Publication No. 91-e05AppE-F-G

Diagnostic Study of Lake Sawyer
March 1991

APPENDIX E

Lake Sawyer
Aquatic Macrophytes

This page is purposely left blank for duplex printing.

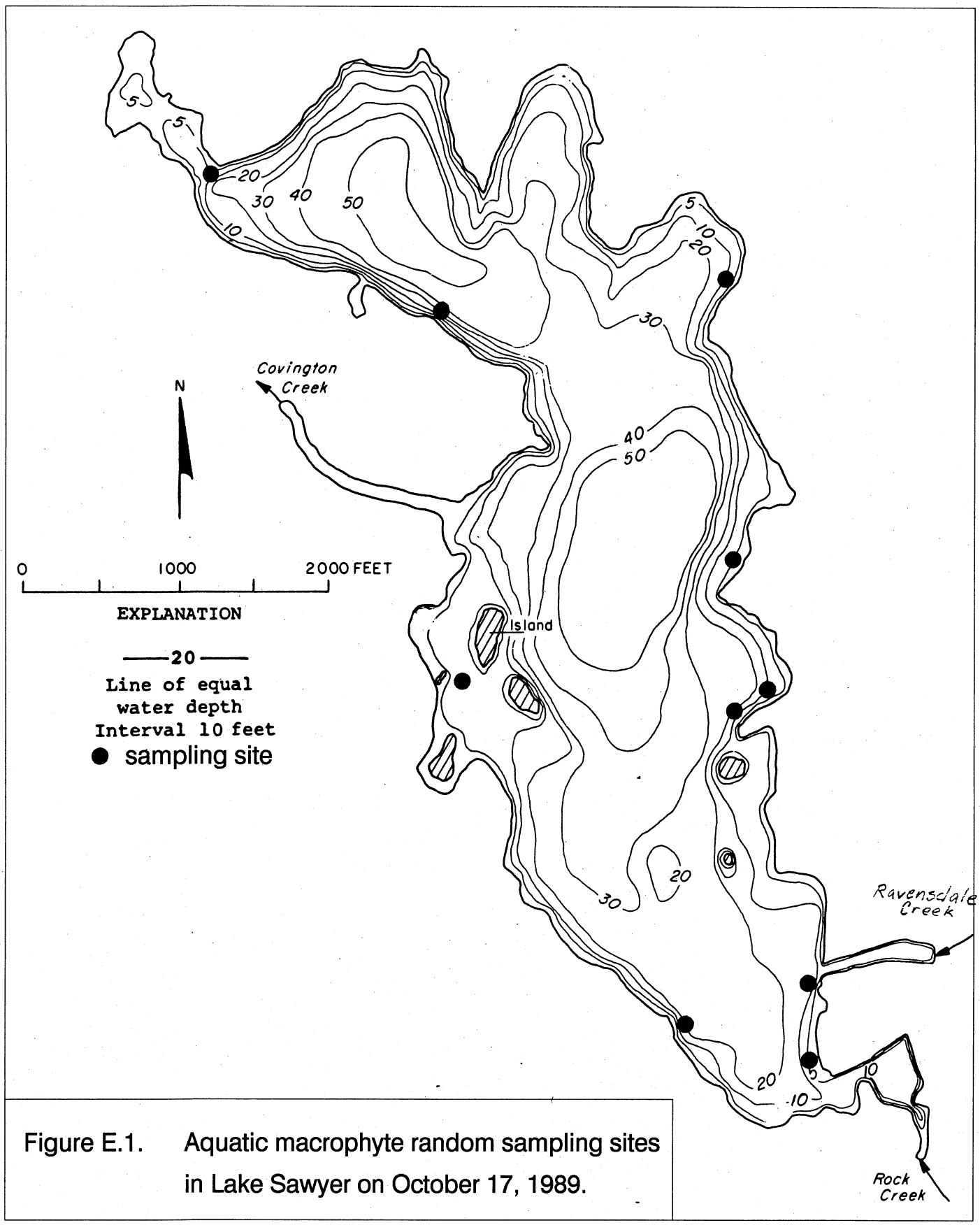


Figure E.1. Aquatic macrophyte random sampling sites in Lake Sawyer on October 17, 1989.

Sawyer Lake - Macrophyte biomass: wet and dry wt
Collection date: 17 Oct 89
Analysis date: 19 Oct 89

		grams wet wt	grams dry wt
STN 7	Nymphaea	190.7	20.45
STN 8	Nymphaea	71.7	8.9
STN 5	Eleocharis	35.9	2.9
STN 7	Elodea canadensis	0.1	0.28
STN 2	Potamogeton	0.85	0.05
STN 10	Potamogeton	7.25	0.70
STN 1	Chara	2.6	0.35
STN 8	Nitella	8.5	0.55
STN 10	Myriophyllum	50.9	2.8
STN 3	Potamogeton	27.4	2.3
STN 1	Potamogeton	25.3	2.5
STN 4	Spirogyra/Rhizoclonium	220.8	33.5
STN 4	Potamogeton	31.1	3.15

		grams wet wt	grams dry wt
STN 3	Elodea canadensis	2.25	0.20
STN 4	Megalodonta	2.05	0.15
STN 7	Myriophyllum	2.05	0.20
STN 5	Myriophyllum	0.85	0.10
STN 8	Myriophyllum	0.40	0.05
STN 2	Elodea canadensis	1.0	0.15
STN 3	Myriophyllum	0.40	0.05
STN 8	Potamogeton	0.35	0.05
STN 1	Myriophyllum	0.1	0.05
STN 4	Elodea canadensis	0.4	0.05
STN 7	Elodea canadensis	0.25	0.05
STN 2	Myriophyllum	224.5	21.15

Wet wts obtained by rinsing with distilled water and spinning in a lettuce rinser

Sawyer Lake - Macrophytes: ashed weight
Collection date: 17 Oct 89
Analysis date: 21 Dec 89

	sample dry wt (g)	ashed wt (g)
Potamogeton	0.49998	0.42898
Spirogyra/Rhizoclonium	0.50002	0.38724
Nitella	0.41442	0.36142
Elodea canadensis	0.21695	0.18788
Megalodonta	0.07424	0.06579
Eleocharis	0~~.21695~~ .25942	0.21893
Myriophyllum	0~~.29950~~ .29950	0.26754
Chara	0.19409	0.15236
Nymphaea	0.29648	0.27092

Total Phosphorus - Sawyer lake macrophytes
Collection date : 17 Oct 89
Analysis date : 9 Dec 89

	mgP/g dry wt
Elodea canadensis	1.482
Chara	3.383
Megalodonta	1.803
Nitella	1.426
Eleocharis	1.728
Nymphaea	0.865
Nymphaea	1.180
Nymphaea	0.872
NBS citrus leaves	1.098 (.11 wt %)
NBS citrus leaves	1.230 (.12 wt %)
NBS Cit lvs true value	0.13 ±0.02 wt %

	mgP/g dry wt
Potamogeton	2.58
Potamogeton	2.47
Potamogeton + 50 µg/l spike	3.58 (81% rec)
Potamogeton	2.34
Potamogeton	2.66
Myriophyllum	1.77
Myriophyllum	1.93
Myriophyllum + 50 µg/l spike	3.33 (117% rec)
Myriophyllum	1.77
Myriophyllum	1.95
Rhizoclonium	1.64
Rhizoclonium	1.41
Rhizoclonium	1.54
Rhizoclonium	1.47
NBS citrus leaves	1.41 (0.14 wt %)
NBS citrus leaves	1.26 (0.13 wt %)

Total Nitrogen - Sawyer lake macrophytes
Collection date: 17 Oct 89
Analysis date: 5 Dec 89

	mgN/g dry wt
Potamogeton	5.49
Potamogeton	8.48
Potamogeton	6.99
Potamogeton + .33mg/l spike	10.82 (80% rec)
Myriophyllum	3.93
Myriophyllum	4.35
Myriophyllum	3.34
Myriophyllum + .33mg/l spike	7.64 (80% rec)
Rhizoclonium	10.49
Rhizoclonium	10.65
Nymphaea	8.75
Nymphaea	7.74
Elodea canadensis	6.18
Chara	10.16
Megalodonta	5.71
Nitella	5.97
Eleocharis	7.96
NBS citrus leaves	12.88 (1.29 wt %)
NBS citrus leaves	12.97 (1.30 wt %)
NBS cit lvs non-certified value	2.86 wt %

METRO Aquatic Macrophyte Surveys

A Baseline Survey of Aquatic Plants in Selected Lakes of King County

by

J. M. Goodpasture
R. N. Brenner
B. K. Uchida
R. G. Swartz

Municipality of Metropolitan Seattle

1976

Lake Sawyer
(Surveyed August, 1976)

plant Species:

Brasenia schreberi

Ceratophyllum demersum

Chara sp. (2 species)

Elodea canadensis

Myriophyllum spicatum var. exalbescenes

Najas flexilis

Nitella sp. (1 specie)

Nuphar variegatum

Nymphaea odorata

Polygonun amphibium

Potamogeton berchtoldii

Potamogeton richardsonii

Potamogeton zosteriformis

Spirodela polyrhiza

Distribution and Abundance:

Myriophyllum spicatum forms a band around the lake of varying density (moderate to dense) and is also the most common aquatic plant in the lake. There are several areas around the lake margin where individual residents have poisoned the M. spicatum. In poisoned areas, Chara sp., and Potamogeton richardsonii were found. P. richardsonii and Potamogeton zosterformis were found mixed with moderate growths of M. spicatum. P. zosterformis and Potamogeton berchtoldii were generally found in mixed patches where M. spicatum was absent. Mixed beds of Elodea canadensis, Potamogeton and Chara sp. also were found where M. spicatum was not at greater densities. M. spicatum was also found alone.

M. Spicatum was not found where Numphaea odorata and Nuphar variegatum grow, in fact, no plants were found growing beneath the lily beds.

The lake shoreline bottom was generally silty with some isolated areas of rocks. In the rocky areas few to no plants were found, the plants being confined to silty bottom areas or rocky areas which had a coating of silt. The rocks in the rocky areas seemed to be in the size range of 2 to 10 inches in diameter.

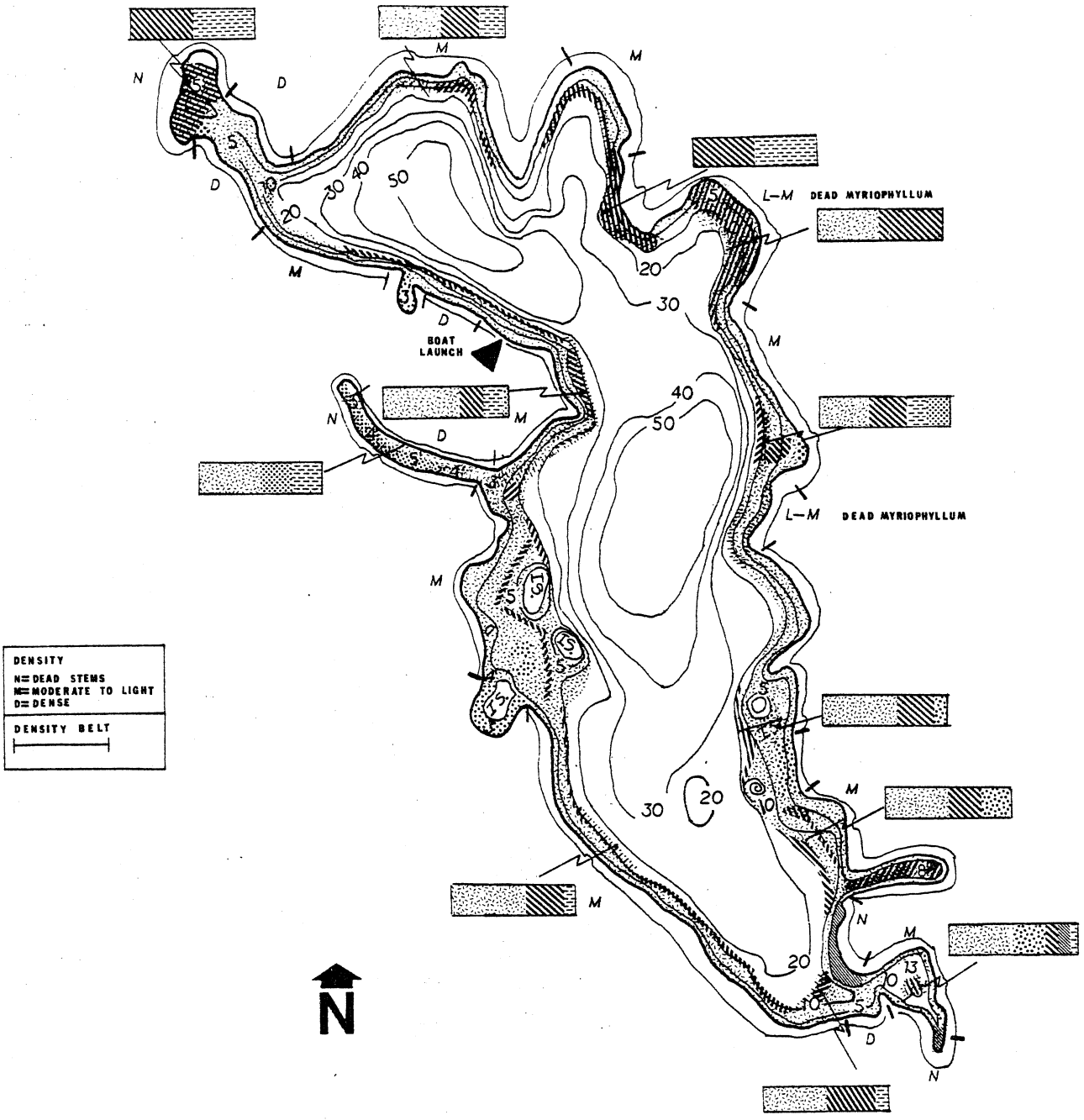
It appears that there has been a major increase in plant growth in the lake since the end of June. The local lake patrol stated that the plant growth has "increased dramatically in the last four weeks" (conversation of July 28). Whether or not the plants were growing before the end of June cannot be determined, however, a visible increase in plant biomass appears to have taken place during the first four weeks of July.

Since 1973, there seems to have been an increase in shoreline covered by aquatic plants based on observations from previous monitoring. About 80 to 90 percent of the shoreline bottom was covered by M. spicatum, with 1-5 percent covered by Potamogeton sp. at the time of the present survey.

Comments

Lake Sawyer was treated with a herbicide in 1972. The extent of the treatment was not divulged.

LAKE SAWYER


DENSITY
N= DEAD STEMS
M= MODERATE TO LIGHT
D= DENSE
DENSITY BELT
BOAT LAUNCH
L–M DEAD MYRIOPHYLLUM
L–M DEAD MYRIOPHYLLUM
N
0 1000 2000
CONTOUR INTERVAL 5FT.
0% 100%
SPIRODELA
NYMPHAE, NUPHAR
NYMPHAEA
MYRIOPHYLLUM
POTAMOGETON
CHARA; NITELLA
ELODEA
NAJAS
BRASENIA

A Study of the Composition, Growth and Distribution of Aquatic Macrophytes in Fourteen Lakes and Bays of King County

by

J. M. Goodpasture

J. I. Davis

R. I. Matsuda

Municipality of Metropolitan Seattle

1977

Lake Sawyer

(Surveyed August 15, 16, 1977)

Plant Species:

Brasenia schreberi

Ceratophyllum domersum

Chara sp.

Elodea canadensis

Myriophyllum spicatum

Najas flexilis

Nitella sp.

Nuphar variegatum

Nymphaea odorata

Potamogeton berchtoldii

Potamogeton richardsonii

Potamogeton zosteriformis

Spirodela polyrhiza

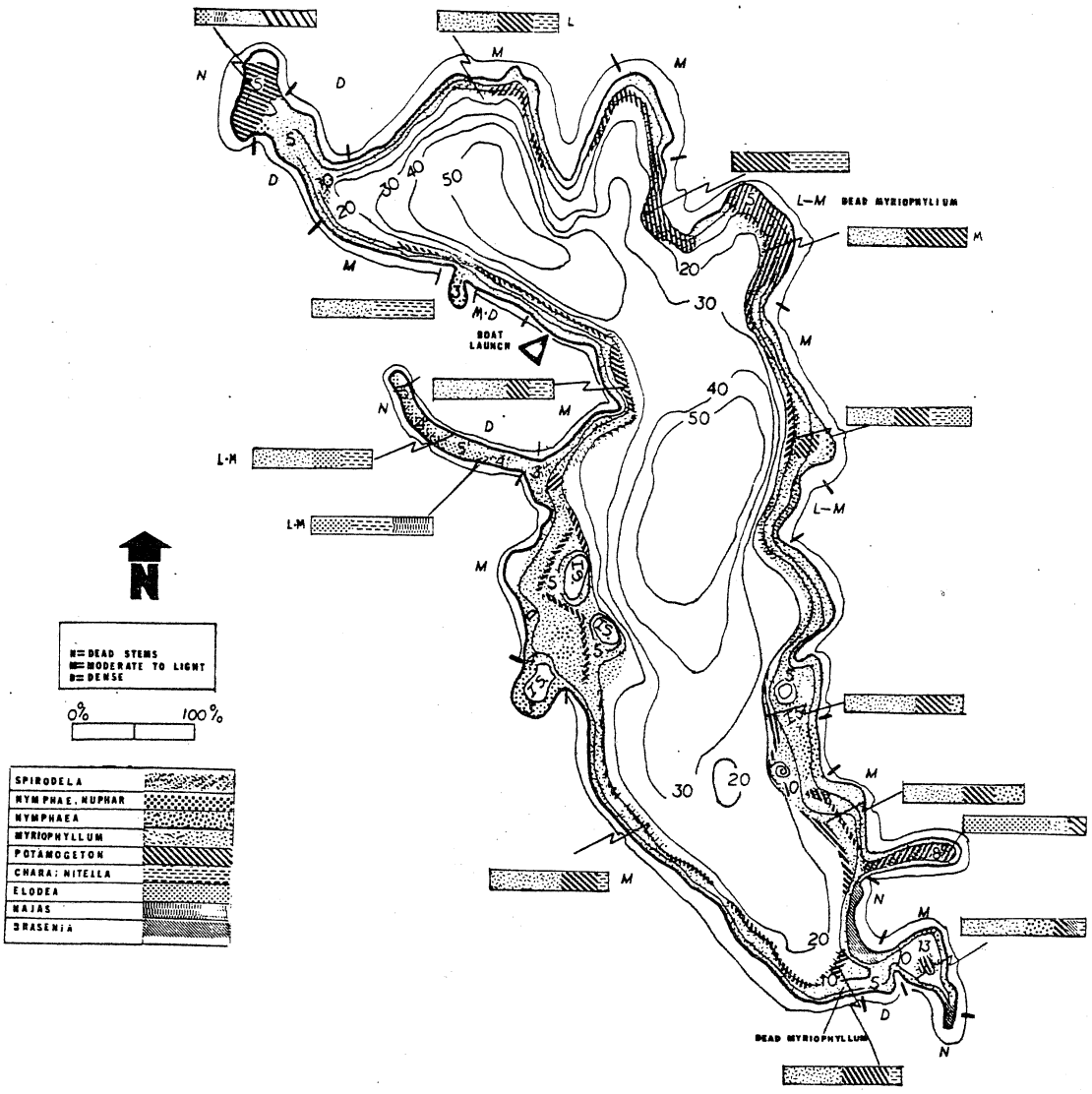
The dominant plant in the lake was M. spicatum. Potamogeton sp. was dominant in areas not occupied by M. spicatum.

Plant distribution and species dominance had not changed since 1976. M. spicatum was found growing to about 1 ft. below the surface. Numerous areas with dead plants and areas without plants were seen. Some of these areas had been treated with herbicides in the previous year. According to one resident, Aquathol was used unsuccessfully by a number of residents.

Another resident reported having used Aquacide in previous years. In areas that had been treated in the previous years there appeared to be an increase in the density of P. richardsonii, along with growths of M. spicatum. Mixed growths of P. richardsonii and M. spicatum were not observed in these areas last year. It appears that Potamogeton sp. was the first species to recolonize a treated area and M. spicatum the second species. It is not known whether the Potamogeton population was killed by the herbicide in the first place. If it was not, then it simply expanded into the area formerly occupied by the major competitor for space (in this case M. spicatum). It thus changed in dominance from secondary species to primary.

Lakeshore residents informed us of, dredging operations 5 years or so before in both the north end and south end (for a housing development) of the lake. Before then the lake bottom had been predominantly rocky but it subsequently turned silty. They first noticed aquatic weeds nearshore about a year after the dredging, but since then "the plants have gotten worse every year."

LAKE SAWYER


N
D=DEAD STEMS
M=MODERATE TO LIGHT
D=DENSE
0%
100%
SPIRODELA
NYMPHAE, NUPHAR
NYMPHAEA
MYRIOPHYLLUM
POTAMOGETON
CHARA; NITELLA
ELODEA
MAJAS
BRASENIA
BOAT LAUNCH
L-M DEAD MYRIOPHYLLUM
DEAD MYRIOPHYLLUM
0
900

Distribution and Community Composition of Aquatic Macrophytes in Selected Waters of King County

by

J. M. Goodpasture

J. I. Davis

R. I. Matsuda

Municipality of Metropolitan Seattle
Water Quality Division
1978

Lake Sawyer
(Surveyed August 7, 1978)

Plant Species:

Brasenia schreberi

Chara sp.

Elodea canadensis

Myriophyllum spicatum

Najas flexilis

Nitella sp.

Nuphar variegatum

Nymphaea odorata

Potamogeton berchtoldii

Potamogeton graminae

Potamogeton richardsonii

Potamogeton zosteriformis

Spirodela polyrhiza

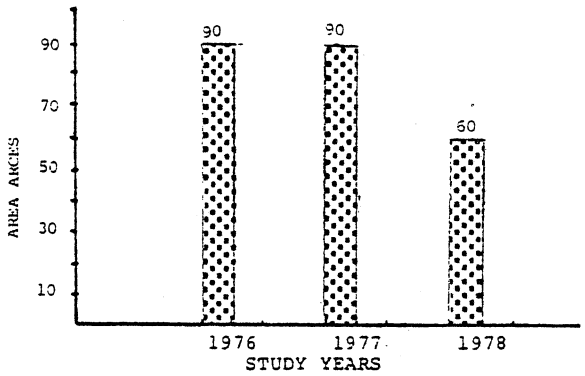


Fig. 34. Histograms of the areal coverage of M. spicatum in Lake Sawyer as indicated by surveys in 1976, 1977, and 1978.

The overall distribution of plants had remained basically unchanged since 1976, but near the east and west sides of the islands the population of Myriophyllum spicatum had markedly decreased.

Concern by residents interviewed about plants (Myriophyllum spicatum in particular) appeared to be high. Several methods of plant control appeared to be used by lake residents. One resident reported using a crosscut saw with a rope attached to each end. The device was dragged through the water, and the severed plants were collected and removed. This device worked well until it was lost. A second device was being used by some residents on the east side of this lake: a 20-ft., 1-1/4-inch pipe with two scythes welded to one end, extending at right angles to the pipe and on opposite sides. The scythe end was placed in the lake from a boat then pulled to shore. It was reported to be heavy enough to sink into sediments and cut the plants off. The plants were then collected and removed. Some residents were simply pulling the plants or diving after them.

Herbicides were also being used. The area from the outlet channel to the point north of the channel had been treated a number of times. It was reported and confirmed that Aquathol was used by a resident in that area in 1977. Kuron liquid had also been used by some residents. They reported that Myriophyllum spicatum was killed but not Potamogeton richardsonii. Therefore, the presence of P. richardsonii in treated areas may be due to herbicide specificity rather than more rapid recolonization.

A resident who had lived on the lake for ten years reported that Myriophyllum spicatum was present when they moved in but was not as dense then. Another resident stated, "The old timers will tell you that these plants (Myriophyllum spicatum and Potamogeton) have always been present." Another resident stated that the plants had appeared in their area about 4-5 years before, but she believed they had few plants because of the steepness of their shoreline. She also stated that there had always been plants in the dredged area at the north end - "it was a marsh." She stated that the north end was dredged about 1960-1961. In 1977, a resident said dredging had been done about 1970-1972.

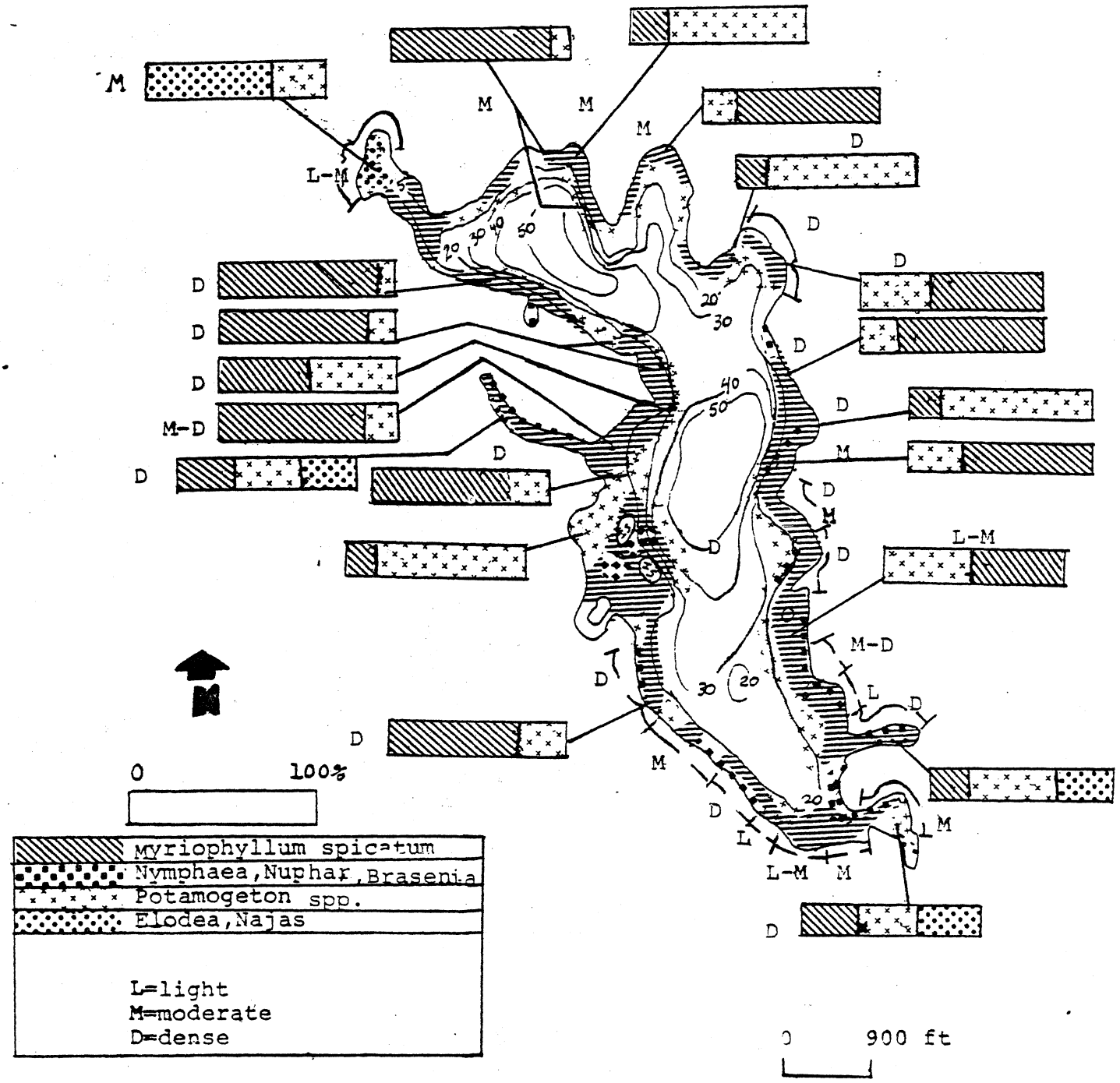


Fig. 35. Contour map showing distribution and densities of macrophytes in Lake Sawyer from the 1978 survey.

AQUATIC PLANTS IN SELECTED WATERS OF KING COUNTY

Distribution and Community Composition of Macrophytes

by

J. M. Goodpasture

J. I. Davis

R. I. Matsuda

Municipality of Metropolitan Seattle

Water Quality Division

1979

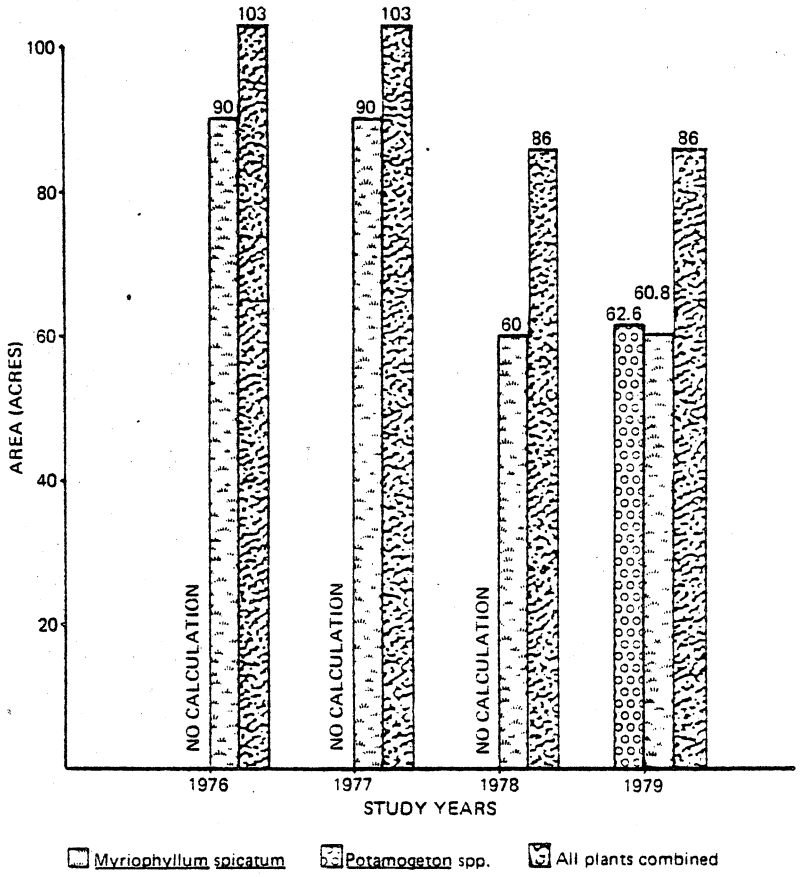
LAKE SAWYER

Survey date:
August 22, 1979

SPECIES LIST

Brasenia schreberi
(water shield)
Chara sp.
(musk grass)
Ceratophyllum demersum
(coontail)
Elodea canadensis
(water weed)
Myriophyllum spicatum
(Eurasian water milfoil)
Najas flexilis
(water nymph)
Nitella sp.
(stonewort)
Nuphar variegatum
(yellow waterlily)
Nymphaea odorata
(fragrant white waterlily)
Potamogeton berchtoldii
(Berchtold's pondweed)
Potamogeton richardsonii
(Richardson's pondweed)
Potamogeton zosteriformis
(flat-stemmed pondweed)
Spirodela polyrhiza
(duckweed)

DENSITY: Moderate to dense.
Unchanged.



TOTAL LAKE AREA 300 ACRES
MAXIMUM POTENTIAL MACROPHYTE COVERAGE 155 ACRES

Fig. 31. Histogram of areal coverages of macrophytes in Lake Sawyer, 1976-1979.

Plant populations in the lake were about the same as in 1978. Potamogeton richardsonii and Myriophyllum spicatum dominated the lake flora. The extent of growth of P. richardsonii appeared to have increased over previous years. It was now found along almost the entire perimeter of the lake. P. berchtoldii was found only in the embayment on the west side and in the outflow channel. P. zosteriformis was found predominantly in the inlet channel area and the channel just south of the inlet.

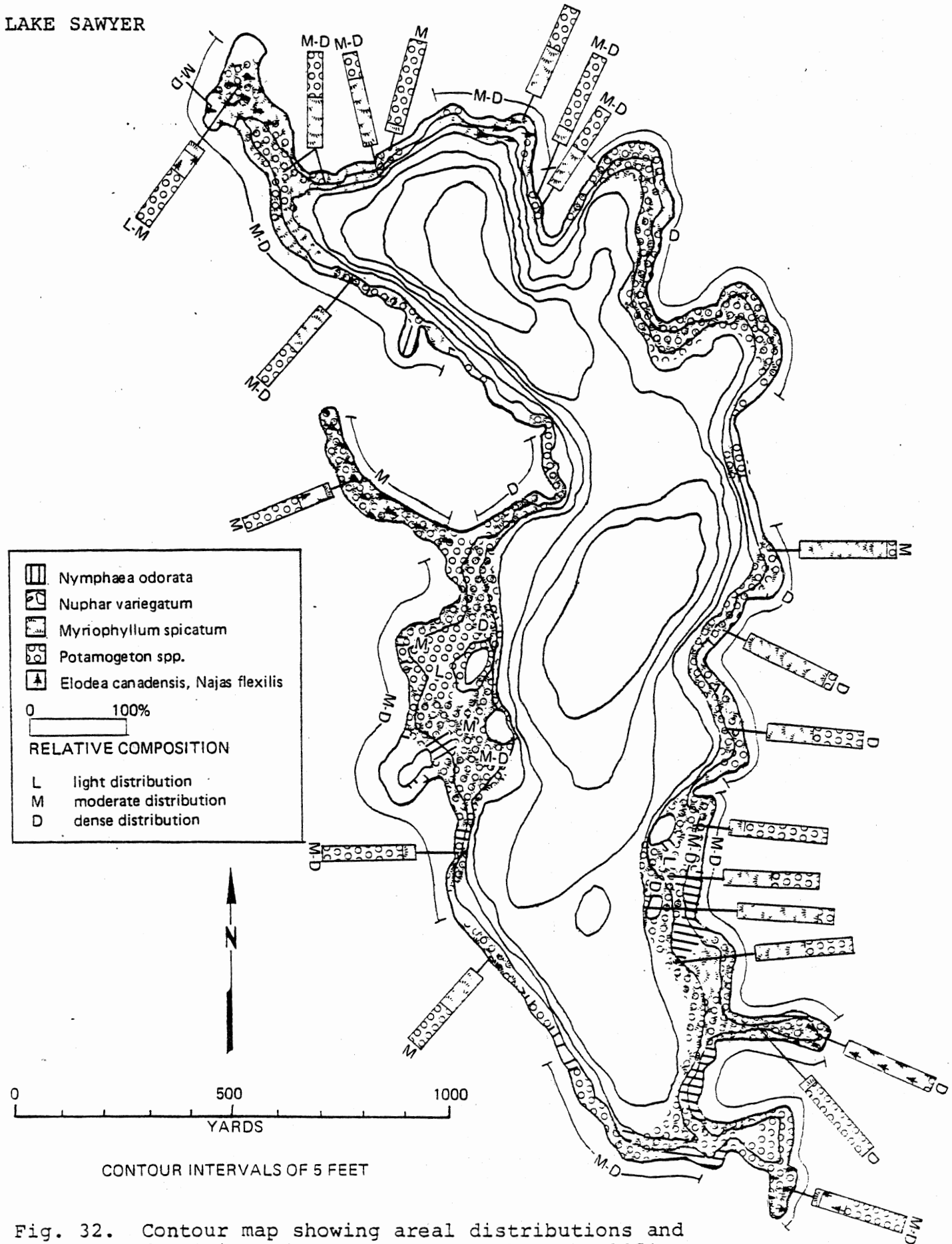


Fig. 32. Contour map showing areal distributions and densities of macrophytes as shown by 1979 survey.

AQUATIC PLANTS IN SELECTED WATERS OF KING COUNTY

Distribution and Community Composition of Macrophytes

by

Harry L. Boston

J. I. Davis

R. I. Matsuda

Municipality of Metropolitan Seattle

Water Quality Division

1980

LAKE SAWYER

Survey date:
AUGUST 25, 1980

SPECIES LIST

Brasenia schreberi
(water shield)
Ceratophyllum demersum
(coontail)
Chara sp.
(musk grass)
Elodea canadensis
(water weed)
Myriophyllum spicatum
(Eurasian water milfoil)
Najas flexilis
(water nymph)
Nitella sp.
(stonewort)
Nuphar variegatum
(yellow waterlily)
Nymphaea odorata
(fragrant white waterlily)
Potamogeton berchtoldii
(Berchtold's pondweed)
Potamogeton praelongus
(whitestemmed pondweed)
Potamogeton richardsonii
(Richardson's pondweed)
Potamogeton zosteriformis
(flat-stemmed pondweed)
Spirodela polyrhiza
(duckweed)

DENSITY: Dense.
Increased.

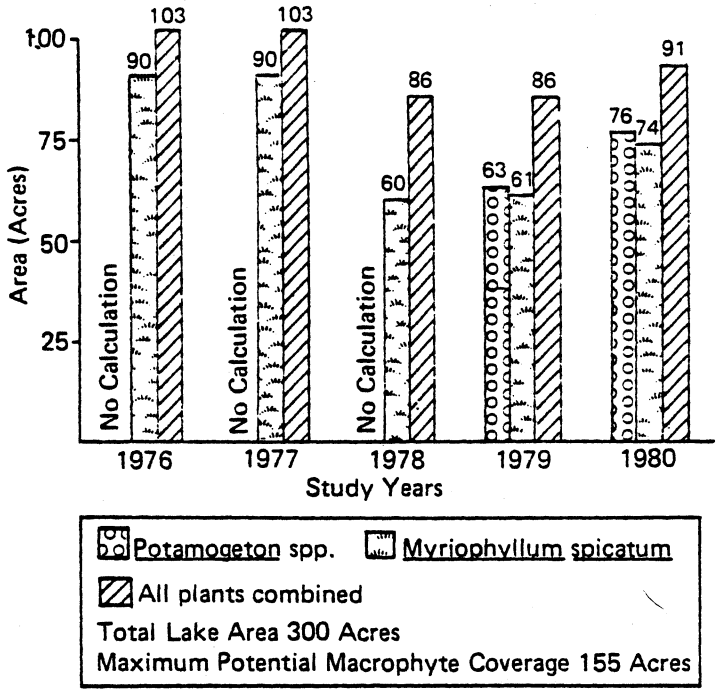


Fig. 27. Histogram of areal coverages of macrophytes, 1976-1980.

The total macrophyte coverage was similar to, or slightly greater than, that found the two previous years. Potamogeton richardsonii and Myriophyllum continued to dominate the macrophyte community. Both species had increased in areal coverage relative to 1979 levels. Based upon the map in Goodpasture, et al. (1979), it appeared as though the lilies had also increased in acreage. Other subdominant species seemed to have remained at 1979 levels.

During the survey, it was noted that Potamogeton praelongus occured in mixed populations with P. richardsonii, and often accounted for a fair portion of the population. While P. praelongus had not been identified in previous surveys, there is a very great morphological similarity between the two species and it is likely that it was present but not identified.

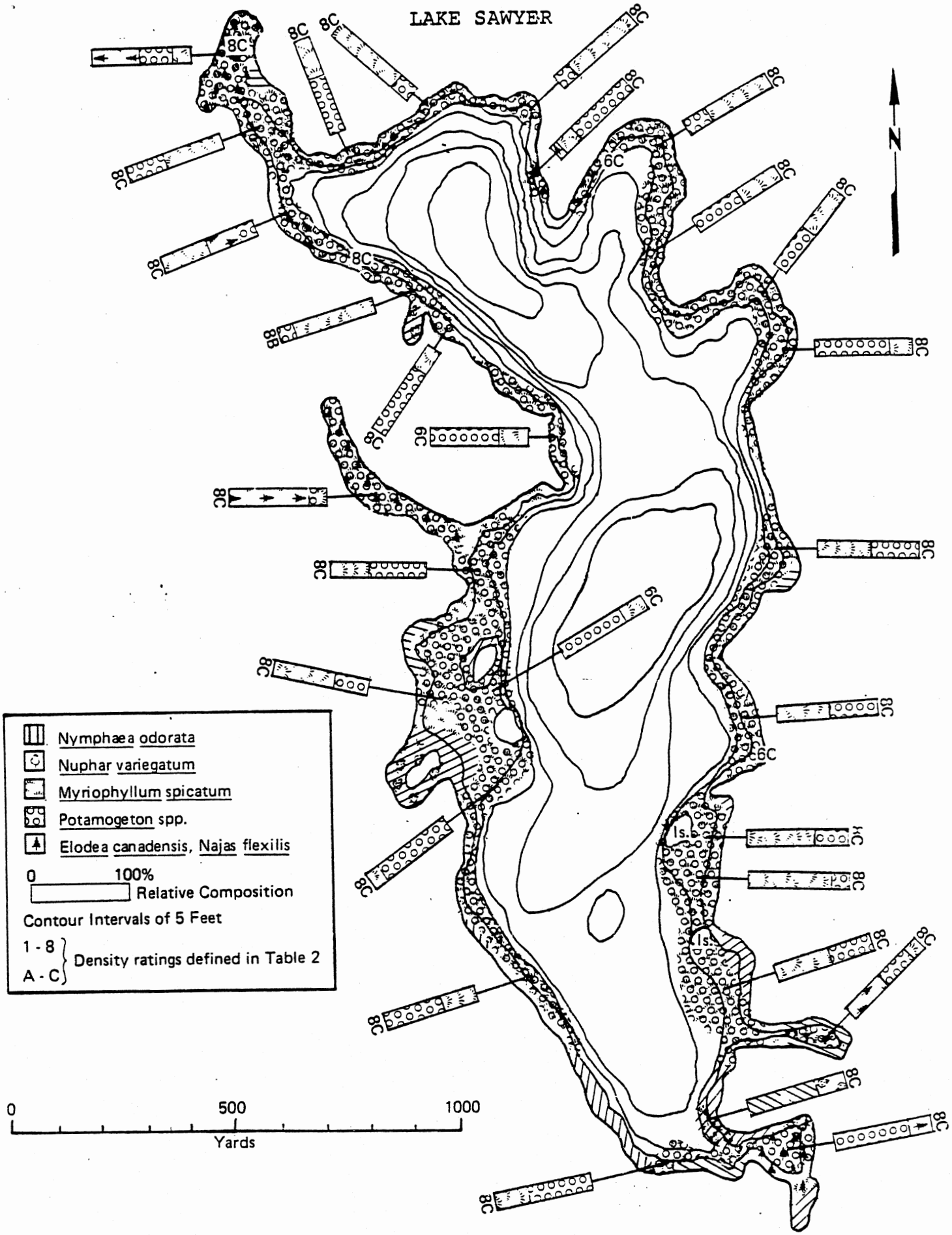


Fig. 28. Contour map showing areal distributions and densities of macrophytes as shown by 1980 survey.

APPENDIX F

Lake Sawyer
Fish

This page is purposely left blank for duplex printing.

WASHINGTON STATE DEPARTMENT OF ECOLOGY
ENVIRONMENTAL INVESTIGATIONS AND LABORATORY SERVICES

June 19, 1989

TO: Bob Newman

THROUGH: Greg Pelletier GP

FROM: Jory Oppenheimer JO

SUBJECT: Lake Sawyer Fishkill

A fishkill of approximately 1,000 fish, largely perch, was reported in Lake Sawyer during the weekend of May 13 and 14. The fishkill appeared to be localized and restricted to the southwestern end of the lake. In response to this fishkill, a team from the Surface Water Investigations Section (SWIS) of Ecology investigated the cause of the fishkill on the afternoon of May 15 and the morning of May 16. The cause of the fishkill was not identified. Based on the collected data, however, a number of potential causes or sources should be disregarded.

Levels of un-ionized ammonia originating from the Black Diamond wastewater treatment plant does not appear to have killed the fish. The criteria for un-ionized ammonia levels varies with temperature and pH, but it is recommended that un-ionized ammonia levels (un-ionized ammonia is only a portion of total ammonia) not exceed 20 ug/L. Total ammonia levels in eight surface samples, collected by Metro personnel in response to the fishkill in the southwest portion of the lake, ranged between levels below detection (1 ug/L) and 21 ug/L. Based on data collected two weeks earlier (which had similar pH and temperatures) and data collected on May 15 and 16, un-ionized ammonia formed about one to six percent of the total ammonia concentrations. Therefore, the highest un-ionized ammonia concentrations were at about 10 times lower than the suggested chronic (4-day) criterion, and 100 times lower than the acute (1-day) criterion. As a result, it seems unlikely that un-ionized ammonia levels reached either chronic or acutely toxic concentrations in Lake Sawyer.

Anoxic conditions, which can result in fishkills, did not occur in Lake Sawyer during May. This conclusion is based on oxygen profiles recorded on the Monday following the fishkill, and surface concentrations observed on Tuesday morning (when oxygen levels should be at their daily lowest). DO concentrations between the surface and five meters ranged between 11 and 12 mg/L on Monday afternoon. Concentrations below five meters ranged between 4 and 7 mg/l. Additionally, oxygen profiles taken at the five in-lake stations on May 2 and May 22 showed that the lake remained oxygenated throughout May. Therefore, the upper layer of the lake had sufficient DO concentrations for fish, as is typical in mesotrophic lakes. DO levels in Rock Creek at the lake shore (RCLS)

varied between 4 and 6 mg/l, but DO on the lake side of the culvert at RCLS, did not have levels below 10 mg/L. In addition, perch are tolerant of low DO concentrations.

Another possible cause of the fishkill that probably should be disregarded is metal contamination. Samples collected for copper and zinc in RCLS and in the lake showed levels for both metals below detection limits (2 ug/L), and well below aquatic life criteria for these metals.

Because the fishkill was localized in the shallow southwestern portion of the lake, a possible cause of the fishkill was an illegal discharge of an unpermitted chemical near the shoreline. However, there is no direct evidence to support this theory. The usual causes of fishkills in most lakes, low dissolved oxygen and/or high un-ionized ammonia, does not appear to explain the event observed in Lake Sawyer.

GP/JO:pb

cc: Dick Cunningham
Lynn Singleton
Myron Saikewicz
Joe Williams

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
4350-150th Ave. N.E. • Redmond, Washington 98052-5301 • (206) 867-7000

July 25, 1989

James and Theresa Dahlager
30067 232nd Place SE
Kent, WA. 98042

RE: Lake Sawyer Fish Kill

Dear Mr. and Mrs. Dahlager:

Thank you for your letter regarding the fish kill event in Lake Sawyer. This response is delayed because of the time consuming nature of investigating all possible causes of the fish kill and chemical analysis of the water.

The Lake Sawyer fish kill was originally reported to our spill response line by Mr. King, a lakeside resident on May 14, 1989. I was the person on duty that responded and have been following through with the investigation.

On Sunday, May 14 after arriving at thelake at Mr. Kings residence and looking at some of the fish, Mr. Grayson Connor arrived in his boat. We looked at the southern end of the lake for more fish and possible causes of the mortality. After this portion of the investigation, and allowing for fish which had been blown around the lake by wind the previous evenin, as reported by Mr. King, I estimated that 500 to 1000 fish had died. The fish were predominantly perch with a few crappie.

The vast majority of these fish had been dead for at least 2 or 3 days as indicated by their bloated and smelly condition. One fish was found that was in the process of dying. The symptoms exhibited by the fish at this time appeared to be from a low dissolved oxygen problem. Other reports from residents observing the fish dying were consistent with this problem. Many lakes, during periods of early algal growth followed by the later die-off of the algae, will show some periods in the early morning with low dissolved oxygen levels.

On Monday, May 15, I requested METRO and Ecology Surface Water Investigations unit to do some dissolved oxygen tests in the lake in the early morning to determine if there was indeed an oxygen problem. METRO also sampled for nitrates,

ortho phosphates, and ammonia, since ammonia at certain levels can cause fish mortalities. Ammonia could enter the lake from normally operating and failed septic systems.

METRO sampled for dissolved oxygen on the evening of May 15 and again on the morning of May 16 to determine the amount of change occurring. Ecology Surface Water Investigations sampled on the morning of May 16 and also included samples for copper and zinc since at certain pH levels and concentrations; these metals also can cause fish mortalities. The Ecology Surface Water Investigations unit has been performing an ongoing study of the lake.

Results of this sampling showed the dissolved oxygen levels adequate for the lake, being over 10 ppm for the samples. The temperature of the surface water was 68 degrees, which correlated with the temperatures indicated by Grayson Connor. The pH of the water was in the range of 8.3 to 8.7, which is slightly above normal for freshwater. This increase in pH indicates that an active algal bloom was occurring in the lake, even though on May 14 it did not appear to be heavy. All of the other parameters sampled did not indicate any gross inputs of material that could have contributed to the fish kill.

Based on this information, no definitive answer as to why the fish kill happened could be given. Other potential problems could have been illegal application of aquatic herbicides to the lake to control weeds, a midnight dumper discharging some unknown material to the lake or stream, or even an over application of fertilizer or lime to a lawn next to the lake with an accompanying watering, helping to wash the material into the lake.

Until June 22, I received no further reports of dead fish in Lake Sawyer. On this date I received a call from a resident who indicated that fish, mostly perch and some sunfish, were continuing to die a few at a time. It was reported that this had been occurring for approximately three weeks.

Since one other possible cause for the fish kill which had not been looked at was a natural occurring disease, state and federal fish pathologists were contacted to check on possible causes and arrange for fish to be examined. For a proper analysis the fish must be recently dead or in the process of dying. When I attempted to collect some fish the only ones found had been dead too long. While out on the lake I did contact a resident who had talked to a Department of Wildlife pathologist who had been at the lake on June 24 and examined fish in a moribund condition.

The pathologist determined that the fish had died from a natural disease caused by a bacteria called Chondrococcus columnaris with a possible secondary infection from another bacteria. An outbreak of this disease has already been reported in catfish at Green Lake in Seattle and Lake Osoyoos on the U.S./Canada border in May and June of this year.

I feel this is also the probable cause of the kill reported on May 14. At this time of year, perch and sunfish are in the shallows for warmth and spawning, or recovering from spawning. The effort expended for spawning produces a high amount of stress on the fish and they can be in a weakened condition. Small amounts of additional stresses such as higher than normal water temperatures, can allow a disease organism to take hold in the fish, proliferate, and eventually kill the fish.

The columnaris bacteria can be found both internally and externally on the fish. One of the places that has the most immediate effect on the fish is when it proliferates in the gills of the fish. Even though not visible to the naked eye, the bacteria can cause the fish to die from lack of oxygen as it clogs the gills, and at times erodes the gill tissue. The symptoms of the fish would not be unlike that of a low dissolved oxygen problem.

Nearshore and shallow water areas, which the perch and sunfish prefer, can have elevated water temperatures during hot days such as we had during this spring. The day the pathologist had been out on the lake was also a hot day with the air temperature in excess of 85 degrees.

The fact that bass and trout also in the lake have not been affected, even though they are also susceptible to this disease, tends to support this. Bass and trout prefer cooler temperatures than the perch and sunfish. Trout are much more susceptible to toxic substances than any of the warmwater species also in the lake. To my knowledge, no trout have been reported to have been found dead during this period.

The flesh and internal organs of the fish can be affected by the disease organism, if the disease progresses beyond affecting the gills or enters the fishes body through a scratch or scrape. The best method of reducing the incidence and amount of bacteria available for reinfection of other fish is for the residents to remove the dead fish from the lake. The best disposal method is to bury the fish so animals cannot get to them and spread them around. Picking up the fish will not harm humans.

If you have any further questions about this subject please contact me at 867-7000.

Sincerely,

Robert Newman

Robert Newman
Water Quality Inspector

cc: Lake Sawyer Community Club, Attn. Mr. Grayson Connor
Tom Johnson, EPA
Valley Daily News Journal
Joe Williams, Ecology WQFAP
Mike Rundlett, NWRO

CURT SMITCH
Director

STATE OF WASHINGTON
DEPARTMENT OF WILDLIFE
600 North Capitol Way, GJ-11 • Olympia, Washington 98504-0091 • (206) 753-5700

July 7, 1989

TO: Bob Newman
Water Quality Inspector

FROM: John Kerwin JK.
Program Manager

SUBJECT: Lake Sawyer

Wayne Brunson, our Fisheries Pathologist for the Regions 4 and 6 examined moribund bluegill and yellow perch he obtained from Sawyer Lake on Saturday, June 24, 1989.

The yellow perch exhibited focal lesions through their dermis and epidermis into the muscle tissue with hemorrhaging along the periphery of the lesions. The gill tissue was pale with yellow to orange lesions and/or yellowish edges along the gill lamalle.

It was Wayne's opinion that the cause of death was due to a myxobacterium, Chondrococcus columnaris . Wayne indicates that he found further evidence of a secondary systemic baterial infection belonging either to the Aermonas or Pseudumonas groups. The Bluegill exhibited the same clinical symptoms and he felt that C. columnaris was also the cause of death for these fish.

In general, outbreaks of C. columnaris when average water temperatures reach 60 degrees Fahrenheit. Some of the low virulent strains require water temperatures in excess of 68 degrees Fahrenheit. All three of these bacterial groups are endemic to waters of Washington. Currently there is a similar epizootic occurring in catfish at Green Lake in Seattle. British Columbia fish health officials believe C. columnaris was responsible for a large yellow perch die-off in Osoyoos Lake (on U.S./Canada border) in May and June of this year.

These diseases can usually be controlled in intensive culture situations through the administration of antibiotics or other theraputants. However, I do not know of adequate control measures for epizootics which occur naturally and generally the disease must run its natural course.

JK:mkt

This page is purposely left blank for duplex printing.

APPENDIX G

Lake Sawyer
Sediment Data

This page is purposely left blank for duplex printing.

Appendix G.1a. Sediment core data.

Station	Upper Horizon Depth (cm)	Lower Horizon Depth (cm)	Percent Solids %	Average Dry Density (gDW/cm3)	Total Pb-210 (dpm/g) dry wt.	Unsupported Pb-210 (dpm/g) dry wt.	Stable Pb (ppm DW)	Total P (% DW)	Total N (% DW)	TOC (% DW)
3	0	1	4.19	0.0486	25.01	23.66		0.123	1.24	14.2
3	1	2	5.36	0.0566	25.59	24.24		0.166	1.33	13.9
3	2	3	5.96	0.0642	30.87	29.52		0.129	1.27	13.8
3	3	4	6.62	0.0728	31.96	30.61		0.117	1.18	14.9
3	4	5	6.93	0.0728	26.69	25.34	32.3	0.098	1.32	15.3
3	5	6	7.15	0.0746	25.25	23.90	46.3	0.107	1.17	15.6
3	6	7	7.34	0.0832	22.70	21.35	31.1	0.100	1.19	16.2
3	7	8	7.73	0.0798	22.00	20.65	25.7	0.098	1.13	15.2
3	8	9	8.14	0.0960	16.63	15.28	28.9	0.099	1.18	16.1
3	9	10	8.23	0.0798	17.12	15.77	24.6	0.115	1.17	16.2
3	10	11	8.91	0.0925	17.23	15.88	26.4	0.092	1.14	15.5
3	11	12	9.54	0.1127	15.49	14.14	21.2	0.096	1.08	15.7
3	12	13	8.69	0.0902	13.54	12.19	27.8	0.090	1.13	15.6
3	13	14	8.80	0.0902	11.40	10.05	23.9	0.083	1.03	16.1
3	14	15	8.58	0.1029	9.36	8.01	28.1	0.083	1.25	17.5
3	15	16	8.40	0.0850	7.76	6.41	24.3	0.082	1.17	17.8
3	16	17	7.49	0.0815	7.98	6.63	21.7	0.075	1.29	17.6
3	17	18	8.50	0.0977	5.61	4.26	15.4	0.054	1.28	19.0
3	18	19	8.89	0.0942	6.85	5.50	3.8	0.085	1.32	19.5
3	19	20	9.10	0.0983	6.40	5.05	13.1	0.082	1.26	18.9
3	20	21	9.43	0.0965			10.5	0.085	1.26	18.8
3	21	22	9.15	0.1064	5.73	4.38	15.5			
3	22	23	9.38	0.0954			9.1	0.080	1.28	19.2
3	23	24	8.88	0.0867	5.09	3.74	11.3			
3	24	25	9.09	0.0960			9.7	0.082	1.29	20.0
3	25	26	8.76	0.0908	5.39	4.04	10.1			
3	26	27	8.54	0.0896			7.2	0.082	1.43	20.5
3	27	28	8.44	0.0861	3.51	2.16	7.7			
3	28	29	8.61	0.0902			7.8	0.083	1.40	20.6
3	29	30	8.26	0.0838	3.29	1.94	8.6			
3	30	31	NA	0.0838						
3	31	32	8.25	0.0838	3.33	1.98	8			
3	32	33	8.40	0.0861			5.6	0.081	1.37	21.0
3	33	34	8.21	0.0867	2.70	1.35	4.3			
3	34	35	NA	0.0850						
3	35	36	8.21	0.0832	3.14	1.79	6.6			
3	36	37	8.60	0.0827			4.9	0.089	1.52	21.4
3	37	38	8.09	0.0867	1.83	0.48	3.3			
3	38	39	8.74	0.0850			4.5	0.085	1.52	22.0
3	39	40	8.36	0.0873	1.81	0.46	4.2			
3	40	41	8.42	0.0798			4.2	0.088	1.50	21.9
3	41	42	7.84	0.0838	1.99	0.64	2.2			
3	42	43	8.32	0.0769			4.2			
3	43	44	8.31	0.0844	2.07	0.72	3.3			
3	44	45	8.71	0.0896			3.4			
3	45	46	8.46	0.0873	1.65	0.30	3.5			
3	46	47	13.03	0.1347						
3	47	48	8.23	0.0821	1.57	0.22				
3	48	49	8.61	0.0844						
3	49	50	8.62	0.0855						
3	50	51	8.68	0.0827						
3	51	52	8.32	0.0850						
3	52	53	8.50	0.0832						
3	53	54	8.39	0.0867						
3	54	55	8.43	0.0838				0.090	1.54	21.7
3	55	56	8.68	0.0884						
3	56	57	8.68	0.0884						
3	57	58	8.68	0.0931						
3	58	59	9.05	0.0919						
3	59	60	8.98	0.0798	1.35					

Appendix G.1b. Sediment core data (continued).

Station	Upper Horizon Depth (cm)	Lower Horizon Depth (cm)	Percent Solids %	Average Dry Density (gDW/cm3)	Total Pb-210 (dpm/g) dry wt.	Unsupported Pb-210 (dpm/g) dry wt.	Stable Pb (ppm DW)	Total P (% DW)	Total N (% DW)	TOC (% DW)
4	0	1	3.40	0.0410	26.73	26.30		0.221	1.13	13.9
4	1	2	4.86	0.0532	29.33	28.90		0.182	1.22	12.8
4	2	3	6.04	0.0607	28.81	28.38		0.126	1.04	11.8
4	3	4	6.93	0.0751	31.02	30.59		0.111	0.99	12.1
4	4	5	7.62	0.0867	29.94	29.51		0.109	1.06	13.0
4	5	6	8.02	0.0717	31.05	30.62		0.108	1.03	12.9
4	6	7	8.50	0.0936	27.64	27.21		0.097	1.04	13.1
4	7	8	9.02	0.0931	22.92	22.49		0.090	0.99	12.6
4	8	9	9.75	0.0977	24.67	24.24		0.088	1.00	12.9
4	9	10	10.27	0.1225	23.33	22.90		0.085	0.94	12.7
4	10	11	11.25	0.1162	23.41	22.98		0.084	0.94	12.5
4	11	12	11.32	0.1225	21.27	20.84		0.083	0.94	12.2
4	12	13	11.29	0.1283	18.96	18.53		0.086	0.94	12.1
4	13	14	11.03	0.1214	19.14	18.71		0.085	0.94	12.4
4	14	15	11.49	0.1139	13.59	13.16		0.078	0.86	12.0
4	15	16	11.28	0.1249	14.715	14.29		0.074	0.89	13.3
4	16	17	10.07	0.1058	13.09	12.66		0.070	0.92	14.1
4	17	18	8.95	0.0948	10.2	9.77		0.067	0.91	14.0
4	18	19	9.66	0.1058	6.26	5.83		0.068	1.00	15.1
4	19	20	9.53	0.1012	5.29	4.86		0.073		
4	20	21	9.12	0.1006						
4	21	22	9.49	0.0902	4.63	4.20		0.070	1.14	17.8
4	22	23	9.24	0.1029						
4	23	24	9.92	0.1040	3.47	3.04		0.071	1.26	18.6
4	24	25	9.56	0.1000						
4	25	26	9.72	0.1023	3.32	2.89		0.072	1.27	18.9
4	26	27	9.08	0.0954						
4	27	28	9.56	0.0983	3.62	3.19		0.074	1.25	19.5
4	28	29	8.90	0.0931						
4	29	30	9.64	0.1006	2.91	2.48		0.075	1.26	19.4
4	30	31	8.92	0.0965						
4	31	32	9.41	0.0948	2.86	2.43		0.075	1.30	19.5
4	32	33	8.64	0.0867						
4	33	34	9.05	0.0890	2.89	2.46		0.075	1.34	20.0
4	34	35	8.46	0.0665						
4	35	36	8.96	0.1052	2.02	1.59		0.077	1.36	20.2
4	36	37	8.74	0.0792						
4	37	38	9.17	0.0988	1.68	1.25		0.082	1.34	20.5
4	38	39	8.58	0.0861						
4	39	40	9.19	0.1029	1.72	1.29		0.082	1.33	19.8
4	40	41	8.72	0.0908						
4	41	42	9.05	0.0884	1.51	1.08				
4	42	43	8.62	0.0925						
4	43	44	9.20	0.0896	1.03	0.60				
4	44	45	8.61	0.0855						
4	45	46	9.16	0.0867	1.45	1.02				
4	46	47	8.60	0.1023						
4	47	48	9.35	0.0954	1.12	0.69				
4	48	49	8.68	0.0948						
4	49	50	8.80	0.0954						
4	50	51	8.84	0.0977						
4	51	52	8.98	0.0873						
4	52	53	8.99	0.0954						
4	53	54	8.89	0.0994						
4	54	55	9.04	0.0913						
4	55	56	9.19	0.0977						
4	56	57	9.46	0.0890						
4	57	58	9.43	0.0960						
4	58	59	9.50	0.0873						
4	59	60	10.12	0.1075	0.43					

DIATOM ANALYSES FROM SEDIMENT CORE #4, LAKE SAWYER

Samples

A total of 31 dried samples from Core #4 were analyzed. 0.020 grams of each sample were weighed and diluted to 250 mL; 10 mL of these samples were filtered and prepared into microscope slides.

Results are reported in the number of diatom units (ie, discrete cells, colonies, or filaments) per milligram of dry sediment.

Diatom Species Observed

A total of 90 diatom species were found throughout the core; a species list is given in the appendix.

Three distinct diatom communities were evident. The lowest portion of the core from 60 to 20 cm was dominated by Cyclotella ocellata, Melosira italica was dominant between 18 to 15 cm, and Cyclotella comta was dominant from 14 cm to the surface of the core.

Dominant and common diatom species included the following:

Cyclotella ocellata - Dominant in all samples below 19 cm sediment depth; decreasingly abundant in more recent samples.

Cyclotella comta - Dominant in all recent samples (14 cm and less sediment depth). Occurred occasionally in older sediments.

Melosira italica - Dominant between 15 to 18 cm sediment depth, representing a transition zone between C. ocellata and C. comta. Very common in most other samples from all sediment depths.

Melosira ambigua - Most common in the deepest sediments (53 to 60 cm), less abundant but present in more recent sediments.

Melosira distans - Most common in older sediments, from 19 cm and deeper.

Cyclotella stelligera - Most common in older sediments, from 19 cm and deeper.

Fragilaria crotonensis - Most common in recent sediments, from 14 cm and less.

Tabellaria fenestrata - Not very common in most samples, occurs ocassionally from any depth sample with the one exception of being very common between the 3 to 4 cm sediment depth (very recent).

SIMILARITY INDICES

Similarity indices were calculated for each successive sample from the surface to the 60 cm sediment depth. This index compares all of the relative abundances of each species in each sample, and ranges from zero for totally different samples to 100 for identical samples.

Depth of Sediment	Similarity Index
1-2	
----------	58
3-4	
----------	55
5-6	
----------	79
7-8	
----------	71
9-10	
----------	72
11-12	
----------	68
13-14	
----------	60
15-16	
----------	77
16-17	
----------	71
17-18	
----------	62
19-20	
----------	79
21-22	
----------	77
23-24	
----------	74
25-26	
----------	76
27-28	
----------	77
29-30	

Depth of Sediment	Similarity Index (continued)
29-30	
	79
31-32	
	84
33-34	
	83
35-36	
	83
37-38	
	77
39-40	
	82
41-42	
	80
43-44	
	81
45-46	
	84
47-48	
	77
49-50	
	71
51-52	
	77
53-54	
	83
55-56	
	81
57-58	
	86
59-60	

These similarity indices are high for the samples between 60 to 20 cm sediment depth, indicating few changes in the diatom communities during this time period. Between 18 and 19 cm, the similarity index is lower (62), reflecting a change in diatom communities (Melosira italica became dominant and Cyclotella ocellata had a lower relative abundance). Between 14 to 15 cm, the similarity index was low again when the dominance shifted to Cyclotella comta. The uppermost samples were not very similar due to a brief increase in Tabellaria fenestrata (and changing relative abundances of other diatoms such as Fragilaria crotonensis).

Densities

Densities of diatoms ranged from about 49,000 to 246,000 per mg dry weight of sediment. The highest densities were generally in the deeper, older sediments. Densities were generally lowest after Cyclotella comta became dominant at the 14 cm depth; they gradually and steadily increased from this depth to the surface.

Jim Sweet
Aquatic Analysts
September 3, 1990

Lake Sawyer Diatom Analyses, Core #4, Data Summary.

Depth	Density	Species #1	Species #2	Species #3	Species #4
1-2	232	CCCM (32)	FRCR (18)	MLIT (12)	MLAM (11)
3-4	159	CCCM (50)	TBFN (25)	MLIT (6)	FRCR (5)
5-6	85	CCCM (30)	MLIT (22)	FRCR (12)	MLAM (11)
7-8	72	CCCM (30)	MLIT (15)	MLAM (15)	FRCR (8)
9-10	79	CCCM (39)	MLIT (20)	FRCR (9)	MLAM (4)
11-12	49	CCCM (44)	FRCR (15)	MLIT (11)	COPC (4)
13-14	90	CCCM (30)	FRCR (21)	MLIT (19)	MLAM (6)
15-16	214	MLIT (38)	CCCM (22)	CCOC (9)	MLAM (7)
16-17	173	MLIT (32)	CCCM (10)	CCOC (9)	MLAM (8)
17-18	246	MLIT (33)	CCOC (20)	STAM (12)	FRCR (7)
19-20	136	CCOC (37)	MLIT (24)	MLDS (7)	MLAM (4)
21-22	164	CCOC (31)	MLIT (23)	STAM (8)	CCST (7)
23-24	222	CCOC (42)	MLIT (22)	MLAM (5)	CCST (4)
25-26	126	CCOC (33)	MLIT (26)	MLAM (9)	MLDS (6)
27-28	136	CCOC (40)	MLIT (19)	CCST (11)	MLDS (5)
29-30	58	CCOC (37)	CCST (15)	MLIT (14)	ACMN (4)
31-32	143	CCOC (36)	MLIT (23)	MLDS (6)	CCST (6)
33-34	197	CCOC (41)	MLIT (17)	CCST (9)	MLDS (6)
35-36	192	CCOC (40)	MLIT (20)	MLAM (8)	MLDS (7)
37-38	105	CCOC (38)	MLIT (17)	MLDS (10)	CCST (9)
39-40	214	CCOC (32)	MLIT (21)	MLAM (9)	MLDS (8)
41-42	150	CCOC (36)	MLIT (19)	MLAM (8)	MLDS (6)
43-44	117	CCOC (37)	MLIT (13)	SNRD (8)	MLDS (8)
45-46	180	CCOC (38)	MLDS (13)	MLIT (12)	MLAM (12)
47-48	150	CCOC (38)	MLDS (13)	MLIT (11)	MLAM (6)
49-50	116	CCOC (39)	MLIT (10)	MLAM (9)	CCST (9)
51-52	181	CCOC (33)	MLIT (16)	MLAM (14)	MLDS (13)
53-54	178	CCOC (37)	MLAM (16)	MLIT (12)	CCST (7)
55-56	207	CCOC (41)	MLAM (14)	MLIT (14)	MLDS (9)
57-58	224	CCOC (33)	MLAM (19)	MLIT (13)	MLDS (8)
59-60	203	CCOC (34)	MLAM (17)	MLIT (14)	MLDS (7)

Density in number per mg dry sediment (in thousands).

Four most abundant diatoms listed.
Species codes (percent relative abundance):

ACMN = Achnanthes minutissima
CCCM = Cyclotella comta
CCOC = Cyclotella ocellata
CCST = Cyclotella stelligera
COPC = Cocconeis placentula
FRCR = Fragilaria crotonensis
MLAM = Melosira ambigua
MLDS = Melosira distans
MLIT = Melosira italica
SNRD = Synedra radians
STAM = Stephanodiscus astraea minutula
TBFN = Tabellaria fenestrata

Lake Sawyer Core #4 - Diatom Species List.

Species	Authority
Achnanthes exigua	Grun.
Achnanthes hungarica	(Grun.) Grun.
Achnanthes lanceolata	(Breb.) Grun.
Achnanthes lewisiana	Patr.
Achnanthes linearis	(W.Sm.) Grun.
Achnanthes minutissima	Kutz.
Achnanthes peragalli	Brun & Herib.
Amphora perpusilla	(Grun.) Grun.
Anomoeoneis vitrea	(Grun.) Ross
Asterionella formosa	Hass.
Caloneis hyalina	Hust.
Cocconeis disculus	(Schum.) Cl.
Cocconeis pediculus	Ehr.
Cocconeis placentula	Ehr.
Cyclotella comta	(Ehr.) Kutz.
Cyclotella kutzingiana	Thwaites
Cyclotella meneghiniana	Kutz.
Cyclotella ocellata	Pantocsek
Cyclotella stelligera	Cl. u. Grun.
Cymbella affinis	Kutz.
Cymbella angustata	(W. Sm.) Cl.
Cymbella lunata	W. Sm.
Cymbella mexicana	(Ehr.) Cl.
Cymbella microcephala	Grun.
Cymbella minuta	Hilse ex Rabh.
Cymbella muelleri	Hust.
Cymbella sinuata	Greg.
Diatoma hiemale mesodon	(Ehr.) Grun.
Diatoma tenue elongatum	Lyngb.
Diploneis elliptica	(Kutz.) Cl.
Diploneis oculata	(Breb.) Cl.
Diploneis smithii	(Breb. ex W.Sm.) Cl.
Epithemia sorex	Kutz.
Eunotia incisa	W.Wm. ex Greg.
Eunotia sp.	Ehr.
Fragilaria brevistriata	Grun.
Fragilaria capucina mesolepta	Rabh.
Fragilaria construens	(Ehr.) Grun.
Fragilaria construens venter	(Ehr.) Grun.
Fragilaria crotonensis	Kitton
Fragilaria pinnata	Ehr.
Fragilaria vaucheriae	(Kutz.) Peters.
Frustulia rhomboides	(Ehr.) Det.
Gomphonema acuminatum	Ehr.
Gomphonema angustatum	(Kutz.) Rabh.
Gomphonema clevei	Fricke
Gomphonema gracile	Ehr. emend V.H.
Gomphonema olivaceum	(Lyngb.) Kutz.
Gomphonema subclavatum	(Grun.) Grun.
Melosira ambigua	(Grun.) O. Mull.
Melosira distans	(Ehr.) Kutz.
Melosira granulata	(Ehr.) Ralfs.

Lake Sawyer Core #4 - Diatom Species List.

Species	Authority
Melosira italica	(Ehr.) Kutz.
Melosira sp.	C. A. Agardh.
Melosira varians	C. A. Agardh.
Navicula anglica	Ralfs.
Navicula capitata	Ehr.
Navicula cascadensis	Sov.
Navicula cryptocephala	Kutz.
Navicula cryptocephala veneta	(Kutz.) Rabh.
Navicula decussis	Ostr.
Navicula gregaria	Donk.
Navicula minima	Grun.
Navicula pupula	Kutz.
Navicula rhynchocephala	Kutz.
Navicula seminulum	Grun.
Navicula sp.	Bory
Navicula tripunctata	(O.Mull.) Bory
Nitzschia amphibia	Grun.
Nitzschia fonticola	Grun.
Nitzschia frustulum	(Kutz.) Grun.
Nitzschia linearis	W. Sm.
Nitzschia paleacea	Grun.
Nitzschia sp.	Hassall
Pinnularia sp.	Ehr.
Rhopalodia gibba	(Ehr.) O. Mull.
Stephanodiscus astraea	(Ehr.) Grun.
Stephanodiscus astraea minutula	(Kutz.) Grun.
Stephanodiscus hantzschii	Grun.
Synedra cyclopum	Brutschy
Synedra delicatissima	W. Sm.
Synedra fasciculata truncata	(Grev.) Patr.
Synedra mazamaensis	Sov.
Synedra parasitica	(W.Sm.) Hust.
Synedra radians	Kutz.
Synedra rumpens	Kutz.
Synedra sp.	Ehr.
Synedra ulna	(Nitz.) Ehr.
Tabellaria fenestrata	(Lyngb.) Kutz.
Tabellaria flocculosa	(Roth) Kutz.

SIMILARITY INDICES FOR ALGAE SAMPLES.

	CB60	CB61	CB62	CB63	CB64	CB65	CB66	CB67	CB68	CB69	CB70	CB71
CB60	....	9	9	8	9	10	10	10	10	7	7	7
CB61	58	....	9	10	8	8	9	10	10	8	7	8
CB62	74	55	....	14	12	10	11	13	14	15	11	13
CB63	67	52	79	....	11	10	11	13	15	14	13	13
CB64	62	59	75	71	....	11	11	11	14	12	12	11
CB65	67	65	65	61	72	....	10	12	13	11	8	9
CB66	73	52	77	70	73	68	....	13	13	10	10	9
CB67	52	40	63	59	60	49	60	....	17	14	12	13
CB68	50	33	63	58	57	43	54	77	....	16	16	17
CB69	31	24	49	45	45	33	40	64	71	....	15	14
CB70	22	14	36	35	38	21	32	49	53	62	....	17
CB71	24	16	38	34	36	20	32	50	57	64	79	....

CODE	SAMPLE
CB60	Lake Sawyer Core #4, 1-2, 90-05-22
CB61	Lake Sawyer Core #4, 3-4, 90-05-22
CB62	Lake Sawyer Core #4, 5-6, 90-05-22
CB63	Lake Sawyer Core #4, 7-8, 90-05-22
CB64	Lake Sawyer Core #4, 9-10, 90-05-22
CB65	Lake Sawyer Core #4, 11-12, 90-05-22
CB66	Lake Sawyer Core #4, 13-14, 90-05-22
CB67	Lake Sawyer Core #4, 15-16, 90-05-22
CB68	Lake Sawyer Core #4, 16-17, 90-05-22
CB69	Lake Sawyer Core #4, 17-18, 90-05-22
CB70	Lake Sawyer Core #4, 19-20, 90-05-22
CB71	Lake Sawyer Core #4, 21-22, 90-05-22

Similarity indices are given at the lower left.
Number of species common between samples are at upper right.

SIMILARITY INDICES FOR ALGAE SAMPLES.

	CB70	CB71	CB72	CB73	CB74	CB75	CB76	CB77	CB78	CB79	CB80	CB81
CB70	....	17	14	14	11	16	18	14	13	14	12	15
CB71	79	....	14	14	12	14	15	13	11	12	12	14
CB72	81	77	....	11	11	14	13	12	14	11	11	13
CB73	79	81	74	....	13	16	15	12	14	10	11	11
CB74	74	77	78	76	....	11	11	10	12	9	11	11
CB75	75	70	73	72	77	....	17	14	16	12	12	13
CB76	85	81	80	81	77	79	....	17	17	12	14	16
CB77	77	75	79	74	84	80	84	....	14	13	11	14
CB78	79	74	81	81	82	78	84	83	....	13	13	13
CB79	79	76	76	75	80	77	79	86	83	....	9	12
CB80	75	77	73	80	76	73	79	76	83	77	....	14
CB81	80	75	77	78	76	75	83	79	85	82	82	....

CODE	SAMPLE
CB70	Lake Sawyer Core #4, 19-20, 90-05-22
CB71	Lake Sawyer Core #4, 21-22, 90-05-22
CB72	Lake Sawyer Core #4, 23-24, 90-05-22
CB73	Lake Sawyer Core #4, 25-26, 90-05-22
CB74	Lake Sawyer Core #4, 27-28, 90-05-22
CB75	Lake Sawyer Core #4, 29-30, 90-05-22
CB76	Lake Sawyer Core #4, 31-32, 90-05-22
CB77	Lake Sawyer Core #4, 33-34, 90-05-22
CB78	Lake Sawyer Core #4, 35-36, 90-05-22
CB79	Lake Sawyer Core #4, 37-38, 90-05-22
CB80	Lake Sawyer Core #4, 39-40, 90-05-22
CB81	Lake Sawyer Core #4, 41-42, 90-05-22

Similarity indices are given at the lower left.
Number of species common between samples are at upper right.

SIMILARITY INDICES FOR ALGAE SAMPLES.

	CB79	CB80	CB81	CB82	CB83	CB84	CB85	CB86	CB87	CB88	CB89	CB90
CB79	....	9	12	12	11	12	13	10	12	11	12	12
CB80	77	....	14	14	11	13	12	9	11	9	13	16
CB81	82	82	....	13	12	15	14	11	13	13	16	16
CB82	81	83	80	....	11	15	13	10	13	13	13	13
CB83	79	77	78	81	....	14	10	8	11	13	11	12
CB84	78	73	78	81	84	....	15	11	14	12	16	14
CB85	81	74	77	80	76	77	....	10	12	12	14	13
CB86	77	77	78	78	82	76	71	....	9	11	12	10
CB87	77	74	78	80	82	76	79	77	....	12	14	15
CB88	76	71	75	79	83	75	75	78	83	....	14	10
CB89	72	76	75	77	76	73	72	81	81	81	....	16
CB90	76	78	80	77	78	73	75	79	83	80	86	....

CODE	SAMPLE
CB79	Lake Sawyer Core #4, 37-38, 90-05-22
CB80	Lake Sawyer Core #4, 39-40, 90-05-22
CB81	Lake Sawyer Core #4, 41-42, 90-05-22
CB82	Lake Sawyer Core #4, 43-44, 90-05-22
CB83	Lake Sawyer Core #4, 45-46, 90-05-22
CB84	Lake Sawyer Core #4, 47-48, 90-05-22
CB85	Lake Sawyer Core #4, 49-50, 90-05-22
CB86	Lake Sawyer Core #4, 51-52, 90-05-22
CB87	Lake Sawyer Core #4, 53-54, 90-05-22
CB88	Lake Sawyer Core #4, 55-56, 90-05-22
CB89	Lake Sawyer Core #4, 57-58, 90-05-22
CB90	Lake Sawyer Core #4, 59-60, 90-05-22

Similarity indices are given at the lower left.
Number of species common between samples are at upper right.

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 1-2

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 232005

DIVERSITY INDEX: 3.06

	SPECIES	DENSITY	PCT
1	Cyclotella comta	73721	31.8
2	Fragilaria crotonensis	41197	17.8
3	Melosira italica	28188	12.1
4	Melosira ambigua	26019	11.2
5	Tabellaria fenestrata	17346	7.5
6	Asterionella formosa	15178	6.5
7	Stephanodiscus astraea minutula	4337	1.9
8	Melosira varians	4337	1.9
9	Stephanodiscus astraea	4337	1.9
10	Navicula rhynchocephala	2168	0.9
11	Cocconeis placentula	2168	0.9
12	Diatoma tenue elongatum	2168	0.9
13	Stephanodiscus hantzschii	2168	0.9
14	Melosira granulata	2168	0.9
15	Synedra sp.	2168	0.9
16	Gomphonema olivaceum	2168	0.9
17	Fragilaria capucina mesolepta	2168	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 3-4

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 159259

DIVERSITY INDEX: 2.20

--	SPECIES	DENSITY	PCT
1	Cyclotella comta	80334	50.4
2	Tabellaria fenestrata	39463	24.8
3	Melosira italica	9866	6.2
4	Fragilaria crotonensis	8456	5.3
5	Stephanodiscus astraea	7047	4.4
6	Stephanodiscus astraea minutula	4228	2.7
7	Cocconeis placentula	2819	1.8
8	Asterionella formosa	2819	1.8
9	Cymbella minuta	1409	0.9
10	Synedra ulna	1409	0.9
11	Melosira ambigua	1409	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 5-6

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 85267

DIVERSITY INDEX: 3.14

	SPECIES	DENSITY	PCT
1	Cyclotella comta	25369	29.8
2	Melosira italica	19027	22.3
3	Fragilaria crotonensis	9866	11.6
4	Melosira ambigua	9161	10.7
5	Tabellaria fenestrata	4228	5.0
6	Stephanodiscus astraea	4228	5.0
7	Achnanthes minutissima	2114	2.5
8	Fragilaria vaucheria	1409	1.7
9	Synedra ulna	1409	1.7
10	Asterionella formosa	1409	1.7
11	Cymbella mexicana	705	0.8
12	Rhopalodia gibba	705	0.8
13	Synedra radians	705	0.8
14	Stephanodiscus astraea minutula	705	0.8
15	Diatoma tenue elongatum	705	0.8
16	Cyclotella ocellata	705	0.8
17	Melosira distans	705	0.8
18	Gomphonema clevei	705	0.8
19	Cyclotella stelligera	705	0.8
20	Fragilaria construens	705	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 7-8

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 71850

DIVERSITY INDEX: 3.43

--	SPECIES	DENSITY	PCT
1	Cyclotella comta	21555	30.0
2	Melosira italica	11054	15.4
3	Melosira ambigua	10501	14.6
4	Fragilaria crotonensis	5527	7.7
5	Achnanthes minutissima	3869	5.4
6	Stephanodiscus astraea	3316	4.6
7	Cyclotella ocellata	2211	3.1
8	Fragilaria construens	1658	2.3
9	Fragilaria construens venter	1105	1.5
10	Melosira distans	1105	1.5
11	Asterionella formosa	1105	1.5
12	Synedra ulna	1105	1.5
13	Gomphonema acuminatum	1105	1.5
14	Tabellaria fenestrata	1105	1.5
15	Synedra fasciculata truncata	553	0.8
16	Gomphonema angustatum	553	0.8
17	Synedra mazamaensis	553	0.8
18	Cymbella minuta	553	0.8
19	Diploneis elliptica	553	0.8
20	Gomphonema clevei	553	0.8
21	Navicula minima	553	0.8
22	Stephanodiscus astraea minutula	553	0.8
23	Achnanthes hungarica	553	0.8
24	Nitzschia sp.	553	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 9-10

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 79063

DIVERSITY INDEX: 3.13

	SPECIES	DENSITY	PCT
1	Cyclotella comta	30938	39.1
2	Melosira italica	15813	20.0
3	Fragilaria crotonensis	6875	8.7
4	Melosira ambigua	3438	4.3
5	Stephanodiscus astraea	3438	4.3
6	Cyclotella ocellata	2750	3.5
7	Achnanthes minutissima	2063	2.6
8	Cocconeis placentula	2063	2.6
9	Navicula cryptocephala veneta	1375	1.7
10	Fragilaria construens	688	0.9
11	Cymbella affinis	688	0.9
12	Navicula sp.	688	0.9
13	Anomoeoneis vitrea	688	0.9
14	Fragilaria vaucheria	688	0.9
15	Stephanodiscus astraea minutula	688	0.9
16	Synedra rumpens	688	0.9
17	Navicula rhynchocephala	688	0.9
18	Gomphonema angustatum	688	0.9
19	Fragilaria brevistriata	688	0.9
20	Tabellaria flocculosa	688	0.9
21	Pinnularia sp.	688	0.9
22	Synedra ulna	688	0.9
23	Diatoma tenue elongatum	688	0.9
24	Epithemia sorex	688	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 11-12

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 49003

DIVERSITY INDEX: 2.99

	SPECIES	DENSITY	PCT
1	Cyclotella comta	21683	44.2
2	Fragilaria crotonensis	7372	15.0
3	Melosira italica	5638	11.5
4	Cocconeis placentula	1735	3.5
5	Stephanodiscus astraea	1735	3.5
6	Achnanthes minutissima	1301	2.7
7	Fragilaria vaucheria	867	1.8
8	Fragilaria construens venter	867	1.8
9	Melosira varians	867	1.8
10	Fragilaria capucina mesolepta	867	1.8
11	Cymbella angustata	867	1.8
12	Asterionella formosa	867	1.8
13	Fragilaria brevistriata	434	0.9
14	Stephanodiscus astraea minutula	434	0.9
15	Cyclotella kutzingiana	434	0.9
16	Navicula cryptocephala veneta	434	0.9
17	Navicula capitata	434	0.9
18	Nitzschia frustulum	434	0.9
19	Achnanthes peragalli	434	0.9
20	Tabellaria fenestrata	434	0.9
21	Cyclotella ocellata	434	0.9
22	Navicula decussis	434	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 13-14

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 90366

DIVERSITY INDEX: 3.07

	SPECIES	DENSITY	PCT
1	Cyclotella comta	27358	30.3
2	Fragilaria crotonensis	19068	21.1
3	Melosira italica	17410	19.3
4	Melosira ambigua	5803	6.4
5	Stephanodiscus astraea	4145	4.6
6	Fragilaria construens venter	2487	2.8
7	Pinnularia sp.	1658	1.8
8	Cocconeis placentula	1658	1.8
9	Stephanodiscus astraea minutula	829	0.9
10	Gomphonema clevei	829	0.9
11	Cocconeis pediculus	829	0.9
12	Nitzschia linearis	829	0.9
13	Synedra rumpens	829	0.9
14	Tabellaria fenestrata	829	0.9
15	Cyclotella stelligera	829	0.9
16	Gomphonema angustatum	829	0.9
17	Asterionella formosa	829	0.9
18	Diatoma tenue elongatum	829	0.9
19	Navicula capitata	829	0.9
20	Gomphonema subclavatum	829	0.9
21	Achnanthes exigua	829	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 15-16

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 213893

DIVERSITY INDEX: 2.93

	SPECIES	DENSITY	PCT
1	Melosira italica	81246	38.0
2	Cyclotella comta	48085	22.5
3	Cyclotella ocellata	19897	9.3
4	Melosira ambigua	14923	7.0
5	Stephanodiscus astraea minutula	6632	3.1
6	Asterionella formosa	6632	3.1
7	Fragilaria construens venter	4974	2.3
8	Cocconeis placentula	4974	2.3
9	Melosira varians	4974	2.3
10	Achnanthes minutissima	4974	2.3
11	Fragilaria crotonensis	3316	1.6
12	Synedra radians	3316	1.6
13	Synedra ulna	1658	0.8
14	Gomphonema angustatum	1658	0.8
15	Stephanodiscus astraea	1658	0.8
16	Cocconeis pediculus	1658	0.8
17	Cyclotella stelligera	1658	0.8
18	Tabellaria fenestrata	1658	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 16-17

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 173152

DIVERSITY INDEX: 3.58

	SPECIES	DENSITY	PCT
1	Melosira italica	55033	31.8
2	Cyclotella comta	17449	10.1
3	Cyclotella ocellata	16107	9.3
4	Melosira ambigua	14765	8.5
5	Fragilaria crotonensis	14765	8.5
6	Stephanodiscus astraea minutula	8054	4.7
7	Cyclotella stelligera	6711	3.9
8	Asterionella formosa	5369	3.1
9	Tabellaria fenestrata	4027	2.3
10	Stephanodiscus astraea	4027	2.3
11	Achnanthes minutissima	4027	2.3
12	Synedra radians	2685	1.6
13	Navicula minima	2685	1.6
14	Fragilaria construens venter	2685	1.6
15	Epithemia sorex	1342	0.8
16	Gomphonema angustatum	1342	0.8
17	Fragilaria construens	1342	0.8
18	Synedra ulna	1342	0.8
19	Cocconeis placentula	1342	0.8
20	Achnanthes peragalli	1342	0.8
21	Synedra rumpens	1342	0.8
22	Achnanthes linearis	1342	0.8
23	Melosira varians	1342	0.8
24	Nitzschia amphibia	1342	0.8
25	Synedra delicatissima	1342	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 17-18

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 245634

DIVERSITY INDEX: 3.24

	SPECIES	DENSITY	PCT
1	Melosira italica	80536	32.8
2	Cyclotella ocellata	48321	19.7
3	Stephanodiscus astraea minutula	30201	12.3
4	Fragilaria crotonensis	16107	6.6
5	Cyclotella comta	14094	5.7
6	Synedra delicatissima	8054	3.3
7	Melosira ambigua	6040	2.5
8	Achnanthes minutissima	4027	1.6
9	Fragilaria construens	4027	1.6
10	Asterionella formosa	4027	1.6
11	Synedra ulna	4027	1.6
12	Melosira distans	4027	1.6
13	Fragilaria construens venter	4027	1.6
14	Synedra cyclopum	2013	0.8
15	Stephanodiscus astraea	2013	0.8
16	Fragilaria vaucheria	2013	0.8
17	Navicula pupula	2013	0.8
18	Gomphonema angustatum	2013	0.8
19	Navicula tripunctata	2013	0.8
20	Synedra radians	2013	0.8
21	Cymbella angustata	2013	0.8
22	Cyclotella stelligera	2013	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 19-20

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 136428

DIVERSITY INDEX: 3.18

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	50738	37.2
2	Melosira italica	32698	24.0
3	Melosira distans	9020	6.6
4	Melosira ambigua	5638	4.1
5	Synedra radians	3383	2.5
6	Synedra delicatissima	3383	2.5
7	Cyclotella stelligera	3383	2.5
8	Fragilaria construens	2255	1.7
9	Asterionella formosa	2255	1.7
10	Cocconeis placentula	2255	1.7
11	Achnanthes minutissima	2255	1.7
12	Cymbella minuta	2255	1.7
13	Navicula tripunctata	2255	1.7
14	Fragilaria crotonensis	2255	1.7
15	Stephanodiscus astraea minutula	1128	0.8
16	Fragilaria construens venter	1128	0.8
17	Navicula minima	1128	0.8
18	Epithemia sorex	1128	0.8
19	Achnanthes exigua	1128	0.8
20	Amphora perpusilla	1128	0.8
21	Navicula cascadensis	1128	0.8
22	Cymbella lunata	1128	0.8
23	Navicula sp.	1128	0.8
24	Navicula rhynchocephala	1128	0.8
25	Gomphonema angustatum	1128	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 21-22

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 164000

DIVERSITY INDEX: 3.32

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	51250	31.3
2	Melosira italica	37156	22.7
3	Stephanodiscus astraea minutula	12813	7.8
4	Cyclotella stelligera	11531	7.0
5	Melosira ambigua	8969	5.5
6	Melosira distans	7688	4.7
7	Cocconeis placentula	3844	2.3
8	Synedra delicatissima	3844	2.3
9	Synedra ulna	3844	2.3
10	Synedra radians	3844	2.3
11	Tabellaria fenestrata	2563	1.6
12	Gomphonema angustatum	1281	0.8
13	Epithemia sorex	1281	0.8
14	Fragilaria construens	1281	0.8
15	Nitzschia frustulum	1281	0.8
16	Fragilaria pinnata	1281	0.8
17	Cymbella muelleri	1281	0.8
18	Navicula cryptocephala	1281	0.8
19	Cymbella lunata	1281	0.8
20	Achnanthes minutissima	1281	0.8
21	Fragilaria crotonensis	1281	0.8
22	Cyclotella meneghiniana	1281	0.8
23	Asterionella formosa	1281	0.8
24	Navicula minima	1281	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 23-24

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 221742

DIVERSITY INDEX: 3.04

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	93958	42.4
2	Melosira italica	48858	22.0
3	Melosira ambigua	11275	5.1
4	Cyclotella stelligera	9396	4.2
5	Melosira distans	7517	3.4
6	Cocconeis placentula	3758	1.7
7	Cymbella minuta	3758	1.7
8	Fragilaria construens venter	3758	1.7
9	Synedra radians	3758	1.7
10	Stephanodiscus astraea minutula	3758	1.7
11	Synedra delicatissima	3758	1.7
12	Achnanthes minutissima	3758	1.7
13	Gomphonema angustatum	1879	0.8
14	Navicula decussis	1879	0.8
15	Navicula anglica	1879	0.8
16	Synedra cyclopum	1879	0.8
17	Pinnularia sp.	1879	0.8
18	Synedra ulna	1879	0.8
19	Cocconeis disculus	1879	0.8
20	Nitzschia sp.	1879	0.8
21	Navicula cryptocephala	1879	0.8
22	Fragilaria construens	1879	0.8
23	Stephanodiscus astraea	1879	0.8
24	Synedra rumpens	1879	0.8
25	Cymbella angustata	1879	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 25-26

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 125760

DIVERSITY INDEX: 3.16

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	41197	32.8
2	Melosira italica	32524	25.9
3	Melosira ambigua	10841	8.6
4	Melosira distans	7589	6.0
5	Cyclotella stelligera	5421	4.3
6	Stephanodiscus astraea minutula	5421	4.3
7	Synedra radians	3252	2.6
8	Fragilaria construens	2168	1.7
9	Synedra cyclopum	1084	0.9
10	Rhopalodia gibba	1084	0.9
11	Caloneis hyalina	1084	0.9
12	Nitzschia amphibia	1084	0.9
13	Fragilaria brevistriata	1084	0.9
14	Fragilaria crotonensis	1084	0.9
15	Epithemia sorex	1084	0.9
16	Cyclotella comta	1084	0.9
17	Nitzschia frustulum	1084	0.9
18	Achnanthes lanceolata	1084	0.9
19	Cymbella lunata	1084	0.9
20	Synedra delicatissima	1084	0.9
21	Achnanthes minutissima	1084	0.9
22	Navicula sp.	1084	0.9
23	Eunotia sp.	1084	0.9
24	Gomphonema clevei	1084	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 27-28

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 136428

DIVERSITY INDEX: 3.01

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	54120	39.7
2	Melosira italica	25933	19.0
3	Cyclotella stelligera	14658	10.7
4	Melosira distans	6765	5.0
5	Melosira ambigua	6765	5.0
6	Stephanodiscus astraea minutula	4510	3.3
7	Tabellaria fenestrata	3383	2.5
8	Fragilaria construens	3383	2.5
9	Cocconeis placentula	2255	1.7
10	Melosira sp.	2255	1.7
11	Eunotia incisa	1128	0.8
12	Melosira varians	1128	0.8
13	Epithemia sorex	1128	0.8
14	Cyclotella comta	1128	0.8
15	Achnanthes minutissima	1128	0.8
16	Caloneis hyalina	1128	0.8
17	Synedra fasciculata truncata	1128	0.8
18	Achnanthes linearis	1128	0.8
19	Synedra radians	1128	0.8
20	Fragilaria brevistriata	1128	0.8
21	Synedra rumpens	1128	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 29-30

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 58425

DIVERSITY INDEX: 3.24

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	21525	36.8
2	Cyclotella stelligera	8713	14.9
3	Melosira italica	8200	14.0
4	Achnanthes minutissima	2563	4.4
5	Melosira distans	2563	4.4
6	Melosira ambigua	2050	3.5
7	Asterionella formosa	1538	2.6
8	Synedra radians	1538	2.6
9	Fragilaria construens	1538	2.6
10	Stephanodiscus astraea minutula	1025	1.8
11	Fragilaria construens venter	1025	1.8
12	Navicula minima	513	0.9
13	Stephanodiscus astraea	513	0.9
14	Cyclotella comta	513	0.9
15	Synedra delicatissima	513	0.9
16	Diploneis elliptica	513	0.9
17	Fragilaria brevistriata	513	0.9
18	Gomphonema clevei	513	0.9
19	Navicula sp.	513	0.9
20	Gomphonema angustatum	513	0.9
21	Rhopalodia gibba	513	0.9
22	Cymbella minuta	513	0.9
23	Nitzschia frustulum	513	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 31-32

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 143106

DIVERSITY INDEX: 3.17

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	52038	36.4
2	Melosira italica	33608	23.5
3	Melosira distans	8673	6.1
4	Cyclotella stelligera	8673	6.1
5	Melosira ambigua	6505	4.5
6	Asterionella formosa	4337	3.0
7	Synedra radians	3252	2.3
8	Stephanodiscus astraea minutula	3252	2.3
9	Fragilaria construens venter	3252	2.3
10	Synedra ulna	2168	1.5
11	Achnanthes minutissima	2168	1.5
12	Navicula pupula	1084	0.8
13	Tabellaria fenestrata	1084	0.8
14	Cymbella lunata	1084	0.8
15	Nitzschia amphibia	1084	0.8
16	Navicula sp.	1084	0.8
17	Fragilaria brevistriata	1084	0.8
18	Navicula sp.	1084	0.8
19	Fragilaria pinnata	1084	0.8
20	Amphora perpusilla	1084	0.8
21	Cocconeis placentula	1084	0.8
22	Gomphonema angustatum	1084	0.8
23	Navicula sp.	1084	0.8
24	Cymbella minuta	1084	0.8
25	Gomphonema clevei	1084	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 33-34

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 197312

DIVERSITY INDEX: 3.00

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	81431	41.3
2	Melosira italica	34451	17.5
3	Cyclotella stelligera	18792	9.5
4	Melosira distans	12528	6.3
5	Melosira ambigua	10962	5.6
6	Stephanodiscus astraea minutula	6264	3.2
7	Achnanthes minutissima	4698	2.4
8	Asterionella formosa	4698	2.4
9	Tabellaria fenestrata	3132	1.6
10	Rhopalodia gibba	1566	0.8
11	Synedra radians	1566	0.8
12	Gomphonema ventricosum	1566	0.8
13	Cymbella lunata	1566	0.8
14	Tabellaria flocculosa	1566	0.8
15	Fragilaria brevistriata	1566	0.8
16	Cymbella minuta	1566	0.8
17	Cymbella microcephala	1566	0.8
18	Nitzschia amphibia	1566	0.8
19	Fragilaria construens venter	1566	0.8
20	Achnanthes exigua	1566	0.8
21	Synedra ulna	1566	0.8
22	Gomphonema angustatum	1566	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 35-36

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 191675

DIVERSITY INDEX: 3.02

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	76106	39.7
2	Melosira italica	38053	19.9
3	Melosira ambigua	15503	8.1
4	Melosira distans	14094	7.4
5	Cyclotella stelligera	11275	5.9
6	Fragilaria construens	5638	2.9
7	Synedra radians	4228	2.2
8	Fragilaria construens venter	2819	1.5
9	Asterionella formosa	2819	1.5
10	Stephanodiscus astraea minutula	2819	1.5
11	Fragilaria brevistriata	1409	0.7
12	Rhopalodia gibba	1409	0.7
13	Cyclotella comta	1409	0.7
14	Cymbella minuta	1409	0.7
15	Cocconeis disculus	1409	0.7
16	Fragilaria vaucheria	1409	0.7
17	Achnanthes peragalli	1409	0.7
18	Nitzschia amphibia	1409	0.7
19	Synedra rumpens	1409	0.7
20	Navicula pupula	1409	0.7
21	Navicula sp.	1409	0.7
22	Navicula cryptocephala	1409	0.7
23	Achnanthes minutissima	1409	0.7

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 37-38

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 105062

DIVERSITY INDEX: 3.02

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	40146	38.2
2	Melosira italica	17938	17.1
3	Melosira distans	10250	9.8
4	Cyclotella stelligera	9396	8.9
5	Melosira ambigua	5979	5.7
6	Stephanodiscus astraea minutula	4271	4.1
7	Synedra radians	3417	3.3
8	Cymbella minuta	2563	2.4
9	Asterionella formosa	1708	1.6
10	Fragilaria crotonensis	1708	1.6
11	Fragilaria construens venter	854	0.8
12	Cyclotella comta	854	0.8
13	Eunotia incisa	854	0.8
14	Cymbella lunata	854	0.8
15	Fragilaria vaucheria	854	0.8
16	Navicula cryptocephala	854	0.8
17	Navicula rhynchocephala	854	0.8
18	Gomphonema angustatum	854	0.8
19	Cymbella microcephala	854	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 39-40

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 213893

DIVERSITY INDEX: 3.16

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	67982	31.8
2	Melosira italica	44768	20.9
3	Melosira ambigua	19897	9.3
4	Melosira distans	18239	8.5
5	Cyclotella stelligera	16581	7.8
6	Fragilaria construens	9949	4.7
7	Synedra radians	8290	3.9
8	Achnanthes minutissima	4974	2.3
9	Stephanodiscus astraea minutula	3316	1.6
10	Cymbella sinuata	1658	0.8
11	Fragilaria pinnata	1658	0.8
12	Achnanthes lanceolata	1658	0.8
13	Melosira sp.	1658	0.8
14	Navicula cryptocephala veneta	1658	0.8
15	Gomphonema acuminatum	1658	0.8
16	Fragilaria construens venter	1658	0.8
17	Cocconeis placentula	1658	0.8
18	Navicula pupula	1658	0.8
19	Asterionella formosa	1658	0.8
20	Nitzschia amphibia	1658	0.8
21	Diploneis elliptica	1658	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 41-42

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 150333

DIVERSITY INDEX: 3.32

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	54026	35.9
2	Melosira italica	28188	18.7
3	Melosira ambigua	11745	7.8
4	Melosira distans	9396	6.2
5	Cyclotella stelligera	8221	5.5
6	Synedra radians	7047	4.7
7	Cymbella minuta	3523	2.3
8	Stephanodiscus astraea minutula	2349	1.6
9	Fragilaria construens venter	2349	1.6
10	Asterionella formosa	2349	1.6
11	Navicula pupula	2349	1.6
12	Fragilaria construens	2349	1.6
13	Frustulia rhomboides	1174	0.8
14	Cymbella angustata	1174	0.8
15	Fragilaria crotonensis	1174	0.8
16	Synedra ulna	1174	0.8
17	Navicula tripunctata	1174	0.8
18	Achnanthes minutissima	1174	0.8
19	Diploneis elliptica	1174	0.8
20	Amphora perpusilla	1174	0.8
21	Synedra parasitica	1174	0.8
22	Tabellaria fenestrata	1174	0.8
23	Fragilaria pinnata	1174	0.8
24	Navicula gregaria	1174	0.8
25	Eunotia incisa	1174	0.8
26	Nitzschia amphibia	1174	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 43-44

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 117296

DIVERSITY INDEX: 3.18

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	43645	37.2
2	Melosira italica	15458	13.2
3	Synedra radians	10002	8.5
4	Melosira distans	10002	8.5
5	Melosira ambigua	10002	8.5
6	Cyclotella stelligera	8183	7.0
7	Fragilaria construens	2728	2.3
8	Achnanthes minutissima	2728	2.3
9	Stephanodiscus astraea minutula	1819	1.6
10	Fragilaria crotonensis	1819	1.6
11	Nitzschia frustulum	909	0.8
12	Cyclotella comta	909	0.8
13	Gomphonema acuminatum	909	0.8
14	Fragilaria vaucheria	909	0.8
15	Tabellaria fenestrata	909	0.8
16	Fragilaria construens venter	909	0.8
17	Nitzschia capitellata	909	0.8
18	Asterionella formosa	909	0.8
19	Diploneis smithii	909	0.8
20	Navicula sp.	909	0.8
21	Achnanthes lanceolata	909	0.8
22	Melosira sp.	909	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 45-46

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 180400

DIVERSITY INDEX: 2.99

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	69059	38.3
2	Melosira distans	23959	13.3
3	Melosira italica	22550	12.5
4	Melosira ambigua	21141	11.7
5	Cyclotella stelligera	8456	4.7
6	Synedra radians	7047	3.9
7	Fragilaria construens	5638	3.1
8	Cyclotella comta	4228	2.3
9	Fragilaria construens venter	2819	1.6
10	Asterionella formosa	2819	1.6
11	Diploneis elliptica	2819	1.6
12	Cyclotella meneghiniana	1409	0.8
13	Tabellaria fenestrata	1409	0.8
14	Nitzschia fonticola	1409	0.8
15	Navicula minima	1409	0.8
16	Navicula rhynchocephala	1409	0.8
17	Gomphonema angustatum	1409	0.8
18	Nitzschia amphibia	1409	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 47-48

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 149906

DIVERSITY INDEX: 3.45

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	56375	37.6
2	Melosira distans	19219	12.8
3	Melosira italica	16656	11.1
4	Melosira ambigua	8969	6.0
5	Synedra radians	7688	5.1
6	Cyclotella stelligera	6406	4.3
7	Fragilaria construens	2563	1.7
8	Asterionella formosa	2563	1.7
9	Stephanodiscus astraea minutula	2563	1.7
10	Navicula seminulum	1281	0.9
11	Gomphonema clevei	1281	0.9
12	Melosira sp.	1281	0.9
13	Navicula minima	1281	0.9
14	Synedra ulna	1281	0.9
15	Nitzschia paleacea	1281	0.9
16	Navicula rhynchocephala	1281	0.9
17	Achnanthes lewisiana	1281	0.9
18	Nitzschia frustulum	1281	0.9
19	Achnanthes peragalli	1281	0.9
20	Fragilaria capucina mesolepta	1281	0.9
21	Achnanthes minutissima	1281	0.9
22	Fragilaria construens venter	1281	0.9
23	Tabellaria fenestrata	1281	0.9
24	Cocconeis disculus	1281	0.9
25	Navicula sp.	1281	0.9
26	Navicula cryptocephala	1281	0.9
27	Fragilaria brevistriata	1281	0.9
28	Navicula tripunctata	1281	0.9
29	Diploneis elliptica	1281	0.9
30	Gomphonema angustatum	1281	0.9

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 49-50

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 116273

DIVERSITY INDEX: 3.40

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	44924	38.6
2	Melosira italica	11451	9.8
3	Melosira ambigua	10570	9.1
4	Cyclotella stelligera	10570	9.1
5	Melosira distans	7047	6.1
6	Synedra radians	4404	3.8
7	Stephanodiscus astraea minutula	3523	3.0
8	Asterionella formosa	1762	1.5
9	Synedra rumpens	1762	1.5
10	Anomoeoneis vitrea	1762	1.5
11	Gomphonema angustatum	1762	1.5
12	Fragilaria crotonensis	1762	1.5
13	Navicula minima	1762	1.5
14	Fragilaria construens	1762	1.5
15	Cymbella mexicana	881	0.8
16	Cymbella lunata	881	0.8
17	Eunotia incisa	881	0.8
18	Navicula cryptocephala	881	0.8
19	Achnanthes minutissima	881	0.8
20	Achnanthes lanceolata	881	0.8
21	Navicula seminulum	881	0.8
22	Diploneis oculata	881	0.8
23	Navicula cascadensis	881	0.8
24	Nitzschia paleacea	881	0.8
25	Amphora perpusilla	881	0.8
26	Cymbella angustata	881	0.8
27	Gomphonema acuminatum	881	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 51-52

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 180656

DIVERSITY INDEX: 3.00

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	60219	33.3
2	Melosira italica	28188	15.6
3	Melosira ambigua	25625	14.2
4	Melosira distans	24344	13.5
5	Cyclotella stelligera	10250	5.7
6	Synedra radians	8969	5.0
7	Fragilaria construens venter	6406	3.5
8	Fragilaria crotonensis	2563	1.4
9	Achnanthes linearis	1281	0.7
10	Achnanthes minutissima	1281	0.7
11	Cymbella minuta	1281	0.7
12	Fragilaria brevistriata	1281	0.7
13	Cymbella mexicana	1281	0.7
14	Fragilaria pinnata	1281	0.7
15	Navicula minima	1281	0.7
16	Caloneis hyalina	1281	0.7
17	Cymbella microcephala	1281	0.7
18	Nitzschia frustulum	1281	0.7
19	Rhopalodia gibba	1281	0.7

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 53-54

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 177581

DIVERSITY INDEX: 3.17

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	66241	37.3
2	Melosira ambigua	28188	15.9
3	Melosira italica	21141	11.9
4	Cyclotella stelligera	12684	7.1
5	Melosira distans	11275	6.3
6	Synedra radians	5638	3.2
7	Cyclotella comta	4228	2.4
8	Asterionella formosa	4228	2.4
9	Tabellaria fenestrata	2819	1.6
10	Fragilaria construens	2819	1.6
11	Stephanodiscus astraea minutula	1409	0.8
12	Synedra ulna	1409	0.8
13	Gomphonema angustatum	1409	0.8
14	Achnanthes peragalli	1409	0.8
15	Gomphonema gracile	1409	0.8
16	Caloneis hyalina	1409	0.8
17	Navicula pupula	1409	0.8
18	Cymbella lunata	1409	0.8
19	Achnanthes minutissima	1409	0.8
20	Synedra parasitica	1409	0.8
21	Fragilaria vaucheria	1409	0.8
22	Diatoma hiemale mesodon	1409	0.8
23	Rhopalodia gibba	1409	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 55-56

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 207261

DIVERSITY INDEX: 2.95

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	84563	40.8
2	Melosira ambigua	33162	16.0
3	Melosira italica	28188	13.6
4	Melosira distans	18239	8.8
5	Synedra radians	4974	2.4
6	Cyclotella stelligera	4974	2.4
7	Asterionella formosa	4974	2.4
8	Nitzschia linearis	3316	1.6
9	Fragilaria construens	3316	1.6
10	Fragilaria construens venter	1658	0.8
11	Cyclotella comta	1658	0.8
12	Caloneis hyalina	1658	0.8
13	Navicula minima	1658	0.8
14	Rhopalodia gibba	1658	0.8
15	Navicula sp.	1658	0.8
16	Pinnularia sp.	1658	0.8
17	Eunotia incisa	1658	0.8
18	Tabellaria fenestrata	1658	0.8
19	Amphora perpusilla	1658	0.8
20	Cymbella sp.	1658	0.8
21	Fragilaria crotonensis	1658	0.8
22	Cyclotella meneghiniana	1658	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 57-58

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 223738

DIVERSITY INDEX: 3.27

--	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	73992	33.1
2	Melosira ambigua	42281	18.9
3	Melosira italica	28188	12.6
4	Melosira distans	17617	7.9
5	Cyclotella stelligera	8809	3.9
6	Fragilaria construens venter	5285	2.4
7	Synedra radians	5285	2.4
8	Achnanthes minutissima	5285	2.4
9	Fragilaria crotonensis	5285	2.4
10	Navicula cryptocephala	3523	1.6
11	Synedra ulna	3523	1.6
12	Stephanodiscus astraea minutula	3523	1.6
13	Tabellaria fenestrata	3523	1.6
14	Navicula pupula	1762	0.8
15	Rhopalodia gibba	1762	0.8
16	Asterionella formosa	1762	0.8
17	Cocconeis placentula	1762	0.8
18	Fragilaria capucina mesolepta	1762	0.8
19	Navicula minima	1762	0.8
20	Fragilaria construens	1762	0.8
21	Eunotia sp.	1762	0.8
22	Amphora perpusilla	1762	0.8
23	Cymbella minuta	1762	0.8

SEDIMENT DIATOM ANALYSIS

SAMPLE: Lake Sawyer Core #4, 59-60

SAMPLE DATE: 90-05-22

TOTAL DENSITY (#/mg): 203247

DIVERSITY INDEX: 3.24

	SPECIES	DENSITY	PCT
1	Cyclotella ocellata	69727	34.3
2	Melosira ambigua	35605	17.5
3	Melosira italica	28188	13.9
4	Melosira distans	13352	6.6
5	Synedra radians	7418	3.6
6	Stephanodiscus astraea minutula	7418	3.6
7	Cyclotella stelligera	5934	2.9
8	Asterionella formosa	4451	2.2
9	Fragilaria construens venter	4451	2.2
10	Cocconeis placentula	2967	1.5
11	Cymbella minuta	2967	1.5
12	Achnanthes minutissima	2967	1.5
13	Fragilaria construens	2967	1.5
14	Navicula pupula	1484	0.7
15	Gomphonema angustatum	1484	0.7
16	Synedra ulna	1484	0.7
17	Anomoeoneis vitrea	1484	0.7
18	Synedra rumpens	1484	0.7
19	Fragilaria vaucheria	1484	0.7
20	Fragilaria pinnata	1484	0.7
21	Tabellaria fenestrata	1484	0.7
22	Navicula cryptocephala veneta	1484	0.7
23	Nitzschia amphibia	1484	0.7