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FATE, DISTRIBUTION AND LIMNOLOGICAL EFFECTS OF VOLCANIC TEPHRA IN THE ST. JOE AND COEUR D' ALENE RIVER DELTAS OF LAKE COEUR D' ALENE, IDAHO

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ABSTRACT

The purpose of this research was to determine the effects of the tephra (volcanic ash) fallout from the May 18, 1980 eruption of Mt. St. Helens on a lake-river system 200-300 miles east of the volcano. Lake Coeur d'Alene in northern Idaho was chosen for the study as a water system which would reflect the more subtle impacts of ash fallout in contrast to the immediate and devastating impact to lakes and streams near the volcano.

The specific objectives were to quantify and identify volcanic ash in the lake sediments and water columns, describe chemical conditions in the sediments and water columns, and to assess the effects of volcanic tephra on the benthic, phytoplankton, and zooplankton communities.

The ash layer was relatively uniform in thickness throughout the lake and delta sediments. Sediments deposited over the initial ash layer contained only small quantities of ash. The ash layer in the lake sediments and throughout the watershed was stable and not easily resuspended or eroded. The volcanic tephra was chemically inert and had no measurable impact on water chemistry or nutrient enrichment. Benthic and planktonic communities were unchanged relative to pre-ash conditions.

INTRODUCTION

Lake Coeur d'Alene has a surface area of 120 Km^2 and is the second largest lake in Idaho. The lake is drained by the Spokane River at Coeur d'Alene, Idaho and fed by two major streams, the Coeur d'Alene and St. Joe Rivers, both draining the west slopes of the Bitterroot Mountains (Figure 1).

Lake Coeur d'Alene and its tributaries were in the path of the highest quantity of tephra fallout from the May 18, 1980 eruption of Mt. St. Helens (Figure 2). The lake is more than 400 Km (250 air miles) east of Mt. St. Helens and was chosen as a drainage which would reflect the more subtle effects of ash fallout in contrast to the immediate and devastating impact to lakes and streams near the volcano. The lower Coeur d'Alene and St. Joe Rivers, flood plain lakes, and river deltas in Lake Coeur d'Alene were expected to act as settling basins for tephra runoff from the large St. Joe and Coeur d'Alene River drainages. This large water system is important to the economy of northern Idaho through its recreation and fisheries value.

The purpose of this study was to measure the quantities and distribution of volcanic ash (tephra) from the May 18, 1980 eruption of Mt. St. Helens which was deposited in Lake Coeur d'Alene, its river deltas and flood plain lakes, and to measure the effect of sedimented and suspended ash on the aquatic communities. The following is a description of the three specific objectives:

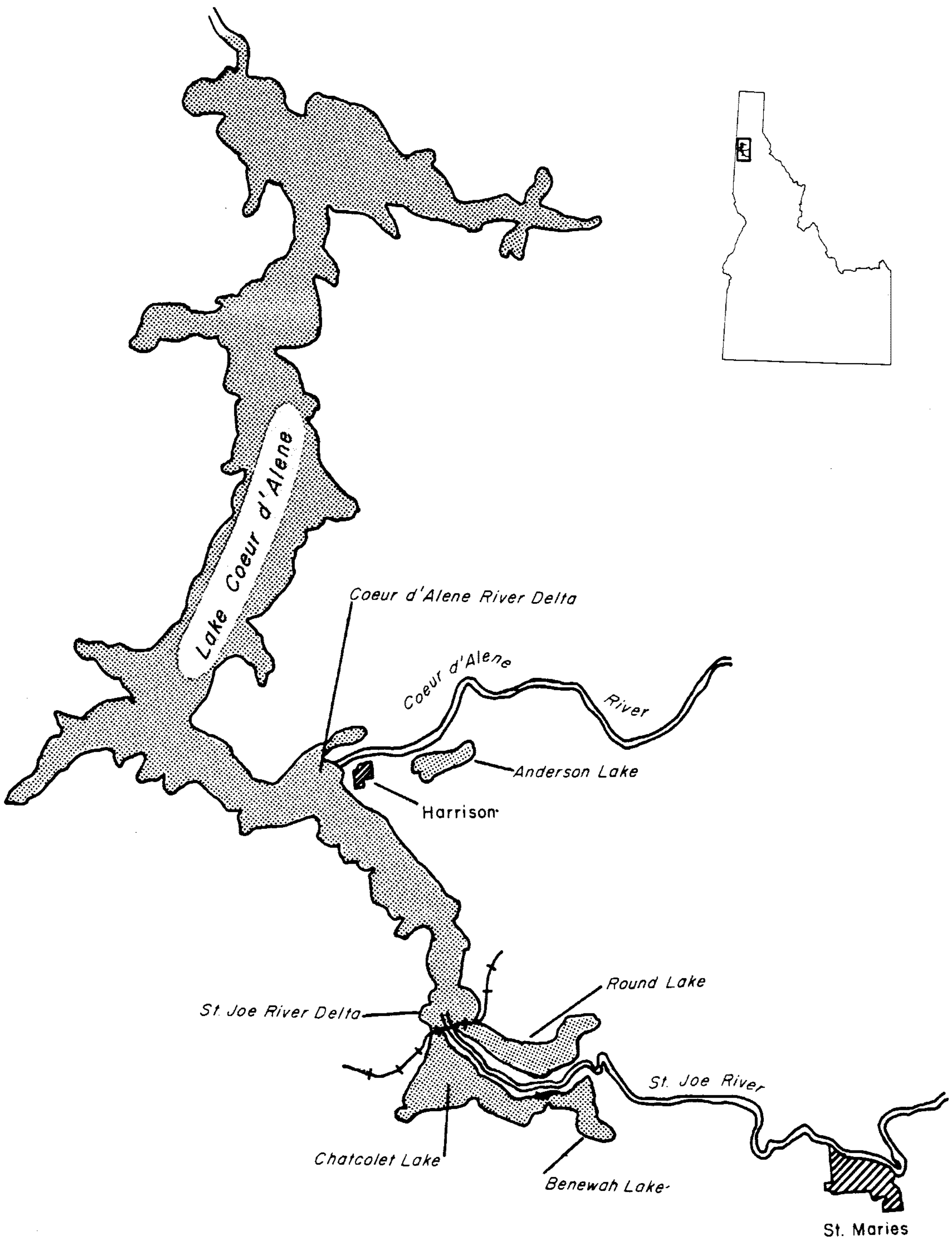


Figure 1. Map of the study area indicating the location of Lake Coeur d' Alene in Idaho and the positions of the deltas, rivers, and lakes.

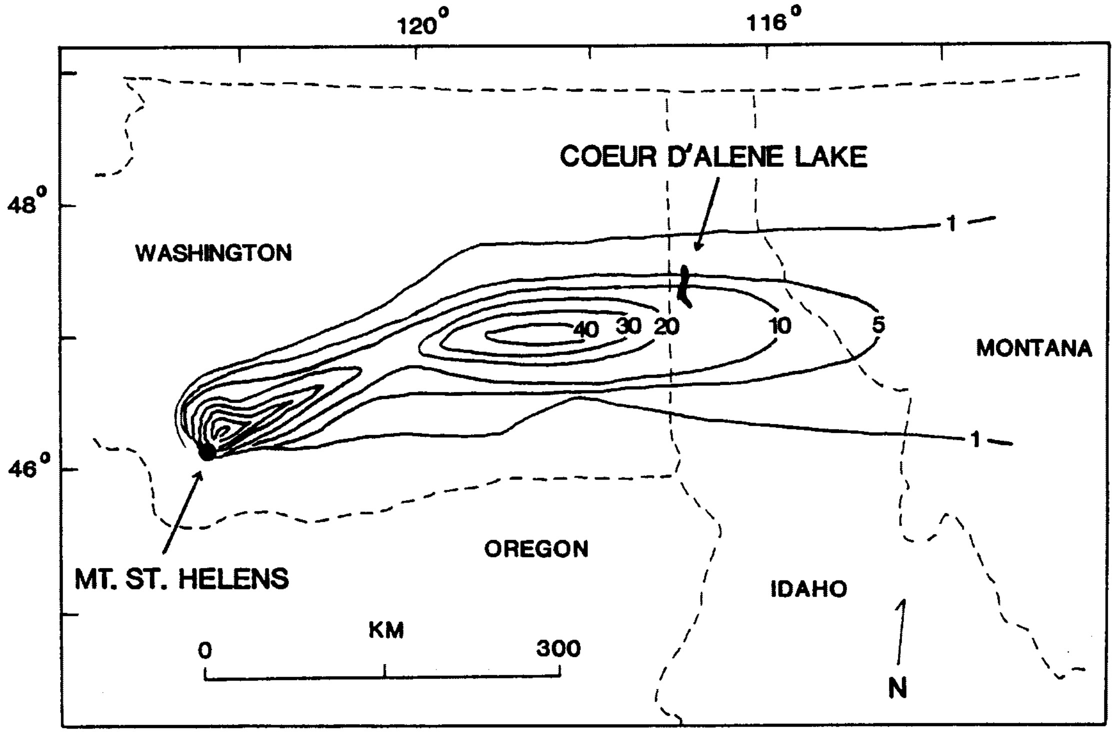


Figure 2. Map of Pacific Northwest, showing ashfall isopleths (mm) and location of Coeur d'Alene Lake (adapted from Sarna-Wojcicki et al. 1981).

Objective I:

To quantify and identify volcanic tephra in the sediments and water columns of:

a. Lake Coeur d'Alene

b. lower Coeur d'Alene and St. Joe Rivers

c. deltas of the rivers in Lake Coeur d'Alene

d. channel (flood plain) lakes on the rivers

Objective II:

To describe the chemical conditions in the sediments and in the water columns throughout the river-lake system

Objective III:

To assess the spatial differences of the following communities in the sediments and water column over ranges of volcanic tephra accumulation through the system:

a. benthic invertebrate community

b. phytoplankton community

c. zooplankton community

This study was a two-year study with field work beginning in June of 1981 and continuing through the fall of 1982. The United States Congress initiated a bill to fund water quality research in June, 1980, immediately after the eruption. The first pre-proposal for this study was submitted on August 15, 1980 and the study was funded June 1, 1981.

METHODS

Previous research with tephra in streams and lakes is limited. Much of the work in this study had not been done before and methods had to be developed as the study progressed. The water chemistry and aquatic organism sampling was done using standard procedures and equipment (APHA, 1980 and USGS, 1973). The following is a list of parameters and a description of the methods used to measure each parameter:

Parameter	Method
Thickness and distribution of primary (May 18, 1980) tephra layer.	Twenty-four inch by 2 1/2 inch diameter cores were taken at each sample site using a 50 pound deep-water core sampler. Measurements were made to the nearest eighth inch.
Thickness and distribution of sediment deposited over the primary tephra layer.	Locations and methods were the same as those used to measure the primary tephra layer.
Percent organic in pre-ash and post-ash sediment layers.	Core samples were separated and 2-3 cubic centimeters were taken from above and below the tephra layer. These samples were dried at 105°C, weighed, then ashed at 500°C in a muffle furnace.
Suspended tephra in the water column as a percent of total particles.	Water samples were collected with a Kemmerer bottle. Fifty milliliters were filtered through a .45µm Millipore filter. The filter was dried and made transparent with immersion oil. The particles were then counted under an 800X microscope. Glass particles were identified using polarized light.
Sedimented tephra in the post-ash layer as a percent of total particles.	Core samples were separated into layers and glass particles were counted under a microscope using polarized light.
Percent tephra of parent sediment (pre-ash layer) as a percent of total particles.	Methods were the same as those used to quantify glass particles in the post-ash layer. Less than one percent of glass is assumed to be from eruptions other than Mt. St. Helens, May 18, 1980.

Parameter	Methods
Physical characteristics of tephra in the primary sedimented layer.	Bottom cores were subsampled. Particle size analyses were done using sieves for particles greater than 0.053 mm and a Coulter Counter for particles down to 0.0079 mm. A microscopic petrographic analysis was used to describe the morphology, minerology, and refractive indices of glass and phenocrysts.
Physical characteristics of tephra in the post-ash layer.	A petrographic analysis including morphology, minerology and refractive indices of glass and phenocrysts was done on selected samples.
Chemical characteristics of tephra in the primary tephra layer to identify tephra as Mt. St. Helens, May 18, 1980.	Electron microprobe analysis of core subsamples.
Chemical characteristics of tephra in the post-ash layer.	Electron microprobe analysis of core subsamples.
Chemical composition of the primary sedimented and terrestrial tephra including these ions: Zn, Cd, Pb, Cu, Fe, Ca, Mg, Na, K, Mo, As, Si, NO_2, NO_3, NH_4, PO_4.	Measurements were made on water leachate samples at the University of Idaho, Soil Chemistry Lab.
Concentrations of the heavy metals Zn, Pb, and Cd in the pre-ash sediments.	Acid leachate analyses were done at the University of Idaho, Soil Chemistry Lab.
Concentrations of the heavy metals Zn, Pb, and Cd in the water columns.	Water samples were collected near the lake bottoms and analyzed at the University of Idaho, Soil Chemistry Lab.
Water column chemistry including: - temperature - turbidity - pH - dissolved oxygen - redox potential of sediments	Samples were collected with a Kemmerer bottle at surface 2m, 5m, 10m and 1m off the bottom at deep water stations and at 2m and 1m off the bottom at shallow and river sites. Temperature, pH, dissolved oxygen and redox were measured with probes. Turbidity was measured with a Hach Turbidimeter.
Secchi disc transparency.	A standard size Secchi disc was used to measure light penetration to the nearest one-tenth of a meter.

Parameter	Methods
Primary production rates.	In 1981 the oxygen light-and-dark-bottle method was used. In 1982 the carbon-14 light-and-dark-bottle method was used. Initially production was measured at several depths to establish a production curve. Subsequent measurements were made at 1m and 3m. A photometer was used to measure available light.
Phytoplankton species composition and quantification.	Phytoplankton were sampled in conjunction with water chemistry. A composite sample was collected from the surface, 2m, and 5m with a Kemmerer bottle and preserved with Lugol's solution. Samples were settled and identification and counts were made with an inverted microscope.
Zooplankton species composition and quantification.	Oblique tows were made with a Miller plankton net. Samples were preserved in formalin for later counting and identification.
Benthic invertebrate composition and quantification.	The benthic community was sampled with a deep-water core sampler. Five cores in river stations and 10 cores in lake stations were pooled. Organisms were separated from sediments using a screened bottom benthos bucket. Samples were preserved in formalin.
Benthos vertical distribution.	An in-site experiment was conducted by graduate student Will Kendra. His methods are discussed in the section on benthos distribution.

The measurement of each parameter meets a slightly different objective. Therefore, not all parameters were measured at each sample site nor were all parameters measured on each sample date. Table 1 describes when and where each parameter was measured.

Sixteen sample sites, representing a wide range of water conditions, were chosen (Figure 3 and Table 2). Habitat types include deep lake,

TABLE 1
LOCATION AND FREQUENCY OF MEASUREMENTS
OF EACH PARAMETER IN THE STUDY

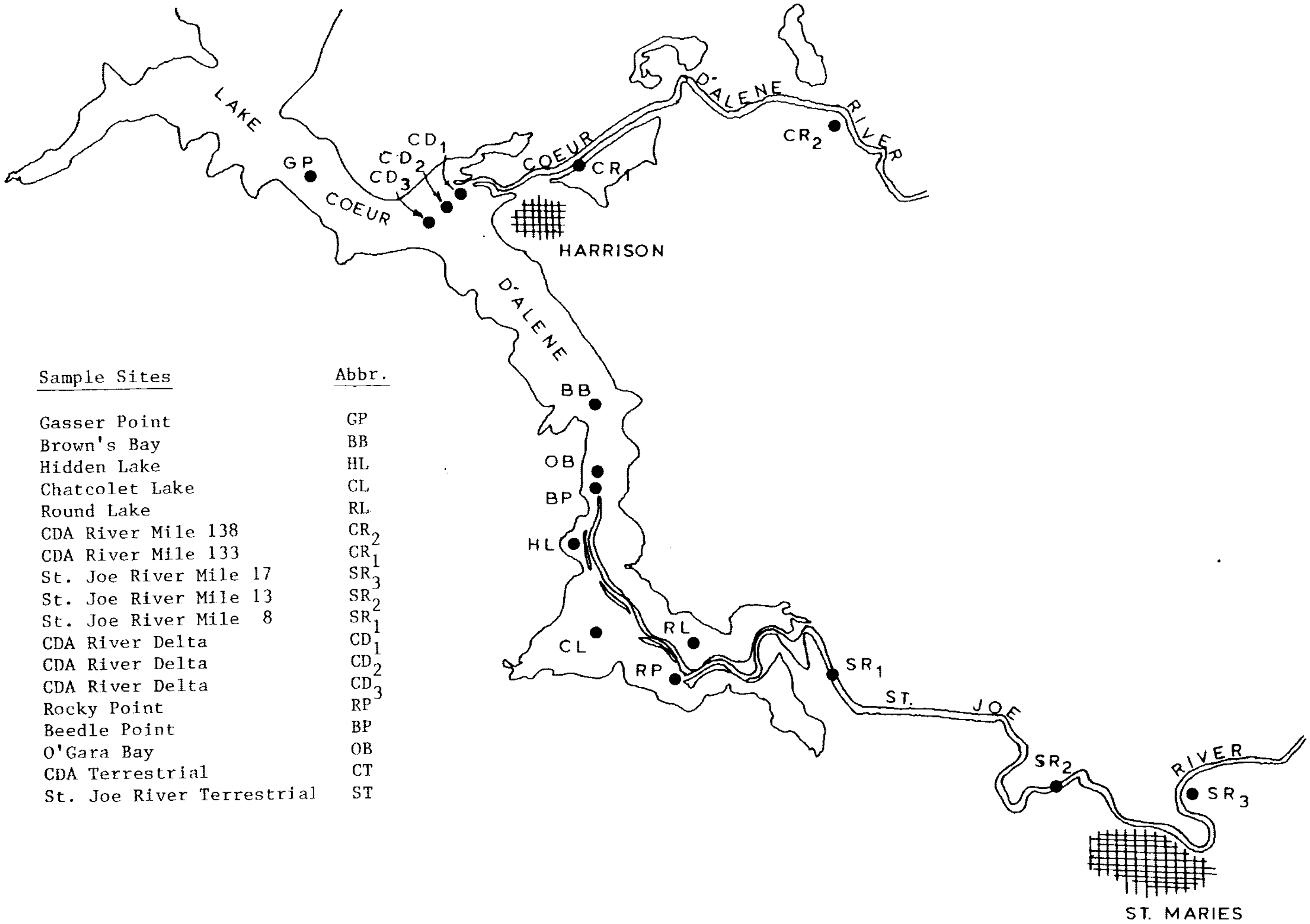
Parameters	Where Sampled	When Sampled
Ash thickness and distribution.	24 lake and river locations 2 terrestrial sites	Fall, 1981 Fall, 1982
Post-ash thickness and distribution.	24 lake and river locations 2 terrestrial sites	Fall, 1981 Fall, 1982
Percent organic in pre- and post-ash sediment.	24 lake and river locations	Fall, 1981 Fall, 1982
Suspended tephra in the post-ash layer.	All 16 sites; 1 sample at 2m depth and 1 sample at 1m above bottom.	Biweekly during the summers of 1981-1982
Sedimented tephra in the post-ash layer.	24 lake and river locations plus two sites in CDL delta.	Fall, 1981 Fall, 1982
Percent tephra of parent sediment.	One sample at each of these sites: - St. Joe River terrestrial - CDL River terrestrial - Gasser Point (deep) - Brown's Bay (deep) - Chatcolet Lake (deep) - CDL delta I - CDL delta II - CDL delta III	Fall, 1981 Fall, 1982
Physical characteristics of tephra in the primary layer.	Same 8 sites as listed for % tephra of parent sediment.	Fall, 1981 Fall, 1982
Physical characteristics of tephra in the post-ash layer.	3 Coeur d'Alene delta sites	Fall, 1981 Fall, 1982

TABLE 1 (Continued):

Parameters	Where Sampled	When Sampled
Chemical characteristics of tephra in the primary layer.	Same 8 sites as listed for % tephra of parent sediment.	Fall, 1981 Fall, 1982
Chemical characteristics of tephra in the post-ash layer.	3 Coeur d'Alene delta sites	Fall, 1981 Fall, 1982
Chemical composition of the primary tephra layer.	15 sites (only the deep of deep-shallow pairs) excluding CDL I; 2 terrestrial sites; initial fallout sample from Plummer, Idaho (May 18, 1980).	Fall, 1981
Zn, Pb, and Cd in pre-ash sediments.	Gasser Point (deep) Brown's Bay (deep) CDL delta I CDL delta III CDL River mile 133 St. Joe River mile 8	Spring & Fall, 1981 Spring & Fall, 1982
Zn, Pb, and Cd in the water column (1m off bottom).	Gasser Point (deep) Brown's Bay (deep) CDL delta I CDL delta III CDL River mile 133 St. Joe River mile 8	Spring & Fall, 1981 Spring & Fall, 1982
Water column chemistry.	Profiles at all 16 sample sites.	Biweekly during the summers of 1981-1982
Secchi disc transparency.	At all 16 sample sites.	Biweekly during the summers of 1981-1982
Primary production rates.	Chatcolet Lake O'Gara Bay CDL delta III CDL River mile 133 St. Joe River mile 13	Monthly during the summers of 1981-1982

TABLE 1 (Continued):

Parameters	Where Sampled	When Sampled
Phytoplankton species composition and quantification.	All 16 sample sites.	Biweekly during the summers of 1981-1982
Zooplankton species composition and quantification.	All 16 sample sites.	Biweekly during the summers of 1981-1982
Benthic invertebrate composition and quantification.	All 16 sample sites plus shallow water sites at Gasser Point, Brown's Bay, O'Gara Bay, and Beedle Point.	Biweekly during the summers of 1981-1982
Benthos vertical distribution study.	Chatcolet Lake (shallow)	Monthly during June through October, 1982



Sample Sites	Abbr.
Gasser Point	GP
Brown's Bay	BB
Hidden Lake	HL
Chatcolet Lake	CL
Round Lake	RL
CDA River Mile 138	CR$_2$
CDA River Mile 133	CR$_1$
St. Joe River Mile 17	SR$_3$
St. Joe River Mile 13	SR$_2$
St. Joe River Mile 8	SR$_1$
CDA River Delta	CD$_1$
CDA River Delta	CD$_2$
CDA River Delta	CD$_3$
Rocky Point	RP
Beedle Point	BP
O'Gara Bay	OB
CDA Terrestrial	CT
St. Joe River Terrestrial	ST

Figure 3. Coeur d'Alene Lake study area showing sampling site locations.

Table 2. Names of sample sites and their abbreviations.

Lakes:	Deep	Shallow	Channel
Gasser Point	GP_1	GP_2	
Brown's Bay	BB_1	BB_2	
Hidden Lake	HL_1	HL_2	HL_3
Chatcolet Lake	CL_1	CL_2	
Round Lake	RL_1	RL_2	RL_3
Coeur d'Alene River:			
CDL RM 138	CR_2	--	
CDL RM 133	CR_1	--	
St. Joe River:			
St. Joe RM 17	SR_3	--	
St. Joe RM 13	SR_2	--	
St. Joe RM 8	SR_1	--	
Coeur d'Alene Delta:			
CDL I	CD_1	--	
CDL II	CD_2	--	
CDL III	CD_3	--	
St. Joe Delta:			
Rocky Point	RP_1	RP_2	
Beedle Point	BP_1	BP_2	
O'Gara Bay	OB_1	OB_2	
Coeur d'Alene River Terrestrial	CT		
St. Joe River Terrestrial	ST		

flood plain lake, Coeur d'Alene River, Coeur d'Alene Delta, St. Joe River and St. Joe Delta. Sampling was concentrated in the deltas and flood plain lakes where more ash was expected to accumulate. Some parameters were measured at additional shallow water sites to make a total of 24 sample sites. Sediment depth and ash distribution were measured over a large area by taking several cores at each site. In most cases coring was done along a transect which passed through a sample site but extended up to a mile in length. In addition, a terrestrial (dry land) site was located near the Coeur d'Alene River and another near the St. Joe River for monitoring ash and sediment accumulations on the flood plains.

RESULTS AND DISCUSSION

Tephra Distribution

The thickness of ash that fell on the Coeur d'Alene area at the time of the May 18, 1980 eruption of Mt. St. Helens varied from one-fourth to three-fourths of an inch. Reports varied depending on where measurements were taken and length of time after fallout since rain tended to compact the ash.

During the fall of 1981 and 1982 several core samples were collected at each sample site. The ash and new sediment thickness were measured in each core and the average thickness of these layers was calculated (Table 3). In addition, a depth profile was drawn using a sonic depth meter at each site. Ash and sediment thicknesses were then placed on the depth profiles so the distribution of sediment could be seen for each sample site (Figures 4 through 16).

Sedimented ash thickness throughout the entire lake system averaged 5.5 mm in 1981 and 7.6 mm in 1982. These figures represent the condition of sediment 17 and 29 months after the May 18, 1980 fallout. The differences in 1981 and 1982 ash thickness probably reflect the errors in sampling and measuring. By the fall of 1983, almost two and one-half years after the fallout, the ash layer on the lake bottoms was very distinct and had not mixed with the parent sediments or the new sediments. While doing experiments with the benthic communities on the lake bottom, we found that the ash layer could literally be rolled away like a carpet.

Originally, it was thought that large quantities of ash would accumulate in the lower rivers and deltas. Our preliminary sampling in the fall of 1980 indicated that several inches of ash were deposited in the

Table 3. Ash and new sediment distribution throughout the Lake Coeur d'Alene drainage one and two years after the Mt. St. Helens eruption.

LOCATION	ASH THICKNESS (mm) Fall 1981	ASH THICKNESS (mm) Fall 1982	NEW SEDIMENT THICKNESS (mm) Fall 1981	NEW SEDIMENT THICKNESS (mm) Fall 1982
1/ Gasser Point (deep)	7.8	9.5	3.0	12.7
2/ Gasser Point (shallow)	4.7	6.3	40.0	50.8
1/ Brown's Bay (deep)	5.0	6.4	3.3	31.7
2/ Brown's Bay (shallow)	3.6	9.5	47.8	88.9
3/ Hidden Lake (deep)	3.2	6.3	10.3	12.7
Hidden Lake (shallow)	5.7	6.3	28.7	31.7
Hidden Lake (channel)	6.4	6.3	44.6	38.1
3/ Chatcolet Lake (deep)	9.6	6.3	3.2	12.7
Chatcolet Lake (shallow)	6.4	4.7	12.8	3.2
3/ Round Lake (deep)	4.0	9.5	42.5	3.2
Round Lake (channel)	5.7	6.3	75.7	139.7
Rocky Point (channel)	9.3	9.5	32.3	38.1
Coeur d'Alene River (mile 138)	2.0	4.7	40.0	127.0
Coeur d'Alene River (mile 133)	5.3	6.3	112.3	38.1
Coeur d'Alene Delta (1m deep)	3.7	3.2	43.2	3.2
Coeur d'Alene Delta (2m deep)	6.2	3.2	53.6	28.6
Coeur d'Alene Delta (3m deep)	2.8	12.7	10.5	76.2
St. Joe River (mile 17)	6.0	7.9	83.5	15.9
St. Joe River (mile 13)	2.5	7.9	58.8	25.4
St. Joe River (mile 8)	3.5	6.3	45.3	38.1
Beedle Point (deep)	6.4	12.7	12.8	19.0
Beedle Point (shallow)	6.4	9.5	19.1	6.3
O'Gara Bay (deep)	7.0	12.7	5.0	127.0
O'Gara Bay (shallow)	7.5	9.5	3.5	50.8
Coeur d'Alene (terrestrial)	3.0	4.7	4.0	38.1
St. Joe (terrestrial)	9.0	9.0	3.0	6.3
Means	5.5	7.6	32.3	40.9
Composite Distribution				
1/ deep lakes	6.4	7.9	3.1	22.2
2/ shallow lakes	4.1	7.9	43.9	69.8
3/ flood plain lakes	5.6	7.4	18.7	9.5
river deltas	6.1	8.6	29.2	46.8
rivers	3.8	6.6	68.0	48.9

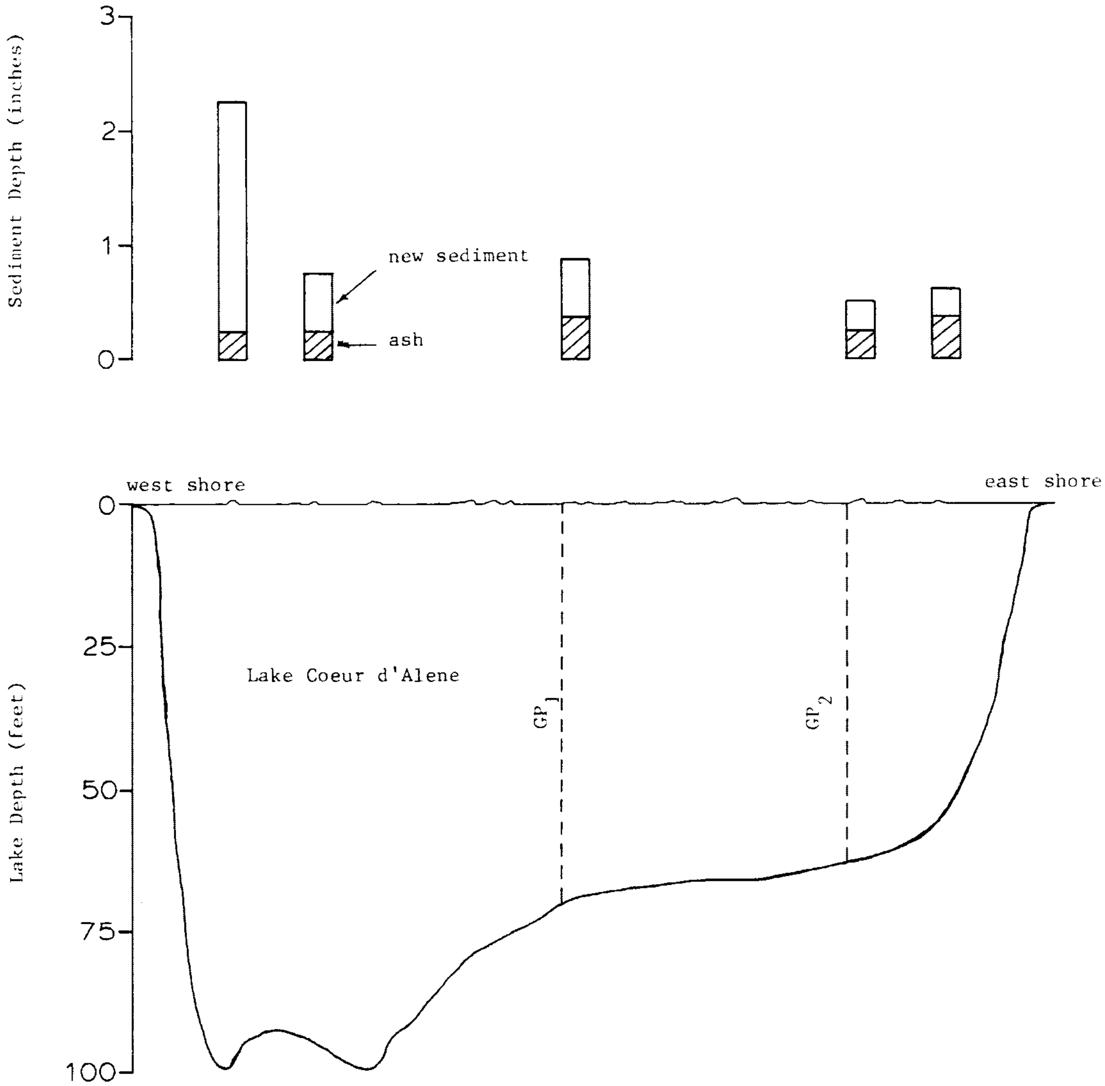


Figure 4. Lake depth, ash layer thickness, new sediment thickness, and sample site locations at Gasser Point, October 1982.

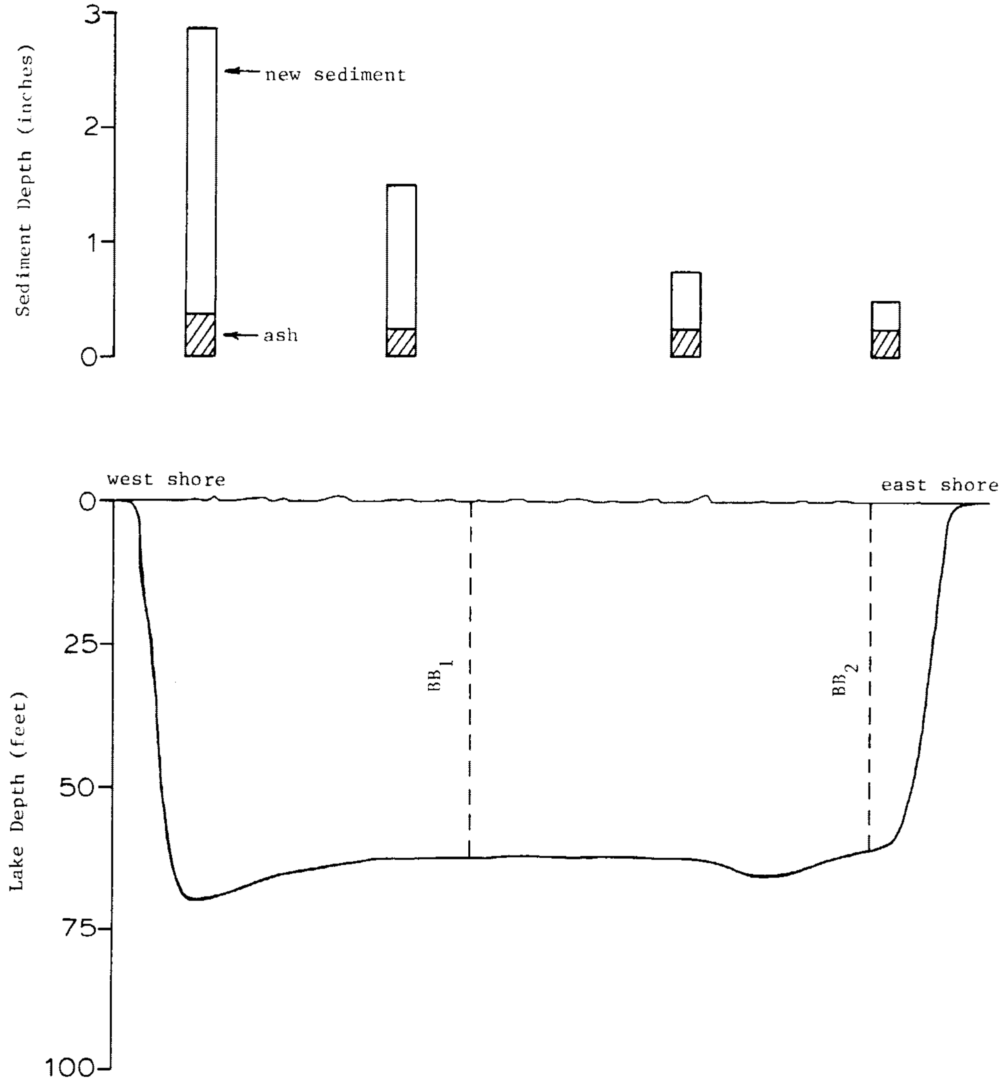


Figure 5. Lake depth, ash layer thickness, new sediment thickness, and sample site locations at Brown's Bay, October 1982.

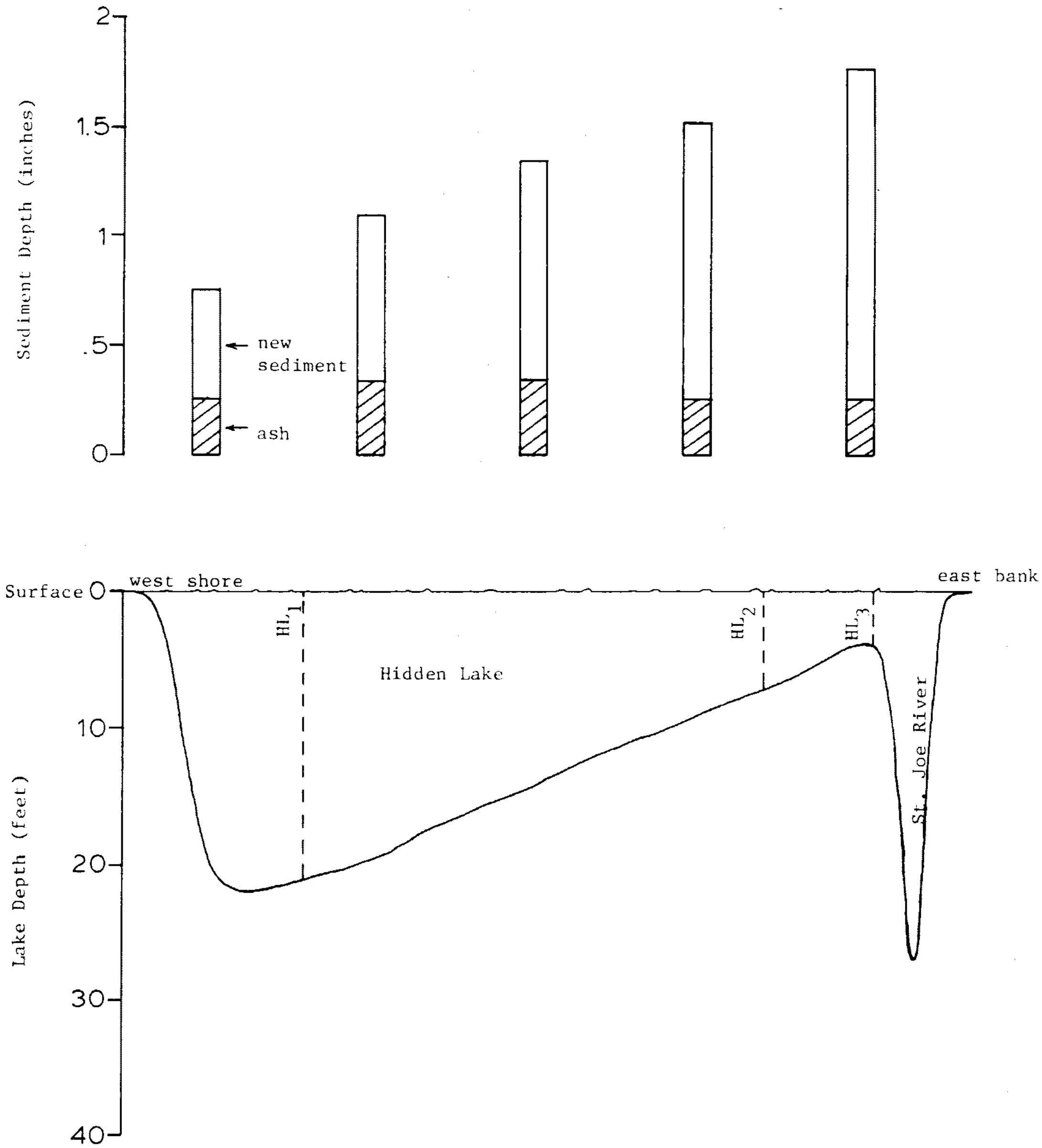


Figure 6. River and lake depth, ash layer thickness, new sediment thickness, and sample site locations in Hidden Lake and the St. Joe River, October 1982.

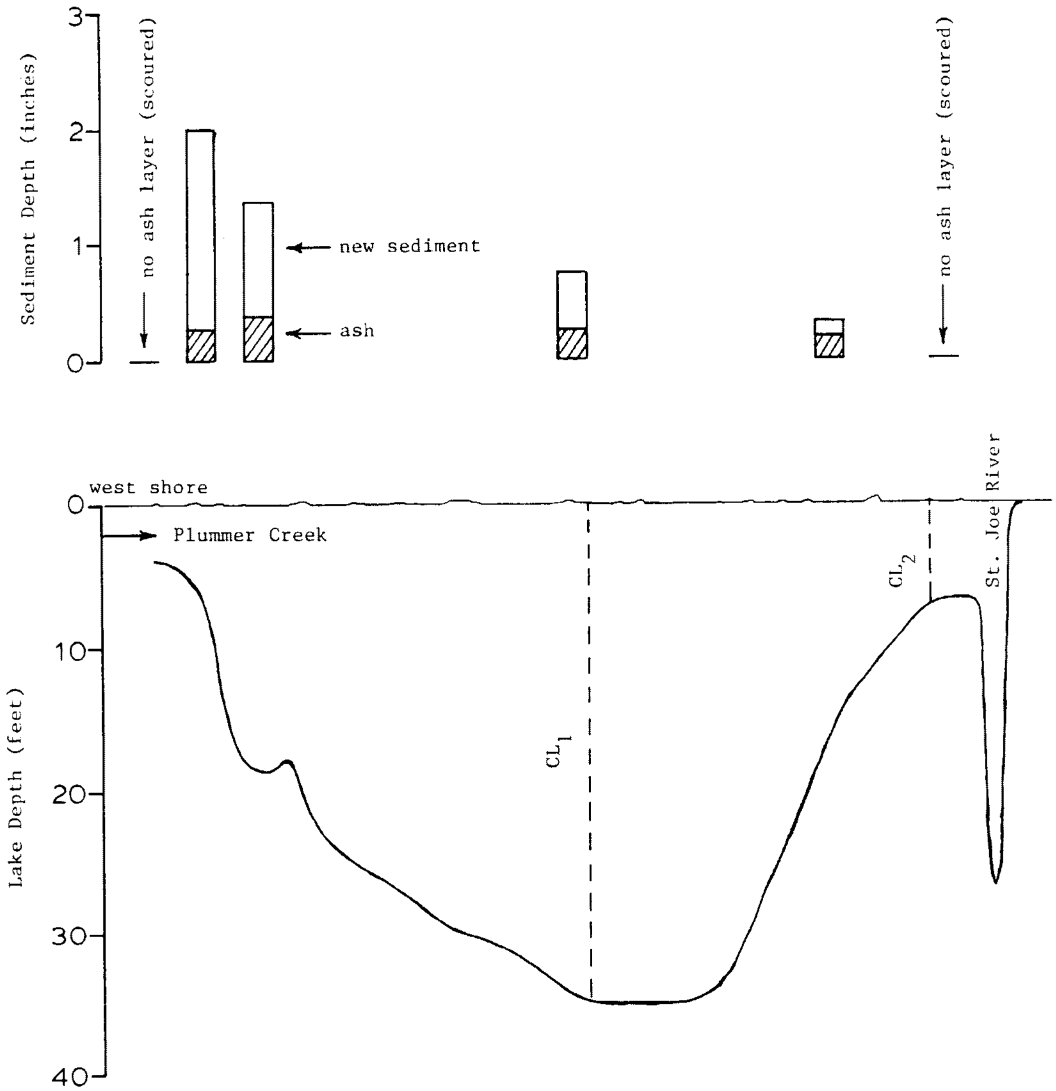


Figure 7. Lake depth, ash layer thickness, new sediment thickness, and sample site locations in Lake Chatcolet, October 1982.

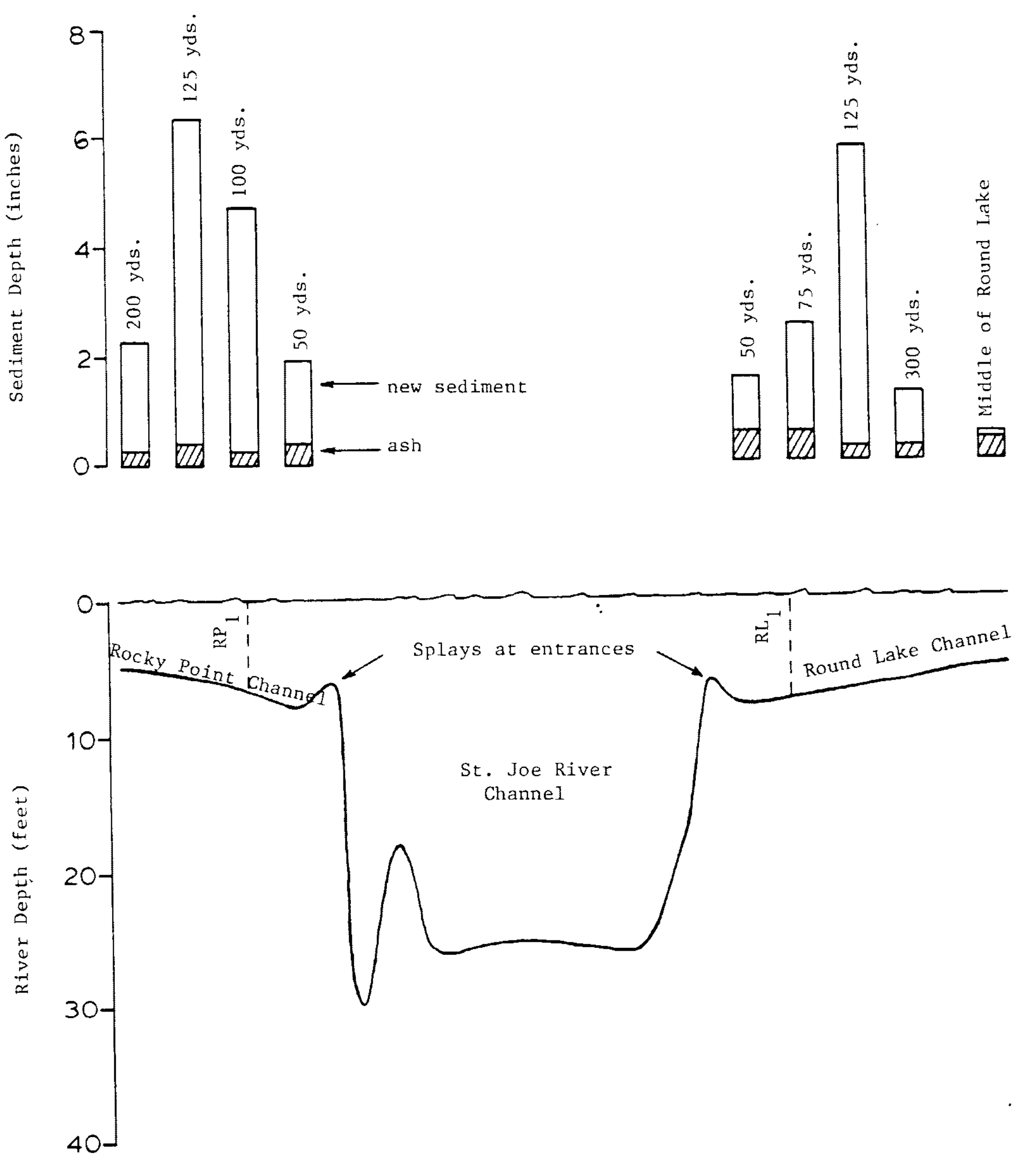


Figure 8. Profile of the St. Joe River and channels where it overflows into RockyPoint and Round Lake indicating ash and new sediment distributions in these channels, October 1982.

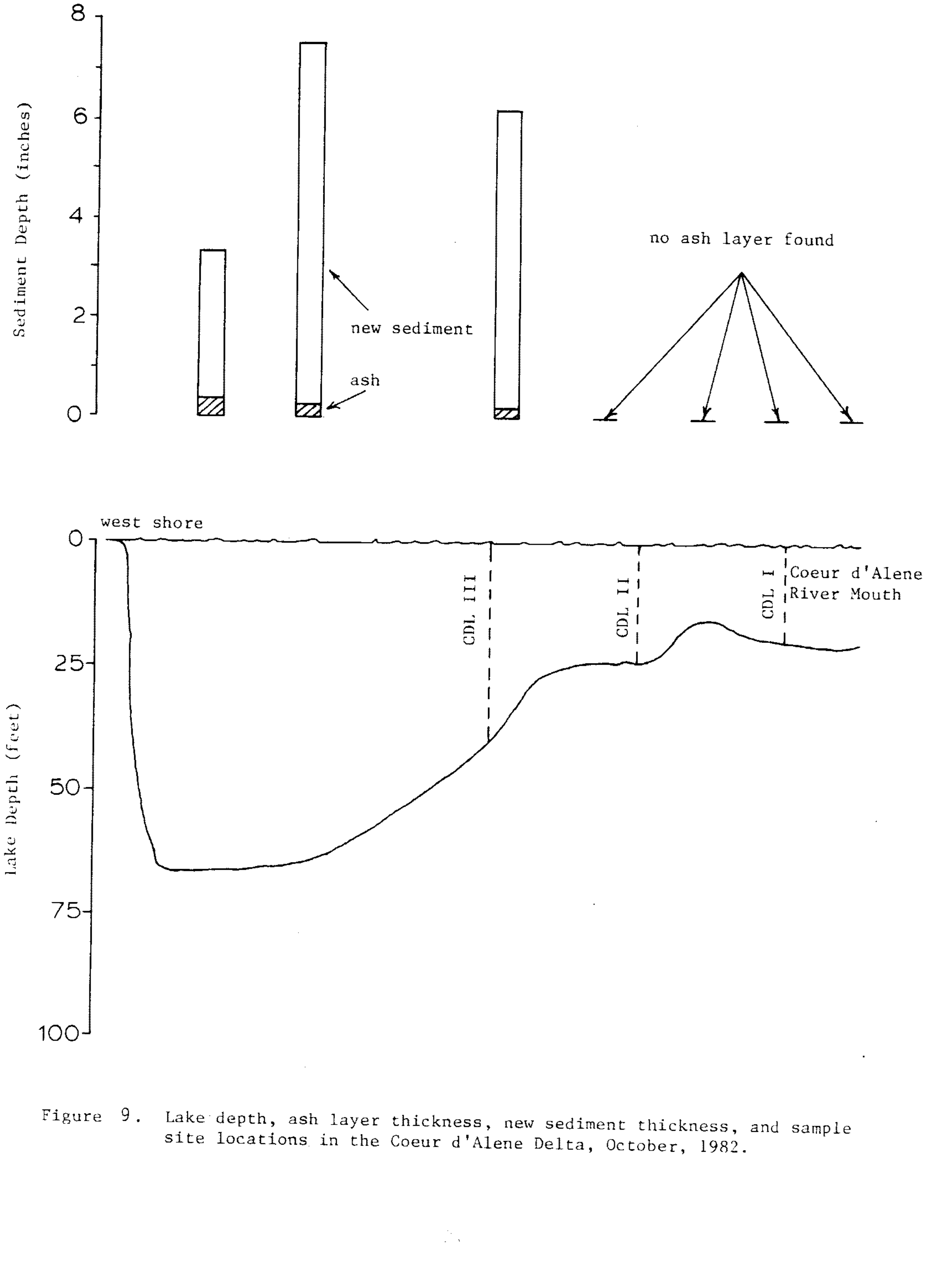


Figure 9. Lake depth, ash layer thickness, new sediment thickness, and sample site locations in the Coeur d'Alene Delta, October, 1982.

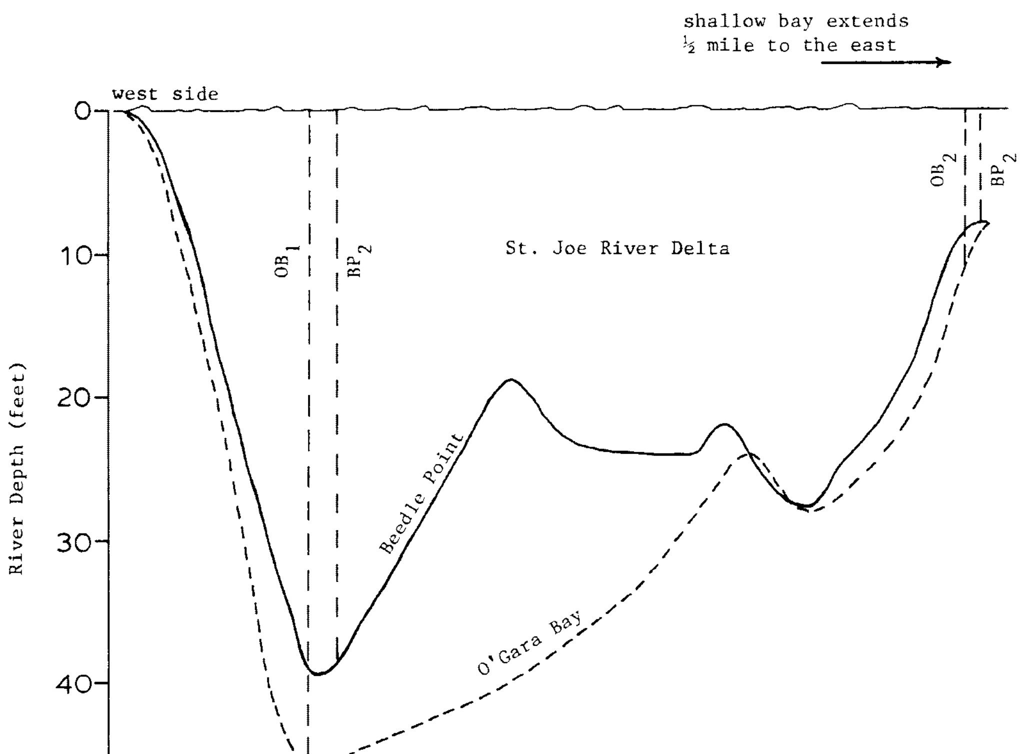


Figure 10. Profile of the St. Joe River Delta at Beedle Point and O'Gara Bay showing sample site locations and depth of channel, October 1982.

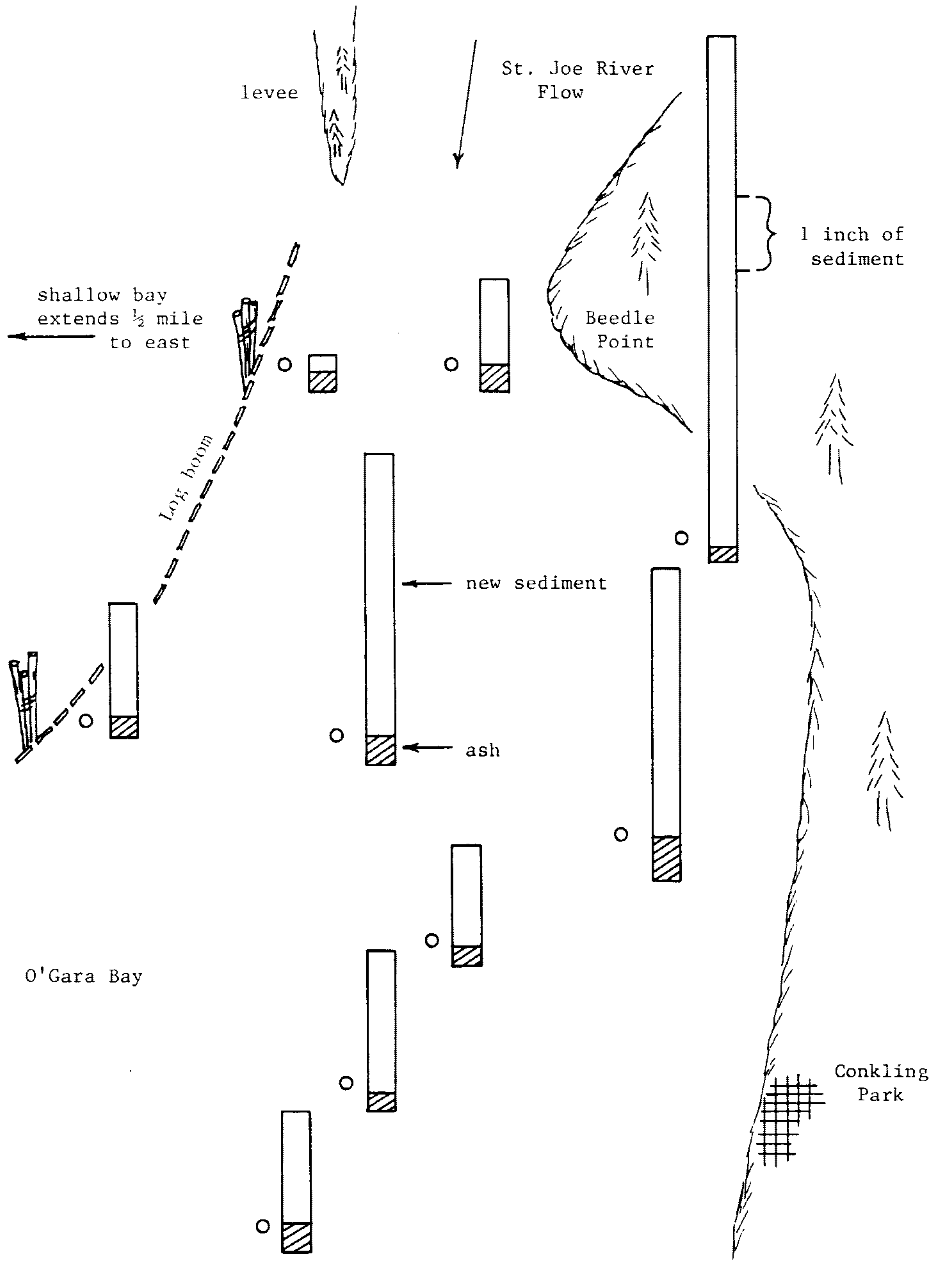


Figure 11. Ash layer thickness and new sediment thickness in the St. Joe River Delta, October 1982.

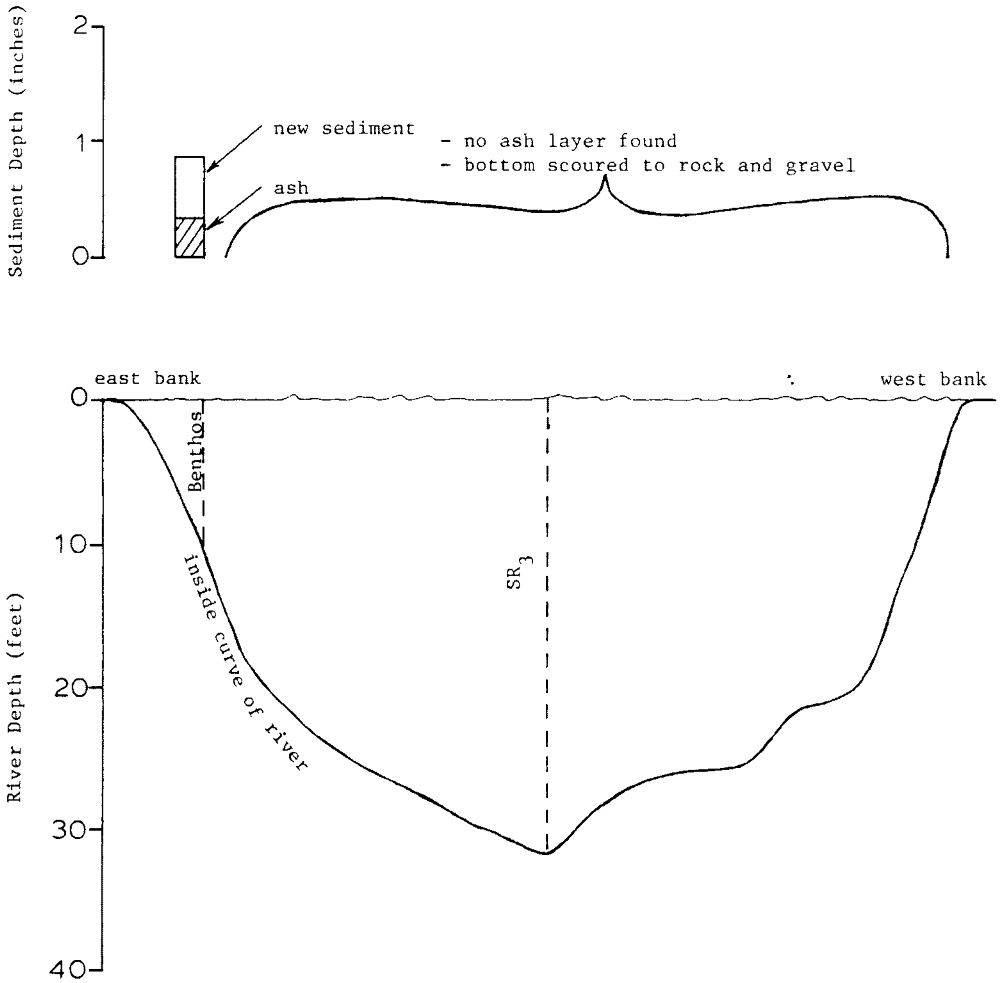


Figure 12. River depth, ash layer thickness, new sediment thickness, and sample site locations in the St. Joe River, mile 17, October 1982.

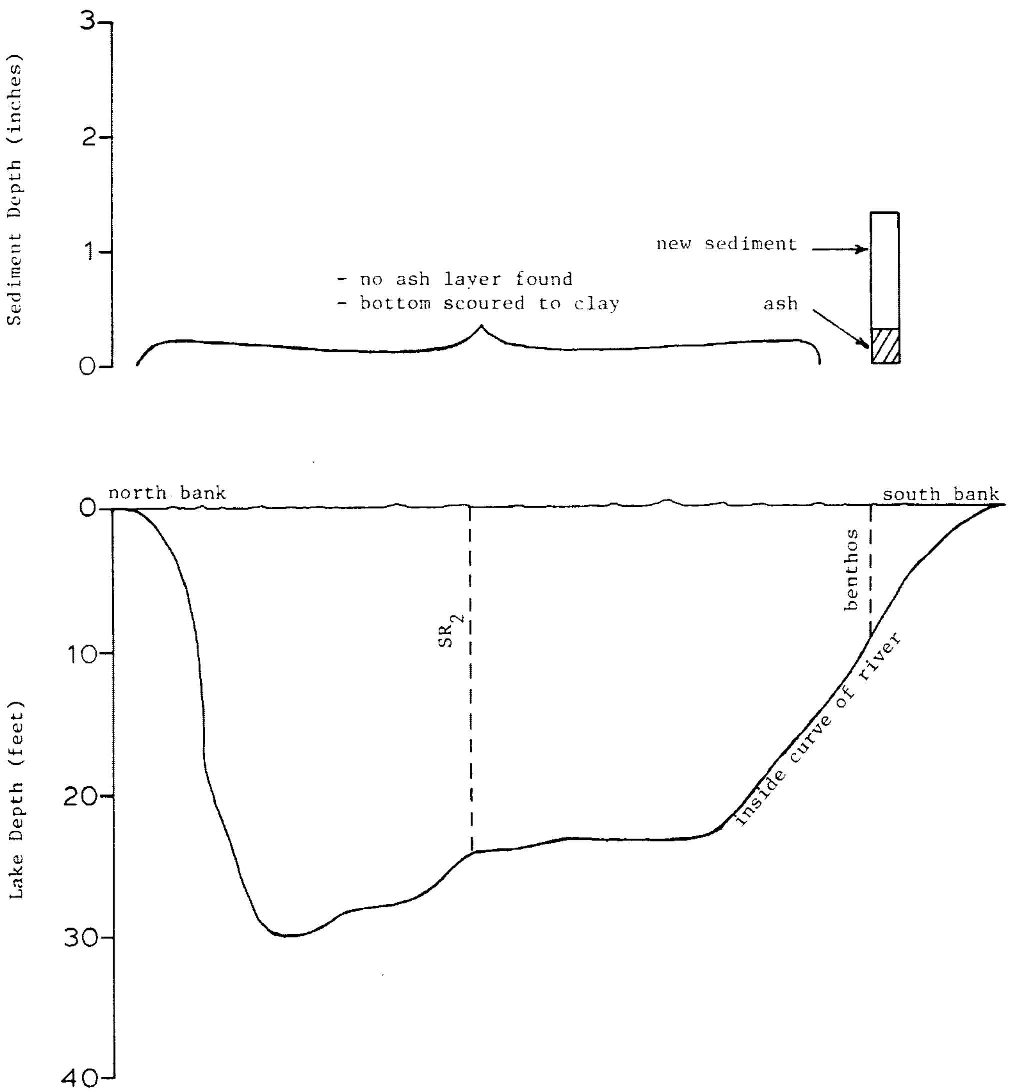


Figure 13. River depth, ash layer thickness, new sediment thickness, and sample site locations in the St. Joe River, mile 13, October 1982.

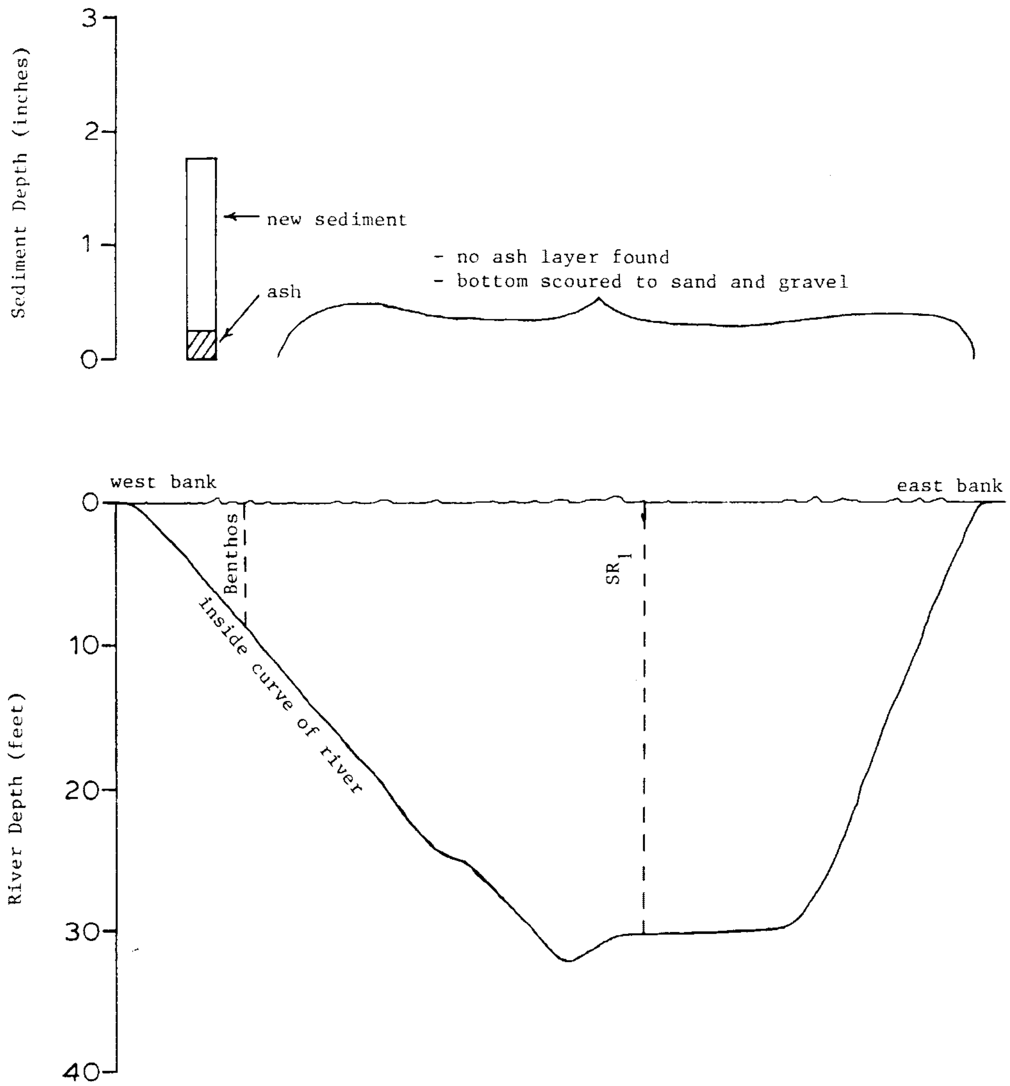


Figure 14. River depth, ash layer thickness, new sediment thickness, and sample site locations in the St. Joe River, mile 8, October 1982.

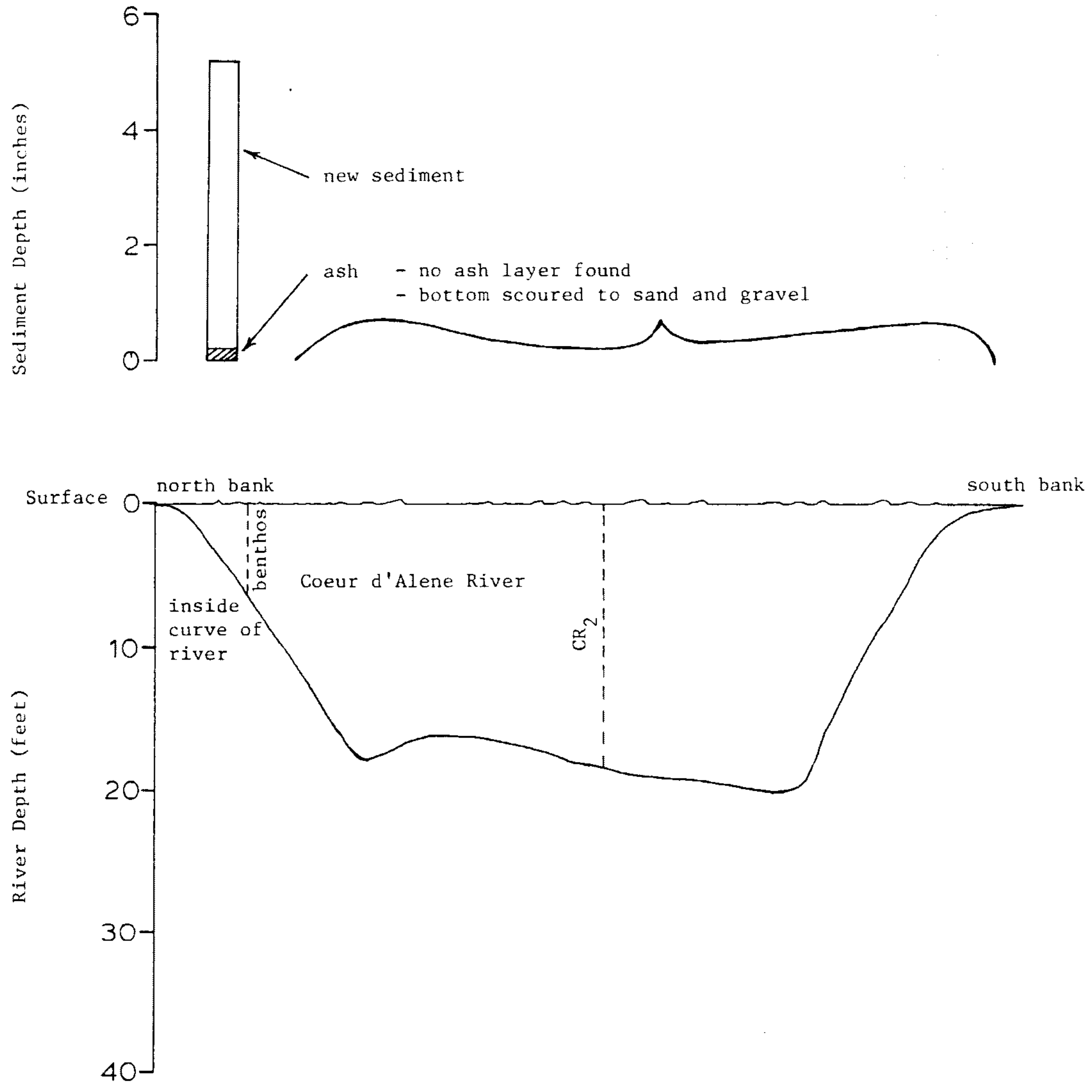


Figure 15. River depth, ash layer thickness, new sediment thickness, and sample site locations in the Coeur d'Alene River, mile 138, October 1982.

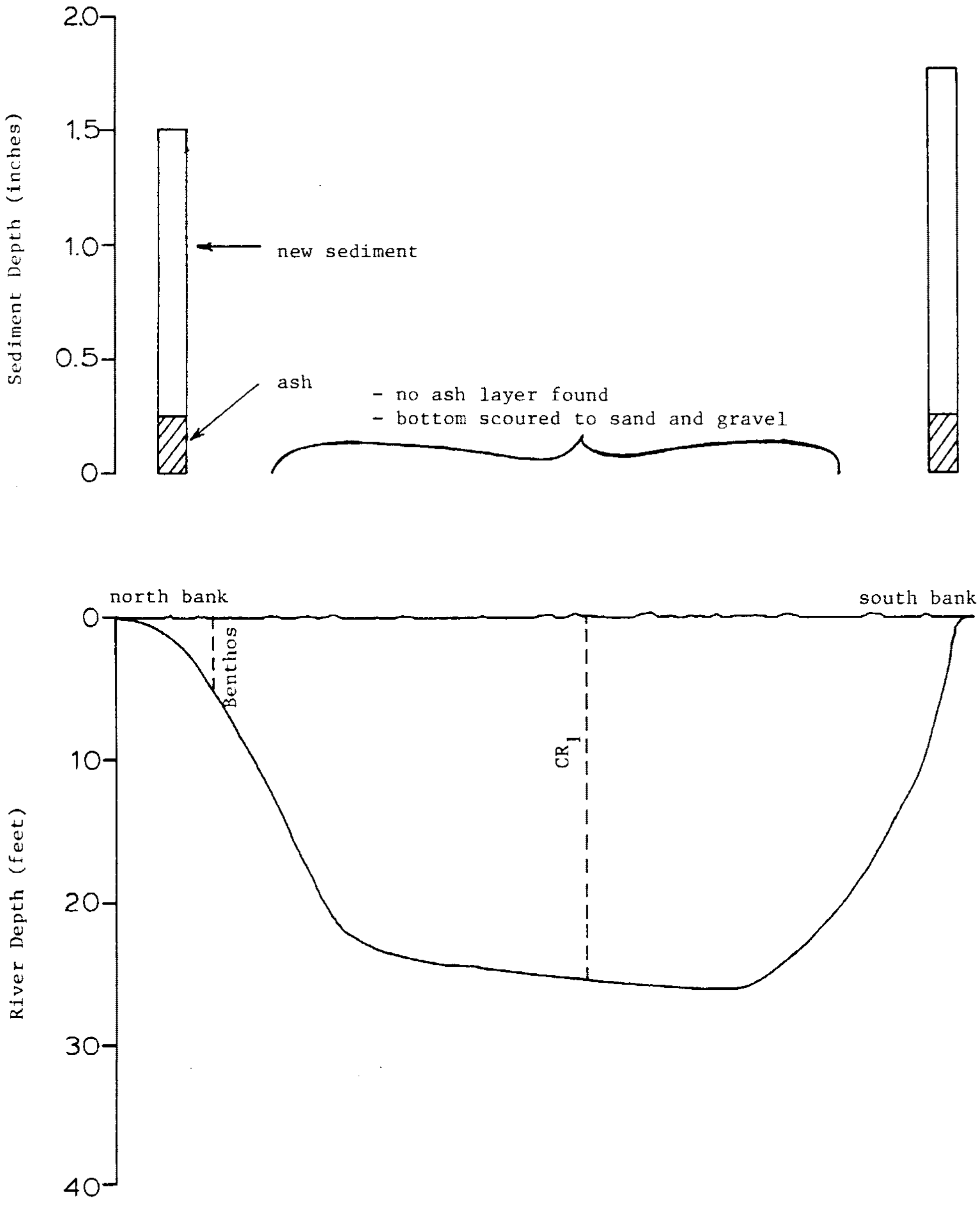


Figure 16. River depth, ash layer thickness, new sediment thickness, and sample site locations in the Coeur d'Alene River, mile 133, October 1982.

St. Joe delta. After more extensive sampling in 1981 and 1982 and after developing better ash identification techniques, we determined that the lower rivers and deltas did not have a significantly greater ash concentration (Table 3). It appears that the fallout of May 18, 1980 settled uniformly over the land and lake. The lake ash settled quite rapidly to the bottom and became very cohesive and immovable. The terrestrial ash was also very resistant to erosion and was not readily moved by rain and surface runoff. The terrestrial samples in the St. Joe and Coeur d'Alene River flood plains indicate that the thickness of ash in the fall of 1981 is about the same as it was in the beginning of the study (Table 3).

The river bottoms tend to be void of ash because the fallout was moved downstream and was unable to settle out. The May 18, 1980 eruption occurred when rivers in northern Idaho were in the spring runoff stage. However, any part of the lake system where water was not flowing experienced a settling of ash followed by very little, if any, secondary addition of incoming ash.

New sediments deposited over the ash layer averaged 32.3 mm (1.25 inches) by the fall of 1981. By the fall of 1982 a total of 40.9 mm (1.6 inches) of new sediment had accumulated. Annual sedimentation rates vary with timing and amount of spring runoff, but these figures indicate that the ash layer is rapidly being buried.

The well-consolidated ash layer provides an excellent benchmark from which future measurements of sedimentation can be made. In the two years after the ash fallout the deep areas of Coeur d'Alene have accumulated 22.2 mm (0.9 inches) of sediment (Figures 4 & 5). This sediment appears to be made up of settled plankton remains and very fine silt. The deep-water sediments are layered in distinct annual increments of about 10 - 15 mm thicknesses.

The shallow areas (within 300 m of the shoreline) accumulated an average of 69.8 mm (2.25 inches) in these two years. This indicates that shoreline erosion and/or surface runoff contributes a significant amount to the Lake Coeur d'Alene sediments.

Hidden Lake, Chatcolet Lake, and Round Lake are the three floodplain lakes in this study. New sediment (post ash sediment) averaged 18.7 mm in the fall of 1981 but only 9.5 mm a year later (Table 3). These lakes receive large flows of water during the spring runoff period. It appears that their sediments can accumulate or be scoured depending on the force of runoff (Figures 6, 7 & 8).

During the two years after the ash fall the St. Joe and Coeur d'Alene River deltas accumulated an average of 46.8 mm of sediment. Both deltas showed annual variations in sediment deposition. The Coeur d'Alene River carries large quantities of sediment and they are carried to the west shore of Lake Coeur d'Alene. The delta near the Coeur d'Alene River mouth is scoured but the delta extends up to one mile up and across the lake where sediments were up to 8 inches thick over the ash layer (Figure 9).

The St. Joe River delta at O'Gara Bay and Beedle Point has accumulated up to 180 mm of sediment in the two years since the ash was deposited. The delta extends about three-quarters of a mile up the lake from Beedle Point (Figures 10 & 11).

The St. Joe and Coeur d'Alene Rivers show typical patterns of scouring and deposition. The outside bends and straight stretches tend to be scoured. There was no new sediment in these areas. The deeper mid-channel areas of both rivers were scoured to sand and gravel where core sampling was not possible. Deposition of post-ash sediment only occurred on inside curves where water velocity slowed and allowed sediment to sink (Figures 12 through 16). New sediment thickness increased toward the mouth of the St. Joe from river mile 17 to river mile 8.

Organic carbon was measured in the pre-ash layer and in the post-ash layer at each sample location in 1981 and 1982. If a significant quantity of ash, which is organic, was being deposited with the post-ash sediment, then the percent organic content of the new sediment would be lower than that of the pre-ash sediment layer. There was no significant difference in the organic content of the sediment above and below the ash layer (Table 4). These results confirm the findings of the percent ash counts in the new sediment. Ash counts indicated that very little ash was deposited in the new sediment and that there were negligible amounts of ash entering the system and settling out each year.

A comparison of the organic content of new sediment (that which deposited after the ash) with the organic content of sediments ten years before the eruption was made (Table 5). There appears to be no important difference in the 1971-72 data (Winner 1972) and the 1981-82 post-eruption data.

Total organic carbon (mg/l) was measured in the water columns at depths of 2 m from the surface and 1 m from the bottom in 1981 and 1982 (Table 6). As with organics in the sediments, our thinking was that if large quantities of tephra entered the system each year it would have an impact on the organic carbon content of the water system. Very little tephra was found in the water columns and it had a negligible impact on the organic carbon

Table 4. Organic Content (percent) of Lake, River, and Delta Sediments Above and Below the 1980 Mt. St. Helen's Ash Layer

Station		Percent Organic Above Ash Layer			Percent Organic Below Ash Layer		
		Fall 1981	Spring 1982	Fall 1982	Fall 1981	Spring 1982	Fall 1982
Gasser Point	GP_1	7.0	2.3	6.1	7.9	7.8	7.5
	GP_2	4.1	10.1	6.6	8.6	6.9	6.4
Brown's Bay	BB_1	15.5	4.6	5.0	7.5	7.0	6.7
	BB_2	6.1	4.8	5.3	5.4	6.1	17.0
Hidden Lake	HL_1	-	5.6	5.0	7.6	6.2	5.5
	HL_2	7.8	5.8	4.4	6.8	4.7	6.4
	HL_3	6.1	4.6	4.8	5.0	4.7	4.5
Chatcolet Lake	CL_1	6.1	2.9	5.8	8.4	4.6	4.8
	CL_2	4.4	5.0	2.8	14.0	5.5	2.6
Round Lake	RL_1	-				-	
	RL_2	7.0	4.9	6.4	8.2	5.5	3.9
	RL_3	10.5	5.4	4.8	7.4	10.0	4.0
Coeur d'Alene River	CR_1	7.5	4.8	3.9	7.3	3.0	4.6
	CR_2	7.9	6.6	2.7	7.8	5.8	5.9
St. Joe River	SR_3	4.1	5.4	1.4	4.5	5.0	1.9
	SR_2	5.1	4.5	3.8	6.7	4.6	5.6
	SR_1	3.5	6.8	5.1	5.0	3.9	5.1
Coeur d'Alene Delta	CD_1	6.7	7.0	8.4	9.2	2.4	6.5
	CD_2	-	-	4.4	-	-	8.6
	CD_3	-	5.7	5.6	-	6.3	5.3
St. Joe Delta:							
Rocky Point	RP_1	4.4	3.8	6.1	5.4	5.7	5.5
	RP_2	6.2	6.7	5.8	8.1	9.1	4.1
Beedle Point	BP_1	7.0	6.5	5.4	6.9	6.0	6.1
	BP_2	7.4	5.2	5.5	8.5	6.4	4.9
O'Gara Bay	OB_1	5.9	6.2	4.0	12.1	8.7	4.8
	OB_2	6.8	5.6	6.5	10.1	4.7	5.8
MEANS		6.6	5.4	5.0	7.7	5.8	5.8

Table 5. Organic Content of Sediments Before and After the Mt. St. Helen's Ash Fallout in the Lake Coeur d'Alene Area

	Organic Content of Sediments (percent)	
Location	Before Ash Fallout (1971-72)*	After Ash Fallout (1981-82)
Deep Lake sediments:		
(> 20m)		
Gasser Point deep (GP_1)	8.6	6.4
River Delta sediments:		
Coeur d'Alene River Delta (CD_1)	8.3	6.9
Coeur d'Alene River Delta (CD_2)	7.1	6.5
Coeur d'Alene River Delta (CD_3)	7.9	5.7
Flood Plain Lake sediments:		
Chatcolet deep (CL_1)	6.1	5.7
Chatcolet shallow (CL_2)	7.5	5.4
Means	7.6	6.0

*Data from Winner (1972)

Table 6. Total Organic Carbon (mg/l) throughout the Coeur d'Alene Lake System in 1981 and 1982.

2 m from Surface

	1981		1982		
	Summer	Autumn	Spring	Summer	Autumn
Deep Lakes	2.082	0.985	1.758	1.288	1.205
Floodplain Lakes	2.871	2.043	0.938	1.312	1.667
Coeur d'Alene River	1.996	2.135	0.758	0.556	0.700
Coeur d'Alene Delta	2.234	2.570	0.792	1.010	0.823
St. Joe River	1.866	2.893	0.953	0.808	1.223
St. Joe Delta	2.462	3.147	1.517	0.918	0.840

1 m from Bottom

	1981		1982		
	Summer	Autumn	Spring	Summer	Autumn
Deep Lakes	2.841	1.985	1.370	1.191	0.725
Floodplain Lakes	2.608	2.317	1.333	1.386	0.962
Coeur d'Alene River	2.120	3.580	1.182	0.448	0.700
Coeur d'Alene Delta	2.098	2.670	1.292	1.012	0.523
St. Joe River	1.332	3.200	1.093	0.848	0.990
St. Joe Delta	1.722	0.907	1.635	1.015	2.160

content of the water. There was slightly more organic carbon in the water system in 1981 than in 1982, but this was probably due to annual variations in algal production. There appears to be no real differences in the organic content of lakes, deltas and rivers nor is there a difference from the top to the bottom of the water columns.

The percent of ash in the new sediment averaged 9.3 in 1981 and 1.2 in 1982 (Table 7). This indicates that new ash coming in from the watersheds reached insignificant levels by 1982. Apparently, ash in the watersheds had stablized and was not moving. As would be expected, the delta sites had the highest concentrations of ash in the new sediments followed by the rivers then the lakes (Table 7 and Appendix A).

The percent of ash in the parent sediments was measured in 1981 and 1982 (Table 8). The objective was to determine if the ash layer was mixing with and settling into the parent sediment. Ash quantities in the parent sediment were at low levels during both 1981 and 1982. An exception was the parent sediment at Brown's Bay which contained 29 percent ash in 1981. The stable, cohesive nature of the ash layer on the lake bottom is reflected in these results.

Table 7. Ash in the New Sediment Layer (glass particles as a percent of total mineral particles) during 1981 and 1982.

Locations	1981	1982
Deep Lakes	7.0	0.0
Floodplain Lakes	8.0	1.0
Coeur d'Alene River	9.0	1.0
Coeur d'Alene Delta	14.0	1.0
St. Joe River	7.0	3.0
St. Joe Delta	11.0	1.0
Means	9.3	1.2

Table 8. Ash in the Parent Sediment (glass particles as a percent of total mineral particles) during 1981 and 1982.

Locations	1981	1982
Gasser Point	2.0	0.0
Brown's Bay	29.0	0.0
Chatcolet Lake	4.0	0.0
Coeur d'Alene Delta		
I	5.0	0.0
II	7.0	1.0
III	4.0	1.0
St. Joe Terrestrial	---	1.0
Coeur d'Alene Terrestrial	---	2.0
Average	8.5	1.0

Suspended Tephra

Suspended tephra in the lakes is from two sources: 1) sedimented tephra which is resuspended during lake mixis, and 2) terrestrial tephra carried into the lakes during rains and spring snowmelt. Personnel from the Idaho Department of Health and Welfare were concerned that resuspended tephra during lake turnover would be a recurring problem in the lakes. It was also feared that the large quantities of ash covering the watersheds would continue to add suspended ash to the lakes through runoff.

To quantify suspended tehpra, water samples were taken in the water column from one meter above the surface of the sediment and from 2m below the lake surface (Appendices B through C). Temperature and oxygen profiles were measured in order to determine the timing of lake mixis.

Suspended tephra measurements indicate that ash is becoming stable in the lake bottoms and stable on the watersheds. In 1981, 11 percent of the samples contained more than 15 percent ash. By 1982 only 3% of the samples had over 15 percent ash. We assume that this trend will continue as sedimented ash becomes more covered with new sediment.

This study found no evidence that a significant amount of ash is resuspending during lake mixis. The deep lake sites (Gasser Point and Brown's Bay) had more suspended ash than any other sites. In 1981 the deep lakes averaged 22.2 percent glass as compared to an annual lake-river system average of 10.5 percent (Table 9). In 1982 the deep lake sites averaged 11.4 percent glass with an overall site average of 7.7 percent (Table 10). There appears to be no relationship between lake mixis and suspended ash. The higher concentrations of suspended ash in the deep lakes may be explained by their stable water system in contrast to the rivers, deltas, and flood plain lakes

Table 9. Suspended ash (glass particles as a percent of total mineral particles) at 2m below the water surface and at 1m above the sediments in 1981.

Location	July 6 - 10	July 19 - 24	Aug. 3 - 7	Aug. 17 - 20	Sept. 30 - Oct. 3
			2m Below Surface		
Deep Lakes	15.3	43.5	0.0	10.6	30.0
Flood Plain Lakes	17.4	24.5	3.2	23.2	8.7
Coeur d'Alene River	5.2	2.8	15.7	3.4	9.2
Coeur d'Alene Delta	12.8	5.2	6.7	5.3	9.8
St. Joe River	7.5	8.0	9.4	14.2	1.9
St. Joe Delta	10.6	5.7	8.5	17.8	2.2
			mean = 11.3		
			1m Above Sediments		
Deep Lakes	23.2	48.3	31.3	9.7	9.7
Flood Plain Lakes	18.1	8.1	18.2	8.3	2.7
Coeur d'Alene River	1.6	5.3	0.9	8.8	3.2
Coeur d'Alene Delta	4.7	2.7	5.6	8.6	1.9
St. Joe River	2.8	8.6	5.1	2.3	11.8
St. Joe Delta	8.2	6.5	11.3	6.1	8.4
			mean = 9.7		

1981 mean = 10.5

Table 10. Suspended ash (glass particles as a percent of total mineral particles) at 2m below the water surface and at 1m above the sediments in 1982.

Location	April 20-21	May 17-21	May 31 June 6	June 16-18	June 30 July 1	July 12-14	July 21-29	August 10-13	August 24-26	October 5-7
				2m Below Surface						
Deep Lakes	12.6	7.8	13.7	17.1	10.4	18.0	10.3	11.6	6.3	24.4
Flood Plain Lakes	3.0	8.1	4.3	3.2	4.9	11.3	18.7	11.7	8.6	10.1
Coeur d'Alene River	8.9	5.9	13.7	12.2	7.4	7.2	4.8	2.0	6.1	8.0
Coeur d'Alene River	4.5	6.1	6.1	11.9	11.4	6.9	9.2	5.4	5.7	6.0
St. Joe River	2.8	2.8	4.1	5.7	4.9	3.2	5.3	9.9	3.6	2.1
St. Joe Delta	5.8	6.5	3.5	8.5	9.2	12.4	8.6	13.1	8.8	9.8
				mean = 8.3						
				1m Above Sediments						
Deep Lakes	7.4	9.2	13.8	10.4	4.3	23.4	4.2	5.9	3.7	6.3
Flood Plain Lakes	4.0	2.7	3.6	4.2	6.0	3.1	7.0	10.8	4.4	5.4
Coeur d'Alene River	7.1	8.0	20.5	12.9	8.9	9.7	2.1	2.5	8.7	9.2
Coeur d'Alene Delta	5.6	6.9	8.0	10.5	8.0	11.9	5.1	6.2	5.0	5.7
St. Joe River	4.9	2.8	3.6	6.2	5.3	1.3	4.2	3.1	1.9	2.5
St. Joe Delta	13.6	4.8	6.5	7.8	4.8	8.9	11.3	16.8	7.2	10.9
				mean = 7.2						

1982 mean = 7.7

which are flow-through systems. Suspended ash in the large deep lakes is not flushed out and that which doesn't completely settle may persist. By 1982 the ash layer in the deep lakes was covered by an inch of new sediment. This covering as well as the cohesive nature of the ash explains why resuspension was not a problem.

During an early spring snowmelt in February of 1982 suspended ash samples were collected at selected sites to determine if ash was moving into the system from the surrounding watersheds. These February samples indicate that the St. Joe and Coeur d'Alene Rivers carried an average of 31.3 percent glass compared to an average lake concentration of 16.5 percent (Table 11). This trend was not observed in the routine river and lake sampling and it must be remembered that the February, 1982 runoff was an exceptionally large flow. At this time a small ephemeral stream flowing into Brown's Bay carried only 6.0 percent ash. This indicates that little ash is carried into the lake from the adjacent hillsides. The thickness of the terrestrial ash layer has not changed significantly since it was deposited and is further evidence that the stable and cohesive nature of the ash prevents erosion from the watersheds.

Redox potential is an expression of the oxidizing or reducing capability of an aqueous solution. Controlled principally by dissolved oxygen, organic content, and pH, it indicates relative availability of metals and certain nutrients between soluble and insoluble phases. A level of +500 m volts is highly oxidizing while negative values are increasingly reducing in nature. Sediment redox values (Σ_h) are an indicator of mixing between sediments and the water column since high redox values are possible only where high exchange rates continually supply dissolved oxygen to the sediments.

Table 11. Suspended ash (glass particles as a percent of total mineral particles) at selected sites throughout the water system during a peak runoff period in February, 1982.

Location	Suspended Ash (%)
Coeur d'Alene River (mile 133)	36.0
St. Joe River near mouth	31.0
St. Joe River (mile 17)	27.0
Chatcolet Lake near Rocky Point	18.0
Brown's Bay near shore	15.0
Ephemeral stream entering Brown's Bay	6.0

Redox potential was measured at 13 sample sites in the rivers, deltas, flood plain lakes and deep areas of Lake Coeur d'Alene from April through August, 1982 (Appendix D). At each point, redox readings were taken from sediment cores immediately after sampling by insertion of the redox probe into the core at three locations... the deep pre-ash layer, the ash layer, and the post-ash sediments. Figure 17 depicts these redox potentials lumped between the four general habitat types. There is a general trend of increasing potential through the spring and early summer with a levelling off or reduction into late summer. This trend reflects sediment flushing and reaeration occurring with high spring flows before developing stagnation in August. Accordingly, the deep lake sites remain lower than other sites through the early summer period because of reduced water circulation in the deep areas. The late summer decline is also more pronounced there. River sites generally had higher and earlier springtime redox values reflecting sediment flushing of high flows.

At most sites, Σ_h values decreased with sediment depth as O_2 availability declined. Since such a decline is normal in aquatic sediments, we reasoned that only different magnitudes of change with depth through ash vs post-ash sediments of comparable thickness would indicate altered reaeration capacity of imported sediments. Redox values were examined above and below ash layers of varying thickness and compared with values above and below the post-ash sediments of comparable thickness. No obvious differences were found. We concluded therefore, that the ash depositions averaging 7-9 mm thickness had no obvious effect on normal redox potential gradation with depth in the aquatic sediments.

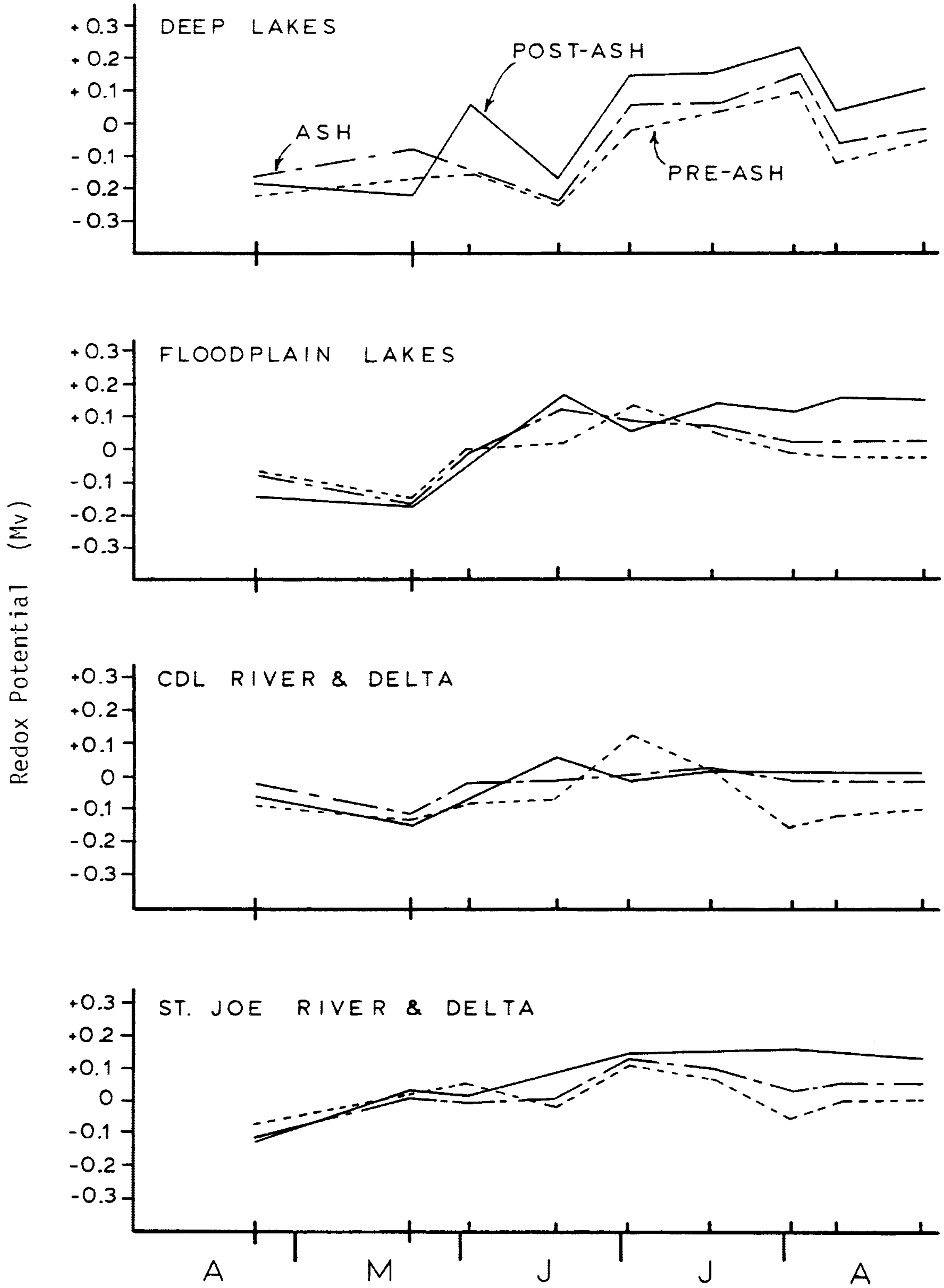


Figure 17. Redox potentials of the pre-ash, ash, and post-ash layers of sediments throughout the Coeur d'Alene Lake system, 1982.

Physical Characteristics of Tephra

Particle size analyses indicate that only trace amounts of clay particles (.63 - 1.59 microns) were in the primary tephra layer found at the terrestrial, lake and delta sample sites (Table 12). Most of the samples were made up of silt (2.00 - 64.0 microns), very fine sand (50 - 100 microns) and fine sand (100 - 250 microns).

Tephra samples taken at the CDL and St. Joe terrestrial sites in 1981 differed greatly in their particle size distribution (Figure 18). The majority of particles found at the CDL terrestrial site were very fine sand . At the St. Joe terrestrial site, the particle size distribution included significant quantities of both silt and very fine sand. The difference in tephra particle sizes from these two terrestrial sites could be explained by differences in atmospheric fallout or simply differences in the micro-topographic environment of each site. The trend at both sites in 1981 to 1982 was similar in that both particle size distributions broadened in 1982, and there were significant amounts of silt as well as sand particles.

The lake samples taken at Brown's Bay, Gasser Point, and Chatcolet Lake in 1981 all contained large amounts of very fine sand particles (Figure 19). In 1982, Brown's Bay and Gasser Point showed a change in particle size distribution to more silt particles and fewer sand particles. However, distribution of particle size from the sample at Chatcolet Lake did not change significantly. More than 80% of the particles were sand in 1981 and 1982, with very small amounts of silt.

This difference in particle size distributions between Chatcolet Lake and the other lake samples could be explained by the depths and

Table 12. Tephra Particle Size Distributions in the Lake Coeur d' Alene System Using a Coulter Counter Analysis

	1981			1982		
	silt	very fine sand	fine sand	silt	very fine sand	fine sand
St. Joe Terrestrial	52.9	43.1	3.6	75.5	16.1	5.8
Coeur d' Alene Terrestrial	18.4	80.0	1.3	74.1	22.6	1.6
Chatcolet Lake	12.5	84.8	2.4	18.1	66.1	14.8
Brown's Bay	35.9	57.0	6.1	81.3	14.7	1.5
Gasser Point	4.4	91.9	3.6	71.6	24.0	2.0
Coeur d' Alene:						
Delta I	4.2	69.8	25.8	72.6	23.5	2.8
Delta II	66.5	30.8	1.1	40.6	43.0	13.2
Delta III	73.7	25.5	0.0	53.8	33.0	9.2

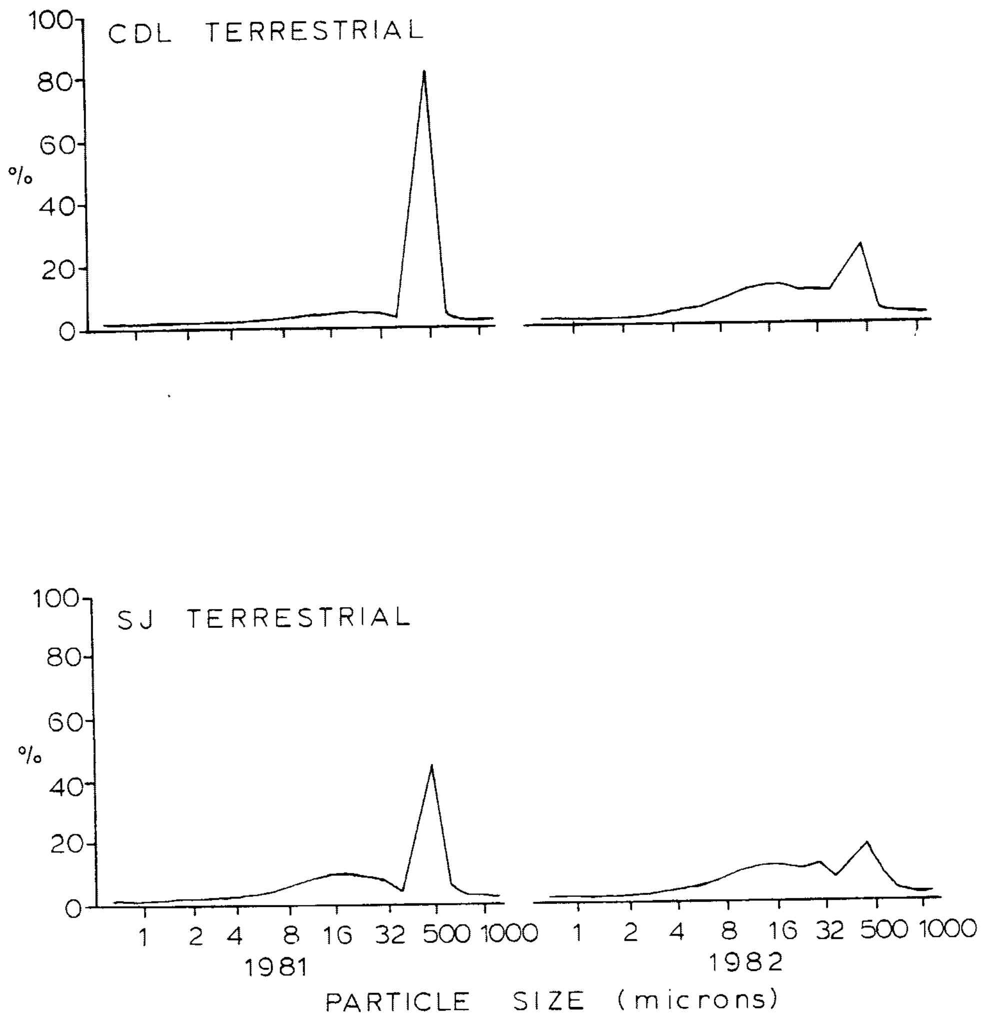


Figure 18. Particle size distribution of terrestrial tephra in 1981 and 1982.

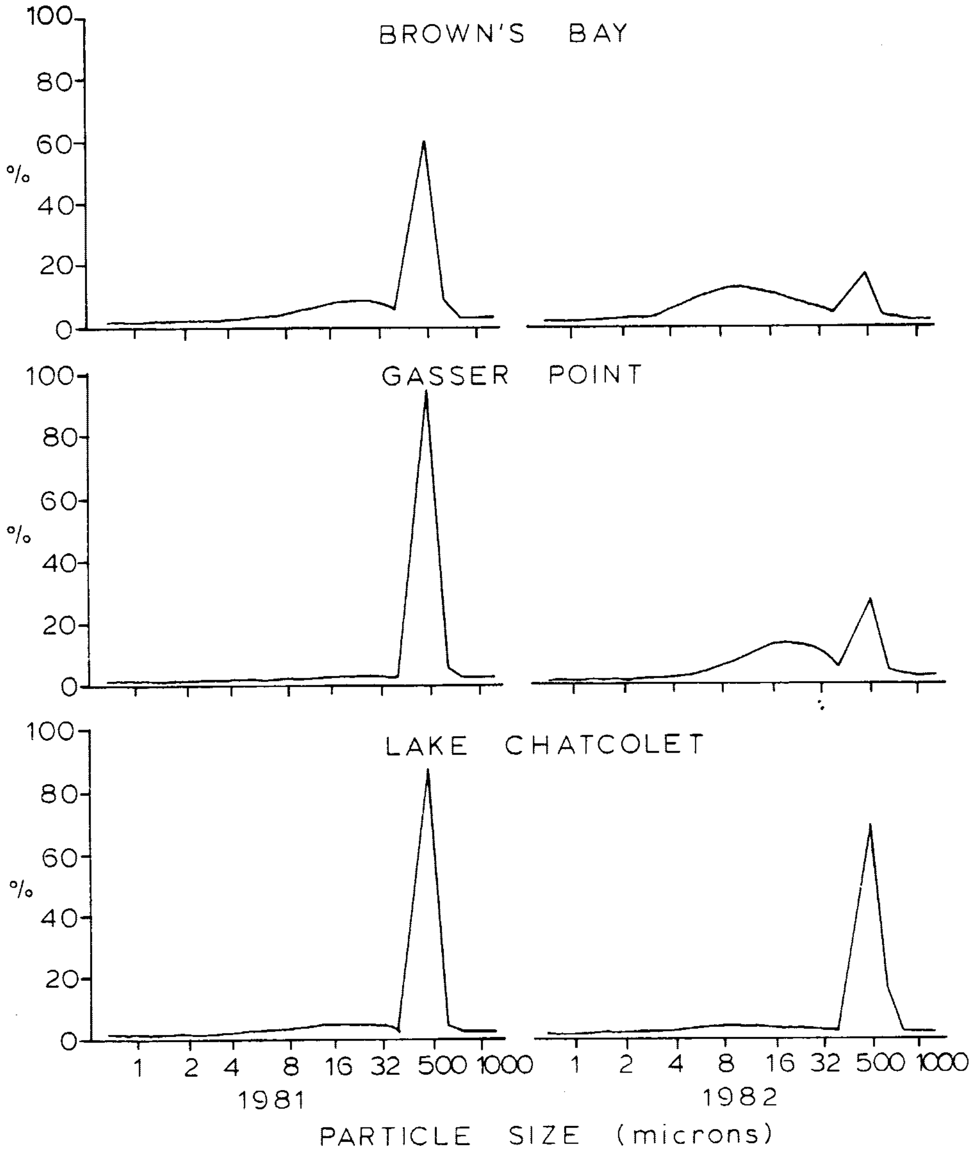


Figure 19. Particle size distributions of sedimented tephra at three lake sites in 1981 and 1982.

types of lakes. Chatcolet is a floodplain lake and shallower than Lake Coeur d'Alene. It is possible that while the May 18, 1980 ash was settling, the "flow-through" system was carrying smaller particles out of the lake and only allowing the sand sizes to settle.

The sample taken from the CDL I site in 1981 contained more than 95% very fine and fine sand particles (Figure 20). In contrast, samples taken 100 meters farther from the river mouth at the CDL II site and 300 meters farther at the CDL III site contained 30% or less sand particles. One-fourth of the CDL I sample contained fine sand particles, significantly more than found at any other site, both years. This stratifying of particle sizes indicates that fine ash that fell in flowing water was carried to the deeper areas of the deltas and lakes while larger ash particles settled out in the shallow deltas and flood-plain lakes. By 1982 the three delta sites had similar particle size distributions (Table 12).

Physical characteristics of the tephra did not vary significantly between sites. The morphology and mineralogy of the ash samples was examined. All ash samples contained large, polymineralic clusters of ash and minerals. Vesicularity of the glass was spherical to sub-spherical. When compared to other mineral particles, the glass particles tended to be smaller and more angular in shape.

Upon analyzing the mineralogy of the ash samples, glass was easily distinguishable from other mineral particles, representing more than 75% of every sample. Feldspar, pyroxene and magnetite were other minerals found in the samples. X-ray defraction analysis done by the Soil Characterization Lab at the University of Idaho revealed similar results from different samples. Glass and feldspar were the main constituents, with most other mineral concentrations below detection.

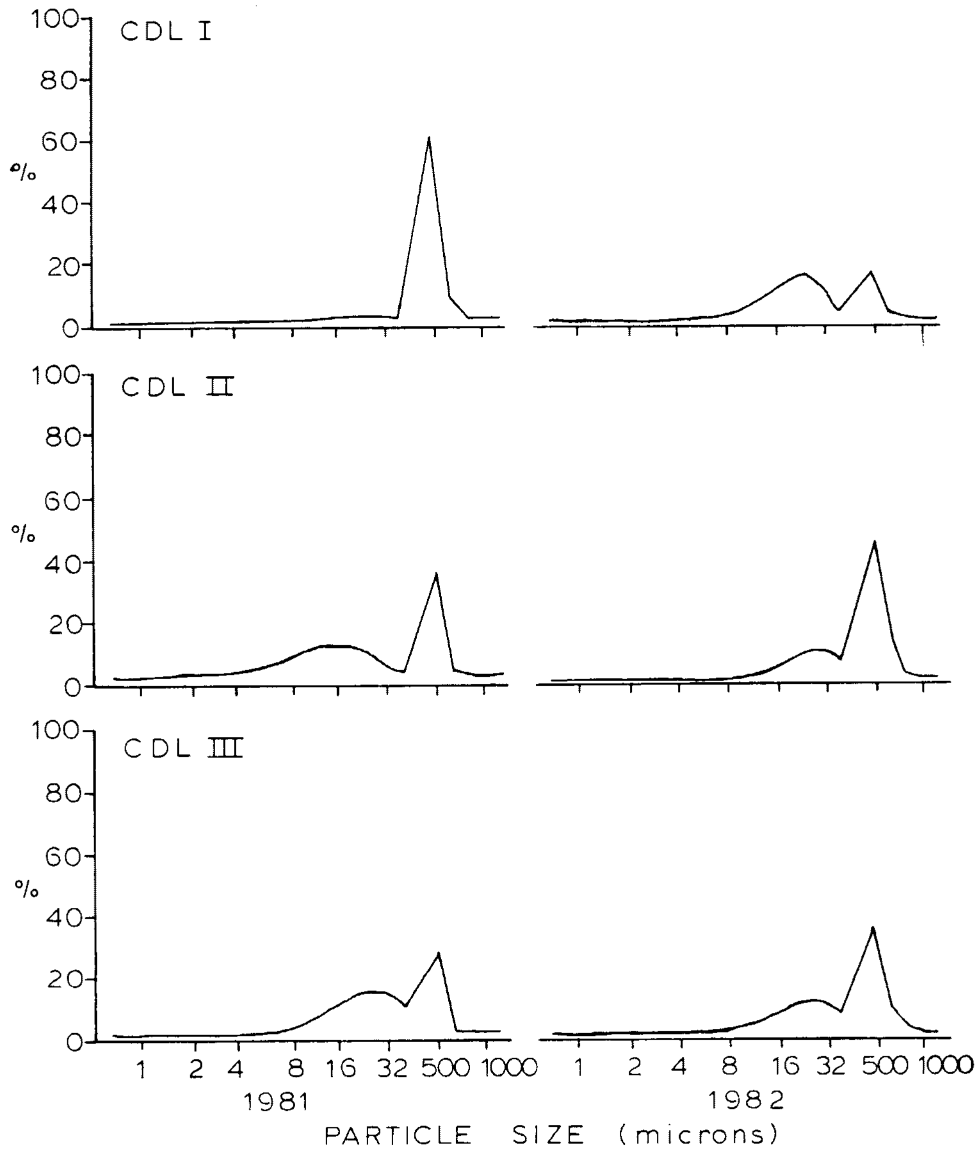


Figure 20. Particle size distributions of sedimented tephra at three delta sites in 1981 and 1982.

Chemical Characteristics of Tephra

Electron microprobe analyses were used to chemically characterize tephra in the sediments. The questions these analyses were directed to answer are: Do chemical properties of primary tephra in the Lake Coeur d' Alene water system differ from other Mt. St. Helens tephra? Do they differ from initial fallout ash, terrestrial ash and sedimented ash? Does the chemistry of ash differ within the lacustrine system? Does the chemistry of the tephra in the sediments change over time?

Ash samples from 12 locations throughout the system were analyzed in 1981 (Figure 21). Ten locations were sampled in 1982 (Figure 22). The electron microprobe measures calcium, iron, and potassium in the ash. The ratio of these three elements identifies ash from the Mt. St. Helens eruptions and Mazama eruptions. Ash from the May 18, 1980 eruption and ash from earlier Mt. St. Helens eruptions are indistinguishable. However, we can assume that earlier layers of ash are now deep in the sediments and it is not likely that we would pick up early layers in most of our sampling. Core samples from the Coeur d' Alene delta in 1981 contained a layer of Mazama ash as well as a layer of May 18, 1980 Mt. St. Helens ash (Figure 21). The electron microprobe analysis enabled us to distinguish ash from these two sources and to modify our core sampling in 1982 to avoid Mazama ash.

The ash in the Lake Coeur d'Alene system had not changed chemically by the fall of 1982. In two and one-half years there was no apparent difference in ash that had been moving through the rivers and deltas and ash which was undisturbed on the lake bottom. Terrestrial ash is no different from sedimented ash. There was no chemical breakdown of ash

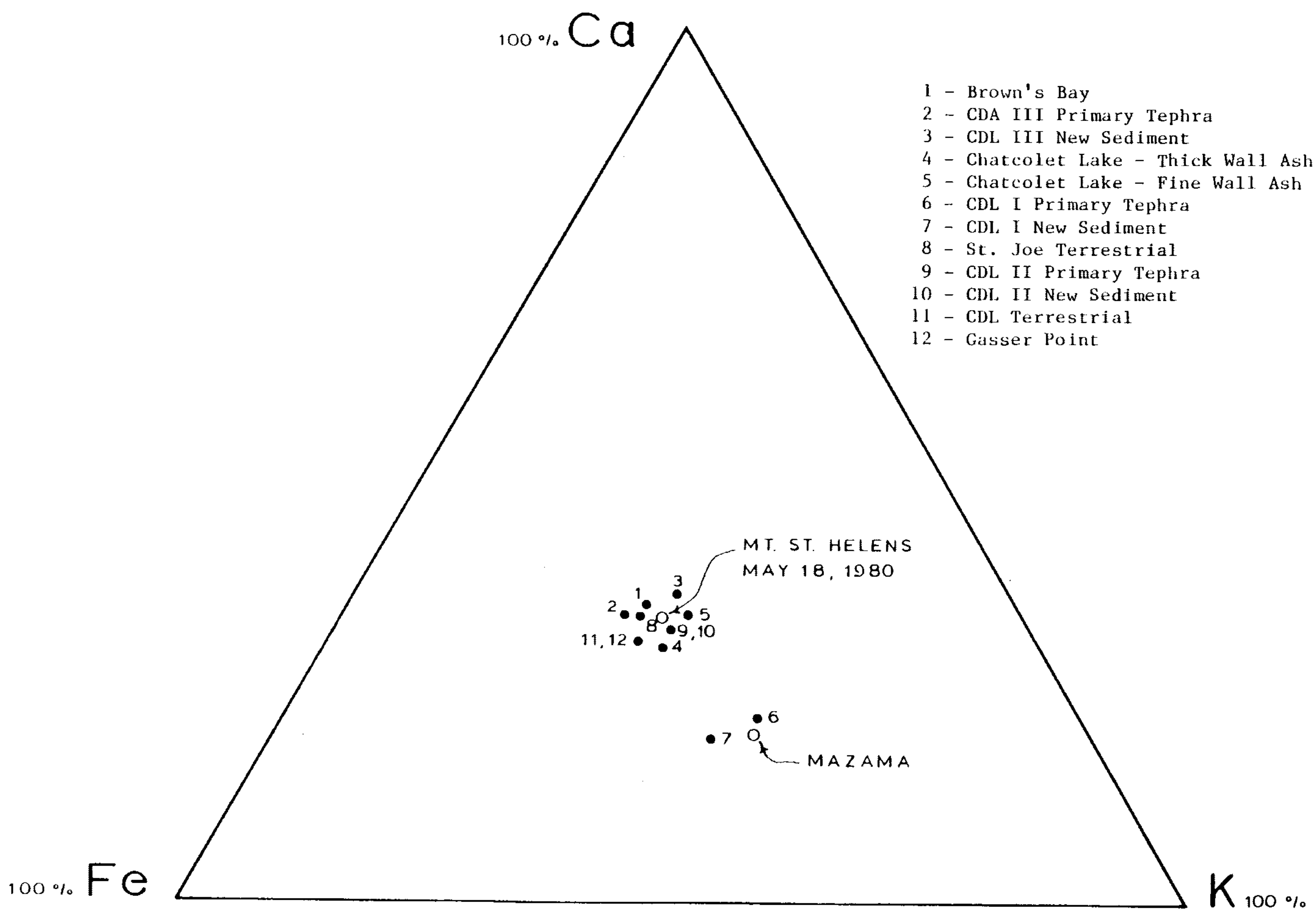


Figure 21. Electron microprobe plot to determine origin of sedimented and terrestrial tephra in the Lake Coeur d'Alene system, Fall 1981.

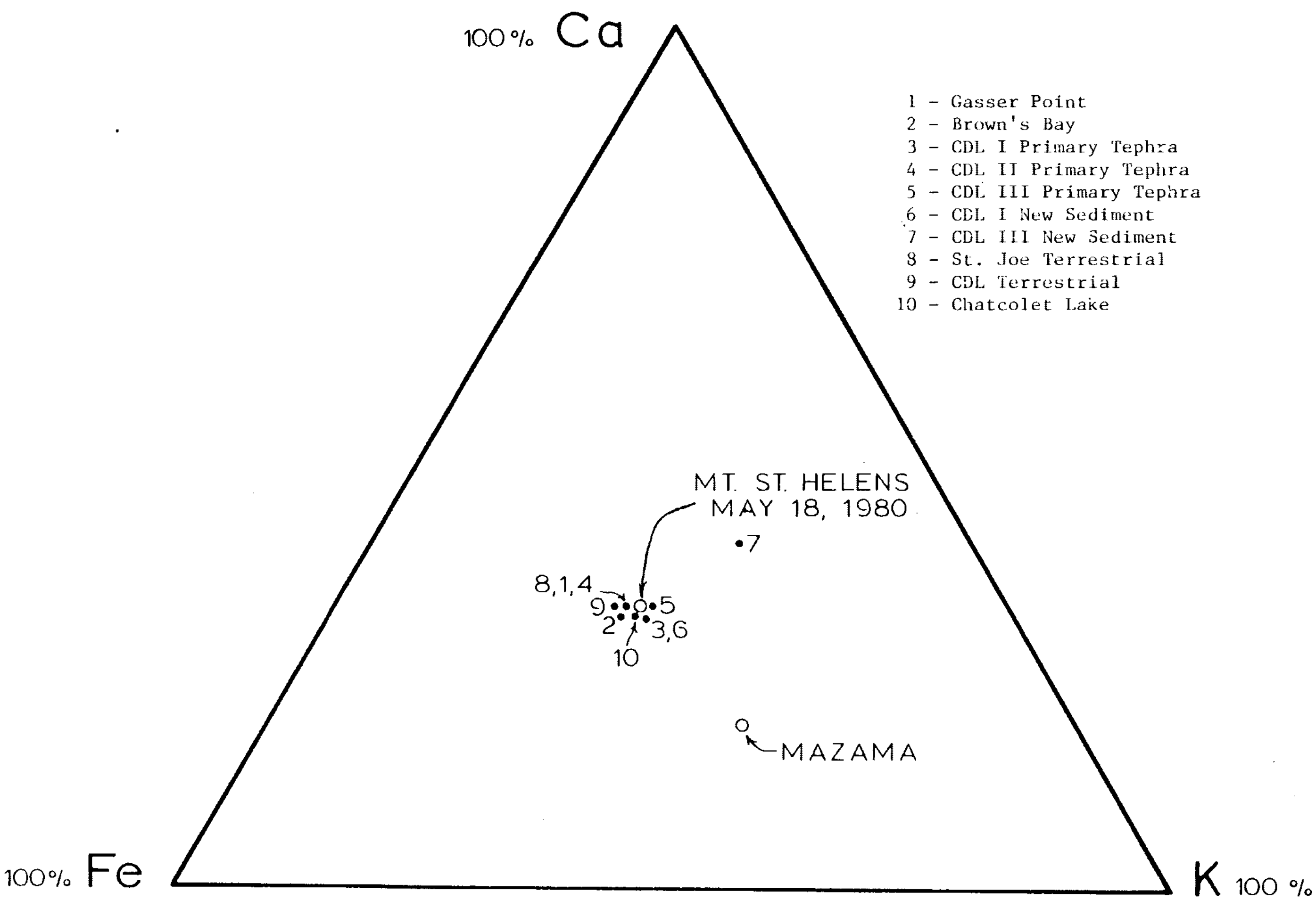


Figure 22. Electron microprobe plot to determine origin of sedimented and terrestrial tephra in the Lake Coeur d'Alene system, Fall 1982.

in any part of the lake-river system since it was deposited there. These findings indicate that the ash is chemically stable and that it will persist unchanged in the system.

During the fall of 1981 samples of tephra were collected at all 16 sample sites plus 2 terrestrial sites for chemical composition analyses. The objective was to determine if ions, especially nutrients, could be leached from the ash. The analysis was a water leaching of the ash followed by the measurements of 16 ions in the leachate. A water leaching rather than acid leaching was done to simulate the natural lake situation. Results indicate that the ash has a very low potential for contributing nutrients to the water column. Phosphate, ammonia, nitrate, and nitrates were in low to non-detectable levels (Appendix E). This indicates that the sedimented tephra has a negligible effect on primary production in the water column, a conclusion supported by our primary production measurements.

The water leachate analysis of the tephra indicates high concentrations of heavy metals (Nn, Pb, Cd) in the Coeur d'Alene delta. These metals are not coming out of the ash but are in high concentrations in the interstitial water and parent sediments. Our analyses of heavy metals in the sediments of the Coeur d'Alene delta supports this supposition.

Heavy Metals

For more than 90 years, the Coeur d' Alene River has received high concentrations of heavy metals from the mining districts of Kellogg and Wallace, Idaho. Previous research on the river-lake system provides evidence of decreased primary production because of metal toxicity (Wissmar 1972); tailings sediments cover most of the river substrate and may limit the benthic invertebrate community.

Zinc, cadmium and lead are of primary concern: they have deposited in the sediments of Coeur d' Alene Lake and continue to leach into the water. Metal concentrations in the sediments and water column of the river-lake system were monitored in the present study to determine if the ash had sealed the metals from leaching into the water column. If so, the concentration of metals in the sediments would increase and possibly limit benthic invertebrate production. On the other hand, if metals were sealed off from entry to the water column, primary productivity may increase.

Sediment and water samples for heavy metal analysis were taken at four times over the course of this study (Appendices F and G). The results of the metal analyses are summarized in Table 13. As expected, zinc and lead were found in highest concentration in the parent sediments (i.e., underneath the ash) of the Coeur d' Alene River and delta. The two deep lake sites had lesser concentrations of zinc and lead due to their distance from the river. All three metals were detected at low levels in the St. Joe River sediments.

Lead and cadmium concentrations in the water column were all below detection limits. Zinc in the water column was present at highest levels in the Coeur d' Alene River and delta. Again, the two deep lake sites had lower concentrations of zinc; this metal was not detected in the waters of the St. Joe River.

TABLE 13

Mean heavy metal concentrations in the parent sediment (mg/kg) and water column (mg/l) at 6 sites in the Coeur d' Alene Lake system, 1981-1982, (values preceded by < are detection limit values; the precision for an element at detection limit is ± 50%).

Sampling Site	Sediment			Water		
	Zinc	Lead	Cadmium	Zinc	Lead	Cadmium
Browns Bay (BB_1)	2,377	1,382	40	0.14	<0.50	<0.03
Gasser Point (GP_1)	2,670	2,500	50	0.19	<0.50	<0.03
CDL River delta I (CD_1)	3,347	8,620	36	0.70	<0.05	<0.03
CDL River delta III (CD_3)	3,330	7,286	49	0.36	<0.05	<0.03
CDL River mile 133 (CR_1)	2,423	5,002	43	0.73	<0.50	<0.03
St. Joe River mile 8 (SR_1)	48	83	2	<0.02	<0.50	<0.03

Heavy metal concentrations in the water column are lower than previously reported (Table 14). St. Joe River zinc concentrations and lead and cadmium concentrations from all 3 sites presently occur at levels below detection limits. Zinc concentrations have decreased from 2.70 to 0.73 mg/l and 0.40 to 0.25 mg/l in the Coeur d' Alene River and Coeur d' Alene Lake, respectively.

Metal concentrations in the sediments have also declined in the past decade. Winner (1972) and Maxfield (unpublished data) reported zinc concentrations in the sediments of the Coeur d' Alene River delta of 6,760 ppm and 4,207 ppm, respectively. We found that mean levels of zinc in the parent sediment of the delta did not exceed 3,350 ppm.

Apparently, upstream pollution control measures (eg. tailings ponds) are reducing the discharge of heavy metals into the river and, thus, into the lake. We attribute the decreased zinc levels in the water column of the lake to decreased metals loading upriver; the lower concentrations of zinc in the river water support our hypothesis. This phenomenon, in conjunction with a decline in the concentration of heavy metals in the parent sediment, indicated that the ash layer has had little, if any, effect on the exchange of metals between the sediments and overlying water.

TABLE 14

Comparison of water column heavy metal concentrations (mg/l), 1969-1970 (Wissmar 1972) vs. 1981-1982, at 3 sites in the Coeur d' Alene Lake system (values preceded by < are detection limit values; the precision for an element at detection limit is ± 50%).

Sampling Site	Zinc		Lead		Cadmium	
	1969-1970	1981-1982	1969-1970	1981-1982	1969-1970	1981-1982
Coeur d' Alene River (CR_1)	2.70	0.73	0.20	<0.50	0.02	<0.03
Coeur d' Alene Lake (CD_3/BB_1)[a]	0.40	0.25	0.20	<0.50	0.01	<0.03
St. Joe River (SR_1)	0.05	<0.02	0.10	<0.50	0.01	<0.03

[a]To match sampling sites from Wissmar's study, the Coeur d' Alene Lake 1981-1982 values represent the means of data from CD_3 and BB_1.

Water Column Chemistry

During each sampling trip, profile measurements of dissolved oxygen, pH, temperature, conductivity, and turbidity were made at all sample sites. In addition, a Secchi disc transparency was recorded at each site.

The objective in measuring oxygen and temperature was to be able to identify the timing of lake mixis or turnover. This would enable us to determine if changes in suspended tephra concentrations were due to upwelling during mixis. Results indicate that Lake Coeur d' Alene, Lake Chatcolet, Hidden Lake and Round Lake turned over during September (Appendices H, I, L and M). This was also the month of turnover for deeper areas of the St. Joe and Coeur d' Alene River deltas.

Spring stratification took place in early May in the deep areas of Lake Coeur d' Alene and Lake Chatcolet. Round Lake and Hidden Lake did not begin to stratify until the end of May. These lakes are smaller, more protected from the wind and remain ice covered longer than the larger bodies of water. The results of the suspended tephra sampling to measure upwelling during mixis are discussed in the section under "Suspended Tephra."

Another objective in measuring these water chemistry parameters was to make pre- and post-ashfall comparisons. Oxygen, pH, temperature, conductivity, turbidity and Secchi transparency are commonly measured in limnological investigations. There have been six studies on the Lake Coeur d' Alene system since 1960 which measured some or all of these parameters. The water chemistry data collected in this study are tabulated in Appendices H through S.

Tables 15 through 19 list condensed data from this study (1981 and

Table 15. A comparison of annual average dissolved oxygen concentrations before and after the Mt. St. Helens ash fallout in the Lake Coeur d'Alene area.

	Dissolved Oxygen (mg/l)		
	Pre-ash	Post-ash	
	1960-1971	1981	1982
1960 (Davis 1961)			
St. Joe River			
Mile 8	11.3	7.9	8.9
Mile 13	11.3	8.0	9.0
Mile 17	11.5	8.5	8.9
1965 (Marcuson 1966)			
Round Lake			
Mid-lake	8.2	9.3	9.4
1970 (Minter 1971)			
Coeur d'Alene River			
Mile 133	9.0	8.6	9.0
Coeur d'Alene			
Delta	9.0	8.4	8.8
1970 (Wissmar 1972)			
Coeur d'Alene River			
Mile 133	8.7	8.6	9.0
Coeur d'Alene			
Delta	8.0	8.4	8.8
St. Joe River			
Mile 8	8.6	7.9	8.9
1971 (Parker 1972)			
Gasser Point	8.0	8.4	8.9
Coeur d'Alene Delta	7.5	8.4	8.5
Brown's Bay	8.5	7.9	8.8
Hidden Lake	8.0	7.9	8.7
Lake Chatcolet	7.5	7.9	8.3
Means	8.9	8.3	8.9

Table 16. A comparison of annual average ph values before and after the Mt. St. Helens ash fallout in the Lake Coeur d'Alene area.

	pH Values		
	Pre-ash	Post-ash	
	1960-1971	1981	1982
1960 (Davis 1961)			
St. Joe River			
Mile 8	7.3	6.9	7.0
Mile 13	7.4	6.9	7.0
Mile 17	7.5	7.0	7.1
1965 (Marcuson 1966)			
Round Lake			
Mid-Lake	7.9	8.1	7.5
1970 (Minter 1971)			
Coeur d'Alene River			
Mile 133	6.8	6.9	7.1
Coeur d'Alene			
Delta	7.0	6.9	7.1
1970 (Wissmar 1972)			
Coeur d'Alene River			
Mile 133	6.9	6.9	7.1
Coeur d'Alene			
Delta	7.3	6.9	7.1
St. Joe River			
Mile 8	7.0	6.9	7.0
1971 (Parker 1972)			
Gasser Point	7.3	7.7	7.1
Coeur d'Alene Delta	7.1	6.9	7.1
Brown's Bay	7.2	7.1	7.0
Hidden Lake	7.3	7.2	7.3
Lake Chatcolet	7.4	7.2	7.0
Means	7.2	7.1	7.1

Table 17. A comparison of annual average water temperatures before and after the Mt. St. Helens ash fallout in the Lake Coeur d'Alene area.

	Temperature (°C)		
	Pre-ash	Post-ash	
	1960-1972	1981	1982
1960 (Davis 1961)			
St. Joe River			
Mile 8	12.6	17.5	14.3
Mile 13	12.3	16.8	13.9
Mile 17	12.6	17.0	13.9
1970 (Wissmar 1972)			
Coeur d'Alene River			
Mile 133	13.7	17.5	15.6
Coeur d'Alene Delta	12.7	18.0	17.2
St. Joe River Mile 8	19.3	17.5	14.3
1972 (Winner 1972)			
Lake Chatcolet	13.0	16.5	14.0
Means	13.7	17.3	14.7

Table 18. A comparison of annual average conductivities (μ mhos) before and after the Mt. St. Helens ash fallout in the Lake Coeur d'Alene area.

	Conductivity (μ mhos)		
	Pre-ash	Post-ash	
	1970-1971	1981	1982
1970 (Minter 1971)			
Coeur d'Alene River			
Mile 133	97	84	81
Coeur d'Alene			
Delta	--	84	54
1970 (Wissmar 1972)			
Coeur d'Alene River			
Mile 133	111	84	81
Coeur d'Alene			
Delta	46	84	54
St. Joe River			
Mile 8	<50	49	45
1971 (Parker 1972)			
Gasser Point	60	50	49
Coeur d'Alene Delta	50	84	54
Brown's Bay	55	45	46
Hidden Lake	60	42	42
Lake Chatcolet	60	42	42
Means	65	65	56

Table 19. A comparison of annual average turbidities and Secchi disc transparencies before and after the Mt. St. Helens ash fallout in the Lake Coeur d'Alene area.

	Turbidity (Hach Turbidimeter)		
	Pre-ash	Post-ash	
	1960	1981	1982
1960 (Davis 1961)			
St. Joe River			
Mile 8	2.0	1.5	2.2
Mile 13	1.6	1.6	2.5
Mile 17	1.4	1.1	2.4
Means	1.7	1.4	2.4

	Secchi Disc Transparency (m)		
	Pre-ash	Post-ash	
	1970	1981	1982
1970 (Wissmar 1972)			
Coeur d'Alene River			
Mile 133	2.3	1.9	1.6
Coeur d'Alene Delta	2.8	1.8	2.9
St. Joe River Mile 8	3.2	2.7	2.3
Means	2.8	2.1	2.3

1982) and compare them to pre-ash data. The only obvious difference in pre- and post-ash dissolved oxygen is in the St. Joe River during 1960 (Table 15). Concentrations were over 11 mg/l in the St. Joe River in 1960 as compared to 8 to 9 mg/l during the summers of 1981 and 1982. If the river underwent a change to lower oxygen concentrations it took place between 1960 and 1970 since 1970 concentrations are about the same as those in 1981 and 1982 after the fallout.

There has been no significant change in pH values throughout the system from 1960 through 1982 (Table 16). Hydrogen ion concentrations average slightly more than 7 and it appears that the inert nature of the ash has not changed the pH.

The average water temperature in 1981 was 3.6 degrees warmer than pre-ash years for the stations compared (Table 17). However, the 1982 temperatures were only one degree warmer, indicating that average summer temperatures can vary with weather, runoff, rainfall, etc. Temperature measurements are valuable in pinpointing turnover but give little insight into pre- and post-ash conditions.

Conductivity, turbidity, and Secchi disc transparencies show no significant changes from pre-ash to post-ash lake conditions (Tables 18 and 19). Even though there is evidence that some tephra resuspends during lake turnover, the quantity is so small that it has little effect on light penetration or water clarity. The initial effect of ash fall-out in Lake Coeur d' Alene was in a Secchi transparency reduction from 2.5 m to 0.3 m (Rieman, 1980). This effect was short lived and when the ash settled to the lake bottoms, it never resuspended in quantities which significantly reduced light penetration or increased turbidity.

Phytoplankton Communities

Phytoplankton communities in the Coeur d' Alene Lake system varied with habitat type and season (Table 20). In 1981, summer maxima were observed in the deep and flood plain lakes, while abundance peaks in the autumn of 1981 and all of 1982 occurred in the Coeur d' Alene River and its delta. Algae counts in the St. Joe River and delta were low both years. Plankton abundance estimates for the specific sites sampled on each field trip are given in Appendix T .

Thirty-four genera of phytoplankton were identified in the present study (Appendix U). Dominant forms include *Asterionella*, *Navicula*, and *Nitzschia* (diatoms), *Cryptomonas* (flagellate), *Anabaena* (bluegreen), and *Ankistrodesmus* and *Scenedesmus* (greens). Flood plain lake blooms were dominated by *Anabaena*, while deep lakes bloom forms included both *Anabaena* and *Asterionella*. Blooms in the Coeur d' Alene River and delta were dominated by *Anabaena*, *Ankistrodesmus* and *Nitzschia*. No blooms occurred in the St. Joe River or its delta, but *Navicula* was the dominant algal form in those waters.

Seasonal changes in phytoplankton abundance at four sampling sites in the Coeur d' Alene Lake system are illustrated in Figure 23. Pre-ashfall (Minter 1971) algal succession patterns were superimposed on the 1981-1982 data (composite water samples were taken in both studies). Although seasonal and annual variability in the abundance estimates were high, we feel that no substantial decreases in algal numbers have occurred relative to 1970. In fact, we found a significant increase in phytoplankton abundance at Coeur d' Alene River mile 133 (CR_1); this phenomenon may be linked to the reduction in sediment and water column heavy metal concentrations over the past decade. Specifically, pollution control measures in the upstream mining district have apparently reduced the

TABLE 20.

Algal abundance estimates (number per liter) in the Coeur d' Alene Lake System, 1981-1982 (Spring = before June 1, Summer = June 1 - September 1, Autumn = after September 1).

Habitat Type	1981		1982		
	Summer	Autumn	Spring	Summer	Autumn
Deep lakes	1,892,363	1,329,302	107,666	658,483	310,206
Flood plain lakes	1,409,465	1,077,371	41,929	971,989	223,860
CDL River	757,926	2,586,116	146,042	970,212	2,407,028
CDL River delta	611,458	1,404,988	151,372	1,075,137	198,276
St. Joe River	132,006	75,331	104,113	119,697	96,651
St. Joe River delta	732,839	427,821	121,879	484,066	144,976

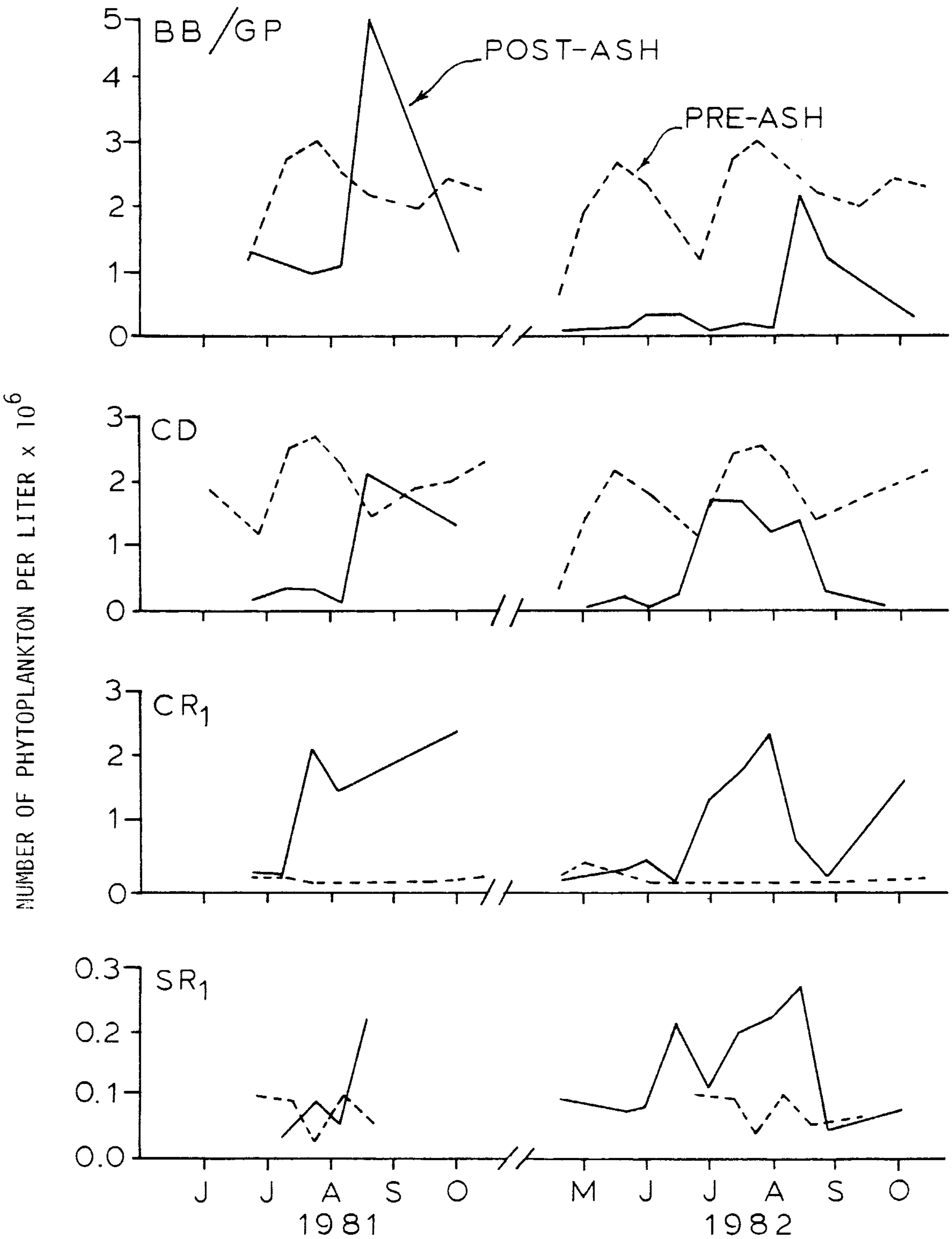


Figure 23. Algal abundance estimates at 4 sites in the Coeur d' Alene Lake system, 1981-1982. The 1970 pre-ash algal abundance (no./l) of Minter (1971) is superimposed over the 1981 and 1982 plots.

loading of metals to the aquatic system, thus allowing the development of a significant algal community.

Minter (1971) reported that *Melosira* was the dominant diatom at the four sites sampled, followed by *Tabellaria*, *Asterionella*, and *Synedra*, respectively. While we found all of these forms in abundance at the same sites, *Asterionella*, *Navicula*, and *Nitzschia* were clearly dominant in 1981-1982. Changes in the composition of an algal community are caused by a variety of physical, chemical and biological factors; we feel that seasonal and annual variability in climate and nutrient levels are responsible for the shift in dominance among the diatoms and we would expect *Melosira* to repeat its dominance in coming years.

Primary Productivity

The biological parameter expected to be most adversely affected by tephra resuspension during mixis or by new tephra flowing into the Coeur d'Alene Lake system during spring runoff was phytoplankton production. Since suspended tephra would reduce light penetration into the water column, primary productivity would be directly inhibited.

To assess the effects of tephra resuspension and inflow on production, we measured primary productivity at 5 sites from 1981 through 1982 (Table 21). Differences between estimates for the 2 years are probably due to methodology: the oxygen light- and dark-bottle method was used in 1981, while the carbon-14 light- and dark-bottle method was used in 1982. In 1981, the highest primary productivity was observed in Chatcolet Lake; however, in 1982, peaks in productivity occurred in the St. Joe River (SR_2) and its delta (OB_1).

Wissmar (1972) studied primary production in the Coeur d'Alene Lake system in 1969-1970. We compared the post-ashfall seasonal trends in productivity to the patterns he observed in each of the major rivers that supply Coeur d'Alene Lake (Figure 24). Both plots illustrate that production has not been adversely affected by the presence of ash in the water; this finding is consistent with the results of our suspended tephra analysis. Specifically, we determined that the ash is not resuspended during lake mixis, nor is it eroded in large quantities from the adjacent watersheds. Because of the stability of the sedimented terrestrial and lacustrine ash, post-ashfall primary production in the Coeur d'Alene Lake system parallels pre-ashfall productivity levels.

Table 21. Net primary productivity values (mg C/m^2/day) at Coeur d'Alene River Mile 133 (CR1), Coeur d'Alene River Delta (CD), O'Gara Bay (OB1), Chatcolet Lake (CL1), and St. Joe River Mile 13 (SR2); 1981 = oxygen method, 1982 = carbon-14 method.

Year	Date	CR1	CD	OB1	CL1	SR2
1981	Aug.	165.4	338.1	201.8	489.8	0
	Aug.	293.6	219.4	123.8	886.9	0
	Oct.	721.9	0	216.0	786.1	0
1982	Apr.	119.7	99.8	65.2	--	12.5
	May	264.5	0	28.5	511.7	0
	June	178.6	0	1,259.8	0	0
	July	0	0	1,689.4	0	2,537.2
	Aug.	3,689.4	1,478.8	6,831.5	--	10,997.5
	Oct.	54.7	30.0	18.2	0	--

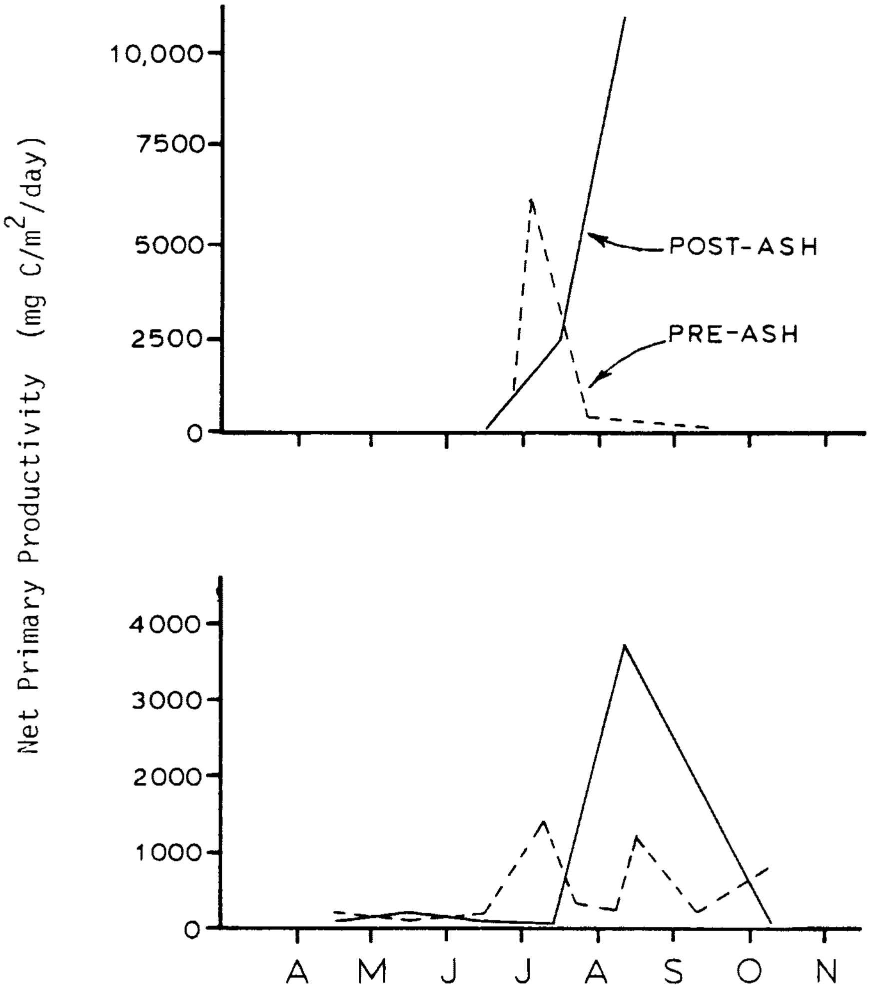


Figure 24. Pre- (1970) and post-ashfall (1982) net primary productivity estimates at St. Joe River Mile 13 (SR2) and Coeur d'Alene River Mile 133 (CR1).

Zooplankton Communities

Seasonal changes in zooplankton abundance in the various habitat types comprising the Coeur d'Alene Lake system are shown in Table 22. Peak zooplankton numbers were observed in the St. Joe River floodplain lakes in both the autumn of 1981 and 1982 (138.3 and 113.8 per liter, respectively). Summer maxima occurred in the St. Joe River delta in 1981 (71.9/l) and the floodplain lakes in 1982 (62.0/l). The lowest zooplankton counts were in the St. Joe River, where the maximum seasonal mean abundance estimate was 2.9 per liter in the summer of 1982. Zooplankton abundance estimates for the sites sampled on each field trip are provided in Appendix V .

Cyclops bicuspidatis thomasi was the dominant copepod collected in the Coeur d'Alene Lake system. Other copepods collected include Cyclops varicans rubellus, Diaptomus ashlandi, D. novamexicanus, D. pygmaeus, and Epischura nevadensis. Dominant cladocerans included Bosmina longirostris, Ceriodaphnia reticulata, Daphnia (3 sp.) and Diaphanosoma (2 sp.). Other cladocerans collected were Alona (2 sp.), Camptocercus rectirostris, Leptodora kindti, Pleuroxus procurvatus, Polyphemus pediculus, Scapholeberis sp. and Sida crystallina. The dominant copepod form and cladoceran genus at the sites sampled on each field trip are given in Appendix V (when a member of the cladoceran family Chydoridae was dominant, "Chydorus" was entered in the column for listing the dominant cladoceran).

Pre- and post-ashfall zooplankton abundance estimates at riverine sites are compared in Figure 25. Peaks in zooplankton numbers were more dramatic in 1970 than in 1981-1982, but abundance estimates over most of the season are similar. Zooplankton data from Gasser Point and Brown's Bay were

Table 22. Zooplankton abundance estimates (number per liter) in the Coeur d'Alene Lake system, 1981-1982 (Spring = before June 1, Summer = June 1 - September 1, Autumn = after September 1).

Habitat Type	1981		1982		
	Summer	Autumn	Spring	Summer	Autumn
Deep lakes	57.0	98.2	4.2	48.2	44.8
Floodplain lakes	35.7	138.3	5.2	62.0	113.8
Coeur d'Alene River	11.7	24.5	6.6	4.9	3.3
Coeur d'Alene River delta	19.2	48.1	7.4	24.9	67.9
St. Joe River	1.8	1.3	0.8	2.9	0.8
St. Joe River delta	71.9	55.3	4.7	54.3	60.4

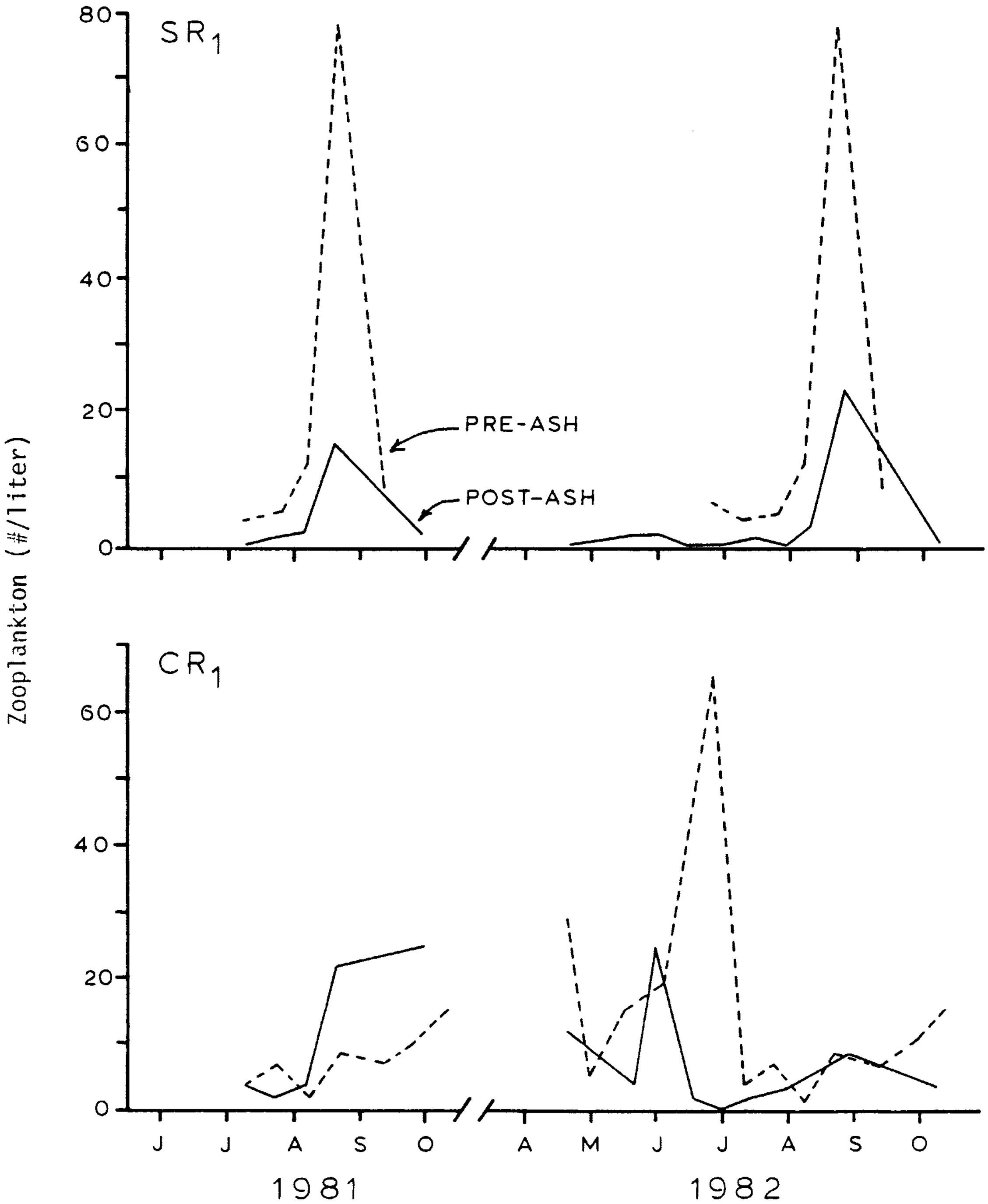


Figure 25. Comparison of pre- and post-ashfall seasonal succession in zooplankton abundance (no./l) at St. Joe River Mile 8 (SR1) and Coeur d'Alene River Mile 133 (CR1); Minter's (1971) estimates from 1970 (---) are superimposed over the 1981-1982 plots.

combined to facilitate comparisons with Rieman's (unpublished) 1977-1980 data (Figure 26). Zooplankton peak abundance estimates in 1977 and 1978 exceeded 100 and 150 organisms per liter, respectively. The trend from 1979-1982 is toward higher zooplankton densities; clearly, the ashfall did not adversely impact zooplankton abundance in the deep lake region. Further, we believe that the deposition of ash in the Coeur d'Alene Lake system did not significantly reduce the abundance of any of that system's component zooplankton communities.

The pre- and post-ashfall composition of 3 cladoceran communities are compared in Table 23. In general, more cladoceran species were found in 1981-1982, probably because of our extensive sampling effort. Daphnia rosea was reported in Round Lake and the "pooled" site prior to the ashfall, but not found in 1981-1982. Daphnia thorata is found in the same couplet of Pennak's (1978) key as D. rosea; since we found D. thorata at these 2 sites, we attribute the speciation discrepancy to differences in the interpretation of Daphnia taxonomic characters.

The pre- and post-ashfall composition of 3 copepod communities are shown in Table 24. Canthocamptus was not found in Round Lake in 1981-1982; however, as a harpacticoid copepod its habitat is benthic, thus we did not expect to find it in our net tows. In general, cyclopoid and calanoid composition has not changed relative to previous studies. Given the similarity of pre- and post-ashfall cladoceran communities, we do not believe that the deposition of ash in the Coeur d'Alene Lake system has significantly altered the species composition of the zooplankton.

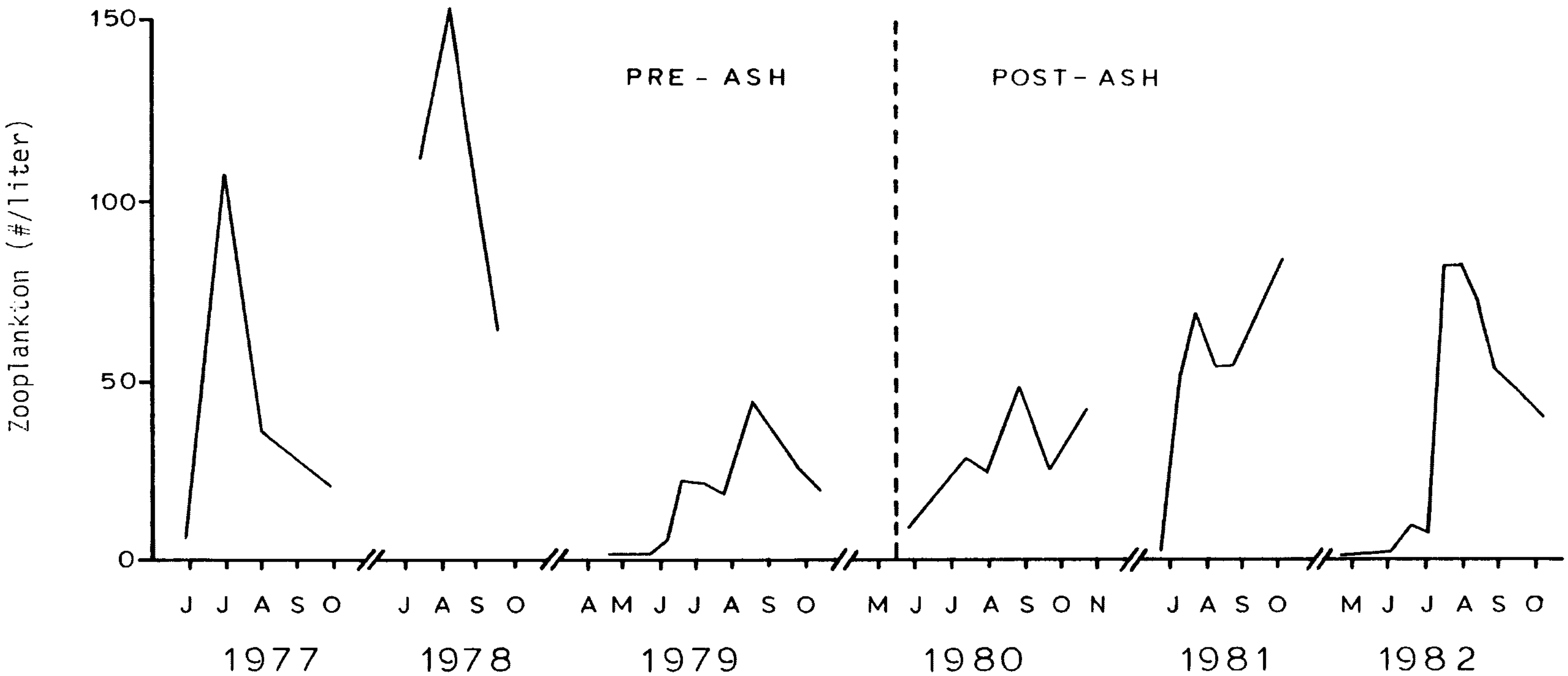


Figure 26. Pre- versus post-ashfall seasonal succession in zooplankton abundance (no./l) at Gasser Point/ Brown's Bay; 1977-1980 data are from Rieman (unpublished). Copepod nauplii larvae counts were subtracted from the total zooplankton counts of 1981-1982 because Rieman did not include those forms in the totals he reported.

Table 23. Comparison of pre- and post-ashfall cladoceran communities at Round Lake (pre-ash data from Marcuson, 1966), Gasser Point/Brown's Bay (pre-ash data from Rieman, unpublished data), and at a "pooled" site which included the lower Coeur d'Alene River and its delta, Gasser Point, Brown's Bay and St. Joe River Mile 8 (pre-ash data from Minter, 1971); "x" denotes presence of cladoceran, "x?" denotes taxonomic uncertainty.

Cladoceran Species	Round Lake		GP/BB		"Pooled" Site	
	Pre-ash	Post-ash	Pre-ash	Post-ash	Pre-ash	Post-ash
Alona affinis						x
Alona guttata						x
Bosmina longirostris	x	x	x	x	x	x
Camptocercus macrurus	x					
Camptocercus rectirostris						x
Ceriodaphnia reticulata		x		x		x
Ceriodaphnia sp.					x	x
Chydorus sphaericus					x	
Daphnia galeata mendotae			x	x		x
Daphnia pulex						x
Daphnia rosea (formerly *D. longispina*)	x				x	
Daphnia thorata		x	x?	x		x
Diaphanosoma brachyurum	x	x		x	x	x
Diaphanosoma leuchtenbergianum		x	x	x		x
Leptodora kindti	x	x	x	x	x	x
Moina sp.					x	
Pleuroxus procurvatus						x
Polyphemus pediculus	x	x			x	x
Scapholeberis sp.				x		x
Sida crystallina		x				x

Table 24. Comparison of pre- and post-ashfall copepod communities at Round Lake (pre-ash data from Marcuson, 1966), Gasser Point/Brown's Bay (pre-ash data from Rieman, unpublished data), and at a "pooled" site which included the lower Coeur d'Alene River and its delta, Gasser Point, Brown's Bay and St. Joe River Mile 8 (pre-ash data from Minter, 1971); "x" denotes presence of copepod, "x?" denotes taxonomic uncertainty.

Cladoceran Species	Round Lake		GP/BB		"Pooled" Site	
	Pre-ash	Post-ash	Pre-ash	Post-ash	Pre-ash	Post-ash
Canthocamptus assimilis	x?					
Canthocamptus staphylinoides	x					
Cyclops bicuspidatus thomasi	x	x	x	x	x	x
Cyclops varicans rubellus		x				
Diaptomus ashlandi				x	x	x
Diaptomus novamexicanus	x?	x				
Diaptomus oregonensis	x					
Diaptomus pygmaeus[a]		x		x		x
Diaptomus sp.			x			
Epischura nevadensis	x?	x	x	x	x	x
Eucyclops agilis	x?					

[a]formerly a synonym of *Diaptomus oregonensis*

Benthic Macroinvertebrates

The abundance and biomass of benthic invertebrates in the Coeur d'Alene Lake system were highest in the St. Joe River and its floodplain lakes (Tables 25 and 26). Estimates from the summer of 1982 were lower than those from the summer of 1981 because the latter represent the means of late summer samples only. Invertebrate abundance and biomass were lowest in the Coeur d'Alene River; no organisms were found at either CR1 or CR2 in the autumn of 1981 and spring of 1982. We attribute this phenomenon to heavy metal pollution in the Coeur d'Alene River. As the river meets the lake, the toxicity of the metals is reduced via dilution, causing increased invertebrate production in the Coeur d'Alene River delta. Benthos abundance and biomass estimates for the sites sampled on each trip are provided in Appendix W.

The majority of benthic macroinvertebrates in the Coeur d'Alene Lake system were oligochaetes and chironomids. The benthos also included representatives from Coelenterata, Nematoda, Hirudinea, Crustacea (Ostracoda, Isopoda, Amphipoda and Hydracarina), Insecta (Plecoptera, Ephemeroptera, Odonata, Trichoptera, Coleoptera and Diptera), Gastropoda and Pelecypoda. Winner (1972) surveyed the macrobenthic communities in the Coeur d'Alene Lake system in 1971-1972; he found a similar diversity of macroinvertebrates at that time.

An experiment was conducted in the littoral zone (2m) of Chatcolet Lake in mid-August 1982 to investigate the short-term toxic effects of the settled ash on the benthic community. On August 20, a diver pushed 24 PVC tubes (length = 50cm, diameter = 4.8cm) into the littoral sediments to a depth of 25cm. An aqueous solution containing 24.3g of ash was then randomly

Table 25. Benthic invertebrate abundance estimates (number per m^2) in the Coeur d'Alene Lake system, 1981-1982 (Spring = before June 1, Summer = June 1 - September 1, Autumn = after September 1).

Habitat Type	1981		1982	
	Summer	Autumn	Summer	Autumn
Deep lakes	374	589	428	231
Floodplain lakes	2,049	2,762	578	522
Coeur d'Alene River	56	0	0	40
Coeur d'Alene River delta	360	225	98	59
St. Joe River	2,501	1,060	711	397
St. Joe River delta	376	164	161	317

Table 26. Benthic invertebrate biomass estimates (mg per m^2) in the Coeur d'Alene Lake system, 1981-1982 (Spring = before June 1, Summer = June 1 - September 1, Autumn = after September 1).

Habitat Type	1981		1982	
	Summer	Autumn	Summer	Autumn
Deep lakes	201	397	234	115
Floodplain lakes	568	484	165	292
Coeur d'Alene River	10	0	0	16
Coeur d'Alene River delta	51	67	10	22
St. Joe River	447	455	747	301
St. Joe River delta	100	37	86	175

applied to 12 of these contained, in situ microenvironments (24.3g of ash in a PVC tube corresponds to a layer of uncompacted ash 22mm thick). Fine-mesh screens were secured to the tops of all 24 tubes to prevent benthos emigration. After 48 hours, each tube was individually recovered and its intact sediment core washed through a 600μm sieve; before retrieving the next tube, live organisms were separated from the filtered debris.

Estimates of five biological parameters were compared between the control and ash-treated microenvironments in the acute mortality experiment (Table 27). Student's t-tests at the $\alpha=0.05$ level failed to demonstrate any statistically significant biological differences between the control and ash-treated microenvironments. Therefore, we believe that no significant changes in the abundance, biomass or composition of the benthic community had occurred in the 48 hours subsequent to the ashfall.

To determine if the volcanic ashfall of 1980 had a significant long-term effect on the abundance of the benthos, we compared our 1981-1982 benthos data to Winner's (1972) pre-ashfall data at 4 sites in the Coeur d' Alene Lake system (Figure 27). The plots of seasonal changes in oligochaete and chironomid abundance reveal that no dramatic increases or decreases in density have occurred in the past decade; specific seasonal differences in abundance are attributed to annual variability in the timing of abundance peaks. Therefore, we conclude that the ash has not had a significant long-term effect on the abundance of the benthos in the Coeur d'Alene Lake system.

To determine if the ashfall affected the biomass of the benthic fauna, we compared our 1981-1982 St. Joe River invertebrate biomass estimates to Davis' (1961) pre-ash estimates (Figure 28). Our estimates are lower than Davis'; however, Davis only air-dried his samples, while ours were oven-dried

Table 27. Biological parameter estimates for control and ash-treated microenvironments in the acute mortality experiment; each estimate represents the mean of n = 12 cores recovered from the littoral zone of Chatcolet Lake on August 22, 1982.

Parameter	Control	Ash-treated
Benthos abundance per core	5.1	4.4
Benthos biomass (mg) per core	0.6	0.5
% Oligochaeta per core	22.9	36.0
% Diptera per core	62.2	60.0
% Chironominae per core	33.6	36.9

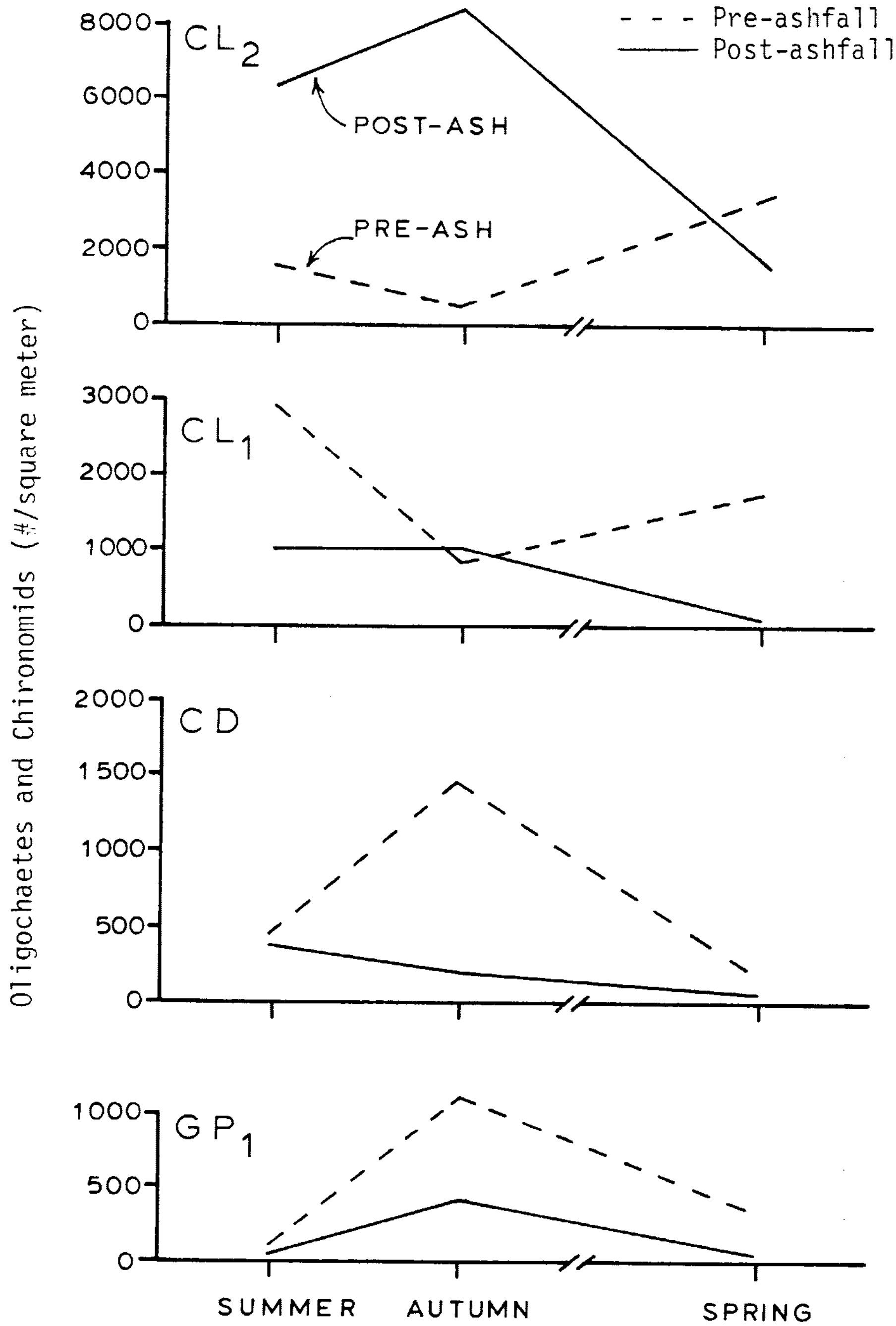


Figure 27. Pre- (1971-1972) and post-ashfall (1981-1982) oligochaete and chironomid abundance estimates at Chatcolet Lake shallow (CL2) and deep (CL1), Coeur d'Alene River delta (CD), and Gasser Point deep (GP1).

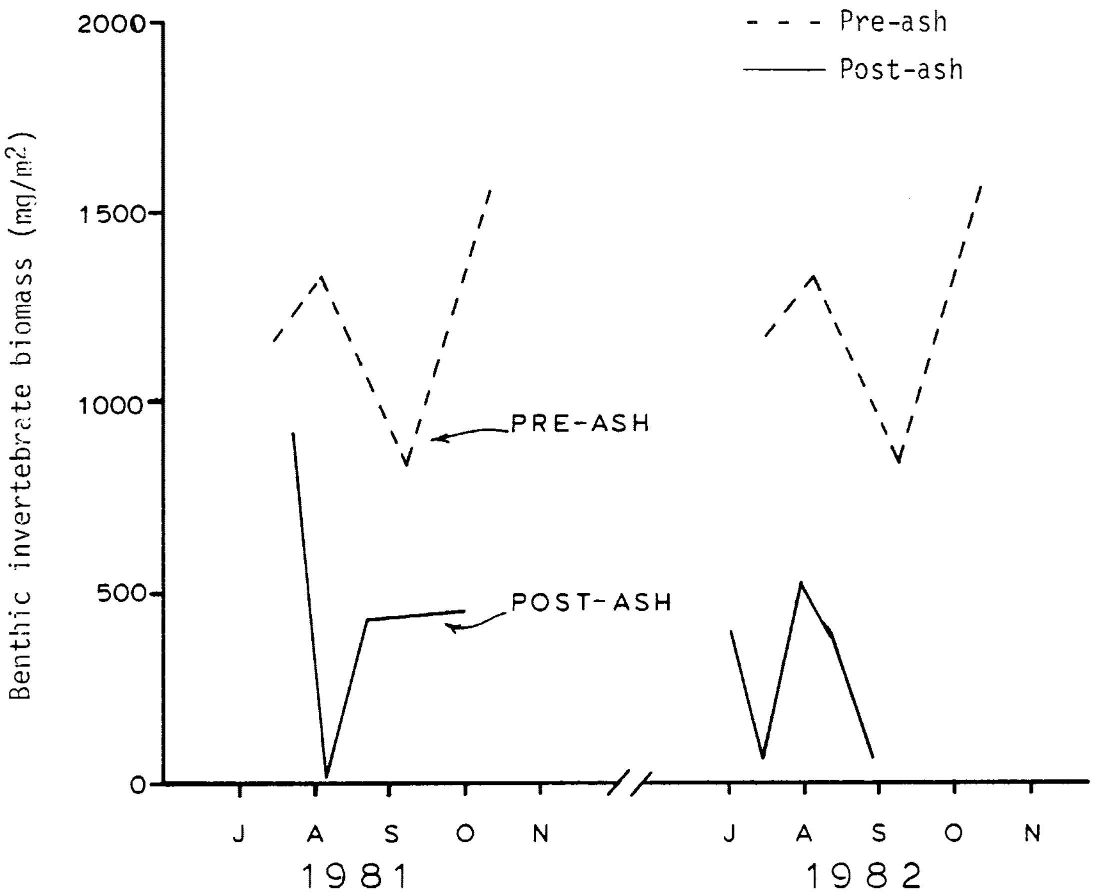


Figure 28. Pre- (1960) and post-ashfall (1981-1982) benthos biomass estimates in the lower St. Joe River; the biomass for a given date represents the mean of the biomass estimates for SR1, SR2 and SR3 on that date.

at 103^{o} C for 24 hours. Given the previous non-significant results of the abundance comparisons, we feel that the different drying techniques account for the biomass discrepancies between the studies and conclude that the ashfall did not adversely effect the biomass of benthic invertebrates in the Coeur d'Alene Lake system.

The dense ash layer could prevent benthic organisms from burrowing into the sediment, thus altering the natural vertical distribution pattern of the benthos within the substrate. The vertical distribution of the benthic fauna was assessed by sectioning sediment cores obtained by a diver with a PVC tube. Each core was divided into 4 sections: 1) an ash and above-ash layer, 2) a 0-4cm below-ash layer, 3) a 4-8cm below-ash layer, and 4) an 8-12cm below-ash layer. Each section was washed through a 500μm sieve before organisms were separated from the debris under a dissecting microscope. The mean vertical population depth (MVPD) of the benthic community was estimated to succinctly quantify the vertical stratification of the benthos. The MVPD for a given core was calculated as $\Sigma XY/\Sigma X$, where X is abundance or biomass at vertical population depth Y (Nalepa and Robertson 1981).

To assess the effects of the sedimented ash on the vertical stratification of the benthic fauna, on June 23, 1982, a diver removed the ash layer from 12 marked 0.1m^2 plots in Chatcolet Lake; hence, these ash-free plots simulated the pre-ashfall littoral sediments. The vertical distribution of the benthic fauna was determined on July 22 and August 21, 1982. On each date, 12 cores were taken from the control sediments and 12 from the ash-free sediments; the results are shown in Table 28. Student's t-tests conducted for each parameter-date combination demonstrated non-significance at the $\alpha = 0.05$ level, leading us to conclude that the sedimented ash layer did

Table 28. Mean vertical population depth (MVPD) estimates for control and ash-free sediments. Each estimate represents the mean of the MVPD's of n = 12 cores (S^2 = variance).

Parameter	Date	Control		Ash-free	
		$\overline{X}$	S^2	$\overline{X}$	S^2
MVPD (cm) - Abundance	July	0.9	0.14	0.8	0.06
	August	1.4	1.23	0.8	0.07
MVPD (cm) - Biomass	July	1.1	0.47	1.0	0.41
	August	2.2	3.29	1.1	0.28

not alter the vertical stratification pattern of the littoral benthic community. Clearly, the majority of benthic forms in Chatcolet Lake are found at or near the surface of the sediments regardless of the presence or absence of ash.

SUMMARY AND CONCLUSIONS

- The purpose of this study was to measure the quantities and distribution of volcanic ash (tephra) from the May 18, 1980 eruption of Mt. St. Helens which was deposited in Lake Coeur d' Alene, its river deltas and floodplain lakes, and to measure the effect of sedimented and suspended ash on the aquatic communities therein.
- Sedimented tephra thickness throughout the lake system averaged 5.5 mm in 1981 and 7.6 mm in 1982; new sediments deposited over the ash layer averaged 32.3 mm in 1981 and 40.9 mm in 1982.
- The sedimented ash layer was cohesive, did not mix with the underlying parent sediment, and did not resuspend during lake mixis; further, the layer had no effect on normal redox potential gradation with depth in the aquatic sediments
- Quantities of ash entering the system via runoff and settling into the post-ash sediments were minimal; the terrestrial tephra layer in adjacent watersheds was stable and not easily eroded.
- The morphology and mineralogy of the tephra layers at different sites were similar, but tephra particle size distributions varied with location.
- The sedimented ash was chemically stable and its potential for contributing ions and nutrients to the water column was low.
- Heavy metal concentrations in the sediments and water column have declined in the past decade due to pollution control measures in the upstream mining districts; the ash layer has had little, if any, effect on the exchange of metals between the sediments and overlying water.
- Physical and chemical characteristics of water throughout the Coeur d' Alene Lake system were not changed by the ashfall.

Summary and Conclusions (con't)

- Composition and abundance of phytoplankton communities in the system were not affected by the ashfall; levels of primary productivity are similar to pre-ash levels.
- Composition and abundance of zooplankton communities in the system were not adversely affected by the ashfall.
- No short- or long-term changes in the composition, abundance and biomass of the benthic invertebrate communities in the lake system were observed; the tephra layer did not alter the vertical distribution pattern of the benthos within the sediments.

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APPENDICES

Appendix A . Ash in the New Sediment Layer (glass particles as a percent of total mineral particles) during 1981 and 1982.

Location	1981	1982
HL1	.04	.00
RP1	.14	.01
CL2	.14	.02
CR1	.09	.01
CD2	.06	.02
BB1	.13	.00
BP2	.13	.01
RP2	.05	.03
SR2	.06	.03
RL2	.06	.02
BP1	.07	.01
CD3	.21	.01
GP2	.06	.01
HL3	.13	.02
OB1	.08	.01
OB2	.17	.02
SR1	.09	.03
CL1	.06	.00
SR3	.06	.02
RL1	.06	.01
HL2	.04	.02
GP1	.06	.01
BB2	.05	.00
CD1	---	.01
CR2	---	.00

Appendix B. Suspended ash (glass particles as a percent of total mineral particles) at 2m below the water surface in 1981 and 1982.

Location	7/6-10/81	7/19-24/81	8/3-7/81	8/17-20/81	9/30-10/3/81	4/20-21/82	5/17-21/82	5/31-6/6/82	6/16-18/82	6/30-7/1/82	7/12-14/82	7/28-29/82	8/10-13/82	8/24-26/82	10/5-7/82
CD1	3.3	0.0	15.0	1.3	2.4	3.0	2.9	0.0	21.7	14.3	13.0	--	4.7	4.7	3.4
CD2	29.0	5.1	0.0	13.4	0.0	5.9	11.2	11.1	1.8	4.3	4.2	16.3	--	10.7	8.4
CD3	6.2	10.7	5.3	1.1	27.0	4.7	4.2	7.1	12.0	15.5	3.4	2.1	6.0	1.7	6.3
CR1	7.4	1.4	2.2	2.0	2.8	8.7	7.1	18.8	6.6	8.5	5.9	5.4	2.0	6.1	8.6
CR2	2.9	4.3	29.2	4.8	15.6	9.2	4.6	8.6	17.8	6.4	8.5	4.2	2.0	--	7.5
BB	29.1	33.6	0.0	15.7	55.4	--	--	14.6	9.0	6.5	2.9	12.3	4.5	8.0	--
GP	1.6	53.5	0.0	5.5	4.5	12.6	7.8	12.8	25.3	14.3	33.0	8.3	18.8	4.5	24.4
RP	6.3	0.0	20.6	16.3	6.7	9.6	5.9	5.3	10.2	13.7	18.1	--	13.5	9.6	22.3
BP	14.6	14.4	4.9	33.3	0.0	7.0	13.0	--	11.1	13.2	17.8	--	22.0	8.0	5.2
OB	11.0	2.7	0.0	3.8	0.0	.8	.8	1.8	4.3	.6	1.2	8.6	3.8	--	2.0
RL	7.9	2.6	9.7	16.3	3.2	1.0	8.4	3.1	1.7	1.7	6.1	2.1	1.0	7.0	5.4
CL	43.2	36.6	0.0	2.6	8.2	6.1	1.2	2.6	4.5	8.9	25.4	4.5	11.8	3.7	5.2
HL	.9	34.2	0.0	50.9	14.7	1.7	14.8	7.2	3.2	4.2	2.5	49.4	22.3	15.0	19.7
SR1	11.6	5.4	10.6	1.9	0.0	5.8	1.4	4.8	6.8	6.2	2.4	3.9	2.3	3.0	3.1
SR2	8.7	18.6	6.0	30.6	2.5	1.2	4.9	5.4	6.7	3.6	4.9	4.9	19.4	5.7	2.3
SR3	2.0	0.0	11.5	10.0	3.3	1.3	2.0	2.0	3.5	--	2.4	7.1	7.9	2.0	1.0

Appendix C . Suspended ash (glass particles as a percent of total mineral particles) at 1m above the lake bottom in 1981 and 1982.

Location	7/6-10/81	7/19-24/81	8/3-7/81	8/17-20/81	9/30-10/3/81	4/20-21/82	5/17-21/82	5/31-6/6/82	6/16-18/82	6/30-7/1/82	7/12-14/82	7/28-29/82	8/10-13/82	8/24-26/82	10/5-7/82
CD1	3.8	2.5	4.1	3.8	2.3	6.8	--	8.1	8.5	11.9	23.4	7.4	9.0	10.4	5.9
CD2	3.5	0.0	3.6	21.7	3.4	3.3	8.8	10.6	13.7	--	7.7	4.4	3.2	0.9	2.4
CD3	6.8	5.5	9.1	0.5	0.0	6.7	5.1	5.2	9.5	4.3	4.6	3.6	6.5	3.6	9.0
CR1	0.0	4.8	0.0	17.4	0.0	5.0	--	33.3	1.1	8.7	7.8	0.8	3.3	5.1	4.3
CR2	3.1	5.8	1.8	0.2	6.4	9.1	8.0	7.7	24.8	9.0	11.6	3.4	1.6	12.3	14.1
BB	30.7	48.3	43.3	2.9	16.2	6.6	5.6	--	--	2.2	44.4	7.7	5.6	3.4	3.1
GP	15.7	--	19.4	16.7	3.2	8.1	12.8	13.8	10.4	6.4	2.4	0.8	6.1	4.0	9.4
RP	10.0	14.3	3.7	--	14.4	22.6	6.2	5.0	11.3	7.4	9.8	9.5	29.7	10.3	16.3
BP	10.2	5.2	9.3	3.7	10.9	17.3	5.2	9.5	8.6	5.5	8.5	22.0	13.9	6.5	16.3
OB	4.4	0.0	20.8	8.6	0.0	1.0	2.8	5.1	3.4	1.6	8.5	2.3	6.8	4.9	0.0
RL	27.9	1.0	0.0	3.8	3.9	4.9	3.0	2.7	2.3	3.0	3.4	--	2.4	6.5	7.6
CL	25.2	15.5	7.6	15.1	0.0	--	2.0	4.4	7.3	6.0	2.8	6.8	11.9	2.7	1.3
HL	1.2	7.8	47.1	6.0	4.2	3.0	3.0	3.7	2.9	9.1	--	7.3	18.1	4.1	7.2
SR1	2.3	10.7	5.6	1.6	1.0	6.4	0.7	2.1	0.6	0.0	1.3	1.4	1.2	2.5	3.1
SR2	3.8	--	5.4	0.0	1.1	5.0	4.9	7.2	15.9	8.9	--	4.1	6.1	0.6	3.3
SR3	2.3	6.5	4.4	5.3	33.3	3.2	3.0	1.4	2.0	7.2	1.3	7.1	2.1	2.4	1.0

Appendix C . (Continued)

Location	Dates								
	Apr. 19-22	May 17-21	May 31-June 2	June 16-17	June 30-July 1	July 12-13	July 28-29	Aug. 10-12	Aug. 24-26
Beedle Point									
post-ash	- 91	-140	+ 70	+185	+259	+295	+310	+220	+161
ash layer	-100	-115	- 8	+ 65	+190	+183	+ 10	+ 60	+ 65
pre-ash	- 61	- 85	- 34	-100	+150	+170	-350	- 65	+ 32
O'Gara Bay									
post-ash	-180	-135	-140	-200	+221	+130	+100	+175	+183
ash layer	-158	-100	-109	-185	+151	+ 55	+ 40	+ 90	+ 91
pre-ash	-152	- 95	- 64	-105	+ 63	+ 20	+ 20	+ 30	+ 40

Appendix D . Redox potentials of pre-ash, ash, and post-ash layers in the sediments during the summer of 1982 (readings in millivolts).

Location	Apr. 19-22	May 17-21	May 31-June 2	June 16-17	June 30-July 1	July 12-13	July 28-29	Aug. 10-12	Aug. 24-26
	Dates								
Gasser Point									
post-ash	-182	+133	-201	-190	+130	+300	+250	- 30	+100
ash layer	-152	+ 49	-200	-215	+ 24	+235	+190	-130	- 20
pre-ash	-205	-162	-167	-200	- 32	+170	+120	-165	- 55
Brown's Bay									
post-ash	-205	-178	+295	-190	+132	- 15	+175	+100	+100
ash layer	-201	-230	- 62	-225	+ 86	-100	+ 90	+ 10	+ 7
pre-ash	-227	-190	-142	-235	+ 19	-145	+ 70	- 65	- 37
Hidden lake									
post-ash	-131	-175	+ 15	+180	+101	+189	+113	+120	+182
ash layer	- 90	-175	+ 39	+168	+146	+154	+ 20	- 90	- 10
pre-ash	- 90	-170	+ 48	+ 60	+190	+140	- 18	-140	- 77
Chatcolet Lake									
post-ash	-145	-160	-138	+175	+ 21	+110	+100	+210	+110
ash layer	-100	-180	-175	+ 65	+ 40	+ 12	+ 20	+130	+ 38
pre-ash	- 62	-129	-165	+ 15	+ 80	- 15	0	+ 75	- 94
Coeur d'Alene River (mile 133)									
post-ash	+130	- 18	+120	-175	-170	+165	+ 50	+285	+ 70
ash layer	+ 92	- 91	+ 21	-135	-100	+115	- 25	+215	- 10
pre-ash	0	- 89	- 82	-110	+ 50	+ 65	- 80	+150	- 80
Coeur d'Alene River (mile 138)									
post-ash	- 92	-160	- 63	+340	+ 47	+210	-100	- 60	+ 90
ash layer	-130	- 83	+162	+340	+ 82	+205	-200	-130	- 30
pre-ash	- 89	- 30	+132	+320	+150	+270	-170	-190	-150

Appendix D. (Continued)

Location	Dates								
	Apr. 19-22	May 17-21	May 31- June 2	June 16-17	June 30- July 1	July 12-13	July 28-29	Aug. 10-12	Aug. 24-26
Coeur d'Alene River Delta I									
post-ash	- 65	-150	-116	+220	+ 4	- 72	+125	- 45	+ 78
ash layer	- 65	-195	-245	-110	+ 26	-148	- 70	-140	+ 45
pre-ash	-119	-200	-219	-225	+129	-146	-140	-180	- 20
Coeur d'Alene Delta III									
post-ash	-229	-250	-191	-115	+ 80	+ 60	+ 66	-140	+ 20
ash layer	-160	-150	-202	-195	+130	- 55	- 75	-240	-110
pre-ash	-160	-195	-198	-230	+160	-160	-169	-220	-159
St. Joe River (mile 8)									
post-ash	- 82	+320	+ 59	+ 90	+160	+150	+170	+110	+130
ash layer	- 75	+260	- 40	+ 89	+155	+ 65	+110	+ 30	+ 40
pre-ash	- 52	+248	+120	+ 85	+152	+ 65	+100	+ 10	- 30
St. Joe River (mile 13)									
post-ash	-161	- 98	- 72	+260	+ 10	+150	+120	+130	+130
ash layer	- 42	-100	- 51	+195	+195	+111	+ 34	+ 75	+ 70
pre-ash	- 12	- 83	- 58	+ 30	+220	+ 73	+ 10	+ 10	+ 30
St. Joe River (mile 17)									
post-ash	-120	+245	+172	+120	+ 35	+170	+168	+130	+ 52
ash layer	-100	+179	+180	+ 12	+ 35	+112	+ 69	+130	+ 21
pre-ash	- 60	+183	+271	0	+ 60	+ 59	+ 40	- 12	- 6

Appendix E. Chemical composition (microgram/gram) of sedimented and terrestrial tephra leachate (Fall, 1981).

	Zn	Cd	Pb	Cu	Fe	Ca	Mg	Na
Gasser Point	2.908	0.109	<2.00	<0.100	2.298	61.61	19.43	41.44
Brown's Bay	2.294	<0.100	<2.00	<0.100	0.571	184.80	53.03	179.90
Hidden Lake	0.527	0.123	2.45	0.123	0.375	136.00	53.20	294.70
Chatcolet Lake	0.079	<0.100	<2.00	<0.100	2.711	3.89	< 2.50	26.44
Round Lake	1.497	<0.100	<2.00	<0.100	2.556	158.50	54.83	682.20
Rocky Point	0.296	<0.100	2.28	<0.100	1.283	110.20	58.60	411.30
Coeur d'Alene River(mile 133)	9.264	<0.100	3.43	<0.100	4.020	58.94	19.70	2.09
Coeur d'Alene Delta I	59.110	0.321	3.14	0.157	0.157	91.08	16.20	1.96
Coeur d'Alene Delta II	15.990	0.125	<2.00	<0.100	1.766	71.02	17.28	31.60
Coeur d'Alene Delta III	7.439	0.466	9.31	0.466	1.752	142.00	41.29	93.97
St. Joe River (mile 17)	0.854	<0.100	<2.00	<0.100	2.503	20.59	< 2.50	18.51
St. Joe River (mile 13)	1.037	0.180	3.61	0.180	1.711	14.32	4.51	25.04
St. Joe River (mile 8)	0.103	0.124	2.49	0.124	1.779	12.15	3.11	24.12
Beedle Point	0.565	<0.100	<2.00	<0.100	1.516	12.10	< 2.50	30.41
O'Gara Bay	2.673	<0.100	<2.00	<0.100	1.162	23.45	6.51	37.92
Coeur d'Alene Terrestrial	3.394	<0.100	<2.00	<0.100	2.141	27.44	16.97	14.44
St. Joe Terrestrial	0.508	<0.100	<2.00	0.169	4.219	8.853	< 2.50	37.57
Initial Fallout (Plummer)	0.563	<0.100	<2.00	<0.100	0.726	21.47	6.65	48.51

Appendix E. (Continued)

	K	Mo	As	Si	NO_3	NH_4	PO_4	NO_2
Gasser Point	12.28	1.551	9.293	47.07	≤0.01	0.14	≤0.01	≤0.01
Brown's Bay	17.66	2.182	20.310	25.01	≤0.01	0.30	≤0.01	≤0.01
Hidden Lake	31.42	2.391	19.58	17.01	≤0.01	0.19	≤0.01	≤0.01
Chatcolet Lake	10.89	2.525	16.75	36.95	≤0.01	0.12	0.02	≤0.01
Round Lake	36.18	1.839	17.78	19.80	≤0.01	0.18	≤0.01	≤0.01
Rocky Point	46.75	0.757	11.59	17.17	≤0.01	0.16	≤0.01	≤0.01
Coeur d'Alene River(mile 133)	7.60	0.793	9.75	25.16	≤0.01	0.83	≤0.01	≤0.01
Coeur d'Alene Delta I	15.89	0.679	3.14	13.94	≤0.01	0.23	≤0.01	≤0.01
Coeur d'Alene Delta II	8.42	2.488	24.09	21.56	≤0.01	0.21	≤0.01	≤0.01
Coeur d'Alene Delta III	29.47	6.885	57.70	27.63	≤0.01	0.18	≤0.01	≤0.01
St. Joe River (mile 17)	9.43	2.272	29.37	29.76	≤0.01	0.13	≤0.01	≤0.01
St. Joe River (mile 13)	15.06	4.518	44.88	33.97	≤0.01	0.13	≤0.01	≤0.01
St. Joe River (mile 8)	16.69	1.525	10.41	29.63	≤0.01	0.12	0.02	≤0.01
Beedle Point	6.65	1.984	19.50	24.13	≤0.01	0.12	≤0.01	≤0.01
O'Gara Bay	13.23	2.380	25.13	24.96	≤0.01	0.16	≤0.01	≤0.01
Coeur d'Alene Terrestrial	43.14	1.497	9.18	28.68	≤0.01	0.13	≤0.01	≤0.01
St. Joe Terrestrial	15.00	1.298	3.33	38.04	≤0.01	0.10	0.09	≤0.01
Initial Fallout (Plummer)	10.38	2.507	19.73	17.61	≤0.01	0.22	≤0.01	≤0.01

Appendix F . Heavy metal concentration (mg/kg) in parent sediment at 6 sites in the Coeur d'Alene Lake system, 1981-1982.

YEAR	SEASON	SITE	ZINC	LEAD	CADMIUM
1981	Spring	BB_1	3,550	1,450	68
		GP_1	3,960	3,240	77
		CD_1	4,080	8,140	41
		CD_3	3,990	8,290	39
		CR_1	2,800	4,610	46
		SR_1	69	88	3
	Autumn	BB_1	3,530	1,650	57
		GP_1	3,920	2,710	67
		CD_1	4,120	7,850	42
		CD_3	5,150	10,540	42
		CR_1	3,190	4,000	49
		SR_1	72	93	3
1982	Spring	BB_1	1,294	1,133	19
		GP_1	1,475	2,261	30
		CD_1	1,967	6,118	35
		CD_3	2,029	4,947	57
		CR_1	1,931	4,842	35
		SR_1	28	81	2
	Autumn	BB_1	1,134	1,294	14
		GP_1	1,324	1,791	27
		CD_1	3,221	12,374	28
		CD_3	2,150	5,365	58
		CR_1	1,771	6,556	43
		SR_1	22	69	1

Appendix G . Heavy metals (mg/l) in the water column at 6 sites in the Coeur d' Alene Lake system, 1981-1982, (values preceded by < are detection limit values; the precision for an element at detection limit is ± 50%).

YEAR	SEASON	SITE	ZINC	LEAD	CADMIUM
1981	Spring	BB_1	0.178	0.504	0.015
		GP_1	0.225	0.408	<0.010
		CD_1	0.597	0.304	<0.010
		CD_3	0.602	0.296	0.017
		CR_1	0.672	0.240	<0.010
		SR_1	0.023	0.368	0.010
	Autumn	BB_1	0.208	0.552	<0.010
		GP_1	0.195	0.240	<0.010
		CD_1	0.849	<0.200	<0.010
		CD_3	0.658	<0.200	<0.010
		CR_1	0.910	<0.200	<0.010
		SR_1	<0.005	0.480	0.012
1982	Spring	BB_1	<0.020	<0.500	<0.030
		GP_1	0.163	<0.500	<0.030
		CD_1	0.340	<0.500	<0.030
		CD_3	<0.020	<0.500	<0.030
		CR_1	0.341	<0.500	<0.030
		SR_1	<0.020	<0.500	<0.030
	Autumn	BB_1	0.169	<0.500	<0.030
		GP_1	0.163	<0.500	<0.030
		CD_1	1.004	<0.500	<0.030
		CD_3	0.173	<0.500	<0.030
		CR_1	0.981	<0.500	<0.030
		SR_1	<0.020	<0.500	<0.030

Appendix H . Profiles of Dissolved Oxygen Concentrations (mg/l) throughout the Lake Coeur d'Alene System during 1981.

Sampling Site	Depth (M)	Dates: June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Coeur d'Alene River Mile 133	2M	7.62	8.78	9.43	8.65	8.03	9.50
	Bottom*	7.62	8.84	9.01	8.19	7.57	9.60
Coeur d'Alene River Mile 138	2M	7.73	8.55	9.86	9.06	8.34	10.20
	Bottom	7.62	8.66	9.54	8.46	7.98	10.35
St. Joe River Mile 8	2M	7.50	9.23	6.94	7.42	6.85	8.30
	Bottom	9.50	9.23	6.42	6.75	--	8.30
St. Joe River Mile 13	2M	7.39	9.40	7.47	7.62	6.70	9.40
	Bottom	7.39	9.46	7.42	7.52	6.03	9.60
St. Joe River Mile 17	2M	7.73	9.69	8.53	8.24	7.72	9.40
	Bottom	7.73	9.69	8.37	8.09	7.31	9.40
Coeur d'Alene River Delta I	Surface	7.28	8.66	9.99	8.65	7.93	9.55
	2M	7.39	8.66	9.17	8.24	7.78	9.60
	Bottom	7.67	8.66	9.01	8.14	7.72	9.45
Coeur d'Alene River Delta II	Surface	7.39	--	9.43	8.65	8.02	9.40
	2M	7.62	--	9.38	8.30	7.78	9.55
	Bottom	7.39	--	9,01	8.29	7.05	9.60
Coeur d'Alene River Delta III	Surface	7.39	--	9.06	8.50	7.78	9.45
	2M	7.39	--	9.33	8.45	7.67	9.65
	Bottom	7.39	--	9.01	8.24	7.16	9.80
St. Joe River Delta Rocky Point Site	2M	7.67	8.44	8.37	7.67	--	7.70
	Bottom	7.50	8.21	8.53	7.24	6.08	7.30
St. Joe River Delta Beedle Point Site	0M	--	--	9.65	8.38	6.59	7.85
	2M	--	--	10.07	8.21	7.42	8.00
	5M	--	--	9.86	8.88	6.45	7.75
	8M	--	--	9.65	8.77	7.88	7.65
	12M	--	--	8.80	9.10	7.16	4.40

Appendix H. (Continued)

Sampling Site	Depth (M)	Dates June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
St. Joe River Delta O'Gara Bay Site	0M	--	--	9.59	8.66	7.78	8.10
	2M	--	--	9.91	8.05	8.03	8.15
	5M	--	--	9.96	9.05	7.67	8.05
	8M	--	--	9.38	9.05	7.83	7.15
	12M	--	--	7.79	8.71	6.49	5.95
Gasser Point	Surface	--	--	8.74	8.55	7.98	8.95
	2M	--	--	9.01	8.05	8.14	8.80
	5M	--	--	8.69	8.21	7.72	8.85
	10M	--	--	9.28	9.16	8.19	8.80
	21M	--	--	8.06	9.10	7.88	6.30
Brown's Bay	Surface	7.39	--	8.90	8.16	6.90	8.35
	2M	7.28	--	8.85	8.55	7.78	8.45
	5M	7.45	--	10.23	8.49	7.93	8.55
	10M	7.67	--	9.28	9.10	8.03	8.35
	21M	6.83	--	7.84	6.44	5.05	4.85
Chatcolet Lake	Surface	7.73	9.29	--	8.50	7.72	8.60
	2M	7.84	9.18	--	8.45	7.88	8.65
	5M	7.95	9.23	--	8.14	7.06	8.40
	8M	7.56	9.46	--	8.27	5.15	8.90
	12M	7.34	9.58	--	6.33	2.88	8.30
Hidden Lake	Surface	7.50	9.12	8.48	7.83	6.93	8.46
	2M	7.17	9.18	8.16	7.93	7.06	8.35
	5M	7.34	10.26	8.27	8.91	7.78	7.90
	7M	7.34	9.80	--	7.72	3.71	7.50
Round Lake	Surface	8.01	--	9.01	11.66	12.98	9.50
	2M	7.78	--	9.33	10.99	9.68	9.70
	5M	7.50	--	9.22	9.05	5.97	9.60

*Bottom samples were taken 1 meter off the bottom.

Appendix I . Profiles of Dissolved Oxygen Concentrations (mg/l) throughout the Lake Coeur d'Alene System during 1982.

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
Coeur d'Alene River Mile 133	2M	9.9	10.9	9.6	9.6	9.0	8.8	8.4	8.0	7.4	7.9
	Bottom*	10.05	10.4	9.4	10.3	9.6	9.8	8.4	8.8	5.8	8.8
Coeur d'Alene River Mile 138	2M	9.9	10.0	9.2	9.1	8.9	8.6	8.9	8.9	7.75	9.0
	Bottom	10.1	10.2	9.6	9.1	9.6	9.2	8.85	9.8	8.5	8.9
St. Joe River Mile 8	2M	10.2	10.1	10.1	10.0	9.3	7.8	7.5	8.6	9.2	7.4
	Bottom	10.3	10.2	10.4	10.2	8.8	8.6	7.2	7.5	7.8	7.85
St. Joe River Mile 13	2M	10.2	10.0	10.6	10.2	9.3	7.6	7.7	8.3	6.95	8.8
	Bottom	10.2	9.7	10.6	10.5	9.2	7.4	7.7	7.8	7.2	9.3
St. Joe River Mile 17	2M	10.2	10.1	10.0	9.6	9.2	7.2	8.2	8.9	7.4	9.1
	Bottom	10.0	10.2	10.2	9.9	9.95	8.2	8.1	8.0	5.0	9.2
Coeur d'Alene River Delta I	Surface	10.2	10.1	10.0	9.6	8.3	7.2	8.1	8.1	8.0	7.7
	2M	9.9	9.7	10.0	9.7	8.5	8.2	8.45	8.2	8.1	7.7
	Botttom	10.3	10.6	10.3	10.3	9.2	8.6	8.1	8.4	8.5	8.1
Coeur d'Alene River Delta II	Surface	10.1	10.5	9.8	9.9	8.6	7.0	8.1	8.2	8.1	7.55
	2M	10.3	10.4	9.2	9.9	9.0	7.8	8.1	7.9	8.2	7.55
	Bottom	10.5	10.6	9.5	9.3	9.4	8.6	8.45	8.8	8.5	7.55
Coeur d'Alene River Delta III	Surface	10.4	10.0	10.0	9.4	8.6	7.2	7.8	8.3	8.0	7.25
	2M	10.0	10.0	9.5	9.3	9.0	7.2	8.2	8.4	8.0	7.45
	Bottom	10.1	10.3	9.4	9.5	9.4	8.2	8.5	9.1	8.1	7.4
St. Joe River Delta Rocky Point Site	2M	10.5	10.2	10.2	10.4	9.1	7.2	7.65	7.6	7.9	7.3
	Bottom	10.6	10.8	10.6	10.5	9.3	8.1	7.25	8.4	7.5	7.65
St. Joe River Delta Beedle Point Site	0M	10.2	10.0	10.7	10.2	8.4	8.0	8.4	8.2	7.6	7.4
	2M	10.3	10.2	10.5	10.2	8.6	8.0	8.2	8.2	8.0	7.55
	5M	10.0	10.2	10.5	9.9	8.9	7.8	7.7	8.1	8.0	7.5
	8M	9.9	10.0	10.7	9.9	7.4	8.2	8.4	6.4	8.0	7.3
	12M	9.7	10.7	10.8	9.2	7.3	8.7	8.55	8.4	7.9	7.25

Appendix I . (Continued)

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
St. Joe River Delta O'Gara Bay Site	0M	10.2	10.1	10.3	9.9	8.5	8.2	8.2	8.4	8.2	7.25
	2M	10.2	10.0	10.5	10.1	8.6	7.9	8.2	8.2	7.8	7.3
	5M	10.0	10.3	10.4	10.1	9.0	7.6	8.8	8.3	7.4	7.4
	8M	10.0	10.4	10.4	9.9	9.0	7.8	7.75	8.5	7.6	7.6
	12M	10.2	10.4	10.9	9.4	8.3	7.9	6.35	8.9	7.8	7.7
Gasser Point	Surface	10.3	10.2	10.6	9.6	8.5	7.1	8.1	8.5	7.5	8.0
	2M	10.4	10.3	10.4	9.7	8.9	7.7	8.3	8.5	7.75	8.0
	5M	10.1	10.2	10.6	10.2	9.1	7.7	8.2	9.0	8.2	8.1
	10M	10.1	10.0	10.3	10.3	8.9	7.8	9.0	7.9	8.3	7.9
	21M	10.2	10.0	10.2	9.8	8.9	6.8	8.4	7.9	6.2	6.8
Brown's Bay	Surface	10.6	9.9	9.9	9.6	8.6	7.7	8.2	8.4	7.9	8.1
	2M	10.4	9.7	9.6	9.7	8.4	7.8	8.3	8.3	8.2	8.1
	5M	10.4	9.7	10.2	9.8	8.2	8.2	8.5	8.8	8.5	8.1
	10M	10.2	9.8	10.2	10.0	8.9	7.9	7.6	7.8	8.7	8.2
	21M	10.1	9.6	9.4	9.4	8.3	7.9	7.6	7.0	6.3	5.4
Chatcolet Lake	Surface	10.4	9.8	10.1	9.9	8.9	8.3	8.5	9.0	8.1	8.1
	2M	10.4	10.0	9.9	10.0	9.1	8.4	9.3	9.0	7.4	8.1
	5M	10.6	10.0	10.0	9.8	9.0	7.4	8.5	7.7	7.6	8.1
	8M	10.3	9.4	9.8	8.7	7.8	6.8	6.4	3.9	3.2	8.2
	12M	10.0	9.4	10.2	8.7	6.6	4.6	4.2	4.7	0.8	8.9
Hidden Lake	Surface	10.2	10.5	10.5	10.0	9.0	7.5	8.4	8.2	7.6	8.0
	2M	10.0	10.4	10.6	10.0	9.2	8.4	9.0	8.4	7.6	7.9
	5M	10.1	10.5	10.5	10.3	9.0	8.3	8.95	6.4	7.9	8.0
	7M	10.0	10.6	10.2	10.0	7.1	6.3	6.4	4.6	2.0	7.7
Round Lake	Surface	10.3	10.25	10.9	9.6	9.2	9.0	8.5	10.7	11.5	--
	2M	10.3	10.10	10.8	10.1	9.2	9.9	9.3	10.4	9.5	--
	5M	10.3	9.9	10.9	10.6	9.2	8.2	7.7	3.8	3.55	--

*Bottom samples were taken 1 meter off the bottom.

Appendix J . Profiles of pH Values throughout the Lake Coeur d'Alene System during 1981.

Sampling Site	Depth (M)	Dates June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Coeur d'Alene River Mile 133	2M	6.3	7.1	-	7.2	7.0	6.9
	Bottom*	6.3	7.0	-	7.1	6.8	6.8
Coeur d'Alene River Mile 138	2M	6.3	7.0	-	7.2	6.9	7.0
	Bottom	6.3	7.0	-	7.2	7.0	6.9
St. Joe River Mile 8	2M	6.6	7.1	7.2	7.2	7.0	6.9
	Bottom	6.1	7.1	7.1	7.1	6.8	6.9
St. Joe River Mile 13	2M	6.2	7.1	7.2	7.3	7.0	7.0
	Bottom	6.1	7.0	7.1	7.3	7.0	6.9
St. Joe River Mile 17	2M	6.2	7.1	7.3	7.2	7.2	6.9
	Bottom	6.2	7.1	7.2	7.3	7.2	7.0
Coeur d'Alene River Delta I	Surface	6.4	6.9	-	7.3	6.9	6.9
	2M	6.3	7.0	-	7.3	6.9	6.9
	Bottom	6.2	7.0	-	7.3	6.9	6.9
Coeur d'Alene River Delta II	Surface	6.5	-	7.4	7.3	7.0	6.9
	2M	6.4	-	7.2	7.2	7.0	6.9
	Bottom	6.3	-	7.2	7.2	6.8	6.9
Coeur d'Alene River Delta III	Surface	6.3	-	7.5	7.3	7.0	6.9
	2M	6.2	-	7.2	7.2	6.8	6.9
	Bottom	6.2	-	7.2	7.2	6.0	6.9
St. Joe River Delta Rocky Point Site	Surface	6.9	7.1	-	7.2	7.1	6.9
	Bottom	6.8	7.2	-	7.2	7.6	6.9
St. Joe River Delta Beedle Point Site	Surface	-	-	7.2	8.0	7.2	7.1
	2M	-	-	7.3	7.5	7.2	7.1
	5M	-	-	7.1	7.9	7.3	7.1
	8M	-	-	7.1	7.9	7.2	7.0
	12M	-	-	7.0	7.3	7.3	7.1

Appendix J . (Continued)

Sampling Site	Depth (M)	June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
		Dates					
St. Joe River Delta O'Gara Bay Site	Surface	-	-	7.3	7.6	7.2	7.1
	2M	6.9	-	7.2	7.1	7.3	7.0
	5M	7.2	-	7.2	7.5	7.4	7.1
	8M	-	-	7.0	7.5	7.3	7.1
	12M	-	-	6.9	7.5	7.0	6.7
Gasser Point	Surface	-	-	7.3	-	7.5	7.2
	2M	-	-	7.3	-	7.5	7.2
	5M	-	-	7.4	-	7.4	7.2
	10M	-	-	7.1	-	7.3	7.2
	21M	-	-	6.8	-	7.9	6.7
Brown's Bay	Surface	6.9	7.4	7.5	-	7.4	7.2
	2M	6.5	7.4	7.5	-	7.4	7.2
	5M	7.1	7.3	7.3	-	7.4	7.2
	10M	6.5	7.2	7.1	-	7.4	7.1
	21M	6.4	7.1	6.8	-	6.8	6.6
Chatcolet Lake	Surface	6.7	-	7.8	8.2	8.0	7.1
	2M	7.0	-	7.8	8.3	7.8	7.1
	5M	6.7	-	7.2	7.9	7.5	7.0
	8M	6.7	-	6.9	6.7	6.9	7.0
	12M	6.6	-	6.7	6.7	6.7	7.0
Hidden Lake	Surface	6.8	7.5	7.6	7.7	7.2	6.9
	2M	6.8	7.6	7.5	7.5	7.3	7.0
	5M	7.1	7.2	7.7	7.7	6.9	7.0
	7M	7.3	7.2	7.0	6.9	6.7	7.0
Round Lake	Surface	8.7	8.4	8.4	-	8.8	7.2
	2M	8.7	8.5	8.5	-	8.8	7.2
	5M	7.1	7.2	8.5	-	8.7	7.1

*Bottom samples were taken 1 meter off the bottom.

Appendix K . Profiles of pH Values throughout the Lake Coeur d'Alene System during 1982.

Sampling Site	Depth (M)	4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
		Dates									
Coeur d'Alene River Mile 133	2M	6.60	7.62	6.98	6.80	7.1	7.2	7.2	7.0	7.3	7.2
	Bottom*	6.64	7.60	6.96	6.85	7.0	7.2	6.9	7.0	7.0	7.2
Coeur d'Alene River Mile 138	2M	6.61	7.30	7.08	6.80	6.9	7.1	7.1	7.05	7.3	7.1
	Bottom	6.68	7.31	7.01	6.80	6.9	7.1	7.1	7.0	7.1	7.0
St. Joe River Mile 8	2M	7.0	7.18	7.07	6.90	6.8	7.0	7.2	7.0	7.1	7.0
	Bottom	6.98	7.29	6.99	6.95	6.9	7.0	7.1	7.1	7.0	7.0
St. Joe River Mile 13	2M	6.97	7.29	7.04	6.90	6.9	7.0	7.2	7.0	7.2	7.0
	Bottom	6.96	7.26	6.93	6.90	6.9	7.0	7.3	6.95	7.0	7.1
St. Joe River Mile 17	2M	7.06	--	7.10	6.90	7.0	7.1	7.2	7.1	7.3	7.1
	Bottom	7.00	--	7.09	6.85	7.0	7.1	7.3	7.1	6.9	7.1
Coeur d'Alene River Delta I	Surface	6.62	7.21	7.06	7.00	6.9	7.2	7.2	7.1	7.2	7.0
	2M	6.64	7.17	7.05	6.85	7.0	7.2	7.3	7.05	7.2	7.1
	Botttom	6.64	7.21	7.05	6.85	7.0	7.1	7.0	7.1	7.2	7.2
Coeur d'Alene River Delta II	Surface	6.82	7.23	--	7.00	7.0	7.1	7.2	7.1	7.2	7.1
	2M	6.88	7.23	--	7.05	7.0	7.2	7.2	7.0	7.3	7.0
	Bottom	6.88	7.25	--	6.95	6.9	7.2	7.1	7.1	7.2	7.0
Coeur d'Alene River Delta III	Surface	--	7.24	--	7.00	7.0	7.2	7.3	7.1	7.2	7.1
	2M	--	7.23	--	7.00	7.0	7.2	7.3	7.15	7.3	7.1
	Bottom	--	7.22	--	6.95	7.0	7.2	7.0	7.1	7.3	7.0
St. Joe River Delta Rocky Point Site	2M	7.06	7.36	7.09	6.95	6.9	7.1	7.2	7.0	7.2	7.0
	Bottom	7.06	7.28	7.12	6.95	6.9	7.1	7.2	7.0	7.7	7.0
St. Joe River Delta Beedle Point Site	0M	7.00	7.20	7.12	6.80	6.9	7.1	7.9	7.05	7.0	7.1
	2M	7.02	7.18	7.14	6.90	6.9	7.1	7.3	7.0	7.1	7.0
	5M	7.01	7.16	7.12	6.90	6.9	7.0	7.2	7.0	7.0	7.6
	8M	7.01	7.16	7.18	6.85	6.6	7.0	7.3	6.7	6.9	6.9
	12M	7.00	7.18	7.25	6.80	6.7	7.0	7.2	7.1	6.9	6.9

Appendix K . (Continued)

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
St. Joe River Delta O'Gara Bay Site	0M	6.99	7.18	7.8	6.80	7.0	7.2	7.4	7.1	7.1	7.0
	2M	6.97	7.22	7.8	6.90	7.0	7.1	7.2	7.0	7.1	7.0
	5M	6.99	7.17	7.11	6.95	6.9	7.0	7.2	7.0	6.9	7.1
	8M	6.99	7.20	7.8	6.70	6.8	7.0	6.9	7.0	7.0	7.2
	12M	6.99	7.19	7.12	6.80	6.8	7.0	6.6	7.05	7.0	7.0
Gasser Point	Surface	6.82	7.40	7.9	7.00	7.0	7.2	7.3	7.3	7.3	7.1
	2M	6.85	7.42	7.9	7.00	7.0	7.2	7.3	7.2	7.3	7.0
	5M	6.79	7.41	7.3	7.00	6.8	7.2	7.3	7.1	7.3	6.9
	10M	6.79	7.38	7.1	6.95	6.9	7.0	7.1	6.8	7.3	7.0
	21M	6.76	7.39	6.5	6.95	6.7	6.7	6.7	6.75	6.5	6.7
Brown's Bay	Surface	6.90	7.29	7.07	6.95	7.1	7.1	7.2	7.1	7.2	7.0
	2M	6.86	7.33	7.05	6.90	7.0	7.2	7.2	7.1	7.3	7.1
	5M	6.89	7.31	7.06	6.95	6.8	7.1	7.3	7.1	7.3	7.0
	10M	6.94	7.30	7.05	6.85	6.8	6.9	6.8	6.8	7.2	7.0
	21M	6.91	7.19	7.07	6.90	6.7	6.7	6.6	6.6	6.3	6.5
Chatcolet Lake	Surface	7.08	7.40	6.8	6.45	7.1	7.3	7.8	8.3	7.3	7.0
	2M	7.06	7.39	6.7	7.05	6.9	7.1	7.8	8.0	7.3	7.0
	5M	7.08	7.40	6.6	6.90	6.8	7.0	7.2	7.1	7.2	7.0
	8M	7.03	7.41	6.4	6.90	6.7	6.8	6.8	6.5	6.4	7.0
	12M	7.06	7.31	6.4	6.95	6.6	6.5	6.6	6.5	6.4	7.1
Hidden Lake	Surface	7.04	7.25	6.9	7.00	7.1	7.2	7.7	7.8	7.7	7.0
	2M	7.03	7.20	7.0	6.95	7.0	7.2	8.0	7.7	7.2	7.1
	5M	7.04	7.28	6.9	7.00	7.0	7.1	7.4	6.85	7.1	7.1
	7M	7.00	7.37	6.9	6.90	6.7	6.0	7.0	6.8	6.4	7.1
Round Lake	Surface	7.01	7.22	7.02	7.0	7.1	8.4	8.7	8.5	8.6	--
	2M	7.08	7.30	7.08	6.9	7.1	8.4	8.3	8.5	8.6	--
	5M	7.01	7.30	7.00	6.9	7.0	7.0	7.4	7.1	7.3	--

*Bottom samples were taken 1 meter off the bottom.

Appendix L. Profiles of Temperature (^{o}C) throughout the Lake Coeur d'Alene System during 1981.

Sampling Site	Depth (M)	June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
		Dates					
Coeur d'Alene	2M	10.5	16.9	20.9	20.9	22.4	14.0
River Mile 133	Bottom*	10.5	16.6	21.0	20.9	22.2	13.8
Coeur d'Alene	2M	10.2	16.8	20.0	19.5	83.4	12.6
River Mile 138	Bottom	10.4	16.2	20.3	20.0	79.8	12.6
St. Joe River	2M	11.5		20.1	21.0	23.5	12.3
Mile 8	Bottom	11.5		20.1	20.9	22.3	12.0
St. Joe River	2M	10.0		20.0	19.4	23.4	11.0
Mile 13	Bottom	11.0		19.7	19.5	23.0	11.0
St. Joe River	2M	11.2		20.4	18.9	23.2	11.0
Mile 17	Bottom	12.4		20.0	18.8	23.0	10.7
Coeur d'Alene	Surface	10.2	17.2	22.6	21.8	22.8	14.0
River Delta I	2M	10.2	17.1	20.6	20.7	22.8	14.0
	Bottom	11.9	17.3	20.5	21.0	22.5	14.0
Coeur d'Alene	Surface	10.2		23.4	22.0	23.5	14.0
River Delta II	2M	10.1		20.8	21.4	22.7	14.0
	Bottom	10.7		20.4	20.0	22.1	14.0
Coeur d'Alene	Surface	10.2		23.0	23.1	23.8	14.4
River Delta III	2M	10.5		20.3	20.7	22.1	14.3
	Bottom	10.7		20.5	21.0	22.2	14.0
St. Joe River							
Delta	2M	11.3	16.0	20.8	21.2	24.4	14.3
Rocky Point Site	Bottom	11.3	16.0	20.8	20.7	23.9	14.0
St. Joe River	0M			17.7	22.6	22.9	14.7
Delta	2M			16.2	21.9	22.4	14.5
Beedle Point Site	5M			15.0	19.4	22.0	14.3
	8M			14.7	19.0	21.9	14.3
	13M			14.0	20.3	22.0	14.3

Appendix L. (Continued)

Sampling Site	Depth (M)	June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
		Dates					
St. Joe River Delta O'Gara Bay Site	0M	11.8		17.7	23.1	22.5	15.0
	2M	11.7		16.4	21.9	22.5	15.0
	5M	11.6		15.4	19.5	22.3	14.6
	8M	11.8		14.0	19.0	21.1	14.4
	13M	11.6		14.3	18.5	18.9	14.2
Gasser Point	Surface			20.0	22.0	23.0	15.0
	2M			19.8	20.9	23.1	15.0
	5M			19.0	20.5	23.2	15.0
	10M			14.3	16.8	19.8	14.8
	21M			12.4	16.0	14.2	9.2
Brown's Bay	Surface	13.2		20.9	22.9	22.8	15.2
	2M	13.2		20.2	20.8	23.0	15.0
	5M	12.3		17.0	20.3	22.7	15.0
	10M	11.8		15.0	17.5	18.8	14.9
	21M	8.9		12.6	11.6	13.1	11.3
Chatcolet Lake	Surface	12.4	16.8	20.7	21.3	26.0	15.1
	2M	12.4	16.8	20.4	20.9	25.0	14.3
	5M	12.0	17.1	18.0	18.6	23.2	14.0
	8M	11.9	14.5	15.5	13.4	16.9	14.2
	12M	11.0	14.2	13.9	13.9	15.7	14.8
Hidden Lake	Surface	12.0	17.5	21.2	22.0	25.5	14.7
	2M	11.9	16.6	20.7	21.0	24.8	14.4
	5M	11.8	13.5	15.0	17.0	20.2	14.2
	7M	11.8	13.0	16.2	19.0	18.4	15.0
Round Lake	Surface	13.4	18.6	22.2	21.9	25.8	11.0
	2M	12.1	18.0	21.0	21.0	22.3	11.0
	5M	11.8	15.4	20.7	20.4	23.3	11.0

*Bottom samples were taken 1 meter off the bottom.

Appendix M . Profiles of Temperature (^{o}C) throughout the Lake Coeur d'Alene System during 1982.

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
Coeur d'Alene River Mile 133	2M	7.0	9.1	12.2	16.0	17.0	19.0	22.0	20.1	21.7	13.3
	Bottom*	7.4	8.8	12.9	16.1	17.0	18.0	20.8	20.1	20.4	13.0
Coeur d'Alene River Mile 138	2M	6.8	10.0	12.0	15.8	16.0	18.4	21.0	19.8	21.3	12.9
	Bottom	7.0	10.5	12.8	16.0	16.0	19.0	20.8	19.8	20.9	12.8
St. Joe River Mile 8	2M	7.5	8.0	9.0	12.0	12.8	16.9	21.1	20.6	22.0	11.1
	Bottom	8.5	9.0	9.5	13.0	14.0	18.0	21.1	19.9	21.2	11.0
St. Joe River Mile 13	2M	7.2	8.0	9.1	11.5	12.6	16.4	19.9	21.0	22.0	10.0
	Bottom	7.9	8.9	10.0	12.1	13.6	16.9	20.2	19.0	22.0	10.0
St. Joe River Mile 17	2M	7.8	7.2	9.0	11.0	13.1	16.3	19.6	20.9	21.2	9.7
	Bottom	8.4	8.0	9.3	12.4	13.8	17.0	19.9	20.0	19.9	9.5
Coeur d'Alene River Delta I	Surface	7.0	8.2	13.1	18.0	19.0	23.0	24.0	20.0	21.8	21.8
	2M	7.3	8.2	13.0	16.7	18.7	21.0	22.8	20.0	21.7	21.7
	Botttom	8.2	8.8	13.0	17.0	18.2	18.3	21.6	20.4	21.0	21.0
Coeur d'Alene River Delta II	Surface	7.2	10.5	13.1	18.6	18.9	23.8	24.0	20.1	21.7	21.7
	2M	7.2	10.0	13.0	18.0	18.0	21.3	23.0	20.2	21.3	21.3
	Bottom	7.1	9.4	12.7	18.1	16.8	19.1	21.5	20.3	21.2	21.2
Coeur d'Alene River Delta III	Surface	7.2	10.4	13.0	18.0	19.0	22.5	24.1	20.1	22.0	22.0
	2M	6.7	10.0	12.9	18.0	18.4	20.2	23.0	20.0	21.8	21.8
	Bottom	6.2	9.4	12.6	17.0	15.6	18.5	22.0	20.5	21.8	21.8
St. Joe River Delta Rocky Point Site	2M	6.7	8.0	9.3	12.0	13.7	17.0	22.3	20.5	23.4	12.2
	Bottom	7.3	8.3	9.5	13.0	14.5	17.3	22.0	20.4	22.0	12.1
St. Joe River Delta Beedle Point Site	0M	6.5	8.5	10.8	13.7	19.0	17.2	24.0	20.2	19.9	14.0
	2M	6.5	8.3	10.1	13.4	18.2	17.2	23.0	20.4	19.3	14.0
	5M	6.0	8.0	10.0	13.0	16.3	16.7	21.0	19.2	19.1	13.9
	8M	6.0	7.9	10.0	12.5	11.0	16.3	20.2	15.8	19.0	13.6
	12M	6.9	7.4	10.1	11.1	11.0	15.8	21.0	19.1	19.3	13.5

Appendix M . (Continued)

Sampling Site	Depth (M)	4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
		Dates									
St. Joe River	0M	7.7	8.5	10.9	13.8	19.3	17.8	25.5	20.7	20.4	13.9
Delta	2M	7.7	8.2	10.7	13.2	18.0	17.7	22.9	20.5	20.0	13.9
O'Gara Bay Site	5M	6.3	8.0	10.0	13.0	14.1	16.3	20.4	20.6	19.1	13.9
	8M	6.8	8.0	9.3	13.0	10.9	14.7	17.1	19.2	19.0	13.7
	12M	7.6	7.1	9.4	10.4	10.8	15.0	14.0	19.4	19.0	13.2
Gasser Point	Surface	7.9	11.7	13.8	19.4	19.3	23.0	24.7	20.8	23.2	23.2
	2M	6.2	10.8	13.0	18.5	18.9	21.0	22.5	20.6	22.0	22.0
	5M	6.0	10.0	11.4	15.4	14.8	17.8	22.0	19.0	19.6	19.6
	10M	6.0	9.0	11.1	13.0	11.3	15.0	17.0	13.4	19.6	19.6
	21M	6.0	7.8	10.1	10.0	10.1	10.9	11.0	11.5	11.3	11.3
Brown's Bay	Surface	8.0	10.0	12.8	12.5	19.7	23.5	25.6	19.4	23.1	23.1
	2M	7.0	9.8	12.2	17.0	19.3	21.4	23.0	19.4	21.9	21.9
	5M	7.0	9.0	10.8	14.8	12.9	18.2	19.0	17.0	20.7	20.7
	10M	6.0	8.4	9.9	11.0	10.0	15.3	14.2	13.0	17.3	17.3
	21M	5.6	7.3	8.0	10.7	10.7	13.4	12.0	10.8	12.4	12.9
Chatcolet Lake	Surface	8.4	12.3	12.0	15.7	19.2	20.4	25.1	22.0	22.4	12.0
	2M	7.2	10.2	11.0	14.1	17.1	18.8	22.7	22.0	22.2	12.0
	5M	6.7	9.0	9.7	11.8	13.0	15.0	19.0	20.2	20.5	12.1
	8M	6.1	8.1	9.2	10.8	14.8	13.7	14.7	14.9	16.8	12.1
	12M	7.1	9.0	9.6	10.8	10.9	11.9	14.1	15.0	16.1	12.0
Hidden Lake	Surface	9.0	9.8	12.7	14.9	19.0	22.1	25.0	22.0	22.7	12.4
	2M	9.0	9.4	11.0	13.2	16.1	18.4	22.6	21.0	22.0	13.0
	5M	8.0	9.4	10.5	13.0	15.5	17.4	21.0	19.1	21.1	12.8
	7M	8.7	9.5	11.0	14.2	15.0	16.3	18.9	14.0	20.1	12.8
Round Lake	Surface	9.4	10.5	12.7	18.1	19.0	21.6	24.8	22.1	24.0	--
	2M	9.2	10.5	10.9	14.2	16.4	17.8	23.2	22.0	22.1	--
	5M	9.6	10.0	9.8	14.0	16.3	12.2	22.0	20.2	21.9	--

*Bottom samples were taken 1 meter off the bottom.

Appendix N . Profiles of Conductivity throughout the Lake Coeur d'Alene System during 1981 (μmhos).

Sampling Site	Depth (M)	Dates: June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Coeur d'Alene River Mile 133	2M	50	68	81	100	74	119
	Bottom*	50	67	104	99	84	109
Coeur d'Alene River Mile 138	2M	52	72	90	89	76	110
	Bottom	53	70	83	89	80	107
St. Joe River Mile 8	2M	49	41	58	43	49	50
	Bottom	49	49	59	47	43	50
St. Joe River Mile 13	2M	50	49	48	45	38	50
	Bottom	50	40	49	48	42	49
St. Joe River Mile 17	2M	49	43	59	43	48	48
	Bottom	49	47	53	47	36	48
Coeur d'Alene River Delta I	Surface	49	60	90	87	90	102
	2M	49	80	101	89	73	108
	Bottom	50	67	82	110	28	114
Coeur d'Alene River Delta II	Surface	49	-	90	100	68	113
	2M	50	-	106	91	89	108
	Bottom	49	-	81	105	78	110
Coeur d'Alene River Delta III	Surface	49	-	80	98	83	73
	2M	50	-	83	109	98	98
	Bottom	49	-	83	91	118	92
St. Joe River Delta Rocky Point Site	2M	41	40	49	46	38	50
	Bottom	41	44	50	44	39	53
St. Joe River Delta Beedle Point Site	Surface	-	-	54	50	35	50
	2M	-	-	48	44	43	50
	5M	-	-	46	50	37	50
	8M	-	-	49	47	48	51
	12M	-	-	49	49	48	52

Appendix N . (Continued)

Sampling Site	Depth (M)	June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
St. Joe River Delta O'Gara Bay Site	Surface	42	-	58	46	39	51
	2M	41	-	49	50	48	51
	5M	40	-	58	50	40	50
	8M	41	-	48	49	46	48
	12M	46	-	58	43	46	48
Gasser Point	Surface	-	-	60	50	39	49
	2M	-	-	57	60	50	51
	5M	-	-	61	53	47	50
	10M	-	-	51	49	33	53
	21M	-	-	57	44	32	45
Brown's Bay	Surface	31	-	55	44	36	50
	2M	41	-	50	46	34	56
	5M	41	-	48	48	37	50
	10M	42	-	50	41	41	50
	21M	52	-	49	41	38	46
Chatcolet Lake	Surface	41	40	43	43	35	48
	2M	41	39	44	50	31	50
	5M	41	44	41	47	39	49
	8M	41	40	45	41	38	45
	12M	41	39	44	40	33	45
Hidden Lake	Surface	41	41	41	41	32	50
	2M	41	48	52	42	41	44
	5M	41	39	49	37	38	50
	7M	41	38	44	40	31	50
Round Lake	Surface	41	40	44	58	30	49
	2M	42	42	51	51	46	49
	5M	42	43	56	47	40	48

*Bottom samples were taken 1 meter off the bottom.

Appendix O . Profiles of Conductivity throughout the Lake Coeur d'Alene System during 1982 (μmhos).

		Dates									
Sampling Site	Depth (M)	4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
Coeur d'Alene River Mile 133	2M	71	45	53	56	67	90	115	84	111	127
	Bottom*	75	45	80	55	69	90	104	52	107	131
Coeur d'Alene River Mile 138	2M	74	46	54	62	74	83	120	61	111	118
	Bottom	71	45	55	61	72	85	114	61	73	118
St. Joe River Mile 8	2M	57	34	32	34	40	45	60	31	53	66
	Bottom	41	34	37	35	40	46	60	31	53	66
St. Joe River Mile 13	2M	53	35	35	34	40	46	54	30	53	63
	Bottom	53	34	35	35	37	42	60	50	55	62
St. Joe River Mile 17	2M	52	34	35	32	40	46	60	31	57	67
	Bottom	58	35	36	33	40	46	60	34	50	67
Coeur d'Alene River Delta I	Surface	74	40	42	49	51	80	70	46	51	61
	2M	70	40	44	53	57	80	101	46	52	61
	Botttom	68	40	49	58	54	89	113	47	77	120
Coeur d'Alene River Delta II	Surface	41	39	40	40	51	50	59	38	51	67
	2M	34	39	48	43	60	52	67	39	60	62
	Bottom	55	40	51	47	44	90	114	42	92	62
Coeur d'Alene River Delta III	Surface	61	39	37	44	53	49	60	34	50	61
	2M	50	39	47	44	55	65	88	32	50	60
	Bottom	61	48	51	55	40	88	113	32	52	63
St. Joe River Delta Rocky Point Site	2M	54	33	35	34	41	44	59	31	53	61
	Bottom	54	36	32	34	35	44	60	31	54	64
St. Joe River Delta Beedle Point Site	OM	51	39	31	38	42	47	54	30	50	60
	2M	52	40	33	37	41	46	57	30	50	62
	5M	51	40	32	38	40	44	56	29	49	60
	8M	52	40	34	38	48	43	58	29	50	62
	12M	51	43	39	45	49	44	58	30	49	61

Appendix O. (Continued)

Sampling Site	Depth (M)	4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
		Dates									
St. Joe River	0M	44	40	33	38	43	43	49	34	52	67
Delta	2M	49	40	32	36	41	44	60	30	51	61
O'Gara Bay Site	5M	52	37	35	37	40	44	60	30	49	60
	8M	51	39	35	39	47	43	55	--	50	64
	12M	52	42	33	46	47	41	54	29	49	60
Gasser Point	Surface	60	40	39	47	49	50	77	31	59	59
	2M	60	37	40	48	49	48	65	31	58	60
	5M	60	41	37	47	40	48	63	30	48	60
	10M	60	41	38	42	48	45	55	28	48	61
	21M	60	47	40	52	52	52	62	31	49	57
Brown's Bay	Surface	32	38	34	41	46	43	58	37	80	61
	2M	51	39	36	41	46	44	57	30	50	60
	5M	51	38	33	38	40	43	61	30	51	61
	10M	31	40	33	46	50	41	54	33	47	61
	21M	51	48	44	51	50	43	59	52	49	55
Chatcolet Lake	Surface	51	37	33	39	38	41	53	28	49	58
	2M	50	35	34	36	39	40	51	28	47	58
	5M	51	35	33	34	39	40	51	28	47	57
	8M	51	37	32	40	40	40	49	27	42	57
	12M	51	36	33	34	41	41	51	26	50	59
Hidden Lake	Surface	50	35	33	37	38	41	51	28	51	54
	2M	51	38	32	37	39	42	51	28	50	58
	5M	50	36	32	38	38	40	51	27	50	52
	7M	50	38	34	37	40	40	51	27	51	55
Round Lake	Surface	55	37	34	37	40	41	56	31	52	--
	2M	39	38	33	35	40	42	55	31	51	--
	5M	52	37	32	35	40	44	58	31	60	--

*Bottom samples were taken 1 meter off the bottom.

Appendix P . Profiles of Turbidity (Hach Turbidimeter) throughout the Lake Coeur d'Alene System during 1981 (N.T.U.'s)

Sampling Site	Depth (M)	Dates June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Coeur d'Alene River Mile 133	2M	0.8	0.9	1.1	2.5	2.2	3.2
	Bottom*	0.9	0.8	1.0	2.5	2.2	2.7
Coeur d'Alene River Mile 138	2M	0.9	1.0	1.3	2.0	2.6	2.1
	Bottom	0.8	0.7	1.5	2.1	2.9	2.4
St. Joe River Mile 8	2M	1.7	1.2	1.2	1.5	1.4	1.4
	Bottom	1.9	1.5	0.7	2.5	1.3	1.7
St. Joe River Mile 13	2M	1.3	2.1	0.9	1.6	1.7	2.2
	Bottom	1.1	1.9	1.1	2.0	1.6	1.7
St. Joe River Mile 17	2M	0.8	0.7	1.6	1.0	1.3	0.9
	Bottom	0.7	1.3	1.5	1.3	1.3	1.1
Coeur d'Alene River Delta I	Surface	1.1	0.8	1.5	2.5	1.8	3.6
	2M	1.0	1.1	2.2	2.5	2.1	3.6
	Bottom	0.7	0.8	1.4	3.0	1.7	3.6
Coeur d'Alene River Delta II	Surface	0.9		1.1	2.2	2.3	3.8
	2M	1.0		2.1	2.0	2.3	3.5
	Bottom	0.9		1.3	2.8	1.6	5.2
Coeur d'Alene River Delta III	Surface	1.0		1.1	2.0	1.8	1.9
	2M	0.7		1.1	2.5	1.3	3.0
	Bottom	0.8		1.4	2.1	1.9	3.2
St. Joe River Delta Rocky Point Site	2M	1.2	0.7	1.1	1.7	1.6	1.3
	Bottom	1.2	1.6	1.1	1.7	1.7	2.8
St. Joe River Delta Beedle Point Site	Surface			0.9	1.5	1.3	2.1
	2M			0.9	1.5	1.3	1.4
	5M			0.8	1.6	0.9	1.4
	8M			1.1	1.4	1.4	2.3
	13M			1.2	1.6	1.2	

Appendix P . (Continued)

Sampling Site	Depth (M)	June 21- 24, 1981	July 6- 10, 1981	July 19- 24, 1981	Aug. 3- 7, 1981	Aug. 17- 20, 1981	Sept. 30- Oct. 3, 1981
		Dates					
St. Joe River	Surface	1.6		0.7	1.4	1.4	1.4
Delta	2M	1.4		0.9	1.7	1.2	1.3
O'Gara Bay Site	5M	1.2		1.9	1.3	1.3	1.6
	8M	1.5		1.2	1.5	1.5	1.1
	13M	1.6		1.3	1.7	2.3	2.1
Gasser Point	Surface			1.1	1.1	1.2	1.0
	2M			1.6	1.2	1.1	1.1
	5M			0.7	1.0	0.7	1.1
	10M			1.5	1.2	1.1	1.3
	21M			1.9	1.2	0.9	1.5
Brown's Bay	Surface	1.2		1.1	1.3	0.9	1.1
	2M	1.2		1.2	1.1	1.3	1.2
	5M	1.1		0.9	1.5	0.8	1.4
	10M	1.4		1.3	1.4	1.1	1.2
	21M	2.2		1.3	2.0	2.3	2.2
Chatcolet Lake	Surface	1.3	0.9	0.9	1.5	0.8	2.4
	2M	1.0	0.8	1.0	1.6	1.0	2.2
	5M	1.1	1.1	1.0	1.5	1.1	2.3
	8M	1.7	1.1	1.5	2.0	1.6	2.5
	12M	4.7	1.1	2.2	7.0	2.2	7.2
Hidden Lake	Surface	0.9	1.0	0.7	1.2	1.2	1.9
	2M	1.3	0.9	2.2	1.0	1.1	2.5
	5M	1.6	0.9	2.5	1.2	1.6	2.2
	7M	1.7	1.6	1.3	1.1	2.7	2.5
Round Lake	Surface	1.3	1.2	1.3	8.2	8.8	2.7
	2M	1.3	1.5	1.8	7.3	9.8	2.9
	5M	1.8	1.8	1.7	3.5	5.5	4.0

*Bottom samples were taken 1 meter off the bottom.

Appendix Q . Profiles of Turbidity (Hach Turbidimeter) throughout the Lake Coeur d'Alene System during 1982 (N.T.U.'s)

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
Coeur d'Alene	2M	1.0	2.8	1.5	1.2	2.8	2.1	2.2	2.1	1.9	1.4
River Mile 133	Bottom*	0.7	2.7	1.6	1.3	2.7	1.9	2.6	2.3	1.0	1.6
Coeur d'Alene	2M	1.1	3.0	2.0	1.4	2.3	1.6	2.2	2.1	1.7	1.0
River Mile 138	Bottom	0.9	3.0	2.0	1.2	2.8	2.9	2.6	2.6	2.0	1.5
St. Joe River	2M	2.0	3.6	1.7	2.6	1.7	3.3	1.6	1.6	1.0	1.0
Mile 8	Bottom	1.6	2.8	2.1	3.7	4.9	1.1	3.1	2.3	1.8	1.0
St. Joe River	2M	1.7	2.9	1.7	2.3	2.5	0.9	1.8	1.5	1.4	1.9
Mile 13	Bottom	2.9	4.7	2.5	4.4	2.3	1.5	2.8	5.6	1.5	3.4
St. Joe River	2M	1.4	3.1	1.9	3.5	2.2	1.1	1.9	1.8	1.5	1.0
Mile 17	Bottom	0.8	2.1	1.8	4.3	2.4	1.0	1.6	1.3	12.0	1.0
Coeur d'Alene	Surface	2.5	3.0	2.4	1.1	1.8	1.1	1.2	2.2	1.1	1.5
River Delta I	2M	5.1	4.7	2.2	1.2	2.0	1.6	1.5	1.7	1.2	1.2
	Bottom	5.3	3.2	5.1	1.6	2.6	2.7	2.5	2.3	2.0	2.0
Coeur d'Alene	Surface	1.6	2.1	2.5	1.2	1.9	1.0	0.9	2.3	1.4	1.3
River Delta II	2M	1.5	2.2	1.7	0.9	2.2	1.4	1.2	1.7	1.4	1.5
	Bottom	2.1	4.0	2.8	1.3	2.6	3.0	2.3	1.8	2.9	0.8
Coeur d'Alene	Surface	3.8	1.5	1.9	1.3	2.1	1.2	0.9	2.2	1.4	1.4
River Delta III	2M	5.2	2.0	2.0	1.3	2.0	1.7	1.6	1.7	1.2	1.4
	Bottom	3.6	5.8	2.5	2.0	2.6	3.1	2.5	1.9	2.1	1.7
St. Joe River											
Delta	2M	2.5	2.5	1.8	3.6	3.0	2.5	2.5	2.0	1.5	1.8
Rocky Point Site	Bottom	1.4	2.6	1.3	3.7	7.8	2.0	3.3	2.0	1.5	1.6
St. Joe River	0M	2.8	2.8	2.2	1.8	1.7	1.5	1.5	1.1	--	1.4
Delta	2M	2.4	2.6	2.1	1.4	2.1	1.5	1.5	1.1	--	1.0
Beedle Point Site	5M	3.8	2.3	2.4	2.0	1.7	1.7	1.5	1.2	--	1.2
	8M	2.5	2.5	1.9	1.1	1.8	3.7	1.7	1.8	--	1.9
	12M	2.8	3.5	2.3	1.4	2.1	1.9	1.9	2.2	--	7.6

Appendix Q . (Continued)

Sampling Site	Depth (M)	Dates 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
St. Joe River Delta O'Gara Bay Site	0M	2.8	1.9	1.6	1.1	1.7	1.4	1.8	1.5	1.2	1.0
	2M	2.0	2.0	1.6	1.2	1.5	1.4	1.1	1.2	1.3	1.2
	5M	2.2	2.2	1.6	1.1	2.1	1.6	1.0	1.4	1.5	1.0
	8M	2.5	2.0	1.6	5.4	2.1	1.7	1.5	--	1.5	1.8
	12M	3.2	2.1	1.9	1.6	2.3	1.6	4.0	1.7	1.9	2.2
Gasser Point	Surface	2.2	2.8	1.9	1.3	1.7	1.3	1.1	1.9	1.0	1.0
	2M	3.3	3.3	2.1	1.1	1.8	1.3	1.1	1.6	1.3	1.1
	5M	4.0	3.7	2.5	1.4	2.0	1.3	1.1	1.8	0.9	1.1
	10M	2.2	3.0	3.1	1.4	2.0	1.6	1.4	1.5	1.1	1.0
	21M	3.1	6.0	3.1	2.4	3.3	1.7	2.1	2.2	2.0	2.0
Brown's Bay	Surface	4.8	2.5	1.4	1.1	1.5	1.3	0.9	1.6	0.8	1.1
	2M	2.9	1.6	1.7	1.2	1.7	1.2	1.1	1.7	1.5	1.3
	5M	4.4	1.7	2.5	1.7	1.6	1.3	1.1	1.7	1.3	1.0
	10M	5.7	2.1	2.2	1.1	2.1	1.4	1.3	1.6	1.7	0.9
	21M	4.4	5.9	1.9	2.0	4.0	1.7	1.7	2.8	2.0	1.3
Chatcolet Lake	Surface	3.1	2.4	2.0	1.5	2.2	1.2	2.1	1.7	1.2	1.7
	2M	3.1	2.4	2.4	1.2	2.3	1.5	1.8	1.3	1.5	2.0
	5M	2.4	3.1	2.3	2.0	2.2	1.5	1.5	1.4	1.3	2.0
	8M	3.5	2.5	2.3	1.9	2.8	1.3	1.5	1.7	1.8	1.6
	12M	2.7	4.3	4.1	2.5	8.0	1.6	3.3	1.3	18.0	2.6
Hidden Lake	Surface	2.5	3.2	1.8	1.9	1.9	1.2	1.8	1.6	1.5	1.7
	2M	2.7	2.0	2.4	1.6	2.1	1.4	1.6	1.6	1.3	2.9
	5M	1.8	1.5	2.3	1.5	2.6	1.6	1.5	1.1	1.9	2.5
	7M	5.2	5.0	3.0	5.5	4.3	3.6	2.0	1.7	5.0	2.6
Round Lake	Surface	2.0	2.1	2.4	1.3	2.0	1.4	1.3	8.0	7.7	--
	2M	2.8	2.5	2.7	1.6	3.4	1.8	1.7	8.1	8.0	--
	5M	3.8	2.8	5.1	2.3	4.0	2.9	2.1	6.8	5.3	--

*Bottom samples were taken 1 meter off the bottom.

Appendix R. Profiles of Secchi Disc Transparency (meters) throughout the Lake Coeur d'Alene System during 1981.

Sampling Site	Dates June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Coeur d'Alene River Mile 133	3.0	2.3	2.0	1.5	1.2	1.2
Coeur d'Alene River Mile 138	2.5	2.6	1.9	1.2	1.4	2.2
St. Joe River Mile 8	2.9	2.5	2.9	2.7	2.3	3.0
St. Joe River Mile 13	3.0	2.1	2.5	2.5	2.1	2.8
St. Joe River Mile 17	3.2	4.0	4.0	3.8	3.0	6.0
Coeur d'Alene River Delta I	2.8	2.3	2.0	1.0	1.4	1.0
Coeur d'Alene River Delta II	2.8		1.9	1.0	1.4	1.2
Coeur d'Alene River Delta III	2.8		2.0	1.1	1.2	1.8
St. Joe River Delta Rocky Point Site	2.0	1.7	2.0	2.0	2.0	2.0
St. Joe River Delta Beedle Point Site			2.2		2.7	2.9
St. Joe River Delta O'Gara Bay Site	3.0		2.0		3.2	3.2

Appendix R . (Continued)

	Dates					
Sampling Site	June 21-24, 1981	July 6-10, 1981	July 19-24, 1981	Aug. 3-7, 1981	Aug. 17-20, 1981	Sept. 30-Oct. 3, 1981
Gasser Point			3.9	3.4	3.0	5.9
Brown's Bay	3.5		3.5	3.5	3.5	4.0
Chatcolet Lake	3.0	2.5	3.6	4.0	5.6	1.9
Hidden Lake	2.2	3.1	4.0	3.7	4.0	2.5
Round Lake	2.0	1.8	2.1	1.0	0.8	1.5

Appendix S . Profiles of Secchi Disc Transparency (meters) throughout the Lake Coeur d'Alene System during 1982.

Sampling Site	Dates: 4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
Coeur d'Alene River Mile 133	1.9	1.4	2.0	1.7	2.0	1.3	1.5	1.1	1.5	1.2
Coeur d'Alene River Mile 138	2.0	1.5	2.4	1.9	2.8	1.9	1.5	1.2	1.2	2.1
St. Joe River Mile 8	2.5	0.9	2.1	0.9	3.8	2.9	2.5	2.7	2.8	1.8
St. Joe River Mile 13	2.3	1.0	2.0	0.8	3.5	3.1	2.5	2.1	3.0	2.0
St. Joe River Mile 17	4.2	0.8	2.0	0.9	3.5	4.1	4.0	3.0	4.1	2.8
Coeur d'Alene River Delta I	1.5	0.6	2.3	1.6	1.8	2.6	2.0	2.0	3.9	3+(Bottom)
Coeur d'Alene River Delta II	1.0	1.3	2.2	2.9	2.0	3.0	2.5	2.6	3.9	3.9
Coeur d'Alene River Delta III	1.0	2.3	1.9	3.0	2.1	3.2	3.5	3.0	5.0	4.1
St. Joe River Delta Rocky Point Site	--	1.0	1.9	0.9	2(Bottom)	2(Bottom)	1.7	2.0	2.1	2(Bottom)
St. Joe River Delta Beedle Point Site	1.1	2.1	1.9	1.6	2.6	3.1	2.5	2.5	3.0	3.1
St. Joe River Delta O'Gara Bay Site	1.1	1.9	2.0	2.0	2.5	3.2	3.2	3.3	3.5	3.1

Appendix S . (Continued)

Sampling Site	4/20-21	5/17-21	5/31-6/6	6/16-18	6/30-7/1	7/12-14	7/28-29	8/10-13	8/24-26	10/5-7
	Dates									
Gasser Point	1.0	1.6	2.1	3.2	2.9	3.9	4.7	4.1	4.5	5.6
Brown's Bay	0.9	2.1	2.0	3.1	3.0	3.7	4.7	3.0	3.8	4.4
Chatcolet Lake	1.1	1.5	1.9	2.1	2.2	2.9	2.8	2.2	5.2	1.7
Hidden Lake	1.1	2.0	1.4	2.1	2.5	3.0	3.0	3.2	5.0	2.4
Round Lake	1.5	1.4	1.8	1.6	2.0	2.5	3.3	1.5	0.9	--

Appendix T. Phytoplankton numbers per liter by algal type in Coeur d'Alene Lake system, 1981-1982 (BG=bluegreens, G=greens, F=flagellates, D= diatoms, T=total phytoplankton, DOM=dominant genera of particular algal type).

Date	Site	BG	DOM	G	DOM	F	DOM	D	DOM	T	DOM
6/21-24/81	CD	17,506	AN	0	--	0	--	138,580	NV	155,636	NV
	CR2	0	--	0	--	0	--	27,716	NV	27,716	NV
	CR1	0	--	0	--	0	--	110,864	NV	110,864	NV
	BB	449,852	AN	0	--	0	--	899,704	AS	1,349,556	AS
	RP	0	--	0	--	0	--	149,240	NV	149,240	NV
	OB	76,752	AN	0	--	0	--	307,008	AS	383,760	AS
	RL	0	--	0	--	0	--	174,824	NV	174,824	NV
	HL	232,388	AN	0	--	0	--	155,636	ML	388,024	AN
	CL	390,156	AN	0	--	0	--	117,260	ML	507,416	AN
7/6-10/81	CD	0	--	0	--	0	--	349,648	AS	349,648	AS
	CR1	0	--	0	--	0	--	76,752	NV	76,752	NV
	CR2	31,980	AN	0	--	0	--	53,300	NV	85,280	NV
	BB	0	--	0	--	0	--	1,048,944	AS	1,048,944	AS
	GP	0	--	0	--	0	--	1,213,108	AS	1,213,108	AS
	RP	0	--	0	--	0	--	125,788	NV	125,788	NV
	OB	225,992	AN	0	--	0	--	46,904	NV	272,896	AN
	BP	373,100	AN	0	--	21,320	CY	889,044	AS	1,283,464	AS
	CL	253,708	AN	0	--	0	--	34,112	ML	287,820	AN
	RL	202,540	AN	0	--	0	--	347,516	NV	550,056	AN
	HL	808,028	AN	0	--	0	--	46,904	ML	854,932	AN
	SR3	0	--	0	--	0	--	19,188	NV	19,188	NV
	SR2	0	--	0	--	0	--	85,280	NV	85,280	NV
	SR1	0	--	0	--	0	--	27,716	NV	27,716	NV
7/19-24/81	CD	0	--	0	--	0	--	281,424	AS	281,424	AS
	CR2	0	--	0	--	4,264	CY	2,404,896	NI	2,049,160	NI
	CR1	0	--	0	--	0	--	2,117,076	NI	2,117,076	NI
	BB	0	--	0	--	0	--	577,772	AS	577,772	AS
	GP	0	--	0	--	0	--	1,351,688	AS	1,351,688	AS
	BP	0	--	0	--	112,996	CY	2,984,800	AS	3,097,796	AS
	OB	49,036	AN	0	--	134,316	CY	2,306,824	AS	2,490,176	AS
	RP	0	--	0	--	0	--	166,296	NV	166,296	NV
	CL	677,976	AN	0	--	0	--	4,264	ML	682,240	AN
	HL	481,832	AN	0	--	0	--	6,396	ML	488,228	AN
	RL	130,052	AN	0	--	0	--	25,584	NV	155,636	AN
	SR3	0	--	0	--	0	--	70,356	NV	70,356	NV
	SR2	0	--	0	--	0	--	40,508	NV	40,508	NV
	SR1	0	--	0	--	0	--	85,280	NV	85,280	NV
8/3-7/81	CD	57,564	AN	23,452	MO	4,264	CY	38,376	NV	123,656	AN
	CR2	106,600	AN	208,936	SC	0	--	196,144	NI	511,680	SC
	CR1	0	--	81,016	SC	10,660	CY	1,394,328	NI	1,486,004	NI
	BB	144,976	AN	81,016	SC	31,980	CY	370,968	AS	628,940	AS

Appendix T. (Continued).

Date	Site	BG	DOM	G	DOM	F	DOM	D	DOM	T	DOM
	GP	584,168	AN	81,016	SC	12,792	CY	874,120	AS	1,552,096	AS
	RP	0	--	0	--	0	--	44,772	GO	44,772	GO
	BP	176,956	AN	0	--	14,924	CY	12,792	AS	204,672	AN
	OB	17,056	AN	0	--	106,600	CY	17,056	AS	140,712	CY
	CL	912,496	AN	364,572	UL	0	--	2,132	CM	1,279,200	AN
	HL	1,549,964	AN	55,432	UL	8,528	CT	17,056	CC	1,630,980	AN
	SR3	0	--	0	--	4,264	CY	8,528	NV	12,792	CY
	SR2	0	--	8,528	CR	2,132	CY	140,712	NV	151,372	NV
	SR1	0	--	0	--	6,396	CY	44,772	NV	51,168	NV
8/17-	CD	2,065,908	AN	66,092	EU	8,528	CY	6,396	NV	2,146,924	AN
20/81	CR2	17,056	AN	185,484	SC	2,132	CY	172,692	NI	377,364	SC
	BB	2,191,696	AN	17,056	MO	4,264	CY	46,904	AS	2,259,920	AN
	GP	7,587,788	AN	0	--	0	--	4,264	NV	7,592,052	AN
	RP	61,828	AN	0	--	42,640	CY	8,528	NV	112,996	AN
	BP	1,172,600	AN	78,884	SC	51,168	CY	112,996	NV	1,415,648	AN
	OB	673,712	AN	0	--	29,848	CY	134,316	AS	837,876	AN
	CL	697,164	AP	36,244	OO	6,396	CY	6,396	NV	746,200	AP
	RL	9,685,676	AN	0	--	127,920	CY	0	--	9,813,596	AN
	HL	1,592,604	AP	471,172	EU	61,828	CY	2,132	NV	2,127,736	AP
	SR3	0	--	46,904	MO	294,216	CY	206,804	NV	547,924	CY
	SR2	0	--	34,112	SC	121,524	CY	110,864	NV	266,500	CY
	SR1	0	--	57,564	SC	87,412	CY	81,016	NV	225,992	CY
9/30-	CD	590,564	AN	208,936	GL	134,316	CY	471,172	AS	1,404,988	AN
10/3,	CR2	1,496,664	AN	635,336	GL	55,432	CY	562,848	NI	2,750,280	AN
1981	CR1	978,588	AN	729,144	GL	287,820	CY	426,400	NI	2,421,952	AN
	BB	324,064	AN	31,980	EU	70,356	CY	1,168,336	AS	1,594,736	AS
	GP	181,220	AN	217,464	GL	130,052	CY	535,132	AS	1,063,868	AS
	RP	0	--	0	--	29,848	CY	40,508	NV	70,356	CY
	OB	0	--	44,772	EU	240,916	CY	181,220	ML	466,908	CY
	BP	8,528	AN	153,504	PL	106,600	CY	477,568	AS	746,200	AS
	HL	341,120	AP	138,580	MO	1,168,336	PH	27,716	AS	1,675,752	PH
	CL	343,252	AP	17,056	EU	81,016	PH	6,396	NV	447,720	AP
	RL	63,960	AN	409,344	EU	413,608	CY	221,728	ML	1,108,640	CY
	SR3	14,924	AN	0	--	0	--	23,452	NV	38,376	NV
	SR2	0	--	0	--	0	--	72,488	NV	72,488	NV
	SR1	0	--	17,056	SC	76,752	CY	21,320	NV	115,128	CY
4/19-	CD	0	--	0	--	0	--	19,188	NV	19,188	NV
23/82	CR2	0	--	10,660	AK	0	--	215,332	AS	225,992	AS
	CR1	0	--	0	--	0	--	23,452	AS	23,452	AS
	BB	0	--	8,528	AK	0	--	8,528	CC	17,056	AK
	GP	0	--	14,924	AK	0	--	98,072	AS	112,996	AS
	BP	21,320	AN	6,396	AK	2,132	CY	112,996	AS	142,844	AS
	OB	0	--	0	--	0	--	10,660	AS	10,660	AS

Appendix T. (Continued).

Date	Site	BG	DOM	G	DOM	F	DOM	D	DOM	T	DOM
	RP	0	--	0	--	0	--	55,432	AS	55,432	AS
	CL	0	--	4,264	AK	0	--	132,184	AS	136,448	AS
	HL	23,452	AN	0	--	0	--	8,528	NV	31,980	AN
	RL	0	--	0	--	0	--	31,980	NV	31,980	NV
	SR2	0	--	0	--	0	--	61,828	NV	61,828	NV
	SR1	0	--	4,264	AK	0	--	81,016	NV	85,280	NV
	SR3	0	--	0	--	0	--	8,528	NV	8,528	NV
5/17-	CD	0	--	0	--	0	--	283,556	ML	283,556	ML
21/82	CR1	249,444	AN	0	--	0	--	76,752	AS	326,196	AN
	CR2	8,528	AN	0	--	0	--	0	--	8,528	AN
	GP	0	--	0	--	0	--	17,056	SY	17,056	SY
	BB	110,864	AN	0	--	0	--	172,692	ML	283,556	AN
	BP	0	--	0	--	0	--	123,656	ML	123,656	ML
	OB	0	--	0	--	0	--	10,660	NV	10,660	NV
	RP	55,432	AN	87,412	UL	0	--	245,180	NV	388,024	NV
	HL	0	--	0	--	0	--	10,660	ML	10,660	ML
	CL	12,792	AN	0	--	0	--	10,660	ML	23,452	AN
	SR1	0	--	0	--	0	--	70,356	AS	70,356	AS
	SR3	0	--	0	--	0	--	183,352	ML	183,352	ML
	SR2	57,564	AN	0	--	0	--	157,768	ML	215,332	ML
5/31-	CD	91,676	AN	0	--	0	--	29,848	ML	121,524	AN
6/2,	CR1	140,712	AN	0	--	0	--	266,500	CN	407,212	AN
1982	GP	0	--	2,132	AK	0	--	490,360	AS	492,492	AS
	BB	0	--	6,396	AK	0	--	264,368	AS	270,764	AS
	BP	0	--	0	--	0	--	144,976	NV	144,976	NV
	OB	0	--	0	--	0	--	51,168	NV	51,168	NV
	RP	0	--	4,264	UL	0	--	102,336	NV	106,600	NV
	CL	87,412	AN	0	--	0	--	61,828	NV	149,240	AN
	HL	14,924	AN	2,132	AK	0	--	8,528	NV	25,584	AN
	RL	0	--	40,508	UL	0	--	277,160	NV	317,668	NV
	SR1	0	--	0	--	0	--	76,752	NV	76,752	NV
	SR3	0	--	0	--	0	--	25,584	ML	25,584	ML
	SR2	0	--	0	--	0	--	38,376	NV	38,376	NV
6/16-	CD	262,236	AN	25,584	SC	0	--	87,412	NV	375,232	AN
18/82	CR1	0	--	0	--	0	--	36,244	NV	36,244	NV
	BB	0	--	14,924	AK	4,264	CY	44,772	ML	63,960	ML
	GP	360,308	AN	123,656	PA	0	--	149,240	AS	633,204	AN
	BP	59,696	AN	0	--	0	--	117,260	NV	176,956	AN
	RP	0	--	0	--	0	--	166,296	NV	166,296	NV
	OB	63,960	AN	0	--	34,112	PH	151,372	NV	249,444	NV
	CL	0	--	0	--	0	--	38,376	ML	38,376	ML
	HL	46,904	AN	0	--	0	--	95,940	NV	142,844	NV
	RL	0	--	0	--	0	--	115,128	FR	115,128	FR

Appendix T. (Continued).

Date	Site	BG	DOM	G	DOM	F	DOM	D	DOM	T	DOM
	SR3	0	--	2,132	AK	0	--	10,660	NV	12,792	NV
	SR2	0	--	0	--	0	--	136,448	NV	136,448	NV
	SR1	0	--	10,660	UL	0	--	200,408	NV	211,068	NV
6/30-	CD	191,880	AN	1,586,208	AK	0	--	162,032	NI	1,940,120	AK
7/2,	CR1	0	--	1,210,976	AK	0	--	85,280	NI	1,296,256	AK
1982	CR2	38,376	AP	1,172,600	AK	0	--	170,560	NI	1,381,536	AK
	BB	115,128	AN	8,528	ST	4,264	CY	27,716	AS	155,636	AN
	BP	1,087,320	AN	0	--	0	--	115,128	AS	1,202,448	AN
	RP	0	--	0	--	0	--	121,524	NV	121,524	NV
	CL	53,300	AN	4,264	AK	0	--	21,320	NV	78,884	AN
	HL	78,884	AN	42,640	MO	0	--	42,640	NV	164,164	AN
	RL	0	--	104,468	SC	74,620	CY	151,372	NV	330,460	NV
	SR2	0	--	21,320	SC	0	--	55,432	NV	76,752	NV
	SR1	8,528	AP	0	--	0	--	98,072	NV	106,600	NV
	SR3	0	--	0	--	0	--	44,772	ML	44,772	ML
7/12-	CD	0	--	863,460	AK	0	--	993,512	NI	1,856,972	NI
14/82	CR2	0	--	1,946,516	AK	0	--	494,624	NI	2,441,140	AK
	CR1	0	--	1,528,644	AK	0	--	170,560	NI	1,699,204	AK
	GP	0	--	176,956	AK	0	--	140,712	AS	317,668	AK
	BB	0	--	21,320	AK	40,508	CY	59,696	AS	121,524	CY
	OB	0	--	0	--	0	--	46,904	SY	46,904	SY
	RP	0	--	12,792	AK	0	--	138,580	NV	151,372	NV
	RL	115,128	AN	40,508	SC	0	--	377,364	NV	533,000	NV
	HL	609,752	AN	0	--	0	--	206,804	AS	816,556	AN
	CL	68,224	AN	38,376	MO	0	--	51,168	NV	157,768	AN
	SR2	0	--	0	--	0	--	136,448	NV	136,448	NV
	SR3	0	--	0	--	0	--	91,676	NV	91,676	NV
	SR1	61,828	AP	6,396	AK	0	--	127,920	NV	196,144	NV
7/28-	CD	14,924	AN	1,159,808	AK	0	--	144,976	NI	1,319,708	AK
29/82	CR2	19,188	AN	1,456,156	AK	0	--	669,448	NV	2,144,792	AK
	CR1	0	--	1,927,328	AK	0	--	347,516	NI	2,274,844	AK
	GP	0	--	147,108	AK	0	--	49,036	AS	196,144	AK
	BB	74,620	AN	0	--	23,452	CY	25,584	AS	123,656	AN
	RP	63,960	AN	266,508	EU	0	--	208,936	NV	539,396	EU
	OB	483,964	AN	25,584	SC	12,792	CY	29,848	ML	552,188	AN
	RL	275,028	AN	36,244	AK	2,132	CT	25,584	NV	338,988	AN
	CL	2,662,868	AN	34,112	AK	2,132	CT	59,696	NV	2,758,808	AN
	HL	0	--	2,863,276	AK	0	--	138,580	NI	3,001,856	AK
	SR2	74,620	AP	0	--	0	--	215,332	NV	289,952	NV
	SR1	0	--	66,092	SC	0	--	153,504	NV	219,596	NV
	SR3	0	--	19,188	AK	0	--	78,884	NV	98,072	NV

Appendix T. (Continued).

Date	Site	BG	DOM	G	DOM	F	DOM	D	DOM	T	DOM
8/10-13/82	CD	0	--	368,836	EU	0	--	1,142,752	AS	1,511,588	AS
	CR2	0	--	345,384	AK	0	--	185,484	NI	530,868	AK
	CR1	0	--	422,136	AK	0	--	262,236	NI	684,372	AK
	GP	0	--	0	--	0	--	1,984,892	AS	1,984,892	AS
	BB	87,412	AN	115,128	GL	0	--	2,104,284	AS	2,306,824	AS
	OB	1,532,908	AN	0	--	0	--	0	--	1,532,908	AN
	BP	200,408	AN	0	--	6,396	CY	690,768	AS	897,572	AS
	RP	130,052	AN	106,600	SC	31,980	CY	51,168	NV	319,800	AN
	HL	1,326,104	AN	8,528	SC	31,980	CY	311,272	NI	1,677,884	AN
	CL	2,144,792	AN	17,056	PE	55,432	CY	29,848	CO	2,247,128	AN
	RL	4,464,408	AN	0	--	0	--	72,488	NV	4,536,896	AN
	SR2	0	--	0	--	0	--	104,468	NV	104,468	NV
	SR1	42,640	AP	136,448	SC	0	--	87,412	NV	266,500	SC
	SR3	0	--	0	--	0	--	61,828	NV	61,828	NV
8/24-26/82	CD	0	--	49,036	SC	0	--	351,780	AS	400,816	AS
	CR1	0	--	51,168	AK	0	--	76,752	NI	127,920	NI
	CR2	12,792	AP	0	--	0	--	102,336	FR	115,128	FR
	BB	0	--	55,432	UL	0	--	1,865,500	AS	1,920,932	AS
	GP	0	--	0	--	0	--	475,436	AS	475,436	AS
	OB	0	--	29,848	MO	0	--	1,775,956	AS	1,805,804	AS
	RP	260,104	AN	14,924	AK	0	--	42,640	NV	317,668	AN
	BP	63,960	AP	2,132	ST	0	--	409,344	AS	475,436	AS
	HL	240,916	AN	0	--	34,112	CT	287,820	FR	562,848	AN
	CL	91,676	AN	179,088	EU	23,452	CY	49,036	FR	343,252	EU
	RL	2,038,192	AN	17,056	SC	0	--	19,188	NV	2,074,436	AN
	SR3	0	--	29,848	MO	0	--	213,200	NV	243,048	NV
	SR2	0	--	0	--	0	--	34,112	NV	34,112	NV
	SR1	0	--	0	--	0	--	42,640	NV	42,640	NV
10/5-7/82	CD	0	--	21,320	SC	8,528	CY	168,428	AS	198,276	AS
	CR1	29,848	AP	1,422,044	AK	0	--	159,900	NI	1,611,792	AK
	CR2	0	--	2,511,496	AK	0	--	690,768	NI	3,202,264	AK
	BB	46,904	AP	110,864	UL	0	--	268,632	AS	426,400	AS
	GP	0	--	0	--	0	--	194,012	CO	194,012	CO
	RP	0	--	61,828	SC	0	--	72,488	NV	134,316	SC
	BP	0	--	0	--	0	--	66,092	NV	66,092	NV
	OB	98,072	AP	0	--	0	--	136,448	AS	234,520	AP
	HL	40,508	AN	98,072	MO	68,224	CY	83,148	ML	289,952	MO
	CL	42,640	AP	25,584	AK	0	--	89,544	ML	157,768	AP
	SR3	0	--	2,132	AK	0	--	25,584	NV	27,716	NV
	SR1	0	--	4,264	AK	0	--	70,356	NV	74,620	NV
	SR2	42,640	AN	25,584	SC	0	--	119,392	FR	187,616	FR

Appendix U. Phytoplankton genera in the Coeur d'Alene Lake system, 1981-1982.

Genus	Algal Type	Appendix T Abbreviation
Anabaena	bluegreen	AN
Aphanizomenon	bluegreen	AP
Ankistrodesmus	green	AK
Closterium	green	CL
Cosmarium	green	CS
Crucigenia	green	CR
Eudorina	green	EU
Gloeocystis	green	GL
Mougeotia	green	MO
Oocystis	green	OO
Pandorina	green	PA
Pediastrum	green	PE
Platydorina	green	PL
Quadrigula	green	QU
Scenedesmus	green	SC
Staurastrum	green	ST
Ulothrix	green	UL
Ceratium	flagellate	CT
Cryptomonas	flagellate	CY
Phacus	flagellate	PH
Asterionella	diatom	AS
Ceratoneis	diatom	CN
Cocconeis	diatom	CO
Cyclotella	diatom	CC
Cymbella	diatom	CM
Fragillaria	diatom	FR
Gomphonema	diatom	GO
Melosira	diatom	ML
Meridion	diatom	MR
Navicula	diatom	NV
Nitzschia	diatom	NI
Pinnularia	diatom	PI
Synedra	diatom	SY
Tabellaria	diatom	TA

Appendix V. Zooplankton numbers per liter in Coeur d'Alene Lake system, 1981-1982 (Cope = Copepods, Clad = Cladocerans).

Date	Site	Cope	Dominant	Clad	Dominant	Total	Dominant
6/21-24/81	CD	0.7	Cyclopoid	0.7	Bosmina	1.4	Cyclopoid
	BB	0.7	Nauplii	0.3	Bosmina	1.1	Nauplii
	RP	0	--	0	--	0	--
	OB	1.5	Nauplii	0.4	Bosmina	1.9	Nauplii
	HL	7.3	Nauplii	1.3	Daphnia	8.7	Nauplii
	RL	0.1	Cyclopoid	0.1	Bosmina	0.2	Cyclopoid
	CL	1.9	Cyclopoid	1.3	Daphnia	3.2	Cyclopoid
7/6-10/81	CD	4.2	Cyclopoid	7.9	Bosmina	12.1	Bosmina
	CR1	3.7	Nauplii	0.8	Bosmina	4.5	Nauplii
	CR2	3.2	Nauplii	1.2	Bosmina	4.3	Nauplii
	BB	10.1	Cyclopoid	34.3	Bosmina	44.4	Bosmina
	GP	12.0	Cyclopoid	53.1	Bosmina	65.2	Bosmina
	RP	1.6	Cyclopoid	0.3	Daphnia	1.9	Cyclopoid
	BP	19.2	Cyclopoid	46.5	Bosmina	65.7	Bosmina
	OB	28.0	Cyclopoid	33.2	Bosmina	61.2	Bosmina
	RL	15.4	Nauplii	17.1	Bosmina	32.5	Bosmina
	HL	6.9	Cyclopoid	2.1	Daphnia	9.1	Cyclopoid
	CL	3.8	Cyclopoid	1.3	Daphnia	5.1	Cyclopoid
	SR1	0.1	Cyclopoid	0	--	0.1	Cyclopoid
	SR3	0.5	Cyclopoid	0.4	Bosmina	0.9	Cyclopoid
	SR2	0.2	Cyclopoid	0.2	Bosmina	0.4	Cyclopoid
7/19-24/81	CD	1.6	Cyclopoid	2.7	Bosmina	4.3	Bosmina
	CR2	0.3	Cyclopoid	0.3	Bosmina	0.6	Cyclopoid
	CR1	1.4	Nauplii	0.2	Bosmina	1.6	Nauplii
	BB	23.7	Cyclopoid	45.8	Bosmina	69.4	Bosmina
	GP	14.4	Cyclopoid	57.5	Bosmina	71.8	Bosmina
	OB	60.3	Cyclopoid	136.3	Bosmina	196.5	Bosmina
	BP	125.2	Cyclopoid	109.4	Bosmina	234.6	Cyclopoid
	RP	0.3	Cyclopoid	0.2	Bosmina	0.5	Cyclopoid
	CL	31.9	Calanoid	23.2	Daphnia	55.2	Daphnia
	HL	16.2	Calanoid	27.3	Daphnia	43.5	Daphnia
	RL	3.1	Nauplii	4.4	Bosmina	7.5	Bosmina
	SR3	0.1	Cyclopoid	0.1	Bosmina	0.2	Cyclopoid
	SR2	0	--	0.1	Chydorus	0.2	Chydorus
	SR1	0.3	Cyclopoid	0.2	Chydorus	0.5	Cyclopoid
8/3-7/81	CD	30.6	Cyclopoid	9.0	Diaphanosoma	39.6	Cyclopoid
	CR1	2.5	Cyclopoid	1.5	Chydorus	4.0	Cyclopoid
	CR2	1.0	Nauplii	0.7	Chydorus	1.8	Nauplii
	GP	32.8	Cyclopoid	2.7	Bosmina	35.6	Cyclopoid
	BB	109.7	Cyclopoid	4.8	Daphnia	114.5	Cyclopoid
	BP	173.0	Cyclopoid	4.1	Daphnia	177.1	Cyclopoid
	RP	1.4	Cyclopoid	2.0	Daphnia	3.4	Daphnia
	OB	101.7	Cyclopoid	1.5	Diaphanosoma	103.1	Cyclopoid
	RL	35.3	Cyclopoid	26.5	Daphnia	61.9	Cyclopoid
	HL	10.4	Calanoid	40.7	Daphnia	51.1	Daphnia
	CL	50.2	Cyclopoid	26.3	Daphnia	76.5	Cyclopoid

Appendix V. (Continued).

Date	Site	Cope	Dominant	Clad	Dominant	Total	Dominant
	SR2	0.3	Cyclopoid	0.3	Bosmina	0.6	Bosmina
	SR1	0.7	Nauplii	1.0	Chydorus	1.7	Nauplii
	SR3	0.1	Nauplii	0	--	0.1	Nauplii
8/17-	CD	18.9	Nauplii	19.6	Bosmina	38.5	Bosmina
20/81	CR2	5.8	Cyclopoid	48.6	Bosmina	54.4	Bosmina
	CR1	5.8	Nauplii	16.4	Bosmina	22.3	Bosmina
	BB	125.2	Nauplii	4.6	Diaphanosoma	129.9	Nauplii
	GP	36.4	Calanoid	1.1	Daphnia	37.4	Calanoid
	RP	1.4	Cyclopoid	35.0	Bosmina	36.4	Bosmina
	OB	93.3	Cyclopoid	8.0	Diaphanosoma	101.4	Cyclopoid
	BP	86.1	Cyclopoid	8.3	Diaphanosoma	94.3	Cyclopoid
	HL	9.7	Calanoid	41.9	Daphnia	51.7	Daphnia
	CL	21.5	Calanoid	19.6	Daphnia	41.0	Daphnia
	RL	17.2	Calanoid	71.0	Daphnia	88.1	Daphnia
	SR3	0	--	0	--	0	--
	SR2	0.5	Nauplii	2.1	Bosmina	2.7	Bosmina
	SR1	0.9	Cyclopoid	13.9	Bosmina	14.8	Bosmina
9/30-	CD	14.2	Cyclopoid	33.9	Daphnia	48.1	Daphnia
10/3/81	CR1	17.3	Nauplii	8.0	Bosmina	25.3	Nauplii
	CR2	12.5	Nauplii	11.1	Bosmina	23.6	Bosmina
	BB	66.1	Cyclopoid	63.4	Daphnia	129.5	Daphnia
	GP	30.2	Cyclopoid	36.6	Daphnia	66.8	Daphnia
	RP	2.3	Calanoid	8.6	Bosmina	10.9	Bosmina
	OB	45.4	Cyclopoid	20.2	Daphnia	65.6	Cyclopoid
	BP	62.8	Cyclopoid	26.5	Daphnia	89.3	Cyclopoid
	CL	83.5	Calanoid	15.5	Daphnia	99.0	Calanoid
	HL	171.3	Nauplii	105.9	Daphnia	277.2	Daphnia
	RL	2.7	Cyclopoid	36.1	Daphnia	38.8	Daphnia
	SR3	0.1	Nauplii	0.2	Chydorus	0.2	Chydorus
	SR2	0.7	Nauplii	2.1	Bosmina	2.8	Bosmina
	SR1	0.1	Cyclopoid	0.8	Bosmina	0.9	Bosmina
4/19-	CD	11.3	Nauplii	0	--	11.3	Nauplii
23/82	CR2	8.4	Nauplii	0.2	Daphnia	8.5	Nauplii
	CR1	11.5	Nauplii	0	--	11.5	Nauplii
	GP	2.8	Nauplii	0	--	2.8	Nauplii
	BB	3.9	Nauplii	0.1	Daphnia	4.0	Nauplii
	RP	1.1	Nauplii	0	--	1.1	Nauplii
	BP	9.0	Nauplii	0.1	Daphnia	9.0	Nauplii
	OB	4.2	Nauplii	0.2	Bosmina	4.5	Nauplii
	HL	15.4	Nauplii	0	--	15.4	Nauplii
	CL	2.4	Nauplii	0.1	Bosmina	2.5	Nauplii
	RL	1.1	Nauplii	0	--	1.2	Nauplii
	SR1	0.4	Nauplii	0	--	0.4	Nauplii
	SR3	0.1	Nauplii	0	--	0.2	Nauplii
	SR2	1.6	Nauplii	0	--	1.6	Nauplii
5/17-	CD	3.4	Nauplii	0.1	Daphnia	3.5	Nauplii
21/82	CR2	2.2	Nauplii	0.4	Daphnia	2.6	Nauplii
	CR1	2.3	Cyclopoid	1.5	Daphnia	3.8	Cyclopoid

Appendix V. (Continued).

Date	Site	Cope	Dominant	Clad	Dominant	Total	Dominant
	GP	3.6	Nauplii	0.1	Daphnia	3.7	Nauplii
	BB	6.1	Nauplii	0.3	Daphnia	6.3	Nauplii
	RP	1.0	Nauplii	0	--	1.0	Nauplii
	OB	3.3	Nauplii	0.2	Bosmina	3.5	Nauplii
	BP	9.2	Nauplii	0	--	9.2	Nauplii
	HL	1.3	Nauplii	0.1	Daphnia	1.4	Nauplii
	CL	8.5	Nauplii	0.7	Daphnia	9.3	Nauplii
	RL	1.3	Nauplii	0.1	Daphnia	1.4	Nauplii
	SR2	0.3	Nauplii	0	--	0.3	Nauplii
	SR1	1.8	Cyclopoid	0.2	Bosmina	2.0	Cyclopoid
	SR3	0.5	Nauplii	0	--	0.5	Nauplii
5/31-	CD	3.8	Nauplii	4.5	Bosmina	8.3	Bosmina
6/2/82	CR1	14.3	Nauplii	9.3	Daphnia	23.6	Daphnia
	CR2	11.5	Nauplii	3.8	Bosmina	15.3	Nauplii
	BB	5.0	Nauplii	0.4	Bosmina	5.4	Nauplii
	GP	9.0	Nauplii	0.3	Bosmina	9.2	Nauplii
	BP	5.6	Nauplii	0.7	Bosmina	6.4	Nauplii
	RP	0.4	Nauplii	0.4	Daphnia	0.7	Daphnia
	OB	7.5	Nauplii	0.5	Bosmina	8.0	Nauplii
	RL	0.4	Nauplii	0.1	Bosmina	0.5	Nauplii
	CL	4.2	Nauplii	0.2	Bosmina	4.4	Nauplii
	HL	1.2	Nauplii	0.3	Daphnia	1.5	Nauplii
	SR1	1.7	Nauplii	0.3	Daphnia	2.0	Nauplii
	SR2	0.3	Cyclopoid	0.7	Bosmina	1.0	Bosmina
	SR3	0.3	Calanoid	0.1	Daphnia	0.5	Calanoid
6/16-	CD	1.7	Nauplii	3.1	Bosmina	4.8	Bosmina
18/82	CR1	1.4	Cyclopoid	0.5	Bosmina	1.9	Cyclopoid
	CR2	0.2	Calanoid	0	--	0.2	Calanoid
	BB	2.2	Cyclopoid	1.9	Bosmina	4.1	Bosmina
	GP	19.9	Nauplii	14.6	Bosmina	34.6	Nauplii
	RP	0.1	Nauplii	0	--	0.1	Nauplii
	OB	0.5	Cyclopoid	0.3	Daphnia	0.8	Cyclopoid
	BP	0.1	Nauplii	0.2	Bosmina	0.3	Bosmina
	CL	0.7	Cyclopoid	0.1	Daphnia	0.8	Cyclopoid
	RL	0.1	Nauplii	0	--	0.1	Nauplii
	HL	0.3	Nauplii	0	--	0.3	Nauplii
	SR1	0.3	Cyclopoid	0.1	Daphnia	0.4	Cyclopoid
	SR3	0.1	Nauplii	0	--	0.1	Nauplii
6/30-	CD	1.0	Calanoid	0.7	Bosmina	1.7	Bosmina
7/2/82	CR2	0.4	Calanoid	0.2	Daphnia	0.6	Calanoid
	CR1	0.4	Calanoid	0.1	Bosmina	0.4	Calanoid
	GP	5.0	Cyclopoid	1.7	Bosmina	6.6	Cyclopoid
	BB	7.2	Cyclopoid	3.0	Bosmina	10.2	Cyclopoid
	OB	15.3	Cyclopoid	36.9	Bosmina	52.2	Bosmina
	BP	61.9	Calanoid	112.6	Bosmina	174.5	Bosmina
	RP	0.9	Cyclopoid	3.3	Bosmina	4.2	Bosmina
	HL	2.8	Calanoid	0.7	Bosmina	3.6	Calanoid

Appendix V. (Continued).

Date	Site	Cope	Dominant	Clad	Dominant	Total	Dominant
	RL	2.2	Cyclopoid	3.4	Bosmina	5.6	Bosmina
	CL	9.6	Cyclopoid	0.8	Ceriodaphnia	10.4	Cyclopoid
	SR2	0.3	Calanoid	2.8	Bosmina	3.1	Bosmina
	SR1	0	--	0	--	0.1	Calanoid
	SR3	0.1	Calanoid	0	--	0.1	Calanoid
7/12-14/82	CD	16.1	Calanoid	48.4	Bosmina	64.5	Bosmina
	CR2	0.6	Cyclopoid	1.1	Bosmina	1.7	Bosmina
	CR1	0.2	Cyclopoid	1.3	Bosmina	1.5	Bosmina
	GP	35.1	Cyclopoid	61.9	Bosmina	97.0	Bosmina
	BB	32.4	Cyclopoid	38.3	Bosmina	70.6	Bosmina
	BP	25.2	Cyclopoid	80.6	Bosmina	105.8	Bosmina
	OB	18.8	Cyclopoid	56.1	Bosmina	75.0	Bosmina
	RP	0.1	Cyclopoid	2.8	Bosmina	2.9	Bosmina
	CL	8.2	Cyclopoid	17.1	Bosmina	25.3	Bosmina
	HL	9.4	Cyclopoid	19.4	Bosmina	28.8	Bosmina
	RL	1.9	Cyclopoid	70.3	Bosmina	72.2	Bosmina
	SR3	1.7	Cyclopoid	2.1	Bosmina	3.8	Bosmina
	SR1	0.1	Cyclopoid	0.9	Bosmina	1.0	Bosmina
	SR2	0.4	Cyclopoid	0.5	Bosmina	0.9	Bosmina
7/28-29/82	CD	21.8	Nauplii	5.5	Basmina	27.3	Nauplii
	CR1	1.0	Calanoid	1.5	Daphnia	2.5	Daphnia
	CR2	0.9	Cyclopoid	2.4	Daphnia	3.3	Daphnia
	BB	25.3	Cyclopoid	27.3	Daphnia	52.6	Daphnia
	GP	63.2	Cyclopoid	58.7	Daphnia	121.9	Cyclopoid
	RP	3.5	Cyclopoid	71.5	Bosmina	75.1	Bosmina
	BP	20.3	Cyclopoid	42.0	Daphnia	62.3	Daphnia
	OB	35.3	Cyclopoid	24.6	Daphnia	59.8	Cyclopoid
	RL	6.5	Calanoid	197.9	Daphnia	204.5	Daphnia
	CL	17.8	Cyclopoid	42.8	Daphnia	60.6	Daphnia
	HL	29.0	Cyclopoid	54.6	Daphnia	83.6	Daphnia
	SR2	0.4	Nauplii	1.9	Bosmina	2.3	Bosmina
	SR1	0.1	Cyclopoid	0.2	Bosmina	0.3	Bosmina
	SR3	0.2	Calanoid	4.0	Bosmina	4.1	Bosmina
8/10-13/82	CD	27.7	Calanoid	9.8	Daphnia	37.5	Calanoid
	CR2	0.7	Cyclopoid	0.7	Bosmina	1.3	Bosmina
	CR1	3.1	Cyclopoid	1.9	Bosmina	5.0	Cyclopoid
	GP	18.9	Cyclopoid	11.6	Daphnia	30.5	Cyclopoid
	BB	101.4	Cyclopoid	19.5	Daphnia	121.0	Cyclopoid
	RP	0.3	Cyclopoid	6.8	Bosmina	7.2	Bosmina
	BP	64.1	Cyclopoid	11.5	Daphnia	75.6	Cyclopoid
	OB	88.2	Cyclopoid	23.4	Daphnia	111.6	Cyclopoid
	RL	1.3	Calanoid	230.3	Daphnia	231.6	Daphnia
	CL	14.4	Cyclopoid	47.2	Daphnia	61.7	Daphnia
	SR2	0.1	Cyclopoid	0.1	Daphnia	0.2	Cyclopoid
	SR3	0.3	Cyclopoid	0.2	Bosmina	0.5	Cyclopoid
	SR1	0.2	Cyclopoid	3.8	Bosmina	4.0	Bosmina

Appendix V. (Continued).

Date	Site	Cope	Dominant	Clad	Dominant	Total	Dominant
8/24-26/82	CD	20.6	Calanoid	10.0	Bosmina	30.6	Calanoid
	CR2	1.0	Cyclopoid	2.4	Bosmina	3.4	Bosmina
	CR1	2.6	Cyclopoid	5.7	Bosmina	8.3	Bosmina
	GP	39.9	Cyclopoid	12.1	Daphnia	52.0	Cyclopoid
	BB	40.8	Cyclopoid	17.8	Daphnia	58.6	Cyclopoid
	OB	30.0	Calanoid	11.4	Daphnia	41.4	Calanoid
	BP	72.2	Cyclopoid	20.7	Ceriodaphnia	92.9	Cyclopoid
	RP	4.7	Calanoid	179.6	Daphnia	184.4	Daphnia
	HL	11.8	Calanoid	67.0	Daphnia	78.8	Daphnia
	CL	27.0	Cyclopoid	46.2	Daphnia	73.2	Daphnia
	RL	3.7	Calanoid	203.1	Bosmina	206.8	Bosmina
	SR1	0.5	Calanoid	22.9	Bosmina	23.4	Bosmina
	SR2	0.5	Calanoid	11.0	Bosmina	11.5	Bosmina
	SR3	0.1	Calanoid	0.5	Daphnia	0.6	Daphnia
10/5-7/82	CD	47.2	Cyclopoid	20.8	Daphnia	67.9	Cyclopoid
	CR1	2.3	Nauplii	0.5	Daphnia	2.7	Nauplii
	CR2	2.7	Calanoid	1.2	Bosmina	3.9	Calanoid
	GP	12.1	Cyclopoid	4.8	Daphnia	16.9	Cyclopoid
	BB	61.0	Cyclopoid	11.7	Daphnia	72.7	Cyclopoid
	OB	71.5	Cyclopoid	27.1	Daphnia	98.6	Cyclopoid
	BP	54.9	Cyclopoid	26.2	Daphnia	81.2	Cyclopoid
	RP	0.8	Cyclopoid	0.5	Bosmina	1.3	Cyclopoid
	CL	46.3	Cyclopoid	50.7	Daphnia	97.0	Daphnia
	HL	56.9	Cyclopoid	73.7	Daphnia	130.6	Daphnia
	SR2	0.8	Cyclopoid	0.3	Daphnia	1.2	Cyclopoid
	SR3	0.6	Cyclopoid	0.2	Daphnia	0.8	Cyclopoid
	SR1	0.2	Cyclopoid	0.2	Bosmina	0.5	Bosmina

Appendix W . Benthos abundance and biomass per square meter in the Coeur d' Alene Lake system, 1981-1982 (OLIGO = No. of oligochaetes, CHIRO = No. of chironomids, TOTAL = Total no. of macroinvertebrates, BIOMASS = biomass of all macroinvertebrates in mg).

Date	Site	OLIGO/m^2	CHIRO/m^2	TOTAL/m^2	BIOMASS/m^2
7/19-24/81	CD1	140	0	140	28
	CD3	842	0	842	168
	GP1	140	0	140	280
	GP2	280	280	701	266
	HL1	5332	1262	6595	1515
	HL2	1683	701	2385	308
	HL3	0	0	0	0
	OB1	420	280	701	126
	SR2	6454	0	6454	912
8/3-7/81	BB1	112	168	280	207
	BB2	842	168	1066	376
	BP1	0	187	374	168
	BP2	280	0	280	84
	CD1	112	168	280	39
	CD3	280	168	449	22
	CL1	898	112	1010	718
	CL2	5725	561	7072	1066
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	56	0	56	11
	GP2	0	0	0	0
	HL1	785	1010	1796	2043
	HL2	561	0	561	112
	HL3	1683	224	1908	493
	OB1	0	0	0	0
	SR1	0	0	0	0
	SR3	0	0	0	0
8/17-20/81	BB1	168	224	392	370
	BB2	505	56	561	140
	BP1	0	0	0	0
	BP2	0	374	374	37
	CD1	112	224	336	28
	CD3	0	112	112	22
	CL1	1122	112	1347	123
	CL2	224	112	785	202
	CR1	168	0	224	39
	CR2	0	0	0	0
	GP1	0	56	56	28
	GP2	280	112	392	179
	HL1	112	336	449	235
	HL2	336	224	561	224
	HL3	280	0	280	252
	OB1	112	0	112	44
	OB2	0	0	0	0
	SR1	1122	0	1403	505
	SR2	842	0	842	645
	SR3	673	0	898	134

Appendix W . (Continued).

Date	Site	OLIGO/m^2	CHIRO/m^2	TOTAL/m^2	BIOMASS/m^2
9/30-10/3/81	BB1	280	449	729	578
	BB2	449	336	785	679
	BP1	187	0	187	37
	BP2	0	0	0	0
	CD1	0	0	0	0
	CD3	112	336	449	134
	CL1	1010	0	1010	123
	CL2	6398	2020	10664	1639
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	336	112	449	123
	GP2	0	392	392	207
	HL1	1010	336	1347	583
	HL2	673	112	785	123
	HL3	0	0	0	0
	OB1	187	0	187	56
	OB2	280	0	280	56
	SR1	841	280	2245	729
	SR2	748	0	935	636
	SR3	0	0	0	0
4/19-23/82	BB1	56	729	841	533
	BB2	112	336	449	376
	BP1	0	0	0	0
	BP2	0	0	0	0
	CD1	0	0	0	0
	CD3	112	0	112	22
	CL1	0	168	168	22
	CL2	1234	505	1740	370
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	56	56	0
	GP2	0	112	112	22
	HL1	112	561	673	246
	HL2	280	841	1122	56
	HL3	0	112	112	213
	OB1	224	56	280	196
	OB2	0	112	112	56
	SR1	561	0	561	830
	SR2	1122	0	1122	2233
	SR3	0	0	0	0
5/17-21/82	BB1	842	112	954	443
	BB2	112	112	224	11
	BP1	374	0	374	224
	BP2	187	0	187	94
	CD1	0	0	0	0
	CD3	0	280	280	16
	CL1	224	56	336	112
	CR1	0	0	0	0

Appendix W . (Continued)

Date	Site	OLIGO/m^2	CHIRO/m^2	TOTAL/m^2	BIOMASS/m^2
5/17-21/82	CR2	0	0	0	0
	GP1	0	280	280	33
	GP2	56	449	505	140
	HL1	673	112	785	291
	HL2	0	112	112	11
	HL3	112	112	336	179
	OB1	449	112	561	370
	OB2	0	112	112	11
	SR1	449	0	561	112
	SR2	1122	0	1122	589
	SR3	898	0	898	718
5/31-6/2/81	BB1	449	505	954	409
	BB2	56	112	168	101
	BP1	187	0	187	18
	BP2	0	0	0	0
	CD1	0	0	0	0
	CD3	0	56	56	5
	CL1	280	168	449	0
	CL2	1234	449	1796	752
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	56	56	5
	GP2	0	0	0	0
	HL1	336	112	449	280
	HL2	0	0	0	0
	HL3	0	0	0	0
	OB1	56	56	112	39
	OB2	0	561	561	243
	SR1	898	0	1010	774
	SR2	561	112	673	617
	SR3	224	224	449	426
6/16-18/82	BB1	168	449	617	443
	BB2	168	112	336	134
	BP1	0	561	561	196
	BP2	0	280	280	140
	CD1	0	0	0	0
	CD3	0	0	0	0
	CL1	336	0	336	101
	CL2	224	224	449	145
	CR1	0	0	0	0
	GP1	0	0	0	0
	GP2	112	0	112	33
	HL1	112	336	449	325
	HL2	785	0	785	179
	HL3	561	280	841	477
	OB1	0	224	224	44
	OB2	0	280	280	56
	SR1	224	112	336	179
	SR2	0	0	0	0
	SR3	0	0	0	0

Appendix W. (Continued).

Date	Site	OLIGO/m^2	CHIRO/m^2	TOTAL/m^2	BIOMASS/m^2
6/30-7/2/82	BB1	112	280	392	258
	BB2	112	112	392	56
	BP1	374	0	748	748
	BP2	280	0	280	112
	CD1	0	224	224	44
	CD3	280	112	392	202
	CL1	392	56	449	0
	CL2	112	561	673	0
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	56	56	5
	GP2	0	112	112	11
	HL1	785	1010	1908	628
	HL2	280	0	280	196
	HL3	1964	280	2245	1599
	OB1	785	112	898	1234
	OB2	0	0	0	0
	SR1	224	0	224	246
	SR2	935	0	935	505
	SR3	0	280	280	449
7/12-14/82	BB1	224	224	449	331
	BB2	112	224	336	336
	BP1	561	374	935	542
	BP2	0	0	0	0
	CD1	0	0	0	0
	CD3	0	0	0	0
	CL1	224	112	336	134
	CL2	224	224	449	101
	CR1	280	0	280	112
	GP1	0	0	0	0
	GP2	56	56	112	50
	HL1	336	112	449	179
	HL2	0	0	0	0
	HL3	0	0	0	0
	OB1	0	0	0	0
	OB2	0	0	0	0
	SR1	336	0	336	56
	SR2	280	280	561	56
	SR3	280	0	280	84
7/28-29/82	BB1	449	224	673	325
	BB2	112	112	224	325
	BP1	224	0	224	11
	BP2	0	0	0	0
	CD1	431	0	43	43
	CD3	0	0	56	5
	CL1	224	280	505	426
	CL2	0	224	336	303

Appendix W. (Continued)

Date	Site	OLIGO/m^2	CHIRO/m^2	TOTAL/m^2	BIOMASS/m^2
7/28-29/82	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	0	0	0
	GP2	112	112	224	44
	HL1	561	449	1122	718
	HL2	112	0	112	11
	OB1	561	0	561	28
	OB2	0	224	336	269
	SR1	336	112	449	314
	SR2	0	112	112	11
	SR3	841	280	1122	1234
8/10-13/82	BB1	112	505	617	0
	BB2	56	0	56	28
	BP1	224	0	224	168
	BP2	112	0	112	157
	CD1	0	0	0	0
	CD3	0	0	0	0
	CL1	336	0	336	336
	CL2	168	0	168	61
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	0	0	0
	GP2	0	56	56	39
	HL1	224	224	449	101
	HL2	561	0	561	0
	HL3	0	0	0	0
	OB2	0	0	0	0
	SR1	561	0	561	785
	SR2	224	224	449	0
	SR3	0	0	0	0
8/24-26/82	BB1	112	224	336	247
	BB2	56	112	168	5
	BP1	224	336	673	336
	BP2	449	336	785	325
	CD1	0	0	0	0
	CD3	56	0	56	5
	CL1	168	56	224	207
	CL2	561	561	1122	280
	CR1	0	0	0	0
	CR2	0	0	0	0
	GP1	0	0	0	0
	GP2	0	0	0	0
	HL1	112	0	224	202
	HL2	0	0	0	0
	HL3	112	112	224	112
	OB1	112	0	224	89
	OB2	280	0	561	28
	SR1	561	0	561	196
	SR2	0	0	0	0
	SR3	0	0	0	0