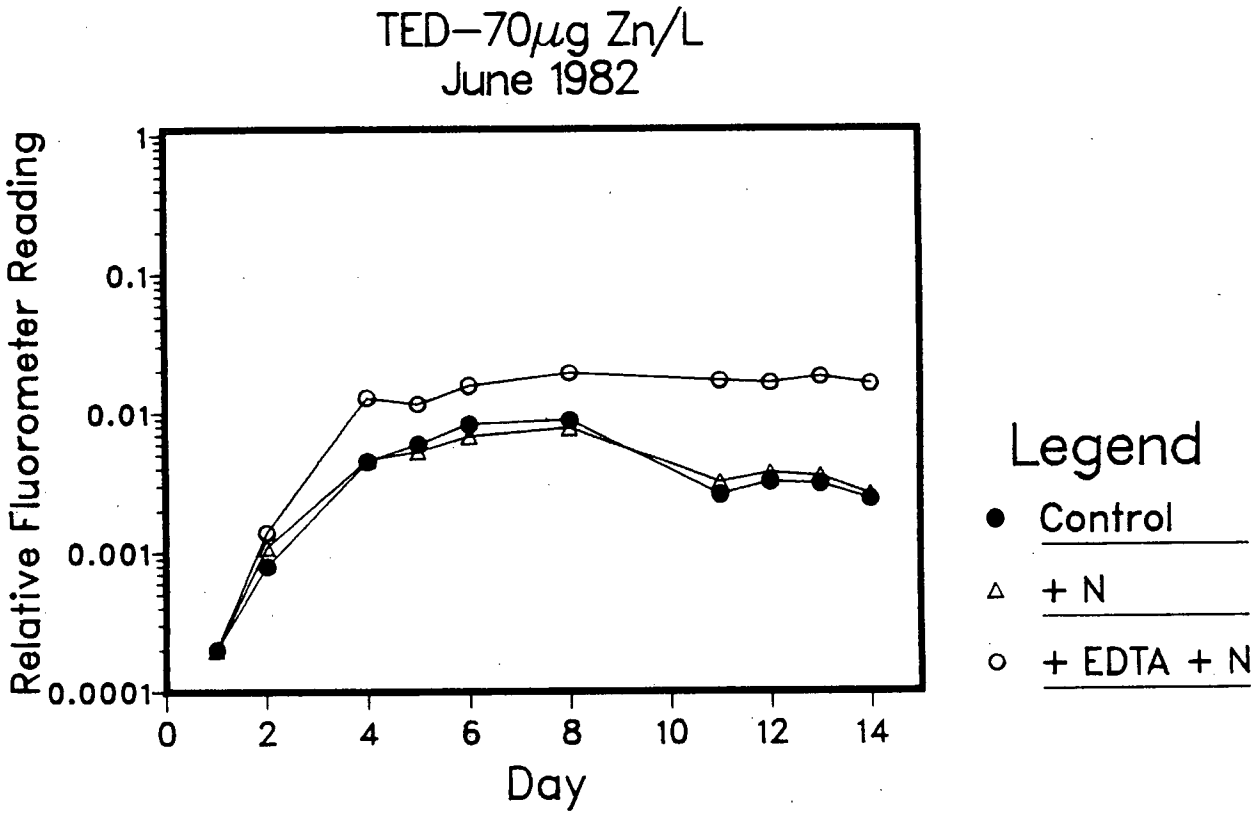

Waneta
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ EDTA + Fe


Waneta
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ P
+ N


Waneta
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P
+ EDTA + N


Waneta
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P + N


TED–70μg Zn/L
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA
+ EDTA + Fe


TED–70μg Zn/L
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ N
+ EDTA + N

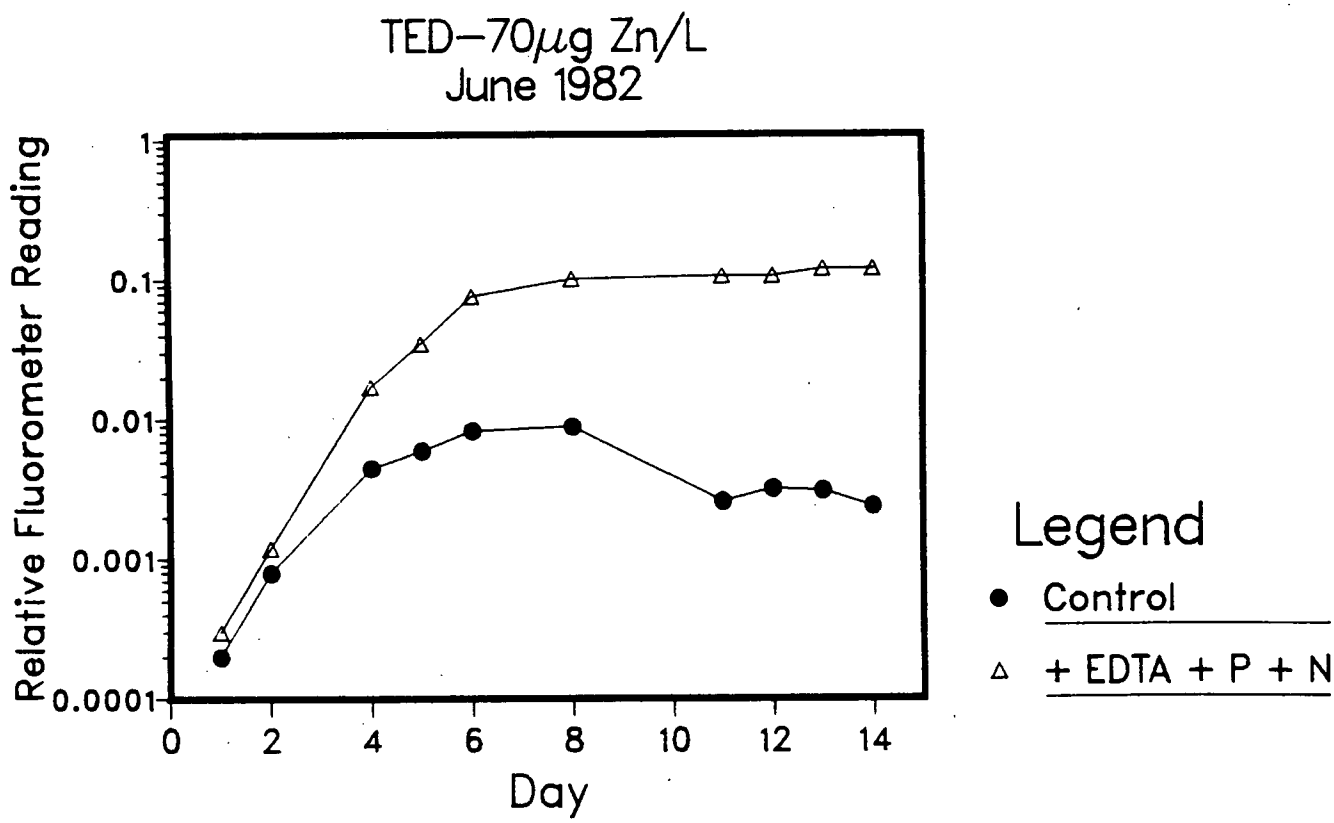

TED–70μg Zn/L
June 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
Day
Legend
Control
+ EDTA + P + N

TABLE 33

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE JUNE 1982 ASSAY.

THE YIELDS ARE EXPRESSED AS CELLS/ML AND MG DRY WT/L.

MEAN CELL VOLUME IS EXPRESSED AS UM^3/CELL.

THE YIELDS WERE DETERMINED WITH THE COULTER COUNTER.

June 23 - July 7, 1982 Algal Assay

Birchbank

Control

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
11384			64	.26		
19384	20015	8963	60	.42	.47	.24
29276			69	.73		

Control + EDTA

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
16816			61	.37		
28440	39241	29356	64	.66	.73	.41
72468			45	1.18		

Control + EDTA + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
16996			52	.32		
11940	15745	3359	60	.26	.34	.10
18300			68	.45		

Control + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
13752			66	.33		
44028	23612	17684	60	.95	.52	.38
13056			60	.28		

Control + EDTA + N + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
13112			60	.28		
25184	16128	7987	67	.61	.38	.20
10088			65	.24		

June 23 - July 7, 1982 Algal Assay, Continued

Birchbank

Control + EDTA + P + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
154377			33	1.84		
144707	129994	34202	38	1.99	1.71	.35
90897			40	1.31		

Waneta

Control

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
36764			65	.86		
34048	38908	6216	65	.80	.89	.11
45912			61	1.01		

Control + EDTA

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
83450			56	1.69		
60050	85820	27033	57	1.24	1.58	.30
113960			44	1.81		

Control + EDTA + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
23396			67	.57		
24076	24019	596	68	.59	.58	.02
24584			67	.59		

Control + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
65600			56	1.33		
47640	51561	12546	64	1.10	1.11	.21
41444			61	.91		

June 23 - July 7, 1982 Algal Assay, Continued

Waneta

Control + P

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
113340			42	1.72		
122330	124610	12566	40	1.77	1.81	.12
138160			39	1.95		

Control + EDTA + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
280014			60	6.07		
86410	150661	112024	63	1.97	3.30	2.39
85560			61	1.88		

Control + EDTA + P

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
181676			36	2.36		
131274	155951	25217	39	1.85	2.15	.27
154902			40	2.24		

Control + EDTA + P + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2383860			37	31.84		
2048190	2123498	232061	40	29.58	28.40	4.15
1938444			34	23.79		

TED-70ug Zn/L

Control

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
16720			59	.36		
16384	15533	1772	57	.34	.33	.04
13496			59	.29		

June 23 - July 7, 1982 Algal Assay, Continued

TED-70ug Zn/L

Control + EDTA

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
42160			77	1.17		
39880	34400	11523	78	1.12	.93	.37
21160			66	.50		

Control + EDTA + 200ug Fe/L

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
10912			62	.24		
17412	14669	3367	68	.43	.35	.10
15684			69	.39		

Control + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
13728			59	.29		
12916	13416	437	63	.29	.29	.00
13604			58	.28		

Control + EDTA + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
20356			66	.49		
23000	23240	3011	66	.55	.56	.08
26364			68	.65		

Control + EDTA + P + N

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
248514			34	3.05		
248808	248724	183	36	3.23	3.14	.09
248850			35	3.14		

TABLE 34

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER
ON AUGUST 17, 1982. CONCENTRATIONS OF ALL
CHEMICALS EXCEPT HG ARE REPORTED IN mg/L;
HG IS IN μg/L. PARAMETERS ARE LISTED UNDER
THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-08-17

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	L.002	L.002	L.002	L.002	.000	L.002	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.003	.002	.002	.002	.001	.002	1.2638
15406	PHOSPHORUS TOTAL	.004	.004	.004	.004	.000	.004	1.0000
07110	NITROGEN DISSOLVED NO3 & NO2	.083	.094	.089	.089	.006	.089	1.0644
07557	NITROGEN DISSOLVED AMMONIA	.004	.006	.003	.004	.002	.004	1.4166
07655	NITROGEN TOTAL DISSOLVED	.155	.170	.155	.160	.009	.160	1.0548
07903	NITROGEN PARTICULATE	.022	.015	.016	.018	.004	.017	1.2276
30105	ZINC DISSOLVED	.013	L.001	L.001	*.005	.007	*.002	4.3968
30305	ZINC EXTRBLE.	.001	L.001	L.001	*.001	.000	*.001	1.0000
29105	COPPER DISSOLVED	.002	.001	L.001	*.001	.001	*.001	1.4921
29305	COPPER EXTRBLE.	.001	.001	L.001	*.001	.000	*.001	1.0000
26105	IRON DISSOLVED	.016	.011	.009	.012	.004	.012	1.3392
26305	IRON EXTRBLE.	.034	.027	.034	.032	.004	.031	1.1424
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	.001	L.001	L.001	*.001	.000	*.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	.001	*.001	.000	*.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
24053	CHROMIUM DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
24303	CHROMIUM EXTRBLE.	.001	L.001	.001	*.001	.000	*.001	1.0000
02011	COLOUR APPARENT	10.	10.	10.	10.	0.	10.	1.0000
02041	SPECIFIC CONDUCT.	97.8	98.6	98.6	98.3	.5	98.3	1.0047
02061	TEMP. WATER ,LAB	21.3	20.9	20.9	21.0	.2	21.0	1.0110
02073	TURBIDITY	1.60	.80	.80	1.07	.46	1.01	1.4921
06001	CARBON TOTAL ORGANIC	1.10	.76	1.40	1.09	.32	1.05	1.3603
06051	CARBON TOTAL INORGANIC	12.0	12.0	13.0	12.3	.6	12.3	1.0473
06101	CARBON DISSOLVED ORGANIC	1.1	1.3	1.5	1.3	.2	1.3	1.1679
06151	CARBON DISSOLVED INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06903	CARBON PARTICULATE	.158	.133	.142	.144	.013	.144	1.0908
09106	FLUORIDE DISSOLVED	.083	.062	.053	.066	.015	.065	1.2556
10101	ALKALINITY TOTAL	41.3	41.4	41.5	41.4	.1	41.4	1.0024
10151	ALKALINITY PHENOL PHTHALEIN			.0	.0			
10301	PH	7.8	7.8	7.8	7.8	.0	7.8	1.0000
10603	HARDNESS TOTAL	48.8	51.0	49.0	49.6	1.2	49.6	1.0247
11103	SODIUM DISSOLVED	1.0	1.0	1.0	1.0	.0	1.0	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)			3.2	3.2		3.2	
14105	SILICA REACTIVE	3.7	3.7	3.7	3.7	.0	3.7	1.0000
16306	SULPHATE DISSOLVED	6.6	7.1	6.8	6.8	.3	6.8	1.0374
17206	CHLORIDE DISSOLVED	.6	.6	.5	.6	.1	.6	1.1110
19103	POTASSIUM DISSOLVED	.4	.4	.4	.4	.0	.4	1.0000
20101	CALCIUM DISSOLVED	14.9	14.5	14.4	14.6	.3	14.6	1.0182

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-08-17

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.082	.082	.082	.082	.000	.082	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.086	.087	.086	.086	.001	.086	1.0067
15406	PHOSPHORUS TOTAL	.085	.095	.094	.091	.006	.091	1.0633
07110	NITROGEN DISSOLVED NO3 & NO2	.107	.099	.097	.101	.005	.101	1.0531
07557	NITROGEN DISSOLVED AMMONIA	.026	.027	.027	.027	.001	.027	1.0220
07655	NITROGEN TOTAL DISSOLVED	.212	.187	.184	.194	.015	.194	1.0806
07903	NITROGEN PARTICULATE	.017	.021	.023	.020	.003	.020	1.1678
30105	ZINC DISSOLVED	.016	.015	.015	.015	.001	.015	1.0380
30305	ZINC EXTRBLE.	.019	.020	.018	.019	.001	.019	1.0541
29105	COPPER DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
29305	COPPER EXTRBLE.	.002	.001	.001	.001	.001	.001	1.4921
26105	IRON DISSOLVED	.020	.019	.001	.013	.011	.007	5.5565
26304	IRON EXTRBLE.	.06	.06	.06	.06	.00	.06	1.0000
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	.01	.01	.01	.01	.00	.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	.001	.001	.001	.001	.000	.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
24053	CHROMIUM DISSOLVED	.001	.001	.001	.001	.000	.001	1.0000
24303	CHROMIUM EXTRBLE.	.002	.002	.004	.003	.001	.003	1.4921
02011	COLOUR APPARENT	15.	15.	10.	13.	3.	13.	1.2638
02041	SPECIFIC CONDUCT.	103.0	102.0	102.0	102.3	.6	102.3	1.0056
02061	TEMP. WATER ,FIELD	15.0			15.0		15.0	
02061	TEMP. WATER ,LAB	20.8	20.7	21.0	20.8	.2	20.8	1.0074
02073	TURBIDITY	1.80	1.10	1.40	1.43	.35	1.40	1.2792
06001	CARBON TOTAL ORGANIC	.96	.94	1.50	1.13	.32	1.11	1.3021
06051	CARBON TOTAL INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06101	CARBON DISSOLVED ORGANIC	1.7	1.5	1.5	1.6	.1	1.6	1.0749
06151	CARBON DISSOLVED INORGANIC	12.0	12.0	12.0	12.0	.0	12.0	1.0000
06903	CARBON PARTICULATE	.152	.170	.165	.162	.009	.162	1.0597
09106	FLUORIDE DISSOLVED	.056	.059	.055	.057	.002	.057	1.0371
10101	ALKALINITY TOTAL	40.9	41.3	41.1	41.1	.2	41.1	1.0049
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.8	7.8	7.8	7.8	.0	7.8	1.0015
10603	HARDNESS TOTAL	50.3	50.1	50.1	50.2	.1	50.2	1.0023
11103	SODIUM DISSOLVED	1.0	1.0	1.0	1.0	.0	1.0	1.0000
12101	MAGNESIUM DISSOLVED (CALCD.)	3.1	3.1	3.1	3.1	.0	3.1	1.0038
14105	SILICA REACTIVE	3.8	3.7	3.8	3.8	.1	3.8	1.0155
16306	SULPHATE DISSOLVED	5.3	5.4	5.4	5.4	.1	5.4	1.0109
17206	CHLORIDE DISSOLVED	.6	.5	.5	.5	.1	.5	1.1110
19103	POTASSIUM DISSOLVED	.4	.5	.5	.5	.1	.5	1.1375
20101	CALCIUM DISSOLVED	15.1	15.0	15.0	15.0	.1	15.0	1.0038

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-08-17

STATION NO.: 20BC08NE0001
COMINCO SEWER #8, TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.028	.026	.026	.027	.001	.027	1.0437
15102	PHOSPHORUS TOTAL DISSOLVED	.029	.027	.028	.028	.001	.028	1.0364
15406	PHOSPHORUS TOTAL	.033	.032	.033	.033	.001	.033	1.0179
07110	NITROGEN DISSOLVED NO3 & NO2	.166	.099	.083	.116	.044	.111	1.4337
07557	NITROGEN DISSOLVED AMMONIA	2.950	3.000	3.230	3.060	.149	3.058	1.0494
07655	NITROGEN TOTAL DISSOLVED	3.170	3.330	3.300	3.267	.085	3.266	1.0266
07903	NITROGEN PARTICULATE	.031	.029	.033	.031	.002	.031	1.0668
30104	ZINC DISSOLVED	35.00	35.00	36.00	35.33	.58	35.33	1.0164
30304	ZINC EXTRBL.	33.00	34.00	37.00	34.67	2.08	34.63	1.0611
29106	COPPER DISSOLVED	.05	.04	.08	.06	.02	.05	1.4245
29306	COPPER EXTRBLE.	.09	.11	.08	.09	.02	.09	1.1747
26104	IRON DISSOLVED	1.30	.98	1.50	1.26	.26	1.24	1.2419
26304	IRON EXTRBLE.	1.50	1.50	1.10	1.37	.23	1.35	1.1961
25104	MANGANESE DISSOLVED	7.60	9.30	7.00	7.97	1.19	7.91	1.1574
25304	MANGANESE EXTRBLE.	5.70	6.70	9.30	7.23	1.86	7.08	1.2833
48101	CADMIUM DISSOLVED	.14	.21	.11	.15	.05	.15	1.3865
48301	CADMIUM EXTRBLE.	.07	.09	.21	.12	.08	.11	1.7782
82101	LEAD DISSOLVED	.18	.18	.25	.20	.04	.20	1.2088
82301	LEAD EXTRBLE.	.27	.22	.30	.26	.04	.26	1.1708
80311	MERCURY EXTRBLE.	2.10	2.20	2.20	2.17	.06	2.17	1.0272
33304	ARSENIC EXTRBLE.	.0024	.0030	.0023	.0026	.0004	.0025	1.1534
34302	SELENIUM EXTRBLE.	.0001	.0001	.0001	.0001	.0000	.0001	1.0000
24052	CHROMIUM DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
24302	CHROMIUM EXTRBLE.	.01	L.01	.01	*.01	.00	*.01	1.0000
02011	COLOUR APPARENT	10.	5.	7.	7.	3.	7.	1.4143
02041	SPECIFIC CONDUCT.	1719.0	2240.0	1792.0	1917.0	282.1	1903.8	1.1530
02061	TEMP. WATER ,LAB	22.9	22.9	22.9	22.9	.0	22.9	1.0000
02073	TURBIDITY	4.40	3.20	3.50	3.70	.62	3.67	1.1785
06001	CARBON TOTAL ORGANIC	L.52	L.52	L.52	L.52	.00	L.52	1.0000
06051	CARBON TOTAL INORGANIC	3.6	3.2	3.2	3.3	.2	3.3	1.0704
06101	CARBON DISSOLVED ORGANIC	L.5	.7	.7	*.6	.1	*.6	1.1375
06151	CARBON DISSOLVED INORGANIC	1.2	1.4	1.4	1.3	.1	1.3	1.0931
06903	CARBON PARTICULATE	.305	.355	.354	.338	.029	.337	1.0907
09106	FLUORIDE DISSOLVED	.139	.200	.270	.203	.066	.196	1.3944
10101	ALKALINITY TOTAL	L.5	L.5	L.5	L.5	.0	L.5	1.0000
10301	PH	2.5	2.5	2.5	2.5	.0	2.5	1.0164
10401	RESIDUE NONFILTR.	10.	L10.	10.	*10.	0.	*10.	1.0000
10451	RESIDUE FILTERABLE	458.	488.	424.	457.	32.	456.	1.0729
10501	RESIDUE FIXED NONFILTR.	L10.	L10.	L10.	L10.	0.	L10.	1.0000
10551	RESIDUE FIXED FILTERABLE	234.	222.	220.	225.	8.	225.	1.0339
10603	HARDNESS TOTAL	157.3	165.6	152.3	158.4	6.7	158.3	1.0431
11103	SODIUM DISSOLVED	1.7	1.6	1.5	1.6	.1	1.6	1.0646
14105	SILICA REACTIVE	4.0	4.0	4.0	4.0	.0	4.0	1.0000
16306	SULPHATE DISSOLVED	335.0	435.0	370.0	380.0	50.7	377.8	1.1409
17206	CHLORIDE DISSOLVED	1.1	1.0	1.0	1.0	.1	1.0	1.0566
19103	POTASSIUM DISSOLVED	1.2	1.4	1.2	1.3	.1	1.3	1.0931
20101	CALCIUM DISSOLVED	38.1	34.1	32.9	35.0	2.7	35.0	1.0795

TABLE 35a.

Concentrations (mg/L) of nutrients and dissolved metals in water from Birchbank used in the August 1982 algal assay. The water was autoclaved, aerated with CO_2, filtered, and pH adjusted before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Orthophosphate	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Total Dissolved Phosphorus	0.002	0.002	0.003	0.002	0.001	0.002	1.2638
Nitrate plus Nitrite	0.091	0.087	0.088	0.089	0.002	0.089	1.0235
Ammonia	0.004	0.005	0.004	0.004	0.001	0.004	1.1377
Total Dissolved Nitrogen	0.130	0.122	0.125	0.126	0.004	0.126	1.0326
Dissolved Zn	0.002	0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Cu	0.003	0.001	0.004	0.003	0.002	0.002	2.0785
Dissolved Fe	0.004	0.004	0.003	0.004	0.001	0.004	1.1810
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	0.002	0.003	0.002	0.001	0.002	1.2638
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

*Hg measured in µg/L

TABLE 35b.

Concentrations (mg/L) of nutrients and dissolved metals in water from Waneta at two stages of preparation for the August 1982 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Filtered Only							
Dissolved Zn	0.02	0.02	0.02	0.02	0.0	0.02	1.0000
Dissolved Cu	0.005	0.005	0.006	0.005	0.001	0.005	1.1109
Dissolved Fe	0.006	0.006	0.006	0.006	0.0	0.006	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.001	0.002	0.001	0.001	0.001	0.001	1.4923
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000
Autoclaved, Aerated with CO_2, Filtered, and pH adjusted							
Orthophosphate	0.093	0.094	0.095	0.094	0.001	0.094	1.0105
Total Dissolved Phosphorus	0.095	0.092	0.097	0.095	0.002	0.095	1.0270
Nitrate plus Nitrite	0.094	0.094	0.096	0.095	0.001	0.095	1.0120
Ammonia	0.023	0.021	0.021	0.022	0.001	0.022	1.0539
Total Dissolved Nitrogen	0.135	0.129	0.134	0.133	0.003	0.133	1.0247
Dissolved Zn	0.019	0.018	0.018	0.018	0.001	0.018	1.0315
Dissolved Cu	0.003	0.001	0.001	0.002	0.001	0.001	1.8857
Dissolved Fe	0.005	0.04	0.005	0.02	0.020	0.01	3.3220
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

*Hg measured in µg/L

TABLE 35c.

Concentrations (mg/L) of nutrients and dissolved metals in water from Cominco sewer #8 at two stages of preparation for the August 1982 algal assay.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D. (=G.F.)
Filtered Only							
Dissolved Zn	23.	23.	23.	23.	0.0	23.	1.0000
Dissolved Cu	0.03	0.03	0.03	0.03	0.0	0.03	1.0000
Dissolved Fe	1.2	1.2	1.2	1.2	0.0	1.2	1.0000
Dissolved Cd	0.0043	0.0041	0.0045	0.0043	0.0002	0.0043	1.0480
Dissolved Pb	0.20	0.20	0.20	0.20	0.0	0.20	1.0000
Dissolved Ni	0.002	0.002	0.001	0.002	0.001	0.002	1.4922
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000
Autoclaved, Aerated with CO_2, Filtered, and pH adjusted							
Orthophosphate	0.024	0.024	0.024	0.024	0.0	0.024	1.0000
Total Dissolved Phosphorus	0.026	0.026	0.026	0.026	0.0	0.026	1.0000
Nitrate plus Nitrite	0.126	0.133	0.134	0.131	0.004	0.131	1.0341
Ammonia	2.65	2.60	2.89	2.71	0.16	2.71	1.0580
Total Dissolved Nitrogen	2.80	2.75	3.04	2.86	0.16	2.86	1.0549
Dissolved Zn	0.04	0.04	0.04	0.04	0.0	0.04	1.0000
Dissolved Cu	0.025	0.025	0.025	0.025	0.0	0.025	1.0000
Dissolved Fe	0.94	0.94	0.94	0.94	0.0	0.94	1.0000
Dissolved Mn	5.4	5.4	5.4	5.4	0.0	5.4	1.0000
Dissolved Cd	0.0037	0.0043	0.0040	0.0040	0.0	0.0040	1.0781
Dissolved Pb	0.25	0.21	0.31	0.26	0.05	0.25	1.2154
Dissolved Ni	0.004	0.005	0.005	0.005	0.001	0.005	1.1375
Dissolved Hg*	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

*Hg measured in µg/L

TABLE 35d.

Composition of the TED-40µg Zn/L dilution of Cominco effluent used in the August 1982 algal assay. Concentrations of all chemicals except Hg are reported in mg/L; Hg is in µg/L.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Orthophosphate	0.092	0.093	0.094	0.093	0.001	0.093	1.0108
Total Dissolved Phosphorus	0.098	0.098	0.098	0.098	0.0	0.098	1.0000
Nitrate plus Nitrite	0.097	0.102	0.102	0.100	0.003	0.100	1.0294
Ammonia	0.026	0.038	0.034	0.033	0.006	0.032	1.2154
Total Dissolved Nitrogen	0.170	0.158	0.150	0.159	0.010	0.159	1.0649
Dissolved Zn	0.04	0.04	0.04	0.04	0.0	0.04	1.0000
Dissolved Cu	0.002	0.003	0.002	0.002	0.001	0.002	1.2638
Dissolved Fe	0.006	0.006	0.018	0.010	0.007	0.009	1.8857
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	0.0006	0.0005	0.0006	0.0006	0.0001	0.0006	1.1109
Dissolved Pb	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Dissolved Ni	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Hg	L0.05	L0.05	L0.05	L0.05	0.0	L0.05	1.0000

TABLE 36

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE AUGUST 1982 ALGAL ASSAY

These readings are graphed in Figure 9

Daily Relative Fluorometer Readings
August 19 - September 5, 1982

Birchbank

Control, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0003	.0003	.0003	.0003	.0000
Day 2	.0007	.0010	.0008	.0008	.0002
Day 4	.0017	.0015	.0016	.0016	.0001
Day 5	.0016	.0014	.0015	.0015	.0001
Day 6	.0015	.0013	.0014	.0014	.0001
Day 8	.0013	.0012	.0018	.0014	.0003
Day 11	.0008	.0008	.0008	.0008	.0000
Day 12	.0012	.0005	.0007	.0008	.0004

Control + EDTA, pH=8.0

Day 1	.0003	.0003	.0002	.0003	.0001
Day 2	.0008	.0009	.0010	.0009	.0001
Day 4	.0014	.0015	.0018	.0016	.0002
Day 5	.0014	.0013	.0017	.0015	.0002
Day 6	.0016	.0015	.0022	.0018	.0004
Day 8	.0017	.0018	.0022	.0019	.0003
Day 11	.0010	.0011	.0016	.0012	.0003
Day 12	.0011	.0010	.0015	.0012	.0003

Control + N, pH=8.0

Day 1	.0002	.0003	.0004	.0003	.0001
Day 2	.0009	.0009	.0008	.0009	.0001
Day 4	.0017	.0016	.0014	.0016	.0002
Day 5	.0017	.0014	.0014	.0015	.0002
Day 6	.0019	.0013	.0013	.0015	.0004
Day 8	.0021	.0013	.0013	.0016	.0005
Day 11	.0015	.0009	.0009	.0011	.0004
Day 12	.0012	.0007	.0007	.0009	.0003

Control + P, pH=8.0

Day 1	.0004	.0004	.0003	.0004	.0001
Day 2	.0008	.0011	.0010	.0010	.0002
Day 4	.0069	.011	.0058	.0079	.0027
Day 5	.020	.032	.016	.023	.008
Day 6	.053	.084	.033	.057	.026
Day 8	.14	.13	.11	.13	.02
Day 11	.13	.12	.080	.11	.03
Day 12	.13	.11	.077	.11	.03
Day 13	.13	.11	.079	.11	.03

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

Birchbank

Control + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0004	.0005	.0002	.0004	.0002
Day 2	.0010	.0008	.0012	.0010	.0002
Day 4	.0038	.0034	.0047	.0040	.0007
Day 5	.0080	.0072	.0090	.0081	.0009
Day 6	.015	.015	.017	.016	.001
Day 8	.046	.067	.047	.053	.012
Day 11	.38	.42	.28	.36	.07
Day 12	.60	.50	.36	.49	.12
Day 13	.72	.59	.45	.59	.14
Day 14	.78	.63	.52	.64	.13
Day 15	.89	.72	.59	.73	.15
Day 16	.91	.68	.62	.74	.15
Day 17	.89	.65	.61	.72	.15

Control + EDTA + P + N, pH=8.0

Day 1	.0002	.0003	.0002	.0002	.0001
Day 2	.0017	.0016	.0015	.0016	.0001
Day 4	.023	.024	.021	.023	.002
Day 5	.087	.083	.074	.081	.007
Day 6	.29	.28	.26	.28	.02
Day 8	.74	.75	.78	.76	.02
Day 11	.95	.92	.96	.94	.02
Day 12	.94	.91	.95	.93	.02
Day 13	.93	.92	.93	.93	.01

Control + EDTA + P + N + Trace Metals, pH=8.0

Day 1	.0003	.0003	.0002	.0003	.0001
Day 2	.0018	.0019	.0019	.0019	.0001
Day 4	.026	.027	.032	.028	.003
Day 5	.11	.12	.14	.12	.02
Day 6	.32	.35	.40	.36	.04
Day 8	.87	.80	.74	.80	.07
Day 11	.81	.75	.82	.79	.04
Day 12	.78	.76	.72	.75	.03
Day 13	.77	.75	.80	.77	.03

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

Birchbank

Control + EDTA + P, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0003	.0004	.0003	.0003	.0001
Day 2	.0018	.0015	.0013	.0015	.0002
Day 4	.022	.023	.017	.021	.003
Day 5	.068	.069	.056	.064	.007
Day 6	.085	.091	.093	.090	.004
Day 8	.11	.12	.14	.12	.02
Day 11	.10	.11	.12	.11	.01
Day 12	.086	.092	.12	.099	.018
Day 13	.088	.093	.11	.097	.012

Waneta

Control, pH=8.0

Day 1	.0004	.0003	.0004	.0004	.0001
Day 2	.0013	.0013	.0014	.0013	.0001
Day 4	.010	.0072	.0070	.0081	.0017
Day 5	.024	.019	.022	.022	.003
Day 6	.040	.032	.039	.037	.004
Day 8	.11	.10	.11	.11	.01
Day 11	.083	.11	.087	.093	.015
Day 12	.079	.083	.080	.081	.002

Control + EDTA, pH=8.0

Day 1	.0002	.0002	.0003	.0002	.0001
Day 2	.0018	.0016	.0013	.0016	.0002
Day 4	.030	.028	.024	.027	.003
Day 5	.093	.088	.075	.085	.009
Day 6	.13	.13	.13	.13	.00
Day 8	.13	.15	.14	.14	.01
Day 11	.12	.14	.14	.13	.01
Day 12	.12	.13	.13	.13	.01

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

Waneta

Control + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0003	.0004	.0003	.0003	.0001
Day 2	.0010	.0013	.0009	.0011	.0002
Day 4	.0055	.0068	.0061	.0061	.0006
Day 5	.0090	.022	.014	.015	.007
Day 6	.031	.049	.025	.035	.012
Day 8	.15	.19	.078	.14	.06
Day 11	.35	.49	.39	.41	.07
Day 12	.41	.58	.52	.50	.09
Day 13	.53	.66	.84	.68	.16
Day 14	.62	.63	.67	.64	.03
Day 15	.67	.60	.70	.66	.05

Control + P, pH=8.0

Day 1	.0003	.0003	.0004	.0003	.0001
Day 2	.0013	.0009	.0010	.0011	.0002
Day 4	.0091	.0063	.010	.0085	.0019
Day 5	.022	.017	.032	.024	.008
Day 6	.043	.038	.078	.053	.022
Day 8	.12	.15	.14	.14	.02
Day 11	.10	.14	.11	.12	.02
Day 12	.077	.12	.11	.10	.02

Control + P + N, pH=8.0

Day 1	.0003	.0003	.0003	.0003	.0000
Day 2	.0009	.0010	.0011	.0010	.0001
Day 4	.0043	.0059	.0051	.0051	.0008
Day 5	.0090	.017	.014	.013	.004
Day 6	.016	.037	.030	.028	.011
Day 8	.045	.17	.12	.11	.06
Day 11	.24	.47	.33	.35	.12
Day 12	.35	.54	.35	.41	.11
Day 13	.36	.76	.43	.52	.21
Day 14	.43	.78	.48	.56	.19
Day 15	.50	.65	.46	.54	.10

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

Waneta

Control + EDTA + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0002	.0002	.0003	.0002	.0001
Day 2	.0017	.0013	.0015	.0015	.0002
Day 4	.031	.022	.024	.026	.005
Day 5	.12	.078	.082	.093	.023
Day 6	.36	.29	.28	.31	.04
Day 8	1.0	1.1	1.0	1.0	.1
Day 11	1.1	1.2	1.4	1.2	.2
Day 12	1.1	1.2	1.3	1.2	.1
Day 13	1.0	1.2	1.3	1.2	.2

Control + EDTA + N, pH=8.0

Day 1	.0003	.0002	.0003	.0003	.0001
Day 2	.0015	.0016	.0014	.0015	.0001
Day 4	.032	.032	.025	.030	.004
Day 5	.14	.12	.10	.12	.02
Day 6	.36	.37	.29	.34	.04
Day 8	.44	1.1	1.1	.88	.38
Day 11	.44	1.2	1.2	.95	.44
Day 12	.44	1.1	1.2	.91	.41
Day 13	.44	1.1	1.2	.91	.41

Control + EDTA + P, pH=8.0

Day 1	.0002	.0002	.0003	.0002	.0001
Day 2	.0015	.0019	.0018	.0017	.0002
Day 4	.019	.021	.023	.021	.002
Day 5	.063	.068	.077	.069	.007
Day 6	.11	.12	.12	.12	.01
Day 8	.12	.12	.12	.12	.00
Day 11	.12	.12	.12	.12	.00
Day 12	.12	.11	.10	.11	.01
Day 13	.12	.11	.11	.11	.01

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

Waneta

Control + EDTA + P + N, pH=7.0

	Replicates			Mean	S. D.
Day 1	.0002	.0003	.0003	.0003	.0001
Day 2	.0015	.0011	.0013	.0013	.0002
Day 4	.019	.017	.018	.018	.001
Day 5	.058	.059	.062	.060	.002
Day 6	.18	.18	.20	.19	.01
Day 8	.94	.87	.93	.91	.04
Day 11	1.3	1.3	1.1	1.2	.1
Day 12	1.3	1.4	1.1	1.3	.2
Day 13	1.3	1.4	1.1	1.3	.2

TED-40ug Zn/L

Control, pH=8.0

Day 1	.0000	.0001	.0000	.0000	.0000
Day 2	.0005	.0005	.0004	.0005	.0001
Day 4	.0020	.0017	.0015	.0017	.0002
Day 5	.0035	.0021	.0019	.0025	.0009
Day 6	.0054	.0029	.0026	.0036	.0015
Day 8	.012	.0060	.0046	.0075	.0039
Day 11	.025	.012	.0090	.015	.008
Day 12	.022	.015	.011	.016	.006
Day 13	.027	.016	.012	.018	.008
Day 14	.028	.017	.013	.019	.008
Day 15	.026	.018	.014	.019	.006
Day 16	.026	.022	.014	.021	.006
Day 17	.022	.020	.014	.019	.004

Control + EDTA, pH=8.0

Day 1	.0001	.0001	.0001	.0001	.0000
Day 2	.0008	.0011	.0010	.0010	.0002
Day 4	.013	.012	.015	.013	.002
Day 5	.038	.036	.040	.038	.002
Day 6	.088	.082	.087	.086	.003
Day 8	.19	.15	.15	.16	.02
Day 11	.16	.15	.14	.15	.01
Day 12	.15	.15	.14	.15	.01
Day 13	.14	.15	.14	.14	.01

Daily Relative Fluorometer Readings
August 19 - September 5, 1982, Continued

TED-40ug Zn/L

Control + EDTA + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0001	.0000	.0000	.0000	.0000
Day 2	.0009	.0009	.0009	.0009	.0000
Day 4	.015	.014	.014	.014	.001
Day 5	.043	.039	.043	.042	.002
Day 6	.13	.12	.13	.13	.01
Day 8	.72	.64	.70	.69	.04
Day 11	1.2	1.3	1.2	1.2	.1
Day 12	1.2	1.3	1.3	1.3	.1
Day 13	1.2	1.3	1.2	1.2	.1

FIGURE 9

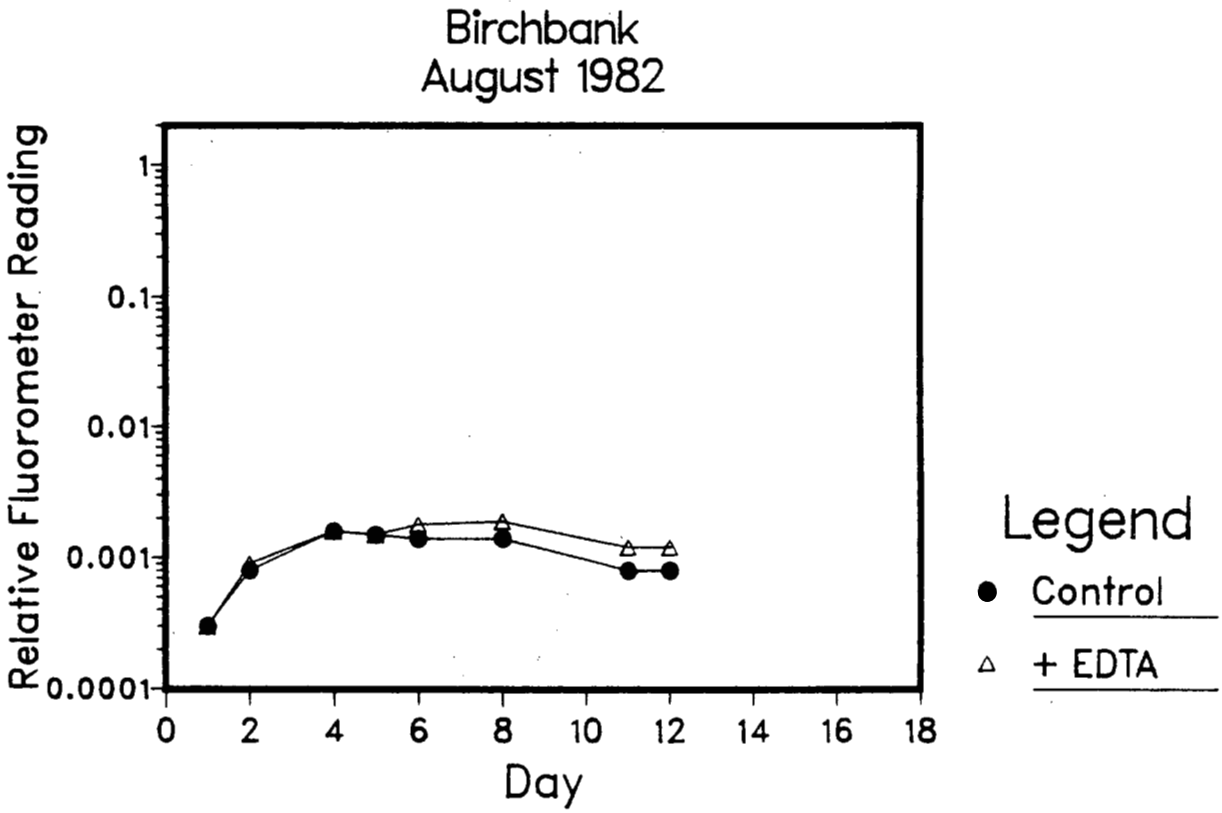
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

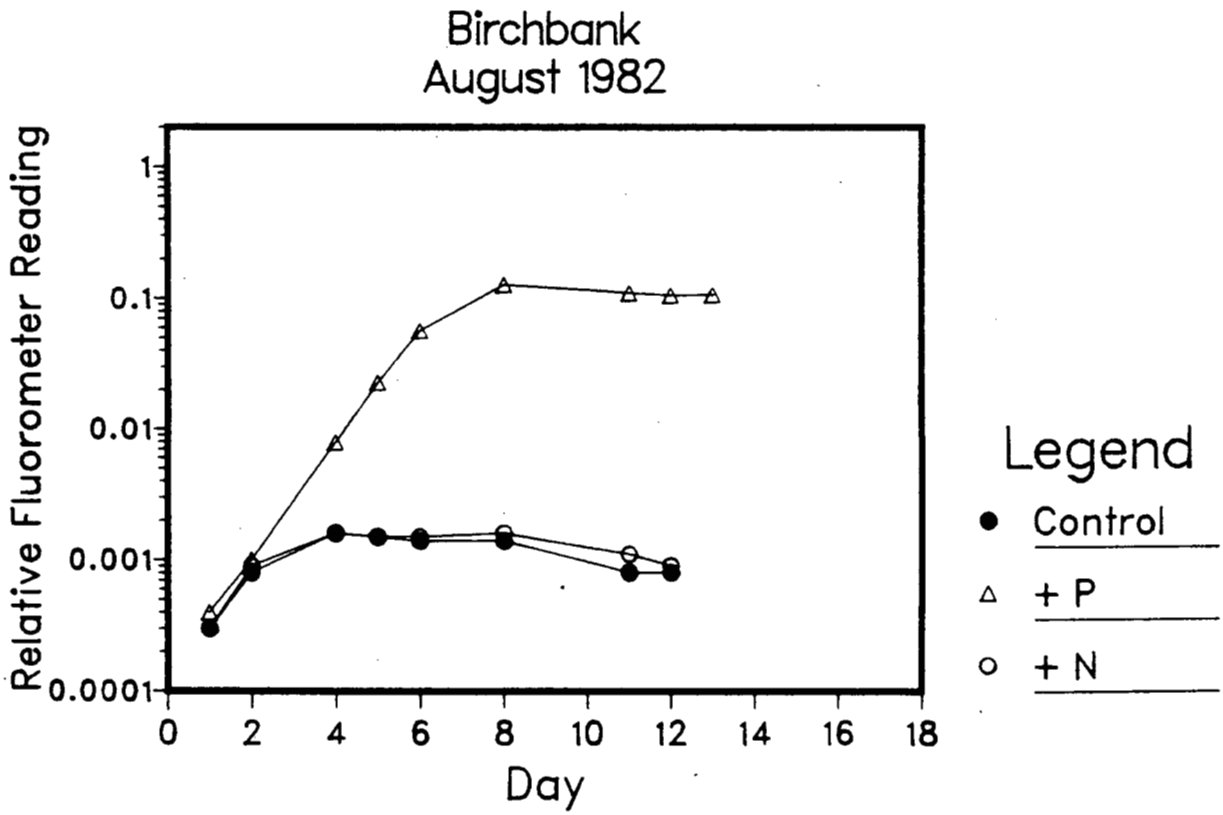
(MEASURED IN RELATIVE FLUOROMETER UNITS)

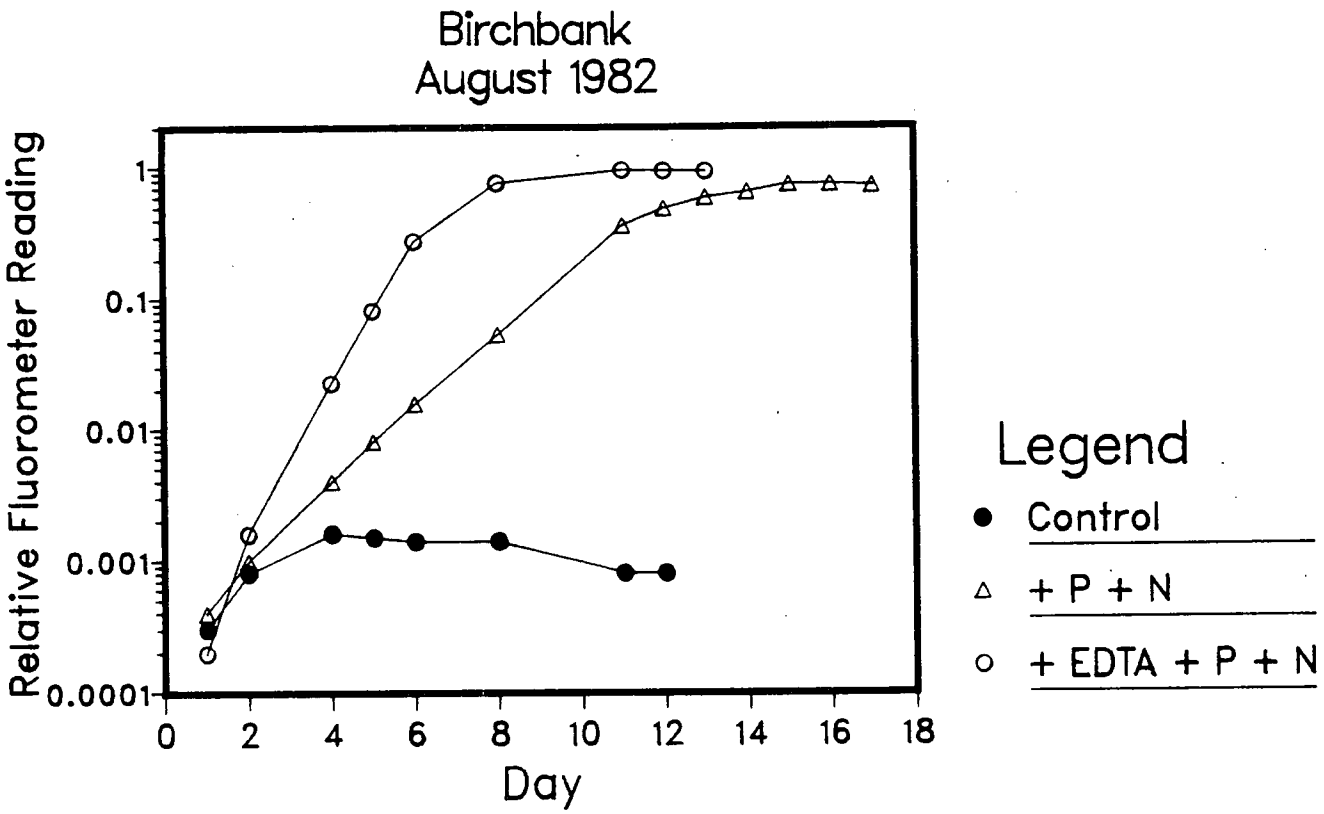
FOR THE AUGUST 1982 ALGAL ASSAY.

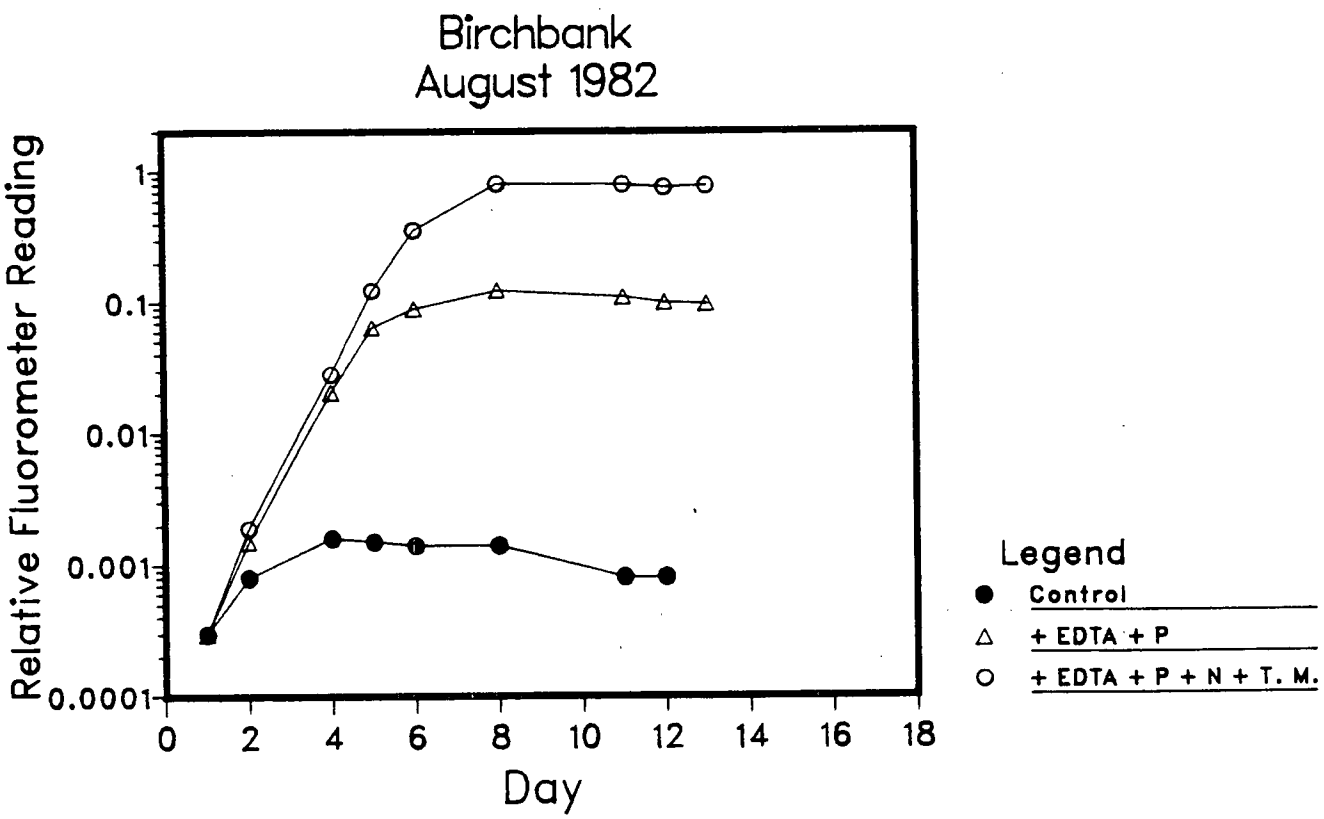
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

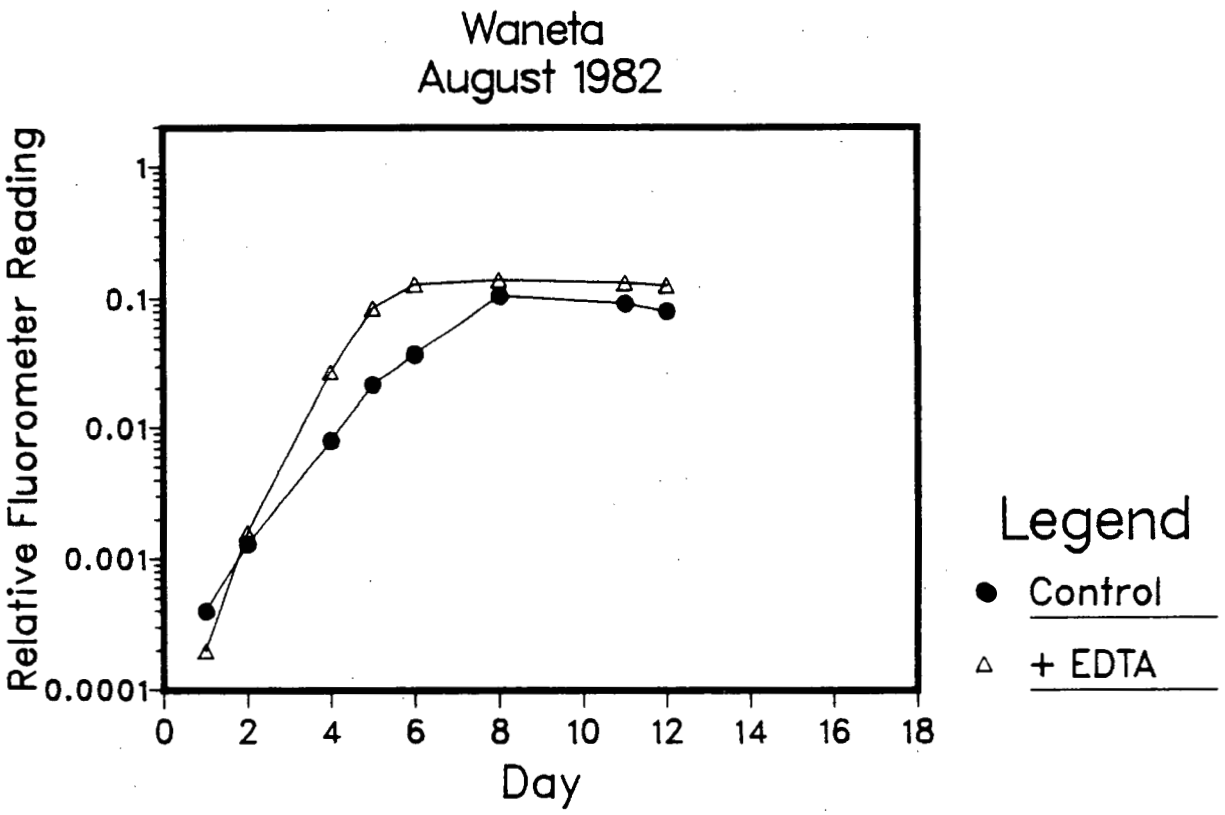
The readings used for these graphs are presented in Table 36

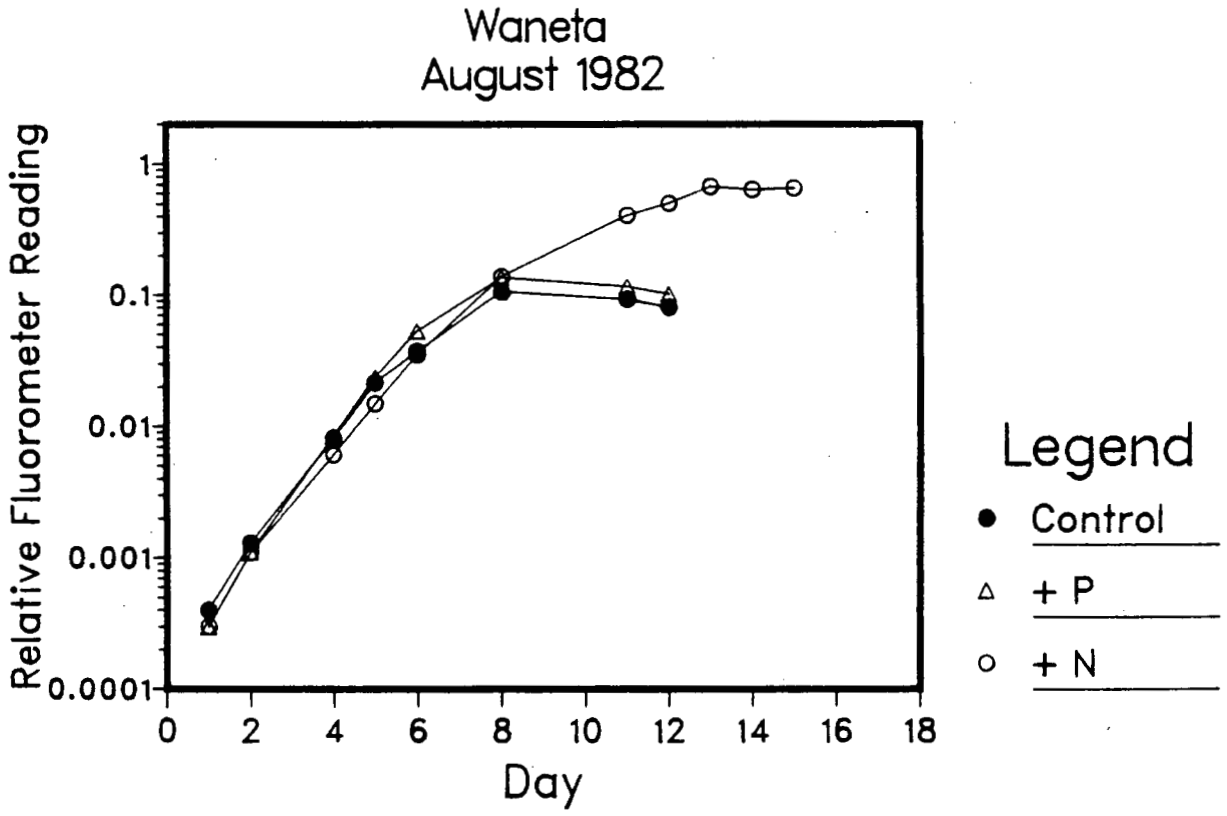

Birchbank
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ EDTA

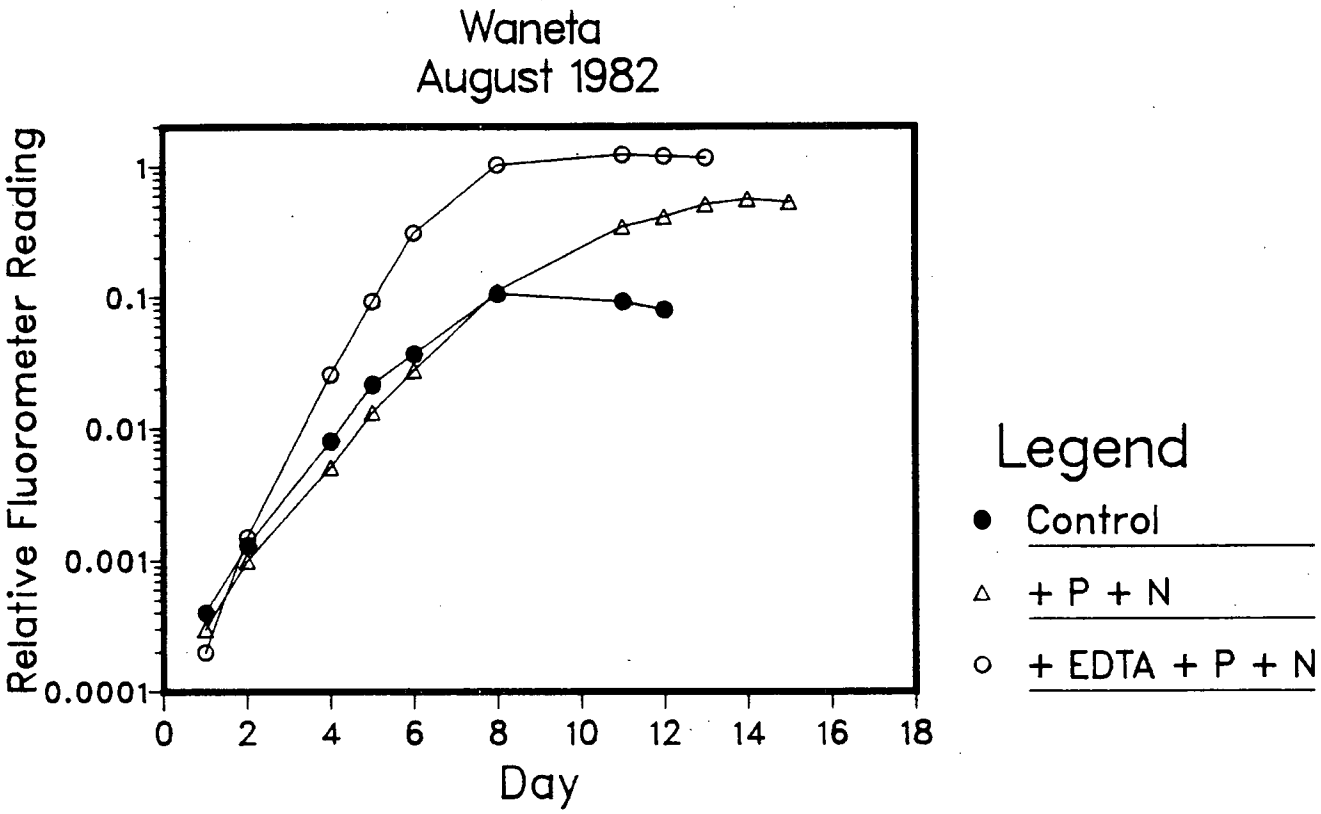

Birchbank
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ P
+ N

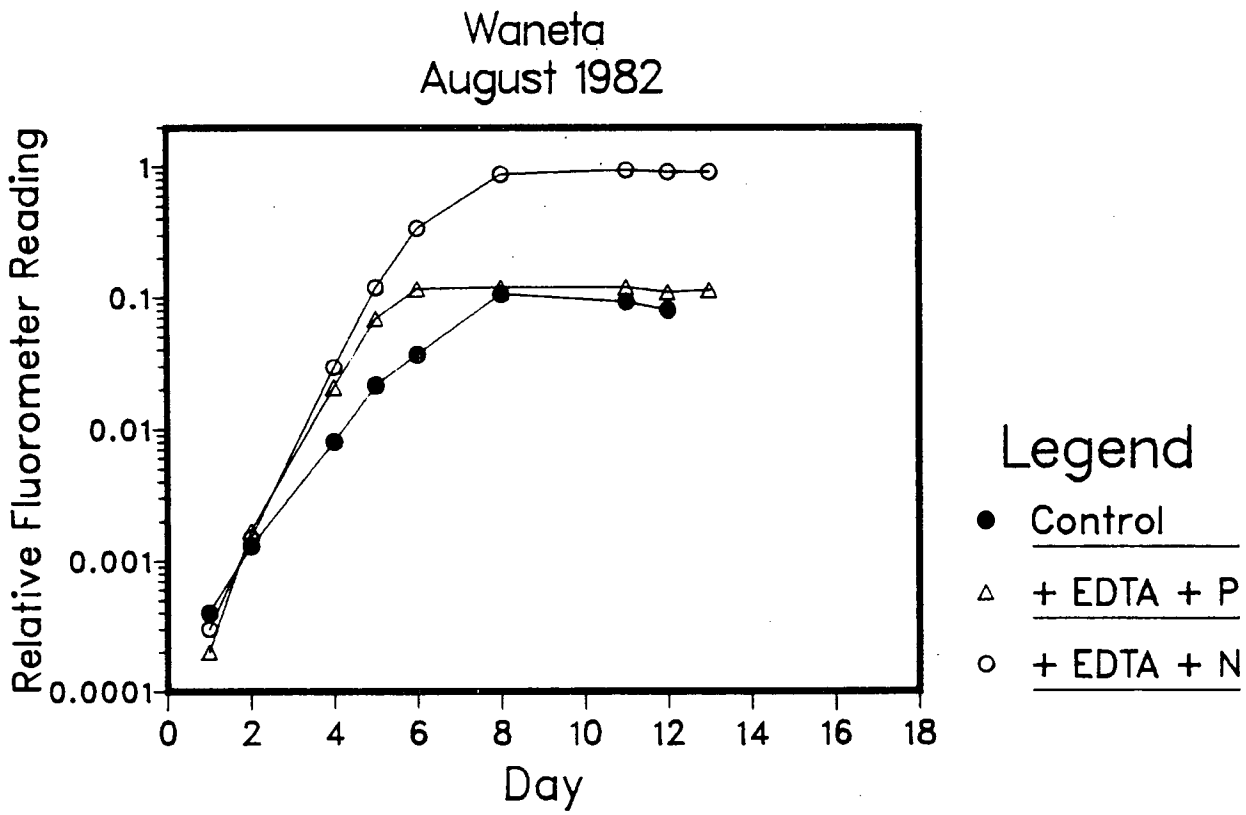

Birchbank
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ P + N
+ EDTA + P + N

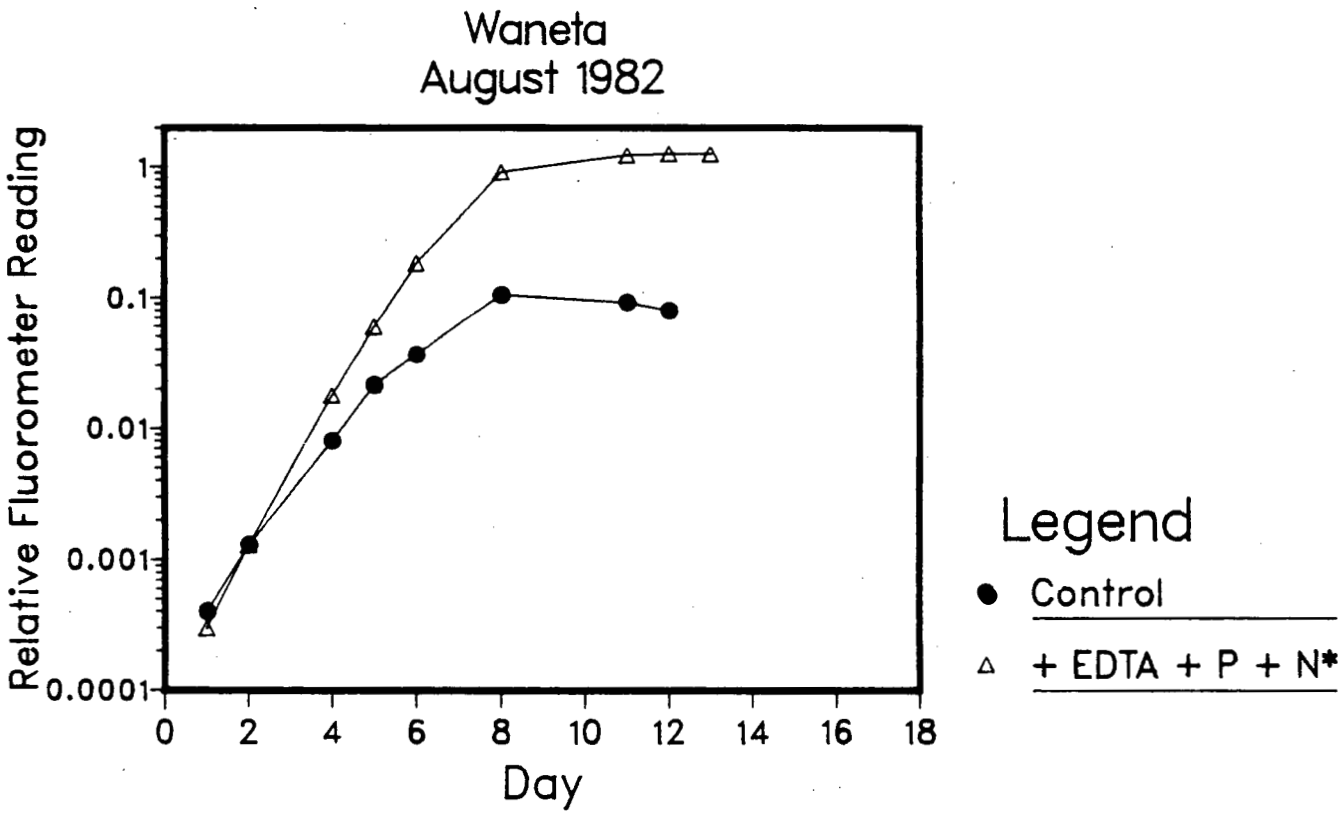

Birchbank
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ EDTA + P
+ EDTA + P + N + T. M.

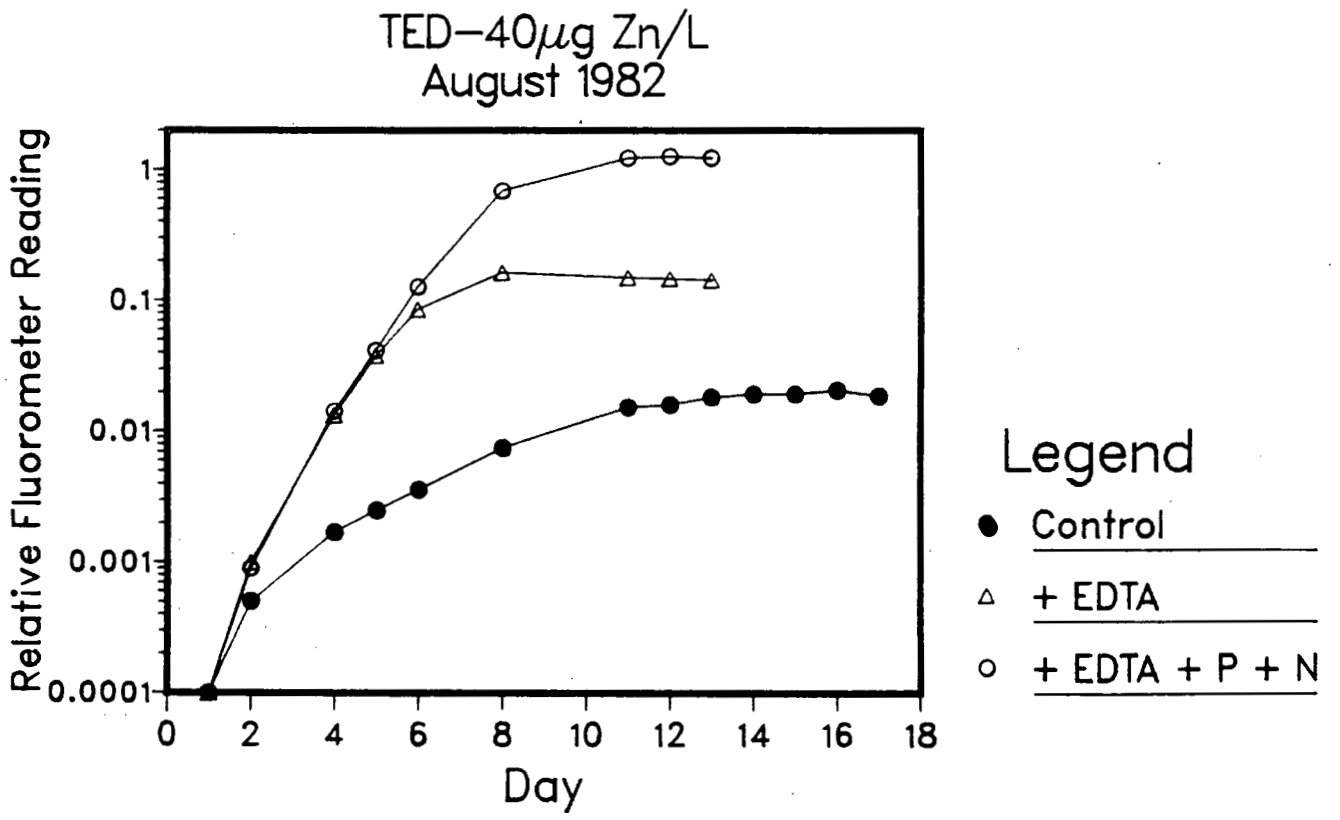

Waneta
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ EDTA


Waneta
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ P
+ N


Waneta
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ P + N
+ EDTA + P + N


Waneta
August 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
18
Day
Legend
Control
+ EDTA + P
+ EDTA + N





* conducted at pH 7 ; all others were conducted at pH 8.

TABLE 37

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT FOR THE AUGUST 1982 ASSAY.

THE YIELDS ARE EXPRESSED AS CELLS/ML AND MG DRY WT/L.

MEAN CELL VOLUME IS EXPRESSED AS UM^3/CELL.

THE YIELDS WERE DETERMINED WITH THE COULTER COUNTER.

August 19 - September 5, 1982 Algal Assay

Birchbank

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
6132			54	.12		
5865	5977	139	53	.11	.12	.00
5934			55	.12		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
5394			54	.11		
5145	6308	1803	57	.11	.13	.04
8385			56	.17		

Control + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
6006			60	.13		
5136	5467	471	59	.11	.12	.01
5259			57	.11		

Control + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
374010			38	5.13		
372288	345436	48008	39	5.24	4.96	.40
290010			43	4.50		

Control + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2597322			47	44.07		
1980654	2242892	318503	49	35.04	39.31	4.54
2150700			50	38.82		

August 19 - September 5, 1982 Algal Assay, Continued

Birchbank

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2293812			47	38.92		
2202156	2281484	73939	48	38.16	38.69	.46
2348484			46	39.00		

Control + EDTA + P + N + Trace Metals, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2145876			53	41.06		
2089596	2023668	165343	47	35.45	36.77	3.81
1835532			51	33.79		

Control + EDTA + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
340218			43	5.28		
357602	369820	37246	43	5.55	5.59	.33
411640			40	5.94		

Waneta

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
384216			44	6.10		
350028	359730	21357	43	5.43	5.63	.41
344946			43	5.35		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
397572			40	5.74		
420462	397782	22576	38	5.77	5.60	.27
375312			39	5.28		

August 19 - September 5, 1982 Algal Assay, Continued

Waneta

Control + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
1060128			49	18.75		
1157976	1243026	237151	48	20.07	21.48	3.65
1510974			47	25.64		

Control + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
353666			44	5.62		
422956	395267	36680	42	6.41	6.13	.44
409180			43	6.35		

Control + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
1020924			51	18.80		
1397088	1146366	217132	44	22.19	20.05	1.86
1021086			52	19.17		

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
4110048			34	50.45		
3937992	3999230	96148	35	49.76	49.56	1.00
3949650			34	48.48		

Control + EDTA + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
1785684			39	25.14		
3764328	3062570	1107627	34	46.20	37.79	11.15
3637698			32	42.02		

August 19 - September 5, 1982 Algal Assay, Continued

Waneta

Control + EDTA + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
360308			40	5.20		
346532	354185	7014	42	5.25	5.20	.06
355716			40	5.14		

Control + EDTA + P + N, pH=7.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
3726540			32	43.05		
3857592	3759638	86304	33	45.96	46.12	3.15
3694782			37	49.35		

TED-40ug Zn/L

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
30776			90	1.00		
22212	23033	7366	86	.69	.73	.25
16112			86	.50		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
449524			42	6.82		
424268	436459	12651	40	6.13	6.62	.43
435584			44	6.92		

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
3804528			35	48.07		
3685938	3682990	123038	34	45.24	46.09	1.72
3558504			35	44.96		

TABLE 38

CONCENTRATIONS OF CHEMICALS IN THE COLUMBIA RIVER ON SEPTEMBER 28, 1982. CONCENTRATIONS OF ALL CHEMICALS EXCEPT HG ARE REPORTED IN mg/L; HG IS IN μg/L. PARAMETERS ARE LISTED UNDER THEIR NAQUADAT CODE NUMBERS AS SUMMARIZED IN TABLE 3

*denotes that the statistics are based on some L (less than detection limit) values.

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-09-28

STATION NO.: 00BC08NE0005
COLUMBIA RIVER AT BIRCHBANK NEAR TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	L.002	L.002	L.002	L.002	.000	L.002	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	L.002	L.002	L.002	L.002	.000	L.002	1.0000
15406	PHOSPHORUS TOTAL	.005	.005	.004	.005	.001	.005	1.1375
07110	NITROGEN DISSOLVED NO3 & NO2	.065	.065	.065	.065	.000	.065	1.0000
07557	NITROGEN DISSOLVED AMMONIA	L.002	L.002	L.002	L.002	.000	L.002	1.0000
07655	NITROGEN TOTAL DISSOLVED	.092	.103	.096	.097	.006	.097	1.0587
07903	NITROGEN PARTICULATE	.014	.007	.009	.010	.004	.010	1.4204
30105	ZINC DISSOLVED	.012	.008	.002	.007	.005	.006	2.5589
30305	ZINC EXTRBLE.	.006	L.001	L.001	*.003	.003	*.002	2.8136
29105	COPPER DISSOLVED	.009	.002	.003	.005	.004	.004	2.1776
29305	COPPER EXTRBLE.	L.001	.001	.002	*.001	.001	*.001	1.4921
26105	IRON DISSOLVED	.005	.003	.007	.005	.002	.005	1.5321
26305	IRON EXTRBLE.	.022	.016	.045	.028	.015	.025	1.6982
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	.001	L.001	L.001	*.001	.000	*.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	.10	*.07	.03	*.06	1.4921
33304	ARSENIC EXTRBLE.	L.0001	.0001	L.0001	*.0001	.0000	*.0001	1.0000
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
24053	CHROMIUM DISSOLVED	.001	L.001	.002	*.001	.001	*.001	1.4921
24303	CHROMIUM EXTRBLE.	.002	.002	.005	.003	.002	.003	1.6973
02011	COLOUR APPARENT	L5.	L5.	L5.	L5.	0.	L5.	1.0000
02041	SPECIFIC CONDUCT.	107.5	108.7	108.7	108.3	.7	108.3	1.0064
02061	TEMP. WATER ,FIELD	14.0			14.0		14.0	
02061	TEMP. WATER ,LAB	21.8	21.7	21.7	21.7	.1	21.7	1.0027
02073	TURBIDITY	.60	.80	.70	.70	.10	.70	1.1548
06001	CARBON TOTAL ORGANIC	2.9	2.9	3.1	3.0	.1	3.0	1.0393
06051	CARBON TOTAL INORGANIC	11.0	11.0	11.0	11.0	.0	11.0	1.0000
06101	CARBON DISSOLVED ORGANIC	2.0	2.0	2.7	2.2	.4	2.2	1.1892
06151	CARBON DISSOLVED INORGANIC	11.0	12.0	11.0	11.3	.6	11.3	1.0515
06903	CARBON PARTICULATE	.085	.092	.106	.094	.011	.094	1.1184
09106	FLUORIDE DISSOLVED	.060	.054	.050	.055	.005	.055	1.0958
10101	ALKALINITY TOTAL	45.9	45.6	45.7	45.7	.2	45.7	1.0033
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	7.9	7.9	7.7	7.8	.1	7.8	1.0112
10603	HARDNESS TOTAL	53.8	54.0	53.6	53.8	.2	53.8	1.0037
11103	SODIUM DISSOLVED	.9	1.1	1.1	1.0	.1	1.0	1.1228
14105	SILICA REACTIVE	3.1	3.1	3.1	3.1	.0	3.1	1.0000
16306	SULPHATE DISSOLVED	7.3	7.2	7.3	7.3	.1	7.3	1.0080
17206	CHLORIDE DISSOLVED	.5	.5	.6	.5	.1	.5	1.1110
19103	POTASSIUM DISSOLVED	.5	.5	.4	.5	.1	.5	1.1375
20101	CALCIUM DISSOLVED	16.0	15.9	15.9	15.9	.1	15.9	1.0036

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-09-28

STATION NO.: 00BC08NE0001
COLUMBIA RIVER BELOW TRAIL, 2 MILES NORTH OF WANETA POWER DAM

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.011	.011	.011	.011	.000	.011	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.013	.013	.013	.013	.000	.013	1.0000
15406	PHOSPHORUS TOTAL	.018	.018	.018	.018	.000	.018	1.0000
07110	NITROGEN DISSOLVED NO3 & NO2	.070	.064	.072	.069	.004	.069	1.0634
07557	NITROGEN DISSOLVED AMMONIA	.016	.016	.019	.017	.002	.017	1.1043
07655	NITROGEN TOTAL DISSOLVED	.110	.104	.105	.106	.003	.106	1.0305
07903	NITROGEN PARTICULATE	.006	.010	.008	.008	.002	.008	1.2919
30105	ZINC DISSOLVED	.004	.002	.003	.003	.001	.003	1.4166
30305	ZINC EXTRBLE.	.005	.005	.005	.005	.000	.005	1.0000
29105	COPPER DISSOLVED	.009	.005	.008	.007	.002	.007	1.3648
29305	COPPER EXTRBLE.	.006	.008	.009	.008	.002	.008	1.2319
26105	IRON DISSOLVED	.007	.004	.007	.006	.002	.006	1.3814
26305	IRON EXTRBLE.	.023	.026	.025	.025	.002	.025	1.0646
25104	MANGANESE DISSOLVED	L.01	L.01	L.01	L.01	.00	L.01	1.0000
25304	MANGANESE EXTRBLE.	L.01	L.01	L.01	L.01	.00	L.01	1.0000
48102	CADMIUM DISSOLVED	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
48302	CADMIUM EXTRBLE.	L.0005	L.0005	L.0005	L.0005	.0000	L.0005	1.0000
82103	LEAD DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
82302	LEAD EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28102	NICKEL DISSOLVED	L.001	L.001	L.001	L.001	.000	L.001	1.0000
28302	NICKEL EXTRBLE.	L.001	L.001	L.001	L.001	.000	L.001	1.0000
80311	MERCURY EXTRBLE.	L.05	L.05	L.05	L.05	.00	L.05	1.0000
33304	ARSENIC EXTRBLE.	.0006	.0007	.0006	.0006	.0001	.0006	1.0931
34302	SELENIUM EXTRBLE.	L.0001	L.0001	L.0001	L.0001	.0000	L.0001	1.0000
24053	CHROMIUM DISSOLVED	.001	L.001	L.001	*.001	.000	*.001	1.0000
24303	CHROMIUM EXTRBLE.	.004	.002	.002	.003	.001	.003	1.4921
02011	COLOUR APPARENT	L5.	L5.		L5.	0.	L5.	1.0000
02041	SPECIFIC CONDUCT.	108.5	110.0		109.3	1.1	109.2	1.0098
02061	TEMP. WATER ,FIELD	14.0			14.0		14.0	
02061	TEMP. WATER ,LAB	21.8	22.1		22.0	.2	21.9	1.0097
02073	TURBIDITY	.50	.90		.70	.28	.67	1.5153
06001	CARBON TOTAL ORGANIC	2.9	3.1	3.1	3.0	.1	3.0	1.0393
06051	CARBON TOTAL INORGANIC	11.0	11.0	11.0	11.0	.0	11.0	1.0000
06101	CARBON DISSOLVED ORGANIC	2.2	2.1	1.7	2.0	.3	2.0	1.1473
06151	CARBON DISSOLVED INORGANIC	11.0	12.0	12.0	11.7	.6	11.7	1.0515
06903	CARBON PARTICULATE	.081	.112	.100	.098	.016	.097	1.1787
09106	FLUORIDE DISSOLVED	.064	.065		.065	.001	.064	1.0110
10101	ALKALINITY TOTAL	45.5	45.8		45.7	.2	45.6	1.0047
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0		.0	.0		
10301	PH	7.8	7.8		7.8	.0	7.8	1.0018
10603	HARDNESS TOTAL	54.4	54.8		54.6	.3	54.6	1.0052
11103	SODIUM DISSOLVED	1.0	1.0		1.0	.0	1.0	1.0000
14105	SILICA REACTIVE	3.1	3.1		3.1	.0	3.1	1.0000
16306	SULPHATE DISSOLVED	7.7	7.5		7.6	.1	7.6	1.0188
17206	CHLORIDE DISSOLVED	.4	.4		.4	.0	.4	1.0000
19103	POTASSIUM DISSOLVED	.4	.4		.4	.0	.4	1.0000
20101	CALCIUM DISSOLVED	16.0	15.9		16.0	.1	15.9	1.0044

COLUMBIA RIVER BIOASSAY DATA

DATE: 82-09-28

STATION NO.: 20BC08NE0001
COMINCO SEWER #8, TRAIL

		REPLICATES			MEAN	S. D.	GEOM MEAN	G.F.
15256	PHOSPHORUS DISSOLVED ORTHO PO4	.011	.011	.011	.011	.000	.011	1.0000
15102	PHOSPHORUS TOTAL DISSOLVED	.013	.017	.012	.014	.003	.014	1.2001
15406	PHOSPHORUS TOTAL	.030	.032	.031	.031	.001	.031	1.0328
07110	NITROGEN DISSOLVED NO3 & NO2	.073	.106	.086	.088	.017	.087	1.2056
07557	NITROGEN DISSOLVED AMMONIA	10.500	12.600	14.100	12.400	1.808	12.310	1.1604
07655	NITROGEN TOTAL DISSOLVED	10.750	12.650	14.190	12.530	1.723	12.450	1.1497
07903	NITROGEN PARTICULATE	.009	.013	.008	.010	.003	.010	1.2882
30104	ZINC DISSOLVED	.60	.59	.59	.59	.01	.59	1.0098
30304	ZINC EXTRBL.	.73	.94	.81	.83	.11	.82	1.1355
29106	COPPER DISSOLVED	.07	.07	.07	.07	.00	.07	1.0000
29306	COPPER EXTRBLE.	.08	.06	.03	.06	.03	.05	1.6556
26104	IRON DISSOLVED	.47	.45	.45	.46	.01	.46	1.0254
26304	IRON EXTRBLE.	.58	.58	.58	.58	.00	.58	1.0000
25104	MANGANESE DISSOLVED	.01	.01	.01	.01	.00	.01	1.0000
25304	MANGANESE EXTRBLE.	.05	.05	.05	.05	.00	.05	1.0000
48102	CADMIUM DISSOLVED	.0290	.0300	.0300	.0297	.0006	.0297	1.0198
48302	CADMIUM EXTRBLE.	.0290	.0450	.0390	.0377	.0081	.0371	1.2512
82103	LEAD DISSOLVED	.050	.053	.053	.052	.002	.052	1.0342
82301	LEAD EXTRBLE.	.11	.11	.12	.11	.01	.11	1.0515
28102	NICKEL DISSOLVED	.003	.002	.002	.002	.001	.002	1.2638
28302	NICKEL EXTRBLE.	.002	.003	.003	.003	.001	.003	1.2638
80311	MERCURY EXTRBLE.	2.00	3.00	1.80	2.27	.64	2.21	1.3096
33304	ARSENIC EXTRBLE.	.0010	.0016	.0013	.0013	.0003	.0013	1.2656
34302	SELENIUM EXTRBLE.	.0003	.0005	.0005	.0004	.0001	.0004	1.3430
24052	CHROMIUM DISSOLVED	.01	L.01	.01	*.01	.00	*.01	1.0000
24302	CHROMIUM EXTRBLE.	.01	.01	.01	.01	.00	.01	1.0000
02011	COLOUR APPARENT	8.	8.	5.	7.	2.	7.	1.3117
02041	SPECIFIC CONDUCT.	280.9	318.1	306.4	301.8	19.0	301.4	1.0659
02061	TEMP. WATER ,LAB	21.6	21.8	21.8	21.7	.1	21.7	1.0053
02073	TURBIDITY	2.00	2.60	1.75	2.12	.44	2.09	1.2231
06001	CARBON TOTAL ORGANIC	2.1	2.2	1.9	2.1	.2	2.1	1.0778
06051	CARBON TOTAL INORGANIC	7.5	7.7	7.7	7.6	.1	7.6	1.0153
06101	CARBON DISSOLVED ORGANIC	1.6	.6	1.1	1.1	.5	1.0	1.6404
06151	CARBON DISSOLVED INORGANIC	6.9	5.6	6.6	6.4	.7	6.3	1.1162
06903	CARBON PARTICULATE	.132	.173	.119	.141	.028	.140	1.2131
09106	FLUORIDE DISSOLVED	5.860	9.880	8.840	8.193	2.087	7.999	1.3167
10101	ALKALINITY TOTAL	14.7	12.8	15.7	14.4	1.5	14.3	1.1099
10151	ALKALINITY PHENOL PHTHALEIN	.0	.0	.0	.0	.0		
10301	PH	6.8	6.7	6.9	6.8	.1	6.8	1.0188
10603	HARDNESS TOTAL	58.0	57.2	59.0	58.1	.9	58.1	1.0156
11103	SODIUM DISSOLVED	1.6	1.9	1.9	1.8	.2	1.8	1.1043
12101	MAGNESIUM DISSOLVED (CALCD.)	4.2	4.0	4.4	4.2	.2	4.2	1.0465
14105	SILICA REACTIVE	3.1	3.2	3.2	3.2	.1	3.2	1.0185
16306	SULPHATE DISSOLVED	75.5	84.0	81.5	80.3	4.4	80.3	1.0565
17206	CHLORIDE DISSOLVED	1.8	1.8	1.8	1.8	.0	1.8	1.0000
19103	POTASSIUM DISSOLVED	19.5	30.5	29.0	26.3	6.0	25.8	1.2776
20101	CALCIUM DISSOLVED	16.3	16.3	16.4	16.3	.1	16.3	1.0035

TABLE 39

Concentrations (mg/L) of nutrients and dissolved metals in water used for the September 1982 algal assay. Water from each site was autoclaved, aerated with CO_2, filtered, and pH adjusted before these measurements were made.

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Birchbank							
Orthophosphate	0.002	0.002	0.002	0.002	0.0	0.002	1.0000
Total Dissolved Phosphorus	0.004	0.004	0.005	0.004	0.001	0.004	1.1377
Nitrate plus Nitrite	0.058	0.066	0.069	0.064	0.006	0.064	1.0944
Ammonia	0.004	0.006	0.006	0.005	0.001	0.005	1.2637
Total Dissolved Nitrogen	0.115	0.117	0.120	0.117	0.002	0.117	1.0216
Dissolved Zn	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
Dissolved Cu	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Fe	0.003	0.030	0.004	0.012	0.015	0.007	3.5065
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Ni	L0.001	L0.001	0.001	L0.001	0.0	L0.001	1.0000
Waneta							
Orthophosphate	0.014	0.014	0.014	0.014	0.0	0.014	1.0000
Total Dissolved Phosphorus	0.017	0.017	0.017	0.017	0.0	0.017	1.0000
Nitrate plus Nitrite	0.078	0.079	0.079	0.079	0.001	0.079	1.0070
Ammonia	0.016	0.019	0.018	0.018	0.002	0.018	1.0918
Total Dissolved Nitrogen	0.145	0.141	0.139	0.142	0.003	0.142	1.0217
Dissolved Zn	0.005	0.005	0.005	0.005	0.0	0.005	1.0000
Dissolved Zn (filtered only)	0.006	0.004	0.004	0.005	0.001	0.005	1.2639
Dissolved Cu	0.005	0.003	0.004	0.004	0.001	0.004	1.2918
Dissolved Fe	0.026	0.003	0.004	0.011	0.013	0.007	3.2303
Dissolved Mn	0.01	0.01	L0.01	0.01	0.0	0.01	1.0000
Dissolved Cd	L0.0005	L0.0005	L0.0005	L0.0005	0.0	L0.0005	1.0000
Dissolved Pb	0.002	L0.001	0.002	0.002	0.001	0.002	1.4922
Dissolved Ni	0.001	0.001	0.002	0.001	0.001	0.001	1.4923

TABLE 39 (Continued)

	Replicates			Mean	S.D.	Geometric Mean	Geometric S.D.(=G.F.)
Cominco Effluent							
Orthophosphate	0.010	0.010	0.010	0.010	0.0	0.010	1.0000
Total Dissolved Phosphorus	0.011	0.011	0.010	0.011	0.001	0.011	1.0565
Nitrate plus Nitrite	0.100	0.099	0.099	0.099	0.001	0.099	1.0058
Ammonia	8.22	8.22	8.51	8.32	0.17	8.32	1.0202
Total Dissolved Nitrogen	8.35	8.38	8.75	8.49	0.22	8.49	1.0264
Dissolved Zn	0.77	0.77	0.76	0.77	0.01	0.77	1.0076
Dissolved Zn (filtered only)	2.4	2.4	2.4	2.4	0.0	2.4	1.0000
Dissolved Cu	L0.001	L0.001	L0.001	L0.001	0.0	L0.001	1.0000
Dissolved Fe	0.004	0.015	0.034	0.018	0.015	0.013	2.9442
Dissolved Mn	0.04	0.04	0.04	0.04	0.0	0.04	1.0000
Dissolved Cd	0.021	0.021	0.021	0.021	0.0	0.021	1.0000
Dissolved Pb	0.013	0.013	0.013	0.013	0.0	0.013	1.0000
Dissolved Ni	0.001	0.001	0.001	0.001	0.0	0.001	1.0000
TED - 23µg Zn/L							
Orthophosphate	0.014	0.014	0.014	0.014	0.0	0.014	1.0000
Total Dissolved Phosphorus	0.016	0.016	0.016	0.016	0.0	0.016	1.0000
Nitrate plus Nitrite	0.083	0.082	0.081	0.082	0.001	0.082	1.0120
Ammonia	0.230	0.260	0.295	0.262	0.032	0.260	1.1325
Total Dissolved Nitrogen	0.318	0.352	0.380	0.350	0.031	0.349	1.0935
Dissolved Zn	0.023	0.023	0.022	0.023	0.001	0.023	1.0260
Dissolved Cu	0.008	0.006	0.006	0.007	0.001	0.007	1.1806
Dissolved Fe	0.004	0.003	0.003	0.003	0.001	0.003	1.1808
Dissolved Mn	L0.01	L0.01	L0.01	L0.01	0.0	L0.01	1.0000
Dissolved Cd	0.0010	0.0010	0.0008	0.0009	0.0007	0.0009	1.1379
Dissolved Pb	0.002	0.001	0.001	0.001	0.001	0.001	1.4923
Dissolved Ni	0.007	0.005	0.002	0.005	0.002	0.004	1.9125

TABLE 40

DAILY *IN VIVO* CHLOROPHYLL *A* READINGS

(EXPRESSED AS RELATIVE FLUOROMETER UNITS)

FOR THE SEPTEMBER 1982 ALGAL ASSAY

These readings are graphed in Figure 10

Daily Relative Fluorometer Readings
September 30 - October 26, 1982

Birchbank

Control, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0002	.0002	.0002	.0002	.0000
Day 4	.0015	.0017	.0016	.0016	.0001
Day 5	.0018	.0018	.0018	.0018	.0000
Day 6	.0022	.0020	.0021	.0021	.0001
Day 7	.0024	.0024	.0022	.0023	.0001
Day 8	.0023	.0023	.0024	.0023	.0001
Day 10	.0024	.0022	.0023	.0023	.0001
Day 12	.0020	.0019	.0018	.0019	.0001

Control + EDTA, pH=8.0

Day 1	.0003	.0002	.0002	.0002	.0001
Day 4	.0021	.0018	.0017	.0019	.0002
Day 5	.0018	.0018	.0018	.0018	.0000
Day 6	.0020	.0021	.0017	.0019	.0002
Day 7	.0022	.0024	.0021	.0022	.0002
Day 8	.0022	.0025	.0021	.0023	.0002
Day 10	.0020	.0024	.0015	.0020	.0004
Day 12	.0017	.0020	.0016	.0018	.0002

Control + N, pH=8.0

Day 1	.0001	.0002	.0001	.0001	.0001
Day 4	.0021	.0024	.0021	.0022	.0002
Day 5	.0023	.0026	.0022	.0024	.0002
Day 6	.0028	.0029	.0022	.0026	.0004
Day 7	.0027	.0028	.0024	.0026	.0002
Day 8	.0030	.0029	.0025	.0028	.0003
Day 10	.0029	.0032	.0024	.0028	.0004
Day 12	.0025	.0027	.0021	.0024	.0003

Control + P, pH=8.0

Day 1	.0000	.0000	.0001	.0000	.0000
Day 4	.0076	.0059	.0060	.0065	.0010
Day 5	.021	.018	.018	.019	.002
Day 6	.064	.047	.046	.052	.010
Day 7	.068	.071	.058	.066	.007
Day 8	.071	.075	.059	.068	.008
Day 10	.057	.070	.054	.060	.008
Day 12	.061	.060	.053	.058	.004

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

Birchbank

Control + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0001	.0001	.0001	.0001	.0000
Day 4	.0041	.0093	.010	.0078	.0032
Day 5	.012	.033	.038	.028	.014
Day 6	.032	.14	.13	.10	.06
Day 7	.082	.24	.25	.19	.09
Day 8	.16	.42	.36	.31	.14
Day 10	.32	.60	.56	.49	.15
Day 12	.56	.76	.69	.67	.10
Day 13	.59	.74	.67	.67	.08
Day 14	.61	.74	.69	.68	.07

Control + EDTA + P + N, pH=8.0

Day 1	.0001	.0001	.0001	.0001	.0000
Day 4	.010	.0093	.0093	.0095	.0004
Day 5	.036	.034	.034	.035	.001
Day 6	.13	.12	.12	.12	.01
Day 7	.25	.26	.23	.25	.02
Day 8	.40	.41	.37	.39	.02
Day 10	.67	.67	.62	.65	.03
Day 12	.89	.89	.86	.88	.02
Day 13	.92	.90	.87	.90	.03
Day 14	.92	.91	.87	.90	.03

Control + EDTA + P, pH=8.0

Day 1	.0001	.0000	.0000	.0000	.0001
Day 4	.0083	.0072	.0093	.0083	.0010
Day 5	.029	.029	.036	.031	.004
Day 6	.062	.058	.063	.061	.003
Day 7	.071	.062	.068	.067	.005
Day 8	.074	.072	.079	.075	.004
Day 10	.074	.068	.075	.072	.004
Day 12	.077	.070	.073	.073	.004
Day 13	.076	.067	.070	.071	.005

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

Birchbank

Control + EDTA + P + N + Trace Metals, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0001	.0001	.0000	.0001	.0000
Day 4	.0016	.0013	.0012	.0014	.0002
Day 5	.062	.052	.048	.054	.007
Day 6	.26	.21	.19	.22	.04
Day 7	.56	.50	.48	.51	.04
Day 8	.73	.71	.72	.72	.01
Day 10	.86	.82	.81	.83	.03
Day 12	.80	.78	.76	.78	.02

Waneta

Control, pH=8.0

Day 1	.0001	.0000	.0001	.0001	.0000
Day 4	.0034	.0060	.0072	.0055	.0019
Day 5	.0070	.016	.018	.014	.006
Day 6	.014	.034	.038	.029	.013
Day 7	.026	.072	.068	.055	.025
Day 8	.042	.11	.074	.075	.034
Day 10	.062	.092	.062	.072	.017
Day 12	.048	.080	.056	.061	.017

Control + EDTA, pH=8.0

Day 1	.0001	.0002	.0000	.0001	.0001
Day 4	.016	.016	.014	.015	.001
Day 5	.059	.066	.046	.057	.010
Day 6	.088	.13	.084	.101	.025
Day 7	.090	.14	.10	.11	.03
Day 8	.096	.15	.11	.12	.03
Day 10	.096	.16	.11	.12	.03
Day 12	.096	.16	.11	.12	.03
Day 13	.094	.15	.11	.12	.03

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

Waneta

Control + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0000	.0001	.0001	.0001	.0000
Day 4	.0031	.0040	.0064	.0045	.0017
Day 5	.0076	.010	.018	.012	.005
Day 6	.020	.020	.052	.031	.018
Day 7	.044	.040	.13	.071	.051
Day 8	.11	.072	.21	.13	.07
Day 10	.22	.20	.28	.23	.04
Day 12	.29	.32	.29	.30	.02
Day 13	.24	.33	.30	.29	.05
Day 14	.26	.36	.29	.30	.05

Control + P, pH=8.0

Day 1	.0000	.0001	.0001	.0001	.0000
Day 4	.0067	.0050	.0072	.0063	.0012
Day 5	.018	.012	.020	.017	.004
Day 6	.042	.022	.044	.036	.012
Day 7	.080	.046	.094	.073	.025
Day 8	.12	.086	.15	.12	.03
Day 10	.082	.11	.13	.11	.02
Day 12	.068	.076	.11	.085	.022

Control + P + N, pH=8.0

Day 1	.0001	.0001	.0001	.0001	.0000
Day 4	.0050	.0053	.0022	.0042	.0017
Day 5	.014	.016	.0046	.012	.006
Day 6	.038	.044	.0081	.030	.019
Day 7	.086	.13	.014	.077	.059
Day 8	.21	.31	.026	.18	.14
Day 10	.49	.65	.068	.40	.30
Day 12	.83	.93	.26	.67	.36
Day 13	.89	.96	.32	.72	.35
Day 14	.90	.93	.36	.73	.32
Day 15	.90	.92	.44	.75	.27
Day 16			.47	.47	
Day 18			.49	.49	

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

Waneta

Control + EDTA + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0001	.0001	.0001	.0001	.0000
Day 4	.018	.016	.014	.016	.002
Day 5	.064	.062	.048	.058	.009
Day 6	.20	.19	.15	.18	.03
Day 7	.42	.34	.28	.35	.07
Day 8	.64	.55	.41	.53	.12
Day 10	.86	.79	.66	.77	.10
Day 12	1.1	1.0	.89	1.0	.1
Day 13	1.1	1.0	.93	1.0	.1
Day 14	1.1	1.0	.94	1.0	.1

Control + EDTA + N, pH=8.0

Day 1	.0000	.0001	.0001	.0001	.0000
Day 4	.010	.010	.012	.011	.001
Day 5	.041	.036	.044	.040	.004
Day 6	.14	.12	.13	.13	.01
Day 7	.20	.18	.19	.19	.01
Day 8	.24	.22	.22	.23	.01
Day 10	.27	.28	.27	.27	.01
Day 12	.28	.26	.25	.26	.02
Day 13	.27	.27	.28	.27	.01

Control + EDTA + P, pH=8.0

Day 1	.0001	.0001	.0000	.0001	.0000
Day 4	.011	.010	.0085	.0098	.0013
Day 5	.036	.034	.028	.033	.004
Day 6	.068	.076	.068	.071	.005
Day 7	.074	.088	.082	.081	.007
Day 8	.081	.11	.086	.092	.016
Day 10	.082	.11	.10	.10	.01
Day 12	.074	.11	.088	.091	.018

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

TED-23ug Zn/L

Control, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0000	.0001	.0003	.0001	.0001
Day 4	.0009	.0009	.0009	.0009	.0000
Day 5	.0013	.0016	.0013	.0014	.0002
Day 6	.0018	.0019	.0019	.0019	.0001
Day 7	.0029	.0026	.0030	.0028	.0002
Day 8	.0039	.0033	.0037	.0036	.0003
Day 10	.0063	.0054	.0070	.0062	.0008
Day 12	.012	.010	.010	.011	.001
Day 13	.016	.014	.021	.017	.004
Day 14	.026	.020	.034	.027	.007
Day 15	.035	.028	.049	.037	.011
Day 16	.033	.026	.048	.036	.011

Control + EDTA, pH=8.0

Day 1	.0000	.0002	.0000	.0001	.0001
Day 4	.0094	.0094	.0094	.0094	.0000
Day 5	.032	.032	.033	.032	.001
Day 6	.093	.091	.11	.098	.010
Day 7	.18	.16	.17	.17	.01
Day 8	.24	.21	.22	.22	.02
Day 10	.25	.26	.27	.26	.01
Day 12	.25	.25	.27	.26	.01
Day 13	.25	.27	.29	.27	.02

Control + EDTA + P + N, pH=8.0

Day 1	.0002	.0000	.0000	.0001	.0001
Day 4	.0076	.0063	.0061	.0067	.0008
Day 5	.027	.020	.020	.022	.004
Day 6	.091	.068	.066	.075	.014
Day 7	.22	.18	.19	.20	.02
Day 8	.36	.31	.43	.37	.06
Day 10	.63	.59	.85	.69	.14
Day 12	.98	.96	1.1	1.01	.08
Day 13	1.1	1.1	1.2	1.1	.1
Day 14	1.1	1.2	1.2	1.2	.1

Daily Relative Fluorometer Readings
September 30 - October 26, 1982, Continued

TED-23ug Zn/L

Control + P + N, pH=8.0

	Replicates			Mean	S. D.
Day 1	.0002	.0000	.0001	.0001	.0001
Day 4	.0007	.0008	.0008	.0008	.0001
Day 5	.0013	.0012	.0011	.0012	.0001
Day 6	.0017	.0015	.0016	.0016	.0001
Day 7	.0021	.0021	.0023	.0022	.0001
Day 8	.0029	.0026	.0026	.0027	.0002
Day 10	.0045	.0040	.0034	.0040	.0006
Day 12	.0070	.0064	.0058	.0064	.0006
Day 13	.0077	.0071	.0072	.0073	.0003
Day 14	.0094	.0084	.0084	.0087	.0006
Day 15	.012	.012	.012	.012	.000
Day 16	.013	.019	.019	.017	.003
Day 18	.020	.031	.031	.027	.006
Day 19	.034	.043	.046	.041	.006
Day 20	.048	.056	.066	.057	.009
Day 21	.066	.076	.090	.077	.012
Day 23	.053	.083	.11	.082	.029
Day 24	.12	.12	.17	.14	.03
Day 25	.15	.13	.19	.16	.03
Day 26	.18	.13	.20	.17	.04
Day 27	.20	.12	.19	.17	.04

FIGURE 10

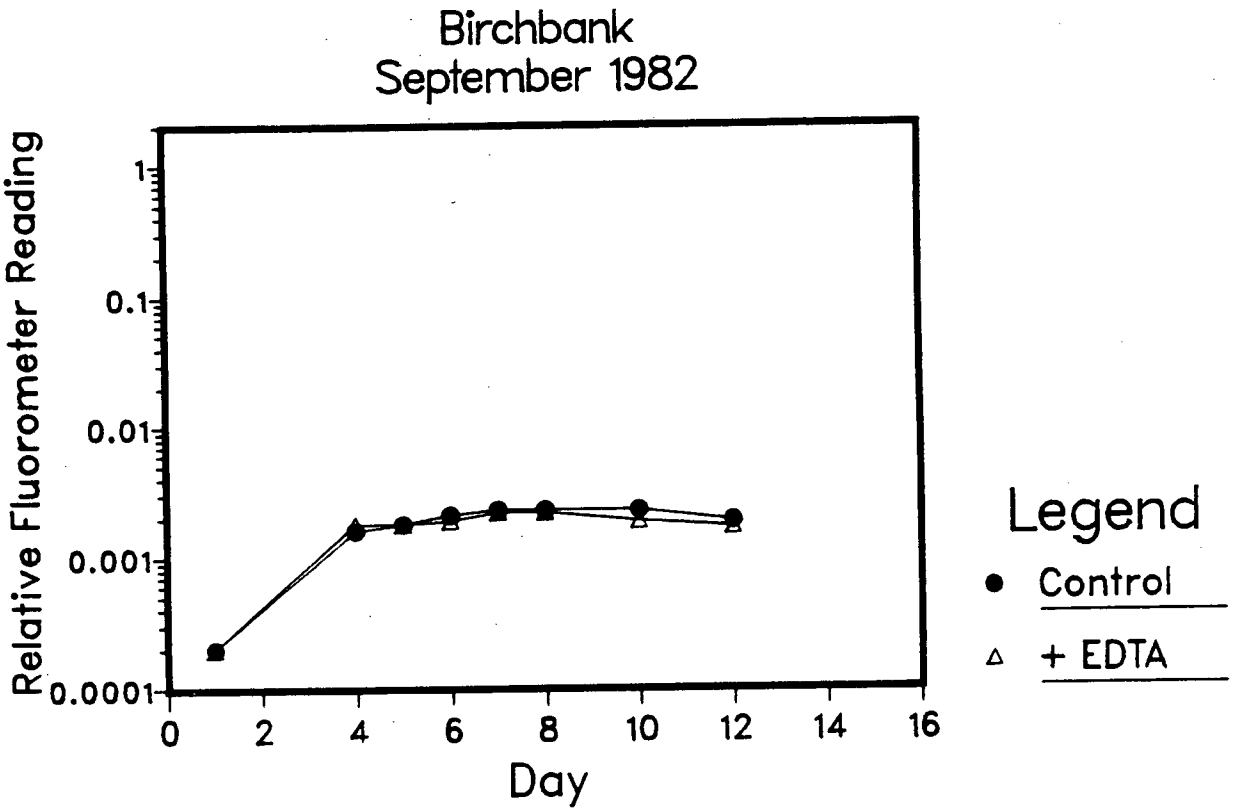
ALGAL GROWTH INDICATED BY IN VIVO CHLOROPHYLL A

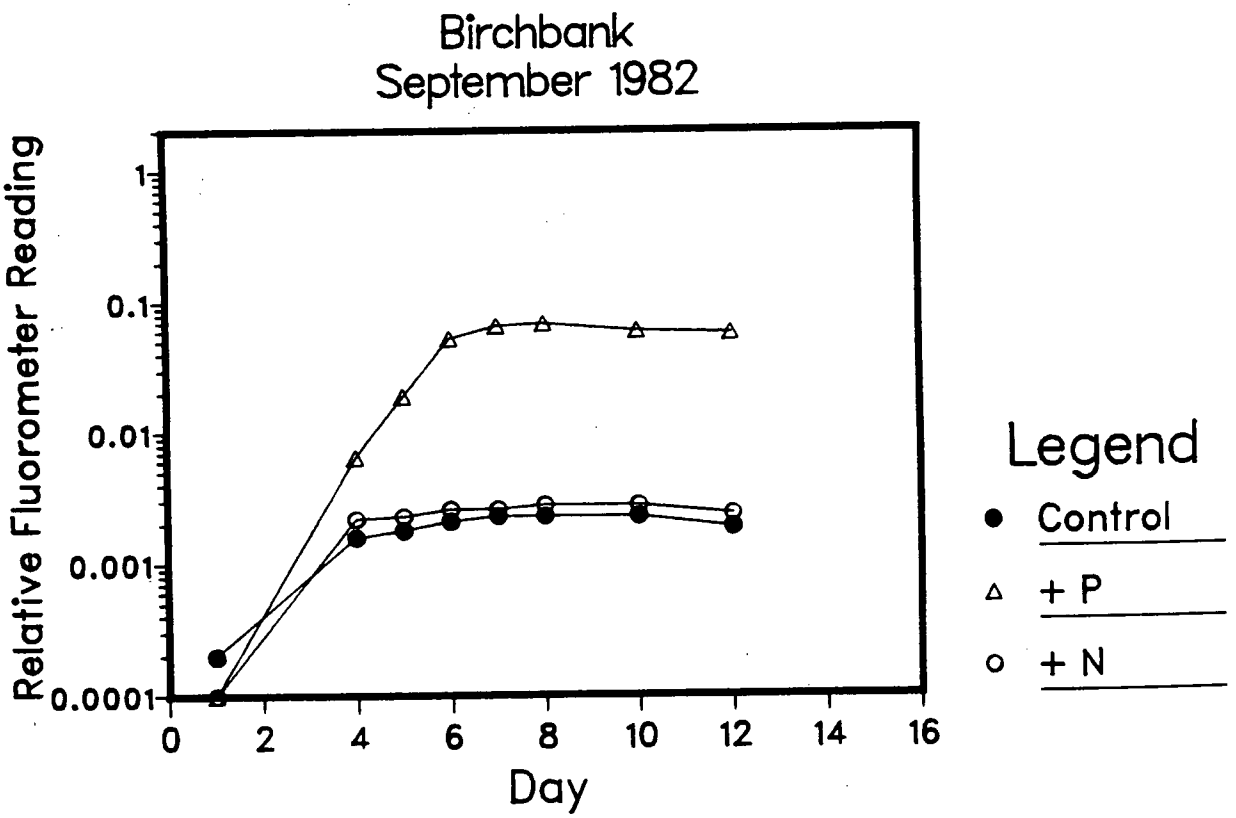
(MEASURED IN RELATIVE FLUOROMETER UNITS)

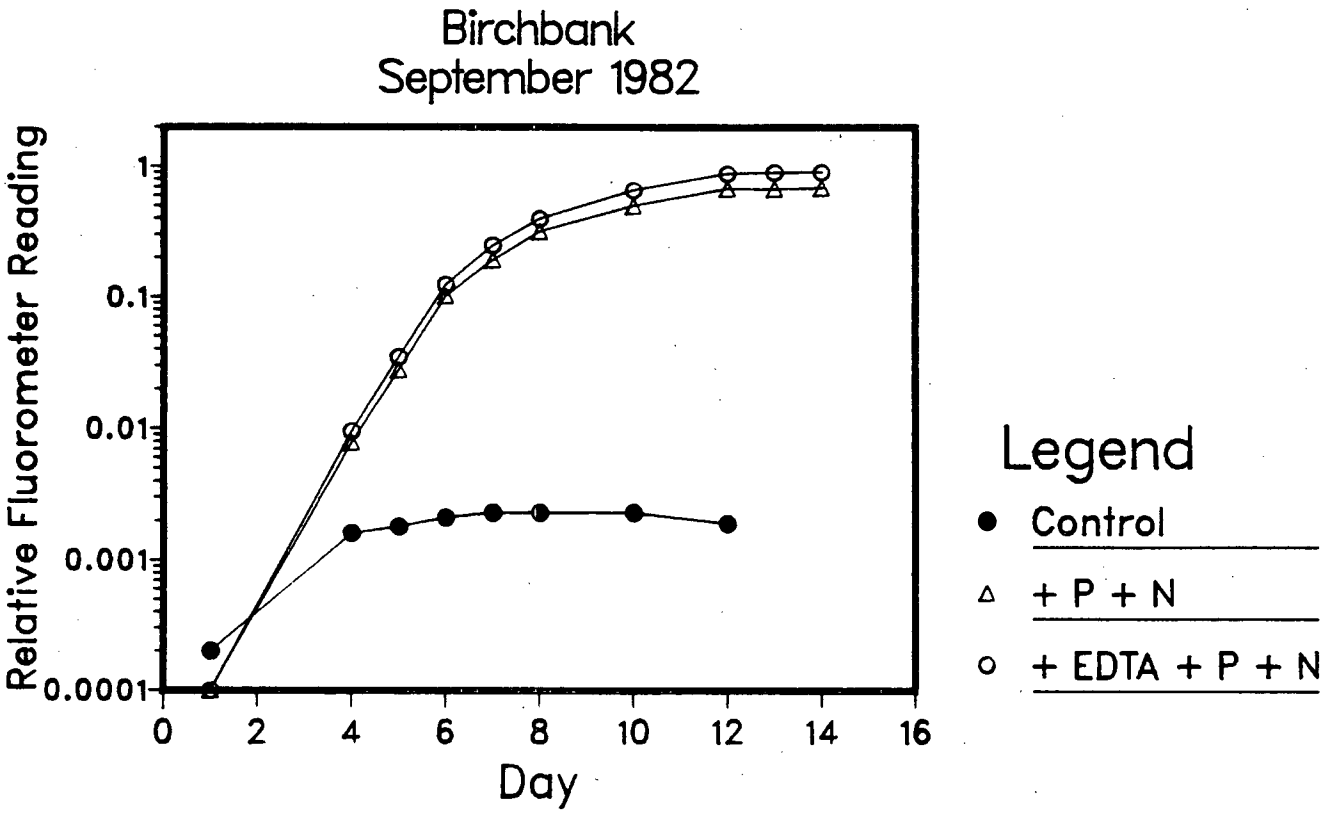
FOR THE SEPTEMBER 1982 ALGAL ASSAY.

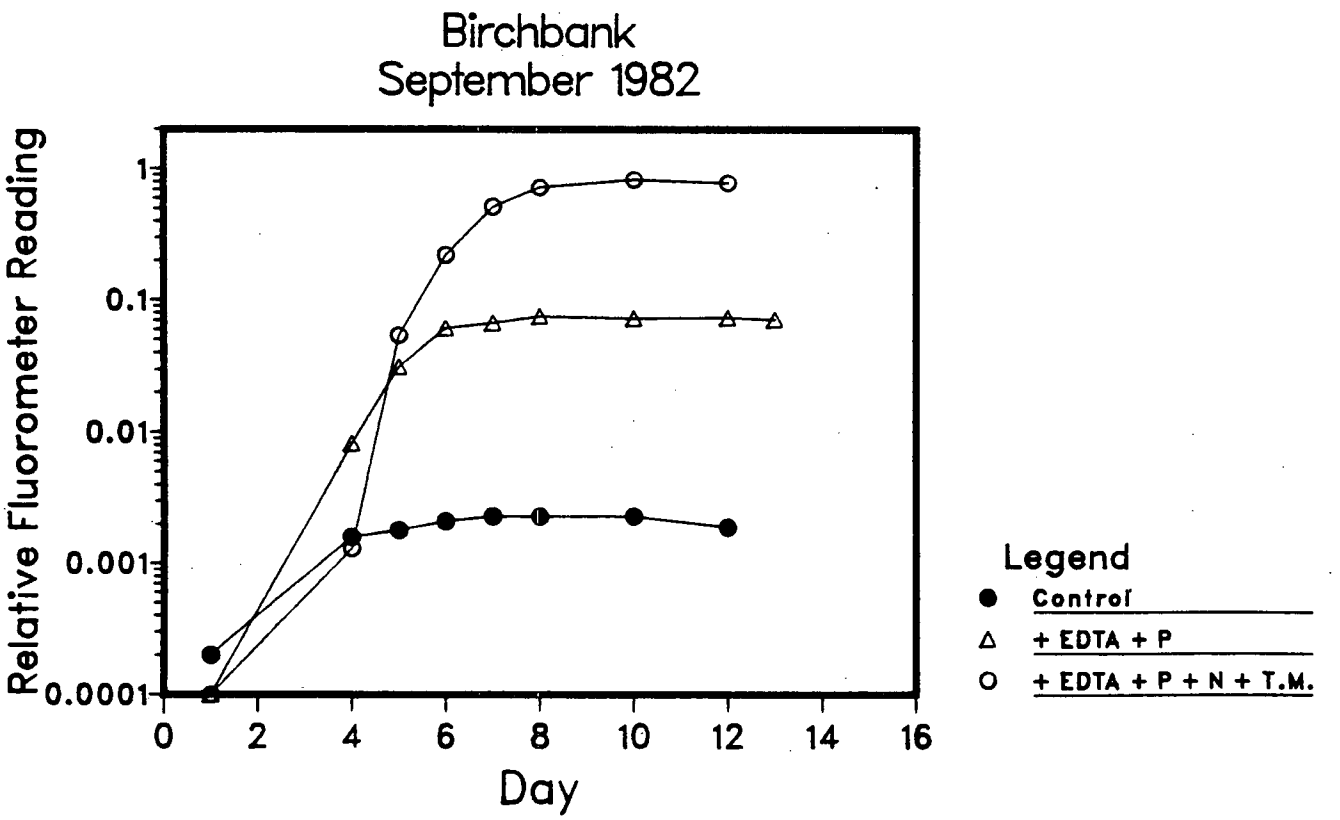
POINTS PLOTTED ARE THE MEANS OF 3 REPLICATES

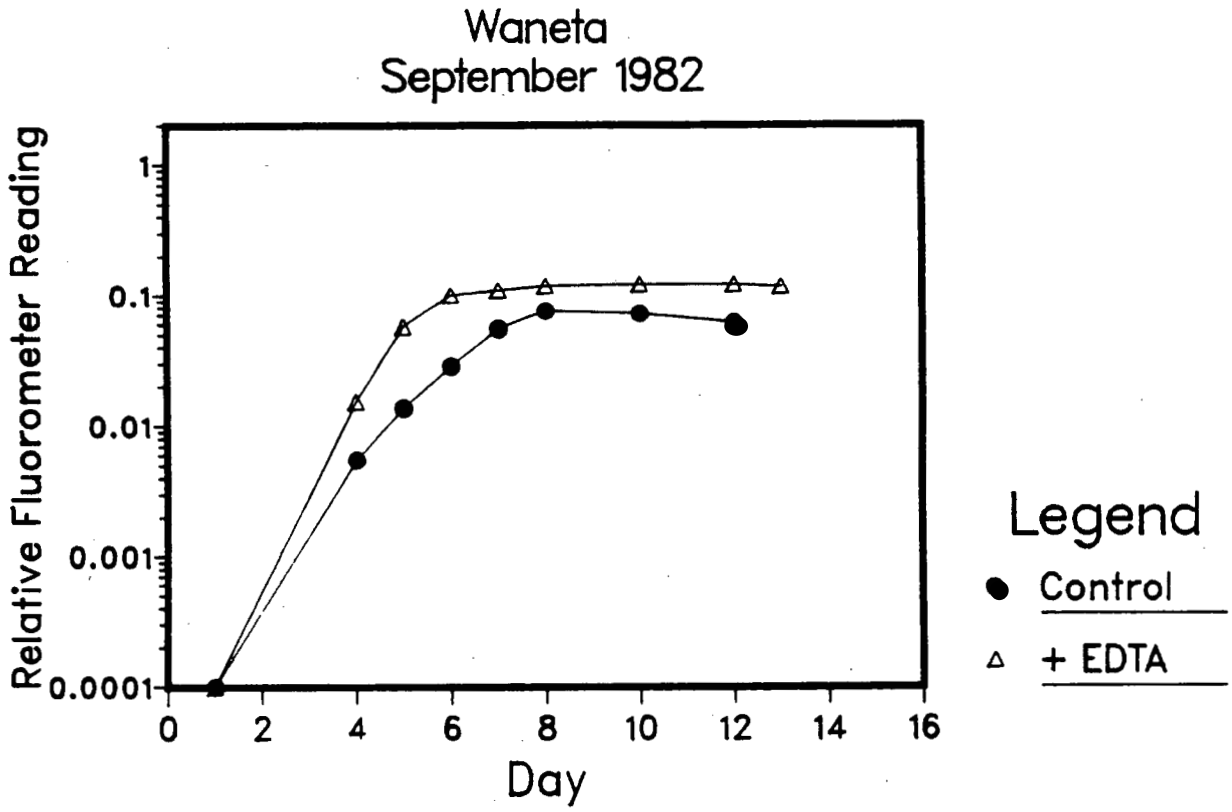
The readings used for these graphs are presented in Table 40

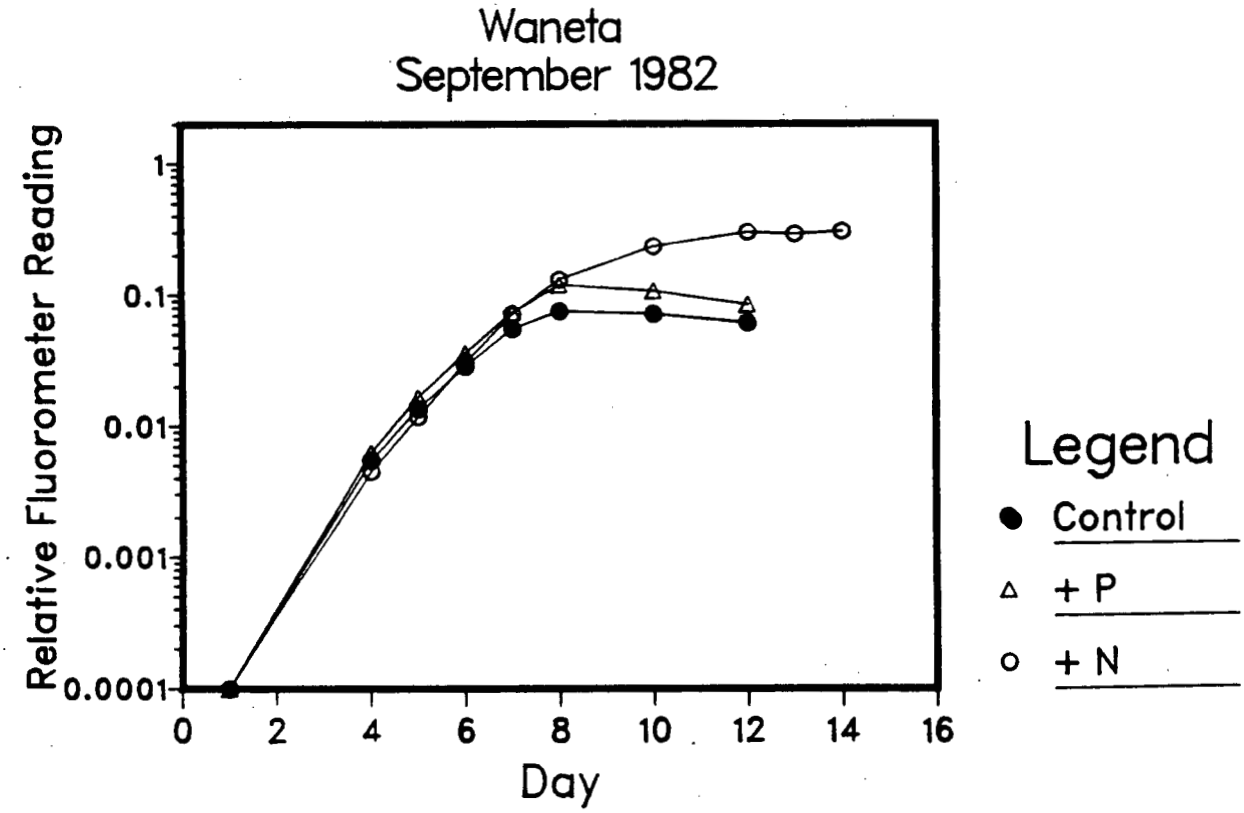

Birchbank
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ EDTA

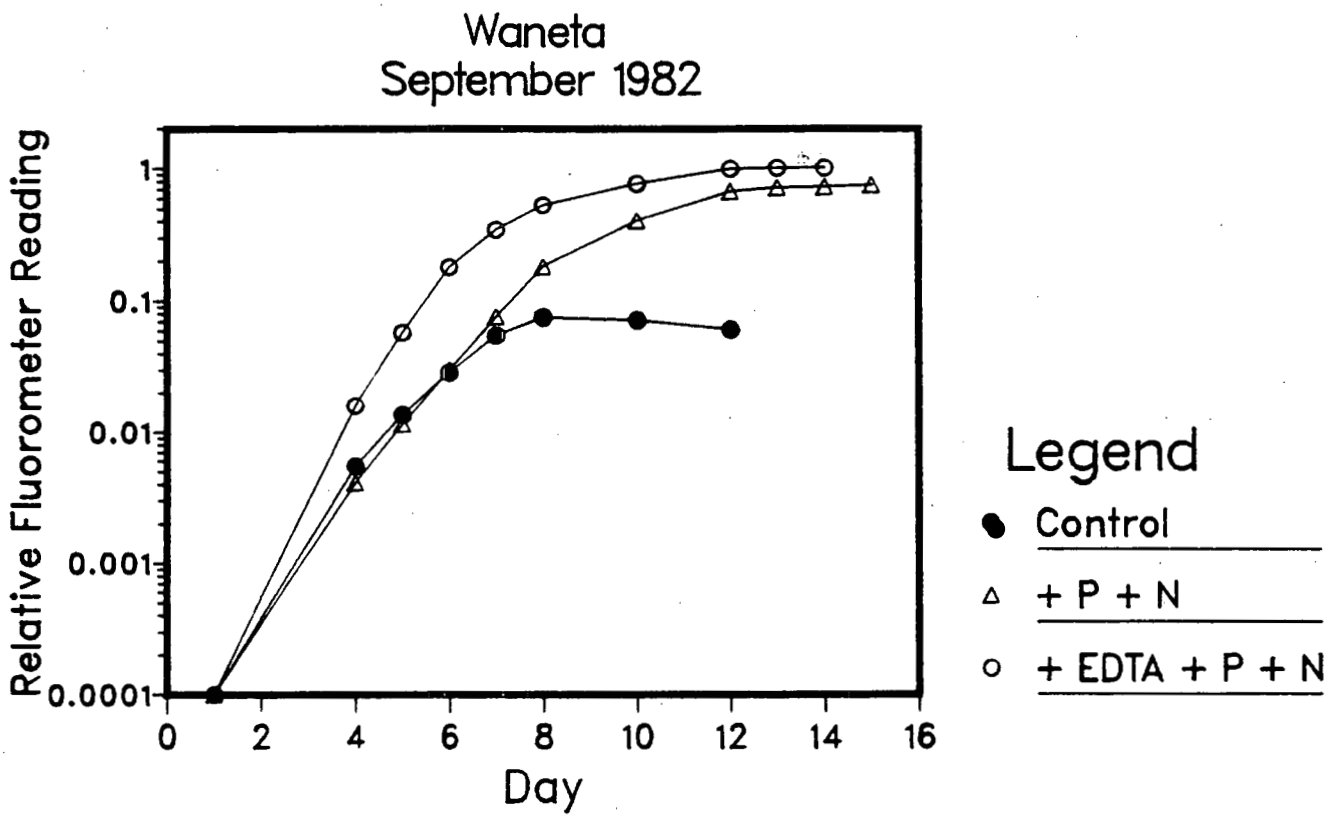

Birchbank
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ P
+ N

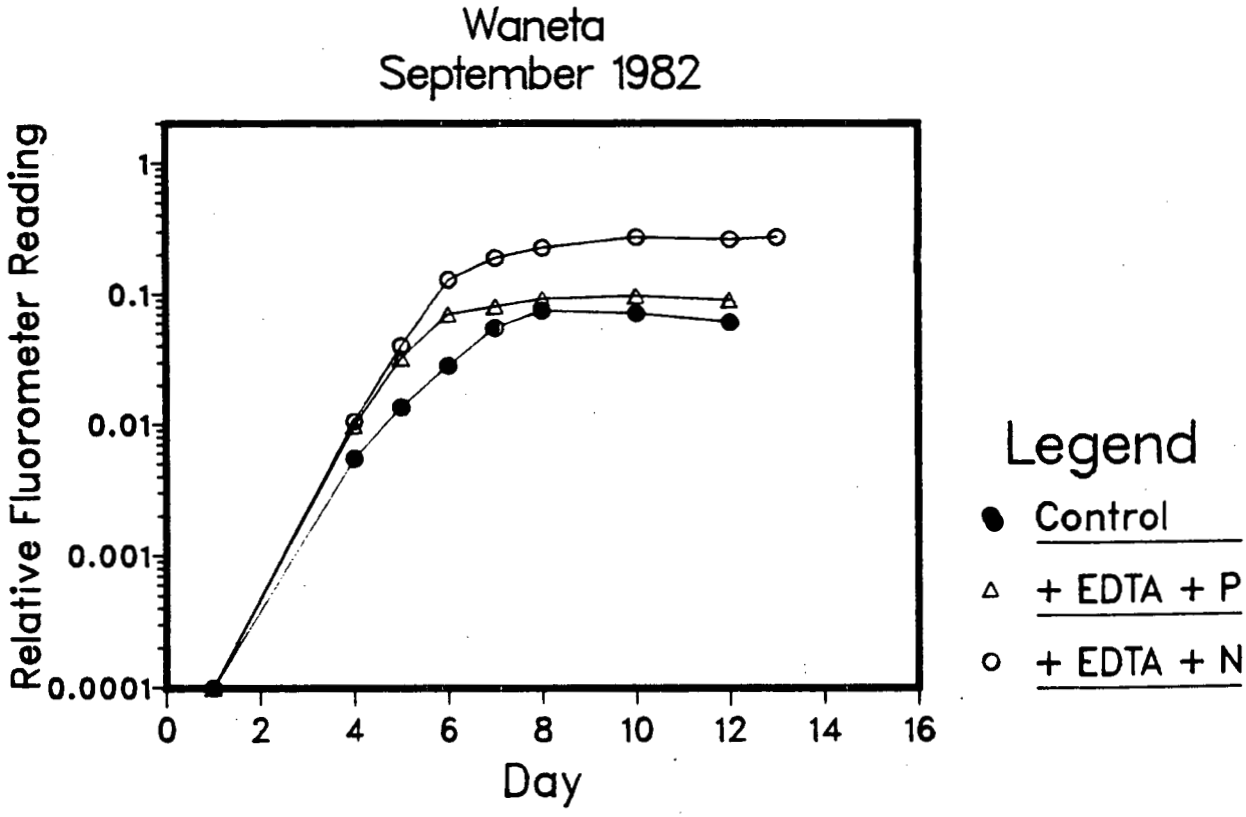

Birchbank
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ P + N
+ EDTA + P + N


Birchbank
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ EDTA + P
+ EDTA + P + N + T.M.


Waneta
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ EDTA


Waneta
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ P
+ N


Waneta
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ P + N
+ EDTA + P + N


Waneta
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0
2
4
6
8
10
12
14
16
Day
Legend
Control
+ EDTA + P
+ EDTA + N

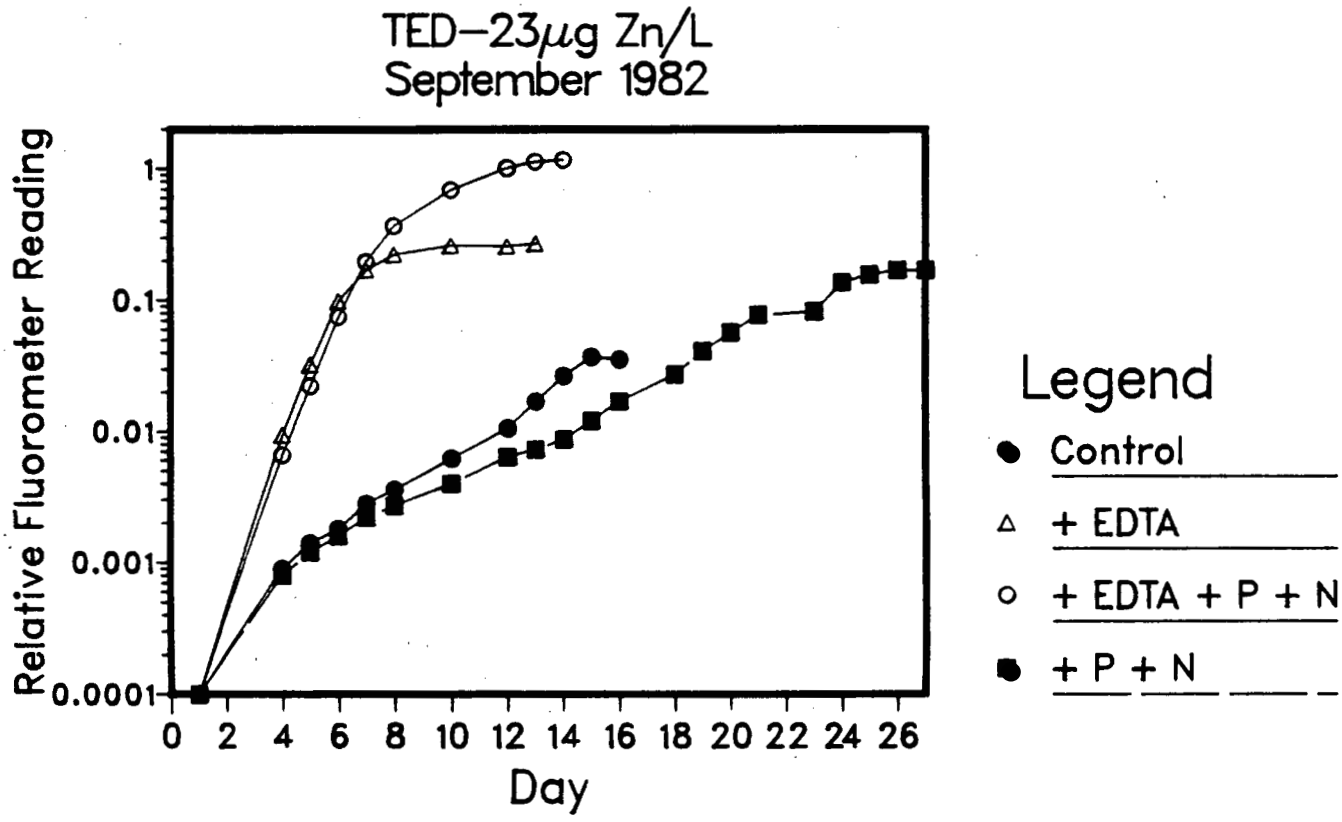

TED–23μg Zn/L
September 1982
Relative Fluorometer Reading
1
0.1
0.01
0.001
0.0001
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Day
Legend
Control
+ EDTA
+ EDTA + P + N
+ P + N

TABLE 41

FINAL YIELD OF EACH ALGAL ASSAY TREATMENT

FOR THE SEPTEMBER 1982 ASSAY. THE YIELDS ARE EXPRESSED

AS CELLS/ML AND MG DRY WT/L.

MEAN CELL VOLUME IS EXPRESSED AS UM^3/CELL.

THE YIELDS WERE DETERMINED WITH THE COULTER COUNTER.

September 30 - October 26, 1982 Algal Assay

Birchbank

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
15308			38	.21		
18244	16275	1706	39	.26	.24	.03
15272			47	.26		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
20154			33	.24		
17529	18308	1605	34	.22	.22	.02
17241			34	.21		

Control + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
13869			41	.21		
18810	16831	2613	35	.24	.23	.02
17814			39	.25		

Control + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
202576			41	3.00		
202708	194480	14137	42	3.07	2.95	.16
178156			43	2.77		

Control + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
1123794			47	19.07		
1322730	1274832	133687	43	20.53	20.66	1.66
1377972			45	22.39		

September 30 - October 26, 1982 Algal Assay, Continued

Birchbank

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2120952			43	32.92		
1869702	1986282	126598	44	29.70	31.53	1.66
1968192			45	31.97		

Control + EDTA + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
337428			37	4.51		
241962	271096	57587	40	3.49	3.82	.59
233898			41	3.46		

Control + EDTA + P + N + Trace Metals, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2076732			51	38.23		
1921560	1986282	80722	51	35.38	35.63	2.49
1960554			47	33.26		

Waneta

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
182028			47	3.09		
244816	214441	31444	49	4.33	3.70	.62
216480			47	3.67		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
300426			43	4.66		
364056	317660	40620	44	5.78	4.91	.78
288498			41	4.27		

September 30 - October 26, 1982 Algal Assay, Continued

Waneta

Control + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
304752			72	7.92		
476154	377097	88768	62	10.66	9.27	1.37
350386			73	9.23		

Control + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
280770			46	4.66		
215796	269248	48724	46	3.58	4.43	.76
311178			45	5.06		

Control + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2938218			49	51.97		
2928168	2328602	1047194	40	42.28	38.29	16.06
1119420			51	20.61		

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2611794			46	43.37		
2484762	2481680	131682	37	33.19	35.98	6.47
2348484			37	31.37		

Control + EDTA + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
487326			43	7.56		
440012	463546	23658	61	9.69	9.10	1.34
463300			60	10.04		

September 30 - October 26, 1982 Algal Assay, Continued

Waneta

Control + EDTA + P, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
223860			41	3.31		
266616	257054	29595	39	3.75	3.71	.37
280686			40	4.05		

TED-23ug Zn/L

Control, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
47544			64	1.10		
40352	52811	15766	58	.84	1.16	.35
70536			60	1.53		

Control + EDTA, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
488966			48	8.47		
404752	451273	42796	50	7.31	8.08	.67
460102			51	8.47		

Control + EDTA + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
2037336			39	28.68		
2091204	2148422	148223	37	27.93	30.86	4.44
2316726			43	35.96		

Control + P + N, pH=8.0

Cells/ml	Mean Cells/ml	S.D.	Mean Cell Volume	Dry Wt. (mg/L)	Mean Dry Wt.	S.D.
251412			57	5.17		
215594	255923	42763	65	5.06	5.73	1.06
300762			64	6.95		

TABLE 42

Data used to determine dry weight per volume ($\mu g/\mu m^3$) of Selenastrum capricornutum.

Sample	Cell Density (cells/ml)	Mean Cell Volume (μm^3)	Volume of Culture Filtered (ml)	Dry Weight of Filtered Cells (mg)	Dry Weight of algae as $\mu g/\mu m^3$	Mean dry weight for culture ($\mu g/\mu m^3$)
Culture A	8.48×10^5	31.5	350	3.5	3.75×10^{-7}	3.66×10^{-7}
			350	3.5	3.75×10^{-7}	
			300	3.1	3.87×10^{-7}	
			250	2.5	3.75×10^{-7}	
			200	1.7	3.18×10^{-7}	
Culture B	1.01×10^6	30.0	500	5.4	3.56×10^{-7}	3.55×10^{-7}
			500	5.4	3.56×10^{-7}	
			450	4.8	3.52×10^{-7}	
					Mean of 2 cultures =	3.61×10^{-7}

B. INDIGENOUS PHYTOPLANKTON AND PERIPHYTON COLLECTED FROM THE COLUMBIA RIVER ON EARLY RECONNAISSANCE TRIPS (1978-1979) AND IN CONJUNCTION WITH SAMPLES FOR ALGAL ASSAYS (1980-1982)

TABLE 43

A list of all algal species collected from the Columbia River Basin, July 26, 1978 - September 28, 1982, indicating whether they were found in the periphyton or in the phytoplankton.

	Phytoplankton	Periphyton
Chrysophyta		
Class Bacillariophyceae		
Achnanthes clevei Grunow	+	+
Achnanthes flexella (Kützing) Brun	+	+
Achnanthes lanceolata (Brébisson) Grunow	+	+
Achnanthes microcephala (Kützing) Grunow		+
Achnanthes minutissima Kützing	+	+
Achnanthes sp.	+	+
Amphipleura pellucida (Kützing) Kützing	+	
Amphora coffeaeformis (Agardh) Kützing		+
Amphora sp.		+
Asterionella formosa Hassall	+	+
Ceratoneis arcus (Ehrenberg) Kützing	+	+
Ceratoneis arcus var. amphioxys (Rabenhorst) Brun	+	
Cocconeis pediculus Ehrenberg	+	+
Cocconeis placentula Ehrenberg	+	+
Cocconeis sp.		+
Cyclotella bodanica Eulenstein in Grunow	+	
Cyclotella comta (Ehrenberg) Kützing	+	
Cyclotella glomerata Bachmann	+	+
Cyclotella kuetzingiana Thwaites	+	+
Cyclotella michiganiana Skvortzow		+
Cyclotella ocellata Pantocsek	+	+
Cyclotella stelligera (Cleve et Grun in Cleve) Van Heurck	+	
Cyclotella sp. A		+
Cyclotella sp. B		+
Cyclotella sp.	+	
Cymatopleura solea (Brébisson) Wm. Smith		+
Cymbella affinis Kützing	+	+
Cymbella caespitosa (Kützing) Brun	+	+
Cymbella cistula (Hemprich) Kirchner	+	
Cymbella prostrata (Berkeley) Cleve	+	
Cymbella sinuata Gregory		+
Cymbella turgida Gregory	+	
Cymbella ventricosa (Kützing) Kützing	+	+
Cymbella sp.	+	

TABLE 43 (Continued)

	Phytoplankton	Periphyton
Denticula elegans Kützing	+	
Diatoma elongatum Lyngbye	+	+
Diatoma hiemale (Lyngbye) Heiberg	+	
Diatoma hiemale var. quadratum (Kützing) Ross	+	+
Diatoma vulgare Bory	+	+
Diploneis decipiens Cleve-Euler	+	
Epithemia sorex Kützing	+	+
Epithemia turgida (Ehrenberg) Kützing	+	+
Eunotia pectinalis (Kützing) Rabenhorst	+	
Fragilaria capucina Desmazieres	+	+
Fragilaria construens (Ehrenberg) Grunow	+	+
Fragilaria construens var. binodis (Ehrenberg) Grunow	+	+
Fragilaria construens var. venter (Ehrenberg) Grunow	+	+
Fragilaria crotonensis Kitton	+	+
Fragilaria leptostauron (Ehrenberg) Hustedt	+	+
Fragilaria pinnata Ehrenberg		+
Fragilaria vaucheriae (Kützing) Peterson	+	+
Gomphonema herculeanum Ehrenberg	+	
Gomphonema intricatum Kützing	+	
Gomphonema olivaceum (Lyngbye) Kützing	+	+
Gomphonema parvulum (Kützing) Kützing	+	
Gomphonema sp.	+	
Gyrosigma sciotense (Sullivan & Wormley) Cleve	+	
Melosira granulata (Ehrenberg) Ralfs	+	
Melosira granulata var. angustissima O.F. Müller	+	+
Melosira varians Agardh	+	+
Meridion circulare (Greville) Agardh	+	
Navicula bicephala Hustedt	+	
Navicula cryptocephala Kützing	+	
Navicula pelliculosa Hilse	+	
Navicula pupula Kützing	+	
Navicula radiosa Kützing	+	
Navicula salinarum var. intermedia (Grunow) Cleve	+	+
Navicula tripunctata (O.F. Müller) Bory	+	
Navicula sp.	+	+
Neidium sp.	+	
Nitzschia acicularis Wm. Smith	+	+
Nitzschia actinasteroides (Lemmermann) Van Goor	+	
Nitzschia dissipata (Kützing) Grunow	+	+
Nitzschia filiformis (Wm. Smith) Van Heurck	+	
Nitzschia frustulum (Kützing) Grunow		+
Nitzschia hantzschiana Rabenhorst		+

TABLE 43 (Continued)

	Phytoplankton	Periphyton
Nitzschia linearis Wm. Smith	+	+
Nitzschia palea (Kützing) Wm. Smith	+	+
Nitzschia sigma (Kützing) Wm. Smith	+	
Nitzschia sp.	+	
Rhizosolenia eriensis H.L. Smith	+	+
Rhizosolenia sp.	+	
Rhopalodia gibba (Ehrenberg) O.F. Müller	+	
Rhopalodia gibberula (Ehrenberg) O.F. Müller	+	
Stauroneis anceps Ehrenberg	+	
Stephanodiscus astraea (Ehrenberg) Grunow	+	+
Stephanodiscus tenuis Hustedt		+
Stephanodiscus sp.	+	
Synedra acus var. radians (Kützing) Hustedt	+	+
Synedra angustata Kützing*	+	
Synedra ulna (Nitzsch) Ehrenberg	+	+
Synedra ulna var. oxyrhynchus (Kützing) Van Heurck	+	+
Synedra sp.	+	
Tabellaria fenestrata (Lyngbye) Kützing	+	+
Tabellaria flocculosa (Roth) Kützing	+	
Non-Diatom Chyrsophyta		
Chromulina-like	+	
Dinobryon bavaricum Imhof	+	
Dinobryon sertularia Ehrenberg	+	
Mallomonas pseudocoronata Prescott	+	
Mallomonas sp.	+	
Ochromonas sp.	+	
Chlorophyta		
Ankistrodesmus falcatus (Corda) Ralfs	+	
Carteria sp.	+	
Chlamydomonas sp.	+	
Cosmarium sp.	+	
Crucigenia sp.	+	
Elakatothrix gelatinosa Wille	+	
Elakatothrix sp.	+	
Franceia sp.	+	
Gemellicystis neglecta Teiling	+	
Gemellicystis sp.	+	

TABLE 43 (Continued)

	Phytoplankton	Periphyton
Gonium sp.	+	
Lagerheimia sp.	+	
Microspora sp.		+
Scenedesmus quadricauda (Turpin) de Brébisson *in* de Brébisson & Godey	+	
Scenedesmus sp.	+	
Selenastrum sp.	+	
Staurastrum sp.	+	
Stigeoclonium sp.	+	+
Ulothrix zonata (Ubber & Mohr) Kützing		+
Ulothrix sp.		+
Unidentified filamentous		+
Cryptophyta		
Chroomonas sp.	+	
Cryptomonas sp.	+	
Cyanophyta		
Chroococcus sp.	+	
Oscillatoria planctonica Woloszynska	+	+
Oscillatoria sp.	+	+
Unidentified colony	+	
Unidentified unicellular		+
Pyrrhophyta		
Ceratium hirundinella (O.F. Müller) Schrank	+	
Peridiniopsis sp.	+	
Peridinium sp.	+	
Miscellaneous		
Unidentified unicellular alga	+	

*Van Landingham gives no correct equivalent for this species

TABLE 44

Concentrations of phytoplankton species (cells/ml)
collected from the Columbia and Pend d'Oreille Rivers,
July 26, 1978 - September 28, 1982. Concentrations
of filamentous species (indicated by *)
are expressed as mm/ml.
Filamentous species are not included in total count of cells.

Date: July 26, 1978

Species	Birch-bank	Waneta	Pend d'Oreille River
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	6
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	6	0
Achnanthes minutissima	0	0	6
Achnanthes sp.	15	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	62	33	1838
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	2	6	0
Cyclotella ocellata	0	0	6
Cyclotella stelligera	0	6	0
Cyclotella sp.	7	0	0
Cymbella affinis	0	0	0
Cymbella caespitosa	2	0	6
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	11	11	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	6	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	4	6	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	141	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	429	778	375
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: July 26, 1978 (Continued)

Species	Birch-bank	Waneta	Pend d'Oreille River
Gomphonema parvulum	4	6	6
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	7	0	0
Melosira granulata var. angustissima	0	0	171
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	11
Navicula sp.	0	0	11
Neidium sp.	0	0	11
Nitzschia acicularis	0	0	44
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	2	0	0
Nitzschia palea	4	6	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	75	50	6
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	2	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	7	0	11
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	28
Synedra angustata	0	0	0
Synedra ulna	2	0	11
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	6
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	11
Dinobryon sertularia	15	11	110
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	20	6	6
Ochromonas sp.	126	77	121

Date: July 26, 1978 (Continued)

Species	Birch-bank	Waneta	Pend d'Oreille River
Chlorophyta			
Ankistrodesmus falcatus	18	33	0
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	7	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	17	22
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	40	155	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	6	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	93	83	11
Cryptomonas sp.	18	11	0
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	10807	16450	21307
Oscillatoria sp.*	0	0	0
Unidentified colony	0	22	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	1114	1330	2832

Date: October 23, 1979
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	3	0	4
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	28	25	6
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	3	0	26
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	61	63	39
Cyclotella sp.	0	0	0
Cymbella affinis	0	0	0
Cymbella caespitosa	3	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	3	3	2
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	2
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	33	22
Fragilaria construens var. venter	0	0	9
Fragilaria crotonensis	75	102	35
Fragilaria leptostauron	0	0	2
Fragilaria vaucheriae	0	0	2
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: October 23, 1979 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	2
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	6	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	3	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	6	3	4
Synedra angustata	0	0	2
Synedra ulna	0	3	2
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	63	6	18
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	19	22	17
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	2
Ochromonas sp.	152	218	110

Date: October 23, 1979 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	30	6	9
Carteria sp.	0	0	0
Chlamydomonas sp.	0	3	4
Cosmarium sp.	0	0	2
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	6	6	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	22	0	0
Lagerheimia sp.	0	0	2
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	229	188	121
Cryptomonas sp.	19	36	11
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	6616	6488
Oscillatoria sp.*	3480	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	3	2
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	720	726	453

Date: October 23, 1979
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	0	3	9
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	0	33	2
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	1	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	8	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	63	0
Cyclotella sp.	0	0	57
Cymbella affinis	0	0	0
Cymbella caespitosa	0	3	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	2
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	6
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	11	0
Fragilaria construens var. binodis	0	28	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	40	33	48
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	47	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: October 23, 1979 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	4	0	2
Neidium sp.	0	0	0
Nitzschia acicularis	1	3	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	3	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	3	3	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	8	0	0
Stephanodiscus sp.	41	0	0
Synedra acus var. radians	0	8	4
Synedra angustata	1	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	21	0	9
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	36	25	26
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	124	127	180

Date: October 23, 1979 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	6	0	4
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	4
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	14	2
Elakatothrix sp.	6	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	26	0	0
Lagerheimia sp.	1	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	11	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	552	0	0
Cryptophyta			
Chroomonas sp.	91	188	138
Cryptomonas sp.	15	28	42
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	0	4587	2425
Oscillatoria sp.*	2076	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	4
Peridinium sp.	3	0	0
Miscellaneous			
Unidentified unicellular alga	3	0	0
Total Number of Cells	435	635	537

Date: October 23, 1979
Station: Cominco Effluent

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	3	1	0
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	8	5	4
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	1	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	9
Cyclotella kuetzingiana	1	1	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	16	10	7
Cymbella affinis	0	0	0
Cymbella caespitosa	0	1	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	1	0	0
Cymbella ventricosa	1	1	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	1	2	0
Diatoma hiemale	1	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	1	0
Diploneis decipiens	0	0	0
Epithemia sorex	1	0	0
Epithemia turgida	0	1	1
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	21
Fragilaria construens var. venter	15	41	24
Fragilaria crotonensis	56	58	40
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	1	1	2
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	1	1	0

Date: October 23, 1979 (Continued)
Station: Cominco Effluent

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	4
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	1	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	2	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	1
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	1
Stauroneis anceps	0	0	0
Stephanodiscus astraea	1	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	2	2	4
Synedra angustata	0	1	0
Synedra ulna	1	1	1
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	13	13	8
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	2	9	0

Date: October 23, 1979 (Continued)
Station: Cominco Effluent

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	1	1	1
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	0	2	0
Cryptomonas sp.	0	0	0
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	36	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	127	149	127

Date: February 14, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	6	4	6
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	9	1	0
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	2	1
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	1	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	1	0	1
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	5	0	1
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	1	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	1
Fragilaria crotonensis	16	6	9
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	1	4	1

Date: February 14, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	4	1	2
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	1
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	1	0	2
Synedra angustata	2	0	0
Synedra ulna	0	2	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	2	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	122	48	109

Date: February 14, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	0	0
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	1	2
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	62	87	87
Cryptomonas sp.	11	7	14
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	6	142
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	240	167	234

Date: February 14, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	5	0	0
Achnanthes minutissima	12	13	6
Achnanthes sp.	0	0	0
Amphipleura pellucida	1	0	0
Asterionella formosa	5	0	1
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	1	1	1
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	1	0
Cyclotella bodanica	1	0	1
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	0	0	0
Cymbella affinis	0	0	0
Cymbella caespitosa	1	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	7	6	3
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	3	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	1	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	1	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	9	12	4
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	4	9	3
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	6	5	1

Date: February 14, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	2	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	3	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	1	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	1	0	0
Synedra angustata	0	0	0
Synedra ulna	5	0	1
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	3	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	5	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	1	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	84	78	69

Date: February 14, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	0	0
Carteria sp.	0	6	6
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	3	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	86	98	65
Cryptomonas sp.	11	5	8
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	46	60	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	256	236	168

Date: March 26, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	17	18	14
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	11	4	7
Ceratoneis arcus	3	17	17
Ceratoneis arcus var. amphioxys	4	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	1
Cyclotella bodanica	0	0	0
Cyclotella comta	4	1	2
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	0	0	0
Cymbella affinis	1	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	3	6	6
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	14	14	13
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	1	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	8
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	22
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	20	33	24
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	22	19	30
Gomphonema herculeanum	0	0	1
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	9	29	11

Date: March 26, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	1	0
Navicula sp.	2	0	10
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	5	0	13
Nitzschia sigma	0	1	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	1	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	2	2
Synedra angustata	8	10	4
Synedra ulna	0	1	7
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	0
Tabellaria flocculosa	6	0	1
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	17	6	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	55	105	72

Date: March 26, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	1	1
Carteria sp.	0	0	0
Chlamydomonas sp.	0	6	3
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	3	0	11
Elakatothrix sp.	0	0	0
Franceia sp.	1	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	69	47	78
Cryptomonas sp.	6	10	17
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	407	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	1	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	279	330	374

Date: March 26, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	1	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	10	23	19
Achnanthes sp.	2	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	7	15	19
Ceratoneis arcus	8	15	15
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	3	4	4
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	0	0	0
Cymbella affinis	0	0	0
Cymbella caespitosa	1	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	15	22	14
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	17	15	18
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	1	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	10	4
Fragilaria construens	24	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	24	43	50
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	9	0	17
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	23	23	19

Date: March 26, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	2	0	1
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	1	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	7	0
Neidium sp.	0	0	0
Nitzschia acicularis	1	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	3	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	4	25	14
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	3	3	0
Synedra angustata	2	0	7
Synedra ulna	1	14	6
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	0
Tabellaria flocculosa	0	3	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	7	14	14
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	1	1	1
Ochromonas sp.	88	77	94

Date: March 26, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	2	0	0
Carteria sp.	19	10	10
Chlamydomonas sp.	14	8	11
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	40	75	66
Cryptomonas sp.	8	11	15
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	166	290
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	1	1	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	342	421	418

Date: July 22, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	14	0	6
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	41	77	50
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	182	491	342
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	22	11
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	381	121	464
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: July 22, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	8	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	3	0	0
Navicula sp.	8	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	28	22
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	6
Synedra angustata	0	0	0
Synedra ulna	3	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	6	17	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	14	33	17
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	17	0
Ochromonas sp.	304	624	911

Date: July 22, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	3	22	11
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	6	0	6
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	99	121	127
Cryptomonas sp.	3	50	39
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	1076	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	6	28	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	1079	1650	2009

Date: July 22, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	6	0	0
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	50	160	36
Ceratoneis arcus	6	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	320	287	229
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	6	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	127	33
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	265	320	226
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: July 22, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	3
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	11	0	3
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	11	28	14
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	6	0
Synedra angustata	0	0	0
Synedra ulna	6	6	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	6
Tabellaria fenestrata	28	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	17
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	6	0	0
Ochromonas sp.	613	657	317

Date: July 22, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	33	0	8
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	11	0	11
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	88	8
Gemellicystis sp.	88	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	1711	0	0
Cryptophyta			
Chroomonas sp.	155	83	77
Cryptomonas sp.	44	17	14
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	1656	1777	1002

Date: July 22, 1980
Station: Cominco Effluent

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	39	33	33
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	44	55	50
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	193	110	270
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	304	243	88
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: July 22, 1980 (Continued)
Station: Cominco Effluent

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	11	0	0
Navicula sp.	0	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	6
Nitzschia sp.	11	0	0
Rhizosolenia eriensis	0	0	6
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	17	6	0
Synedra angustata	0	0	0
Synedra ulna	0	6	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	11	6
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	28	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	50	77	28

Date: July 22, 1980 (Continued)
Station: Cominco Effluent

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	6	0
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	39	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	0	0	0
Cryptomonas sp.	0	0	0
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	6	6	17
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	712	580	502

Date: August 11, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	0	149	22
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	22	39	11
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	15	28	11
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	2
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	2
Diatoma hiemale var. quadratum	0	6	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	17	0
Fragilaria construens var. binodis	17	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	151	61	144
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	11	2
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	2
Gomphonema olivaceum	0	0	0

Date: August 11, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	7
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	2	0	6
Neidium sp.	0	0	0
Nitzschia acicularis	0	3	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	3	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	2	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	2	3	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	4	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	2	6	0
Synedra angustata	0	0	0
Synedra ulna	2	3	2
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	17	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	2
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	2	0	0
Ochromonas sp.	64	144	68

Date: August 11, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	2	17	18
Carteria sp.	0	0	0
Chlamydomonas sp.	4	0	0
Cosmarium sp.	0	3	7
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	7	6	9
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	239	320	217
Cryptomonas sp.	15	8	18
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	957	966	202
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	2	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	11	8	2
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	580	831	552

Date: August 11, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	20	9	7
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	0	48	24
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	22	13	18
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	2	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	142	144	127
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	37	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	2	0

Date: August 11, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	0	2
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	2	2	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	2	0	2
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	4	4
Synedra angustata	0	0	0
Synedra ulna	4	6	4
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	11	0	6
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	4	4	9
Mallomonas pseudocoronata	2	2	0
Mallomonas sp.	0	0	0
Ochromonas sp.	140	96	127

Date: August 11, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	4	22
Carteria sp.	0	0	0
Chlamydomonas sp.	2	0	2
Cosmarium sp.	6	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	6	11	4
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	197	191	219
Cryptomonas sp.	15	11	18
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	166	0	184
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	9	9	7
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	581	592	602

Date: August 11, 1980
Station: Cominco Effluent

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	35	11	6
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	23	29	29
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	4	3	6
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	25	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	85	98	191
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	17	0	5
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: August 11, 1980 (Continued)
Station: Cominco Effluent

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	6
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	2	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	2	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	1	2
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	28	6	2
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	0	0	0

Date: August 11, 1980 (Continued)
Station: Cominco Effluent

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	15	6	9
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	1	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	0	0	0
Cryptomonas sp.	0	0	0
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	1
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	1	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	237	155	258

Date: September 17, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	8	0	6
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	22	41	66
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	50	58	61
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	3	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	28	47	30
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	235	201	179
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: September 17, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	6	0	8
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	6	3	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	3	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	3	0
Synedra angustata	0	0	0
Synedra ulna	3	11	8
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	25	33	97
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	41	8	28
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	276	282	320

Date: September 17, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	6	0
Carteria sp.	0	0	0
Chlamydomonas sp.	3	0	0
Cosmarium sp.	0	0	3
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	8	8	3
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	22	11	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	3	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	80	94	88
Cryptomonas sp.	17	6	17
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	4554	5520	3036
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	3	8	3
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	834	825	916

Date: September 17, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	6	0	0
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	35	39	39
Ceratoneis arcus	1	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	17
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	44	86	52
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	1	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	105	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	170	168	193
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	1	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: September 17, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	3	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	6	0
Navicula tripunctata	0	0	0
Navicula sp.	0	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	1	0	3
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	6	0
Synedra angustata	0	0	0
Synedra ulna	1	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	22	8	17
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	3	0	3
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	6	0
Ochromonas sp.	120	304	342

Date: September 17, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	4	6	0
Carteria sp.	0	0	0
Chlamydomonas sp.	0	6	0
Cosmarium sp.	3	3	3
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	1	0	11
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	6
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	17
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	6	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	87	155	110
Cryptomonas sp.	4	8	3
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	2029	4526	0
Oscillatoria sp.*	0	0	5824
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	14
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	511	905	828

Date: September 17, 1980
Station: Pend d'Oreille River

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	0	0	0
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	69	7	69
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	3	2	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	63	92	124
Cymbella affinis	0	0	0
Cymbella caespitosa	0	2	3
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	8	7	11
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	44	0	0
Fragilaria construens var. venter	0	0	44
Fragilaria crotonensis	356	259	279
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	2	3
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	3	0	0

Date: September 17, 1980 (Continued)
Station: Pend d'Oreille River

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	3
Melosira granulata	11	9	8
Melosira granulata var. angustissima	91	63	146
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	3	2	0
Navicula tripunctata	0	0	0
Navicula sp.	6	0	6
Neidium sp.	0	0	0
Nitzschia acicularis	3	0	0
Nitzschia actinasteroides	0	0	88
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	11	8
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	8	0	8
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	2	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	6	0	0
Synedra angustata	0	0	0
Synedra ulna	66	44	30
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	3	4	6
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	41	162	248

Date: September 17, 1980 (Continued)
Station: Pend d'Oreille River

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	13	14
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	3	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	11	26	17
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	33	40	39
Selenastrum sp.	0	0	0
Staurastrum sp.	3	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	88	166	323
Cryptomonas sp.	14	17	28
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	0	478	1021
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	936	929	1504

Date: December 2, 1980
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	0	0	0
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	17	0	0
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	18	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	28	33	39
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	2
Diatoma elongatum	2	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	22	15	29
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	31	96	35
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	7	0	0

Date: December 2, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	7	4	4
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	4	4	4
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	2	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	2	0	0
Synedra angustata	0	0	0
Synedra ulna	0	2	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	17	15
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	11	4	11
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	2	2	0
Ochromonas sp.	131	144	232

Date: December 2, 1980 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	9	11	20
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	0	0
Crucigenia sp.	7	0	0
Elakatothrix gelatinosa	0	2	6
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	232	210	199
Cryptomonas sp.	15	11	11
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	1435	681	350
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	2	4
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	545	556	609

Date: December 2, 1980
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	2	4	4
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	0	0	15
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	2	2
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	39	52	20
Cymbella affinis	0	0	0
Cymbella caespitosa	0	4	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	2
Cymbella turgida	0	0	0
Cymbella ventricosa	0	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	4
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	29	0	33
Fragilaria construens var. venter	15	0	18
Fragilaria crotonensis	39	94	46
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: December 2, 1980 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	2	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	11	4	0
Neidium sp.	0	0	0
Nitzschia acicularis	2	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	4	2	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	2	4	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	2	6
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	2	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	2	0	7
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	6	2	17
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	2	0
Ochromonas sp.	234	237	237

Date: December 2, 1980 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	17	0
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	2	2	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	4	2	4
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	15	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	2	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	155	144	140
Cryptomonas sp.	13	17	9
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	1730	681	662
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	576	587	563

Date: February 17, 1981
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	7	8	8
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	10	0	0
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	0	0
Cyclotella comta	1	0	0
Cyclotella glomerata	0	2	6
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	19	11	12
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	1	0	7
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	3	1	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	8	29	0
Fragilaria construens var. venter	12	0	14
Fragilaria crotonensis	8	14	22
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	4	1	4

Date: February 17, 1981 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	7	0	4
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	3	3	7
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	1	0	1
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	4	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	1	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	7	0	1
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	121	139	168

Date: February 17, 1981 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	0	0	0
Carteria sp.	0	0	0
Chlamydomonas sp.	1	4	3
Cosmarium sp.	0	0	0
Crucigenia sp.	0	4	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	6	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	175	112	141
Cryptomonas sp.	4	11	18
Cyanophyta			
Chroococcus sp.	0	0	0
Oscillatoria planctonica*	0	55	290
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	1	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	402	345	417

Date: February 17, 1981
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	6	6	7
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	0	0	0
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	1	0
Cyclotella bodanica	0	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	3	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	15	10	12
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	1
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	1	1	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	1	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	1
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	1
Eunotia pectinalis	0	0	0
Fragilaria capucina	1	0	0
Fragilaria construens	0	0	0
Fragilaria construens var. binodis	0	0	21
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	10	10	21
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	2	1	1
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	3	4	7

Date: February 17, 1981 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	1
Navicula tripunctata	0	0	0
Navicula sp.	3	3	11
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	22	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	6	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	0	0	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	1	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	1	1	3
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	0
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	0	0	0
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	0
Ochromonas sp.	160	197	192

Date: February 17, 1981 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	6	0	0
Carteria sp.	0	0	0
Chlamydomonas sp.	3	7	8
Cosmarium sp.	0	0	0
Crucigenia sp.	4	0	0
Elakatothrix gelatinosa	0	0	3
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	0	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	119	127	132
Cryptomonas sp.	9	14	18
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	231	152	580
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	0
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	344	414	442

Date: June 22, 1982
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	65	65	108
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	11
Asterionella formosa	54	119	151
Ceratoneis arcus	0	11	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	11	22
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	32	108	32
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	11	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	11	0	11
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	11	0
Fragilaria capucina	0	0	11
Fragilaria construens	11	216	0
Fragilaria construens var. binodis	0	0	237
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	2544	2900	2242
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: June 22, 1982 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	22
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	162	32
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	11	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	11	11
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	22	32	0
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	32	43	54
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	119	183	183
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	0	11
Ochromonas sp.	485	809	496

Date: June 22, 1982 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	11	11	11
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	0	11	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	0	54	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	1078	1186	582
Cryptomonas sp.	32	32	65
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	0	0
Oscillatoria sp.*	0	0	323
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	11	22
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	4517	5983	4312

Date: June 22, 1982
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	54	54	75
Achnanthes sp.	0	0	11
Amphipleura pellucida	0	0	0
Asterionella formosa	86	97	65
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	11	0	0
Cyclotella bodanica	11	11	32
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	22	86	11
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	11	0	11
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	11	0	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	22	11	22
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	11	0	0
Fragilaria construens	0	593	0
Fragilaria construens var. binodis	11	11	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	2264	2781	2145
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	11

Date: June 22, 1982 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	0	0	22
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	11	22
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	11	22
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	22	32	43
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	32	54	43
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	162	216	108
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	11	0	11
Ochromonas sp.	711	485	496

Date: June 22, 1982 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	11	22	22
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	0
Cosmarium sp.	22	11	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	32	0	22
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	733	561	356
Cryptomonas sp.	0	43	22
Cyanophyta			
Chroococcus sp.	0	0	0
*Oscillatoria planctonica**	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	0	11
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	4247	5088	3579

Date: August 17, 1982
Station: Birchbank

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	4	8	18
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	25	11	39
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	0	5	4
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	718	559	890
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	4	5	0
Cymbella sp.	0	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	0
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	0	0	18
Fragilaria construens var. binodis	0	27	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	57	57	72
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	4

Date: August 17, 1982 (Continued)
Station: Birchbank

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	11	0	7
Meridion circulare	0	0	0
Navicula bicephala	0	0	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	4
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	0	8	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	8	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	22	0	18
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	4
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	14	11
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	39	35	39
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	11	0	0
Ochromonas sp.	36	32	32

Date: August 17, 1982 (Continued)
Station: Birchbank

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	7	3	25
Carteria sp.	0	0	0
Chlamydomonas sp.	0	0	7
Cosmarium sp.	7	0	0
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	57	8	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	108	62	90
Cryptomonas sp.	25	14	32
Cyanophyta			
Chroococcus sp.	0	11	0
*Oscillatoria planctonica**	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	0	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	0	3	7
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	1131	869	1321

Date: August 17, 1982
Station: Waneta

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes clevei	0	0	0
Achnanthes flexella	0	0	0
Achnanthes lanceolata	0	0	0
Achnanthes minutissima	7	22	16
Achnanthes sp.	0	0	0
Amphipleura pellucida	0	0	0
Asterionella formosa	14	14	11
Ceratoneis arcus	0	0	0
Ceratoneis arcus var. amphioxys	0	0	0
Cocconeis pediculus	0	0	0
Cocconeis placentula	0	0	0
Cyclotella bodanica	7	0	0
Cyclotella comta	0	0	0
Cyclotella glomerata	0	0	0
Cyclotella kuetzingiana	0	0	0
Cyclotella ocellata	0	0	0
Cyclotella stelligera	0	0	0
Cyclotella sp.	765	651	572
Cymbella affinis	0	0	0
Cymbella caespitosa	0	0	0
Cymbella cistula	0	0	0
Cymbella prostrata	0	0	0
Cymbella turgida	0	0	0
Cymbella ventricosa	0	3	3
Cymbella sp.	4	0	0
Denticula elegans	0	0	0
Diatoma elongatum	0	0	3
Diatoma hiemale	0	0	0
Diatoma hiemale var. quadratum	0	0	0
Diatoma vulgare	0	0	0
Diploneis decipiens	0	0	0
Epithemia sorex	0	0	0
Epithemia turgida	0	0	0
Eunotia pectinalis	0	0	0
Fragilaria capucina	0	0	0
Fragilaria construens	11	14	0
Fragilaria construens var. binodis	0	0	0
Fragilaria construens var. venter	0	0	0
Fragilaria crotonensis	158	32	97
Fragilaria leptostauron	0	0	0
Fragilaria vaucheriae	0	0	0
Gomphonema herculeanum	0	0	0
Gomphonema intricatum	0	0	0
Gomphonema olivaceum	0	0	0

Date: August 17, 1982 (Continued)
Station: Waneta

Species	Replicates		
Gomphonema parvulum	0	0	0
Gomphonema sp.	0	0	0
Gyrosigma sciotense	0	0	0
Melosira granulata	0	0	0
Melosira granulata var. angustissima	0	0	0
Melosira varians	7	0	0
Meridion circulare	0	0	0
Navicula bicephala	0	3	0
Navicula cryptocephala	0	0	0
Navicula pelliculosa	0	0	0
Navicula pupula	0	0	0
Navicula radiosa	0	0	0
Navicula salinarum var. intermedia	0	0	0
Navicula tripunctata	0	0	0
Navicula sp.	4	0	0
Neidium sp.	0	0	0
Nitzschia acicularis	0	0	0
Nitzschia actinasteroides	0	0	0
Nitzschia dissipata	0	0	0
Nitzschia filiformis	0	0	0
Nitzschia linearis	0	0	0
Nitzschia palea	0	0	0
Nitzschia sigma	0	0	0
Nitzschia sp.	0	0	0
Rhizosolenia eriensis	14	11	22
Rhizosolenia sp.	0	0	0
Rhopalodia gibba	0	0	0
Rhopalodia gibberula	0	0	0
Stauroneis anceps	0	0	0
Stephanodiscus astraea	0	0	0
Stephanodiscus sp.	0	0	0
Synedra acus var. radians	0	0	0
Synedra angustata	0	0	0
Synedra ulna	0	0	0
Synedra ulna var. oxyrhynchus	0	0	0
Synedra sp.	0	0	0
Tabellaria fenestrata	0	0	8
Tabellaria flocculosa	0	0	0
Non-Diatom Chrysophyta			
Chromulina-like	0	0	0
Dinobryon bavaricum	0	0	0
Dinobryon sertularia	65	24	35
Mallomonas pseudocoronata	0	0	0
Mallomonas sp.	0	3	0
Ochromonas sp.	7	8	11

Date: August 17, 1982 (Continued)
Station: Waneta

Species	Replicates		
Chlorophyta			
Ankistrodesmus falcatus	18	8	27
Carteria sp.	0	0	0
Chlamydomonas sp.	4	0	0
Cosmarium sp.	0	5	3
Crucigenia sp.	0	0	0
Elakatothrix gelatinosa	0	0	0
Elakatothrix sp.	0	0	0
Franceia sp.	0	0	0
Gemellicystis neglecta	0	0	0
Gemellicystis sp.	0	0	0
Gonium sp.	0	0	0
Lagerheimia sp.	0	0	0
Scenedesmus quadricauda	22	35	0
Scenedesmus sp.	0	0	0
Selenastrum sp.	0	0	0
Staurastrum sp.	0	0	0
Stigeoclonium sp.*	0	0	0
Cryptophyta			
Chroomonas sp.	126	54	51
Cryptomonas sp.	36	5	14
Cyanophyta			
Chroococcus sp.	0	0	19
Oscillatoria planctonica*	0	0	0
Oscillatoria sp.*	0	0	0
Unidentified colony	0	0	0
Pyrrhophyta			
Ceratium hirundinella	4	0	0
Peridiniopsis sp.	0	0	0
Peridinium sp.	4	0	5
Miscellaneous			
Unidentified unicellular alga	0	0	0
Total Number of Cells	1274	891	896

Date: September 28, 1982
Station: Birchbank

Species	Replicates	
Chrysophyta		
Class Bacillariophyceae		
Achnanthes clevei	0	0
Achnanthes flexella	0	0
Achnanthes lanceolata	0	0
Achnanthes minutissima	27	27
Achnanthes sp.	0	0
Amphipleura pellucida	0	0
Asterionella formosa	22	16
Ceratoneis arcus	0	0
Ceratoneis arcus var. amphioxys	0	0
Cocconeis pediculus	0	0
Cocconeis placentula	0	0
Cyclotella bodanica	16	5
Cyclotella comta	0	0
Cyclotella glomerata	0	0
Cyclotella kuetzingiana	0	0
Cyclotella ocellata	0	0
Cyclotella stelligera	0	0
Cyclotella sp.	1822	1887
Cymbella affinis	0	0
Cymbella caespitosa	0	0
Cymbella cistula	0	0
Cymbella prostrata	0	0
Cymbella turgida	0	0
Cymbella ventricosa	0	0
Cymbella sp.	0	0
Denticula elegans	0	0
Diatoma elongatum	0	0
Diatoma hiemale	0	0
Diatoma hiemale var. quadratum	0	0
Diatoma vulgare	0	0
Diploneis decipiens	0	0
Epithemia sorex	0	0
Epithemia turgida	0	0
Eunotia pectinalis	0	0
Fragilaria capucina	0	0
Fragilaria construens	0	5
Fragilaria construens var. binodis	27	0
Fragilaria construens var. venter	0	0
Fragilaria crotonensis	135	65
Fragilaria leptostauron	0	0
Fragilaria vaucheriae	0	0
Gomphonema herculeanum	0	0
Gomphonema intricatum	0	0
Gomphonema olivaceum	0	0

Date: September 28, 1982 (Continued)
Station: Birchbank

Species	Replicates	
Gomphonema parvulum	0	0
Gomphonema sp.	0	16
Gyrosigma sciotense	0	0
Melosira granulata	0	0
Melosira granulata var. angustissima	0	0
Melosira varians	0	0
Meridion circulare	0	0
Navicula bicephala	0	0
Navicula cryptocephala	0	0
Navicula pelliculosa	0	0
Navicula pupula	0	0
Navicula radiosa	0	0
Navicula salinarum var. intermedia	0	0
Navicula tripunctata	0	0
Navicula sp.	0	0
Neidium sp.	0	0
Nitzschia acicularis	0	0
Nitzschia actinasteroides	0	0
Nitzschia dissipata	0	0
Nitzschia filiformis	0	0
Nitzschia linearis	0	0
Nitzschia palea	16	5
Nitzschia sigma	0	0
Nitzschia sp.	0	0
Rhizosolenia eriensis	5	5
Rhizosolenia sp.	0	0
Rhopalodia gibba	0	0
Rhopalodia gibberula	0	0
Stauroneis anceps	0	0
Stephanodiscus astraea	0	0
Stephanodiscus sp.	0	0
Synedra acus var. radians	0	0
Synedra angustata	0	0
Synedra ulna	5	0
Synedra ulna var. oxyrhynchus	0	0
Synedra sp.	0	0
Tabellaria fenestrata	0	0
Tabellaria flocculosa	0	0
Non-Diatom Chrysophyta		
Chromulina-like	0	0
Dinobryon bavaricum	0	0
Dinobryon sertularia	162	172
Mallomonas pseudocoronata	0	0
Mallomonas sp.	0	0
Ochromonas sp.	81	38

Date: September 28, 1982 (Continued)
Station: Birchbank

Species	Replicates	
Chlorophyta		
Ankistrodesmus falcatus	27	5
Carteria sp.	0	0
Chlamydomonas sp.	0	0
Cosmarium sp.	5	11
Crucigenia sp.	0	0
Elakatothrix gelatinosa	0	0
Elakatothrix sp.	0	0
Franceia sp.	0	0
Gemellicystis neglecta	0	0
Gemellicystis sp.	0	0
Gonium sp.	0	0
Lagerheimia sp.	0	0
Scenedesmus quadricauda	27	0
Scenedesmus sp.	0	0
Selenastrum sp.	0	0
Staurastrum sp.	0	0
Stigeoclonium sp.*	0	0
Cryptophyta		
Chroomonas sp.	189	97
Cryptomonas sp.	43	22
Cyanophyta		
Chroococcus sp.	5	22
*Oscillatoria planctonica**	0	259
Oscillatoria sp.*	0	0
Unidentified colony	0	0
Pyrrhophyta		
Ceratium hirundinella	0	0
Peridiniopsis sp.	0	0
Peridinium sp.	0	0
Miscellaneous		
Unidentified unicellular alga	0	0
Total Number of Cells	2614	2399

Date: September 28, 1982
Station: Waneta

Species	Replicates	
Chrysophyta		
Class Bacillariophyceae		
Achnanthes clevei	0	0
Achnanthes flexella	0	0
Achnanthes lanceolata	0	0
Achnanthes minutissima	16	27
Achnanthes sp.	0	0
Amphipleura pellucida	0	0
Asterionella formosa	27	11
Ceratoneis arcus	0	0
Ceratoneis arcus var. amphioxys	0	0
Cocconeis pediculus	0	0
Cocconeis placentula	0	0
Cyclotella bodanica	11	0
Cyclotella comta	0	0
Cyclotella glomerata	0	0
Cyclotella kuetzingiana	0	0
Cyclotella ocellata	0	0
Cyclotella stelligera	0	0
Cyclotella sp.	1703	1908
Cymbella affinis	0	0
Cymbella caespitosa	0	0
Cymbella cistula	0	0
Cymbella prostrata	0	0
Cymbella turgida	0	0
Cymbella ventricosa	5	5
Cymbella sp.	0	0
Denticula elegans	0	0
Diatoma elongatum	0	0
Diatoma hiemale	0	0
Diatoma hiemale var. quadratum	0	0
Diatoma vulgare	0	0
Diploneis decipiens	0	0
Epithemia sorex	0	0
Epithemia turgida	0	0
Eunotia pectinalis	0	0
Fragilaria capucina	32	32
Fragilaria construens	0	0
Fragilaria construens var. binodis	0	0
Fragilaria construens var. venter	0	0
Fragilaria crotonensis	81	65
Fragilaria leptostauron	0	0
Fragilaria vaucheriae	0	5
Gomphonema herculeanum	0	0
Gomphonema intricatum	0	0
Gomphonema olivaceum	0	0

Date: September 28, 1982 (Continued)
Station: Waneta

Species	Replicates	
Gomphonema parvulum	0	0
Gomphonema sp.	0	0
Gyrosigma sciotense	0	0
Melosira granulata	0	0
Melosira granulata var. angustissima	0	0
Melosira varians	22	16
Meridion circulare	0	0
Navicula bicephala	0	0
Navicula cryptocephala	0	0
Navicula pelliculosa	0	0
Navicula pupula	0	0
Navicula radiosa	0	0
Navicula salinarum var. intermedia	0	0
Navicula tripunctata	0	0
Navicula sp.	16	0
Neidium sp.	0	0
Nitzschia acicularis	0	0
Nitzschia actinasteroides	0	0
Nitzschia dissipata	0	0
Nitzschia filiformis	0	0
Nitzschia linearis	0	0
Nitzschia palea	5	5
Nitzschia sigma	0	0
Nitzschia sp.	0	0
Rhizosolenia eriensis	11	11
Rhizosolenia sp.	0	0
Rhopalodia gibba	0	0
Rhopalodia gibberula	0	0
Stauroneis anceps	0	0
Stephanodiscus astraea	0	0
Stephanodiscus sp.	0	0
Synedra acus var. radians	0	5
Synedra angustata	0	0
Synedra ulna	11	0
Synedra ulna var. oxyrhynchus	0	0
Synedra sp.	0	0
Tabellaria fenestrata	5	11
Tabellaria flocculosa	0	0
Non-Diatom Chrysophyta		
Chromulina-like	0	0
Dinobryon bavaricum	0	0
Dinobryon sertularia	183	124
Mallomonas pseudocoronata	0	0
Mallomonas sp.	11	5
Ochromonas sp.	38	5

Date: September 28, 1982 (Continued)
Station: Waneta

Species	Replicates	
Chlorophyta		
Ankistrodesmus falcatus	11	5
Carteria sp.	0	0
Chlamydomonas sp.	16	5
Cosmarium sp.	11	22
Crucigenia sp.	0	0
Elakatothrix gelatinosa	0	0
Elakatothrix sp.	0	0
Franceia sp.	0	0
Gemellicystis neglecta	0	0
Gemellicystis sp.	0	0
Gonium sp.	0	0
Lagerheimia sp.	0	0
Scenedesmus quadricauda	0	0
Scenedesmus sp.	0	0
Selenastrum sp.	0	0
Staurastrum sp.	0	0
Stigeoclonium sp.*	0	0
Cryptophyta		
Chroomonas sp.	124	86
Cryptomonas sp.	43	16
Cyanophyta		
Chroococcus sp.	0	0
*Oscillatoria planctonica**	0	0
Oscillatoria sp.*	0	0
Unidentified colony	0	0
Pyrrhophyta		
Ceratium hirundinella	0	0
Peridiniopsis sp.	0	0
Peridinium sp.	0	11
Miscellaneous		
Unidentified unicellular alga	0	0
Total Number of Cells	2382	2382

TABLE 45

Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River Basin in July, 1978.
+ denotes that algal group or species made up <10% of total algal volume examined
++ denotes that algal group or species made up 10-50% of total algal volume examined
+++ denotes that algal group or species made up >50% of total algal volume examined

Species	Birchbank July 26	Waneta July 16	Pend d'Oreille River, July 26 Sample 1	Pend d'Oreille River, July 26 Sample 2
Bacillariophyceae	++	++	++	+++
Chlorophyta				
Stigeoclonium sp.	-	+	-	-
Ulothrix sp.	++	++	+++	+
Unidentified filamentous	-	++	-	-
Cyanophyta				
Oscillatoria planctonica	+	-	-	-
Unidentified unicellular	++	-	++	++

TABLE 46

Percent numeric composition of periphytic diatoms collected from the Columbia River Basin in July, 1978.

+ denotes that number of cells was <10% of total cells enumerated
++ denotes that number of cells was 10-50% of total cells enumerated
+++ denotes that number of cells was >50% of total cells enumerated

Date: July 16, 1978
Station: Columbia River

Species	Birchbank Abundance	Waneta Abundance
Achnanthes clevei		+
Achnanthes minutissima	++	+
Amphora coffeaeformis	+	+
Amphora sp.	+	
Asterionella formosa	+	
Ceratoneis arcus	+	
Cyclotella glomerata		+
Cyclotella kuetzingiana		+
Cyclotella michiganiana	+	
Cyclotella ocellata		+
Cymbella caespitosa	+	+
Cymbella ventricosa	+	+
Diatoma elongatum	+	
Diatoma vulgare	+	
Fragilaria construens	+	+
Fragilaria construens var. *binodis*	++	+
Fragilaria crotonensis	+	+
Fragilaria leptostauron		+
Fragilaria vaucheriae	+	+
Gomphonema olivaceum	+	+
Navicula sp.	+	
Nitzschia acicularis		+
Nitzschia dissipata		+
Nitzschia frustulum	+	++
Nitzschia hantzschiana	+	
Nitzschia palea	+	++
Stephanodiscus tenuis	+	+
Synedra acus var. *radians*	+	+
Synedra ulna	+	
Number of Species	22	20

TABLE 46 (Continued)

Date: July 26, 1978
Station: Pend d'Oreille River

Species	Sample 1 Abundance	Sample 2 Abundance
Achnanthes lanceolata	+	+
Achnanthes microcephala	+	
Achnanthes minutissima	+	+
Achnanthes sp.	+	+
Amphora coffeaeformis		+
Asterionella formosa	+	+
Cocconeis pediculus	+	+
Cocconeis placentula	+	
Cyclotella glomerata	+	
Cyclotella ocellata	+	
Cymatopleura solea	+	
Cymbella caespitosa	+	+
Diatoma elongatum	+	+
Diatoma vulgare	+	+++
Epithemia sorex	+	
Epithemia turgida	+	
Fragilaria construens var. binodis	+	
Fragilaria construens var. venter	++	
Fragilaria crotonensis	+	
Fragilaria leptostauron	+	
Fragilaria vaucheriae	+	+
Gomphonema olivaceum	+	
Melosira granulata var. angustissima		+
Melosira varians	+	
Navicula sp.		+
Nitzschia dissipata	+	
Nitzschia frustulum	+	
Nitzschia linearis	+	
Nitzschia palea	+	+
Stephanodiscus astraea		+
Stephanodiscus tenuis	+	+
Synedra acus var. radians	+	+
Synedra ulna	++	++
Synedra ulna var. oxyrhynchus	+	+
Tabellaria fenestrata	+	
Number of Species	31	18

TABLE 47

Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River on April 2, 1981.
+ denotes that algal group or species made up <10% of total algal volume examined
++ denotes that algal group or species made up 10-50% of total algal volume examined
+++ denotes that algal group or species made up >50% of total algal volume examined

Species	Birchbank	Waneta
Bacillariophyceae	++	+
Chlorophyta		
Microspora sp.*	-	+++
Stigeoclonium sp.	+++	-
Cyanophyta		
Oscillatoria sp.	+	-

*With epiphytic diatom assemblage

TABLE 48

Percent composition (by volume) of diatom and non-diatom periphyton collected from the Columbia River at Waneta on June 22, 1982.
+ denotes that algal group or species made up <10% of total algal volume examined
++ denotes that algal group or species made up 10-50% of total algal volume examined
+++ denotes that algal group or species made up >50% of total algal volume examined

Species	Sample 1	Sample 2	Sample 3
Bacillariophyceae	++	++	++
Chlorophyta			
Stigeoclonium sp.	-	+	-
Ulothrix zonata	++	+++	+++
Ulothrix sp.	+	+	++

TABLE 49

Percent numeric composition of periphytic diatoms collected from the Waneta station on June 22, 1982.

+ denotes that number of cells was <10% of total cells enumerated
++ denotes that number of cells was 10-50% of total cells enumerated
+++ denotes that number of cells was >50% of total cells enumerated

Date: June 22, 1982
Station: Waneta

Species	Sample 1 Abundance	Sample 2 Abundance	Sample 3 Abundance
Achnanthes lanceolata	+	+	+
Achnanthes minutissima	++	+	++
Asterionella formosa		+	
Ceratoneis arcus	+	+	+
Cocconeis placentula	+		
Cocconeis sp. A			+
Cyclotella sp. A	+		+
Cyclotella sp. B		+	
Cymbella affinis		+	
Cymbella sinuata		+	+
Cymbella ventricosa	+	+	+
Diatoma elongatum	+		
Diatoma hiemale var. quadratum		+	
Diatoma vulgare	+	+	
Fragilaria capucina			+
Fragilaria construens var. binodis	+	++	
Fragilaria construens var. venter	+	++	++
Fragilaria crotonensis	+	+	+
Fragilaria leptostauron	++	+	+
Fragilaria pinnata	+		
Fragilaria vaucheriae	++	++	++
Navicula salinarum var. intermedia			+
Nitzschia dissipata	+	+	+
Nitzschia palea	+	+	+
Rhizosolenia eriensis		+	
Synedra ulna	++	++	+
Tabellaria fenestrata			+
Number of Species	17	19	17

C. CONCENTRATIONS OF METALS AND COMPOSITION OF PHYTOPLANKTON IN SAMPLES COLLECTED ON AUGUST 11, 1980 AND SEPTEMBER 17, 1980 FROM KOOTENAY RIVER AND COLUMBIA RIVER DOWNSTREAM OF HUGH KEENLEYSIDE DAM

TABLE 50a

Concentrations (mg/L) of metals in the Kootenay River on August 11, 1980

Metal	Replicates			Mean	S.D.	Geom. Mean	G.F.
Extractable Zn	.004	.003		.004	.001	.004	1.226
Dissolved Zn	.004	.003	.002	.003	.001	.003	1.417
Extractable Cu	.002	.002		.002	0	.002	1.000
Dissolved Cu	.002	L.001	L.001	L.001	L.001	.001	1.492
Extractable Fe	.028	.022		.025	.004	.025	1.186
Dissolved Fe	.005	.006	.005	.005	.001	.005	1.111
Extractable Mn	L.01	L.01		L.01	0	L.01	1.000
Dissolved Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Extractable Cd	L.0005	L.0005		L.0005	0	L.0005	1.000
Dissolved Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Extractable Pb	.001	.001		.001	0	.001	1.000
Dissolved Pb	.001	L.001	L.001	L.001	0	L.001	1.000
Extractable Ni	L.001	L.001		L.001	0	L.001	1.000
Dissolved Ni	L.001	L.001	L.001	L.001	0	L.001	1.000

TABLE 50b

Concentrations (mg/L) of metals in the Columbia River downstream from the Hugh Keenleyside Dam on August 11, 1980

Metal	Replicates			Mean	S.D.	Geom. Mean	G.F.
Extractable Zn	.003	L.001	.002	.002	.001	.002	1.743
Dissolved Zn	.007	.010	.003	.007	.004	.006	1.856
Extractable Cu	.001	.001	.003	.002	.001	.001	1.886
Dissolved Cu	.002	.002	L.001	.002	.001	.002	1.492
Extractable Fe	.027	.018	.013	.019	.007	.018	1.442
Dissolved Fe	.004	.005	.006	.005	.001	.005	1.225
Extractable Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Dissolved Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Extractable Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Dissolved Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Extractable Pb	L.001	L.001	.001	L.001	0	L.001	1.000
Dissolved Pb	.002	.001	L.001	.001	.001	.001	1.492
Extractable Ni	L.001	.001	.001	.001	0	.001	1.000
Dissolved Ni	.002	.001	L.001	.001	.001	.001	1.492

TABLE 50c

Concentrations (mg/L) of metals in the Kootenay River on September 17, 1980

Metal	Replicates			Mean	S.D.	Geom. Mean	G.F.
Extractable Zn	L.001	.001	.001	.001	0	.001	1.000
Dissolved Zn	.002	.002	.001	.002	.001	.002	1.492
Extractable Cu	L.001	.001	L.001	L.001	0	L.001	1.000
Dissolved Cu	L.001	L.001	.003	.002	.001	.001	1.886
Extractable Fe	.026	.025	.023	.025	.002	.025	1.065
Dissolved Fe	.029	.004	.004	.012	.014	.008	3.139
Extractable Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Dissolved Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Extractable Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Dissolved Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Extractable Pb	L.001	.001	.001	.001	0	.001	1.000
Dissolved Pb	L.001	.002	L.001	.001	.001	.001	1.492
Extractable Ni	L.001	L.001	L.001	L.001	0	L.001	1.000
Dissolved Ni	L.001	L.001	L.001	L.001	0	L.001	1.000
Extractable Hg*	L.05	L.05	L.05	L.05	0	L.05	1.000
Extractable As	.0003	.0004	.0003	.0003	0	.0003	1.181
Extractable Se	.0001	.0001	.0001	.0001	0	.0001	1.000

*Concentration in μg/L

TABLE 50d

Concentrations (mg/L) of metals in the Columbia River downstream from the Hugh Keenleyside Dam on September 17, 1980

Metal	Replicates			Mean	S.D.	Geom. Mean	G.F.
Extractable Zn	L.001	L.001	L.001	L.001	0	L.001	1.000
Dissolved Zn	L.001	L.001	L.001	L.001	0	L.001	1.000
Extractable Cu	L.001	L.001	L.001	L.001	0	L.001	1.000
Dissolved Cu	.001	.002	L.001	.001	.001	.001	1.492
Extractable Fe	.003	.005	.005	.004	.001	.004	1.343
Dissolved Fe	.045	.029	.001	.025	.022	.011	8.025
Extractable Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Dissolved Mn	L.01	L.01	L.01	L.01	0	L.01	1.000
Extractable Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Dissolved Cd	L.0005	L.0005	L.0005	L.0005	0	L.0005	1.000
Extractable Pb	L.001	.001	.001	.001	0	.001	1.000
Dissolved Pb	.001	L.001	L.001	L.001	0	L.001	1.000
Extractable Ni	L.001	L.001	L.001	L.001	0	L.001	1.000
Dissolved Ni	L.001	L.001	L.001	L.001	0	L.001	1.000
Extractable Hg*	L.05	L.05	L.05	L.05	0	L.05	1.000
Extractable As	.0001	.0001	.0001	.0001	0	.0001	1.000
Extractable Se	L.0001	L.0001	L.0001	L.0001	0	.0001	1.000

*Concentration in μg/L

Table 51a

Concentrations of phytoplankton species (cells/ml) collected from the Kootenay River on August 11, 1980. Concentrations of filamentous species (indicated by *) are expressed as mm/ml. Filamentous species are not included in total count of cells.

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes minutissima	0	0	3
Asterionella formosa	61	33	135
Cyclotella sp.	0	8	8
Diatoma elongatum	11	14	33
Diploneis decipiens	0	0	3
Fragilaria construens var. *binodis*	44	0	0
Fragilaria crotonensis	1154	182	328
Fragilaria vaucheriae	39	3	0
Navicula sp.	0	11	0
Nitzschia palea	0	0	6
Rhizosolenia eriensis	0	11	0
Synedra acus var. *radians*	6	6	6
Synedra ulna	50	25	11
Tabellaria fenestrata	33	8	11
Non-Diatom Chrysophyta			
Dinobryon sertularia	0	33	0
Mallomonas pseudocoronata	0	8	0
Ochromonas sp.	132	232	400
Chlorophyta			
Ankistrodesmus falcatus	77	44	28
Cosmarium sp.	0	6	6
Elakatothrix gelatinosa	0	0	6
Gemellicystis neglecta	0	22	0
Cryptophyta			
Chroomonas sp.	166	359	582
Cryptomonas sp.	17	22	6
Cyanophyta			
*Oscillatoria planctonica**	1766	386	911
Pyrrhophyta			
Peridinium sp.	0	3	0
Total Count	1788	1029	1570

Table 51b

Concentrations of phytoplankton species (cells/ml) collected from the Columbia River downstream from the Hugh Keenleyside Dam on August 11, 1980.

Species	Replicates		
Chrysophyta			
Class Bacillariophyceae			
Achnanthes minutissima	3	0	2
Asterionella formosa	8	44	35
Cyclotella sp.	3	3	5
Cymbella ventricosa	0	0	<1
Diploneis decipiens	<1	0	0
Fragilaria construens var. *binodis*	49	6	9
Fragilaria crotonensis	38	29	33
Fragilaria vaucheriae	0	1	0
Navicula sp.	0	4	0
Nitzschia acicularis	<1	0	0
Synedra ulna	1	0	2
Tabellaria fenestrata	2	0	0
Non-Diatom Chrysophyta			
Dinobryon sertularia	8	4	17
Ochromonas sp.	0	9	0
Chlorophyta			
Elakatothrix gelatinosa	<1	0	0
Cryptophyta			
Chroomonas sp.	12	21	51
Cryptomonas sp.	17	2	4
Pyrrhophyta			
Peridinium sp.	2	7	8
Total Count	145	129	165

REFERENCES

Battarbee, R.W. 1973. A new method for the estimation of absolute microfossil numbers, with reference especially to diatoms. Limnol. Oceanogr. 18:647-653.

Bourrelly, P. 1966-1970. Les Algues d'Eau Douce. N. Boubée et Cie, Paris. 3 vol.

Cleve-Euler, A. 1951-1955. Die Diatomeen von Schweden und Finnland. Kungl. Svenska Vetensk. Handl. Ns. 2i(1951), 3iii(1952), 4i(1953), 4v(1953), 5iv(1955).

Davis, J. and J. DeCosta. 1980. The use of algal assays and chlorophyll concentrations to determine fertility of water in small impoundments in West Virginia. Hydrobiologia, 71:19-34.

Dobolyi, E. and V. Ördög. 1981. Determination of the limiting plant nutrient in the water of Lake Balaton by algal assay procedure. Int. Revue ges. Hydrobiol., 66(6):889-893.

Gerhold, R.M. 1975. Algal Nutritional bioassays of Lake Wylie, North Carolina. In: E.J. Middlebrooks, D.H. Falkenborg and T.E. Maloney, eds. Biostimulation and Nutrient Assessment Workshop Proceedings, Utah State University, Logan, Utah. pp. 175-220.

Gerhold, R.M. and R.G. Otto. 1976. Algal bioassays to evaluate a proposed cooling lake. Journal WPCF, 48(10):2351-2366.

Greene, J.C., W.E. Miller, T. Shiroyama and T.E. Maloney. 1975a. Utilization of algal assays to assess the effects of municipal, industrial, and agricultural wastewater effluents upon phytoplankton production in the Snake River system. Water, Air, and Soil Pollution 4:415-434.

Greene, J.C., R.A. Soltero, W.E. Miller, A.F. Gasperino and T. Shiroyama. 1975b. The relationship of laboratory algal assays to measurements of indigenous phytoplankton in Long Lake, Washington. In: E.J. Middlebrooks, D.H. Falkenborg and T.E. Maloney, eds. Biostimulation and Nutrient Assessment Workshop Proceedings, Utah State University, Logan, Utah. pp. 93-126.

Greene, J.C., W.E. Miller, T. Shiroyama, R.A. Soltero and K. Putnam. 1978. Use of laboratory cultures of Selenastrum, Anabaena and the indigenous isolate Sphaerocystis to predict effects of nutrient and zinc interactions upon phytoplankton growth in Long Lake, Washington. Mitt. Internat. Verein. Limnol. 21:372-384.

Grizzard, T.J., R.N. Waterman, C.W. Randall and R.C. Hoehn. 1980. The stimulation of autotrophic production by urban stormwater-borne nutrients. Prog. Wat. Tech., 12:883-896.

Hasle, G.R. and G.A. Fryxell. 1970. Diatoms: cleaning and mounting for light and electron microscopy. Trans. Am. Micros. Soc., 89:469-474.

Huber-Pestalozzi, G. 1938-1972. Das Phytoplankton des Süsswassers. In: A. Thienenmann ed. Die Binnengewässer. 16 (1, 2.1, 3, 4, 5, 6). E. Schweizerbart. Verlags., Stuttgart.

Huber-Pestalozzi, G. 1942. Das Phytoplankton des Süsswassers. pp. 342-549 In: A. Thienenmann ed. Die Binnengewässer. 16 (2:2). Diatomeen. E. Schweizerbart. Verlags., Stuttgart.

Hustedt, F. 1930. Bacillariophyta (Diatomeae) In: A. Pascher ed. Die Süsswasser-flora Mitteleuropas. 10. Gustav Fischer, Jena.

Hustedt, F. 1930-1966. Die Kieselalgen. In: L. Rabenhorst (ed.) Kryptogamen - Flora von Deutschland, Österreich und der Schweiz. 7(1-3). Akad. Verlags. Leipzig.

Inland Waters Directorate, Water Quality Branch. 1983a. NAQUADAT dictionary of parameter codes. Available from: Data Systems Section, Water Quality Branch, Ottawa, Canada.

Inland Waters Directorate, Water Quality Branch. 1983b. Sampling for water quality. Available from: Water Quality Branch, Ottawa, Canada.

Inland Waters Directorate, Water Quality Branch. 1979. Analytical methods manual. Available from: Water Quality Branch, Ottawa, Canada.

Markee, T.P., D.A. Bahnick, D.J. Call and L.T. Brooke. 1982. Assessment of surface water quality at selected Northwestern Wisconsin sites by combined biological and chemical techniques. Technical Completion Report Project Number A-086-WIS, Madison Wisconsin.

Miller, W.E., T.E Maloney and J.C. Greene. 1974. Algal productivity in 49 lake waters as determined by algal assays. Wat. Res., 8:667-679.

Miller, W.E., J.C. Greene and T. Shiroyama. 1975. Application of algal assays to define the effects of wastewater effluents upon algal growth in multiple use river systems. In: E.J. Middlebrooks, D.H. Falkenborg and T.E. Maloney, eds. Biostimulation and Nutrient Assessment Workshop Proceedings, Utah State University, Logan, Utah. pp. 77-92.

Miller, W.E., J.C. Greene and T. Shiroyama. 1976. Use of Algal Assays to define trace-element limitation and heavy metal toxicity. In:

Proceedings of the Symposium on Terrestial and Aquatic Ecological Studies of the Northwest, March 26-27, 1976. pp. 317-325.

Miller, W.E., J.C. Greene and T. Shiroyama. 1978. The Selenastrum capricornutum Printz algal assay bottle test. U.S. Environmental Protection Agency, Corvallis, Oregon. EPA-600/9-78-018.

Olive, J.H. and G. Higgins. 1981. Algal bioassay of the Portage Lakes, Summit County, Ohio. Environ. Pollut. Ser. A, 26:59-67.

Parr, M.P. and R.V. Smith. 1976. The identification of phosphorus as a growth-limiting nutrient in Lough Neagh using bioassays. Wat. Res., 10:1151-1154.

Patrick, R., and C.W. Reimer. 1966-1975. The diatoms of the United States, exclusive of Alaska and Hawaii. Acad. Nat. Sci. Philadelphia, Monogr. 13. 2 vol.

Perry, W.B. and J.A. Stanford. 1982. Algal growth stimulus by phosphorus in Flathead Lake, Montana, sediments. Northwest Science, 56(1):48-52.

Prescott, G.W. 1962. Algae of the Western Great Lakes Area. Wm. C. Brown Co. Inc., Dubuque, Iowa.

Ram, N.M. and S. Plotkin. 1983. Assessing aquatic productivity in the Housatonic River using the Algal Assay: Bottle Test. Wat. Res., 17(9):1095-1106.

Sheehan, S.W. and M. Lamb. (in prep.) Water chemistry of the Columbia and Pend D'Oreille Rivers near the International Boundary (Data Report).

Sreenivasa, M.R. and H.C. Duthie. 1973. Diatom flora of the Grand River, Ontario, Canada. Hydrobiol. 42:161-224.

Turbak, S.C., S.B. Olson and G.A. McFeters. 1986. Comparison of algal assay systems for detecting waterborne herbicides and metals. Wat. Res., 20(1):91-96.

Utermöhl, H. 1958. The improvement of quantitative phytoplankton methodology. Mitt. Internat. Verein. Limnol. 9:1-39. (Transl. from German). Fish. Res. Board. Can. Transl. Ser. 2713.

Van Landingham, S.L. 1967-79. Catalogue of the fossil and recent genera and species of diatoms and their synonyms. J. Cramer, Lehre. 8 vol.

Weber, C.I. 1966. A guide to the common diatoms at water pollution surveillance system stations. U.S. Environmental Protection Agency, Cincinnati, Ohio.