P 8.5
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Practicum in Aquatic Biology Course Paper

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I. LAKE ENVIRONS

A. Bergner Lake

Bergner Lake is a large dumbell shaped lake. It's flat shoreline is covered with shrubs which are immediately surrounded by a coniferous forest. The lake supports a diversified group of plankton and a large fish population of Blue Gills, Golden Shiners, Yellow Perch and Bass. Water drains into Firestone Lake which in turn flows into Tenderfoot Creek.

B. Beaver Bog

Beaver Bog is a small bog hidden in a forest of evergreens and decidious trees. As a kettle bog, its perimeter is covered with a floating Sphagnum mat. The bog is not fed or emptied by any stream but is a seepage lake.

II. WATER CHEMISTRY DATA

A. Bergner Lake

Data collection date: 7/27/83 (10:30 - 12:30 am)

Ambient temperature: 27°C.

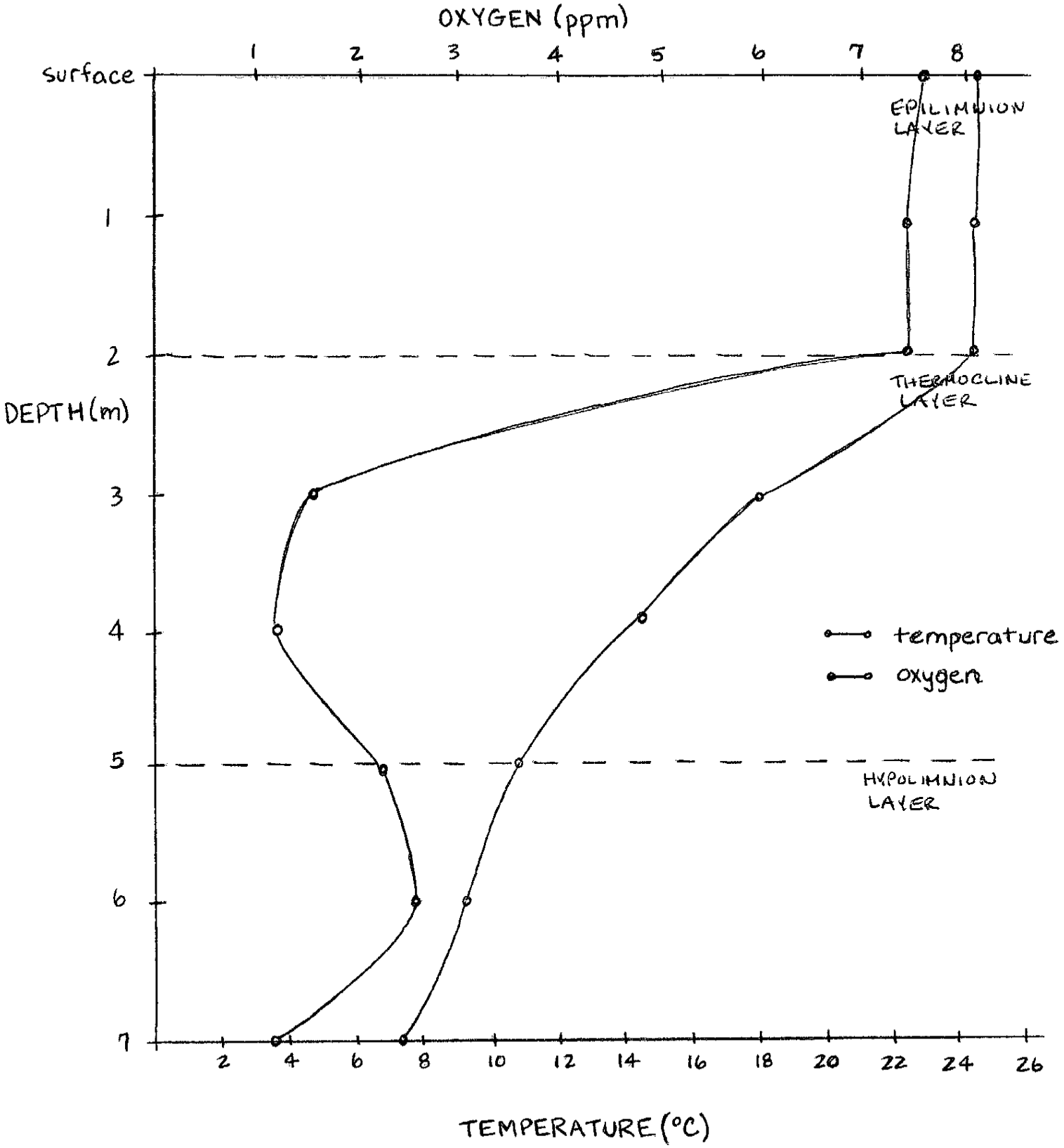
DEPTH (m)	TEMPERATURE (°C)		O_2 (ppm)	
	Site 1	Site 2	Site 1	Site 2
Surface	24.5	25.5	7.6	7.4
1	24.5	25.5	7.4	7.4
2	24.5	24.0	7.4	6.3
3	18.0	19.5	1.5	2.3
4	14.5	13.0	1.1	0.9
5	11.0	10.0	2.2	0.4
6	9.5	8.5	2.4	0.5
7	7.5	7.5	1.3	0.4

Secchi disk reading (m):	Site 1	Site 2
	1.30	1.35

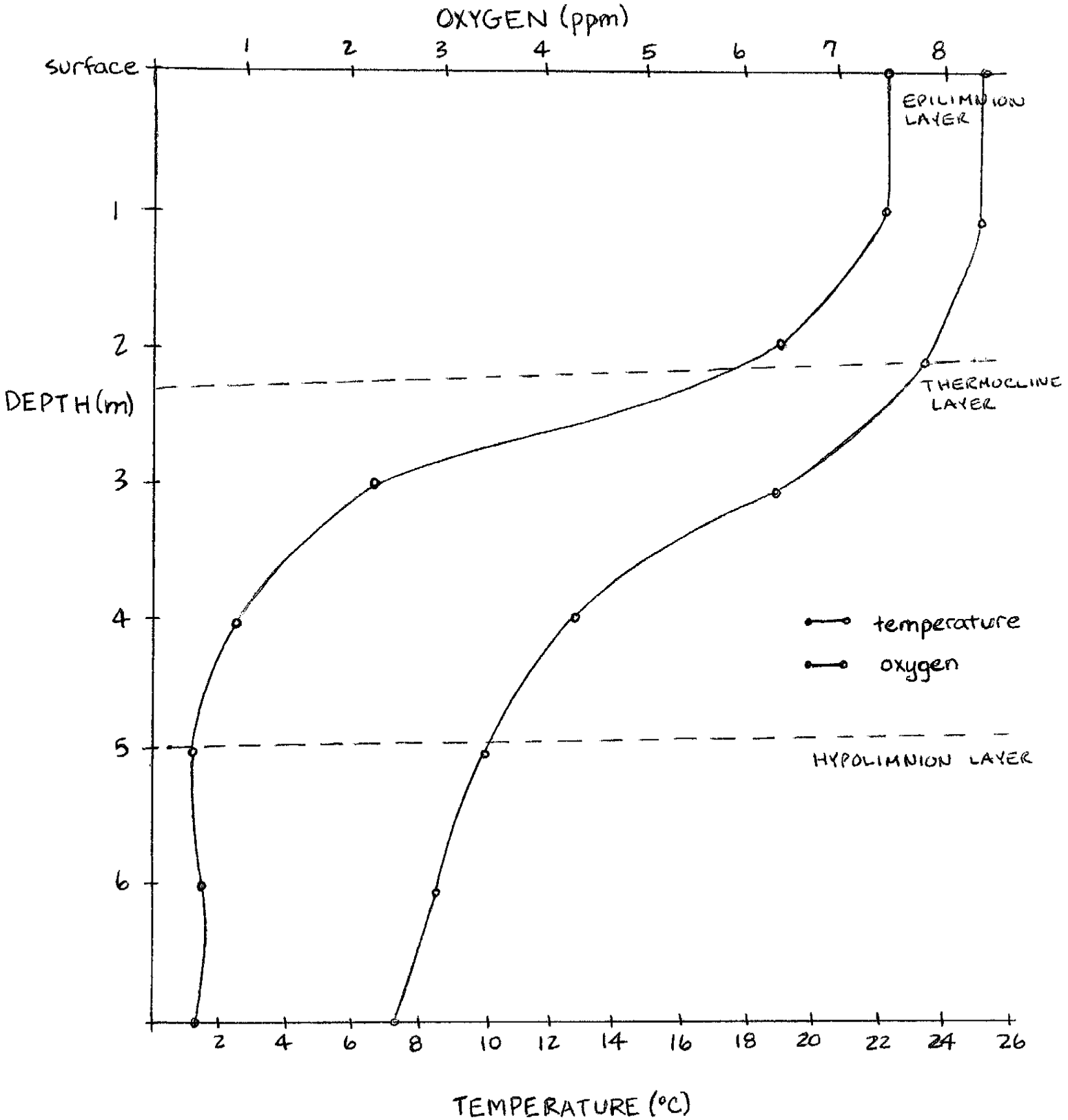
Bergner Lake (cont.)

	EPILIMNION		HYPOLIMNION	
	Site 1	Site 2	Site 1	Site 2
ACIDITY (mg/l)				
Methyl Orange	10.0	-	-	-
Phenolphthalein	10.0	15.0	10.0	25.0
Total	20.0	15.0	10.0	25.0
ALKALINITY (mg/l)	-	-	-	-
HARDNESS (mg/l)				
Calcium	20.0	10.0	15.0	20.0
Magnesium	30.0	55.0	75.0	55.0
Total	50.0	65.0	90.0	75.0
IRON (mg/l)	0.170	0.185	0.250	0.650
NITRATE NITROGEN (mg/l)	0.5	1.2	0.5	1.5
PH	5.0	5.6	5.4	5.6
PHOSPHATE (mg/l)	0.25	0.24	0.11	0.21
CONDUCTANCE (μmhos/cm)	20	15	18	22
SULFATE (mg/l)	6.0	6.0	8.0	2.5
HYDROGEN SULFIDE	ABSENT	ABSENT	ABSENT	PRESENT

Bergner Lake Site 1
Temperature/O_2 / Depth Profile



Bergner Lake Site 2
Temperature / O_2 / Depth Profile



B. Beaver Bog

Data collection date: 7/28/83 (8:30 - 10:30 am)
Ambient temperature: 24°C

DEPTH (m)	TEMPERATURE (°C)	O_2 (ppm)
Surface	20.0	4.2
1	16.0	1.5
2	8.0	1.2
3	5.0	2.1
4	4.5	2.0
5	4.0	2.0
6	4.0	2.0
7	4.0	2.0
8	4.0	1.9
9	4.0	1.8
10	4.0	1.8
11	4.0	1.7
12	4.0	1.7
13	4.0	1.6
14	4.0	1.6

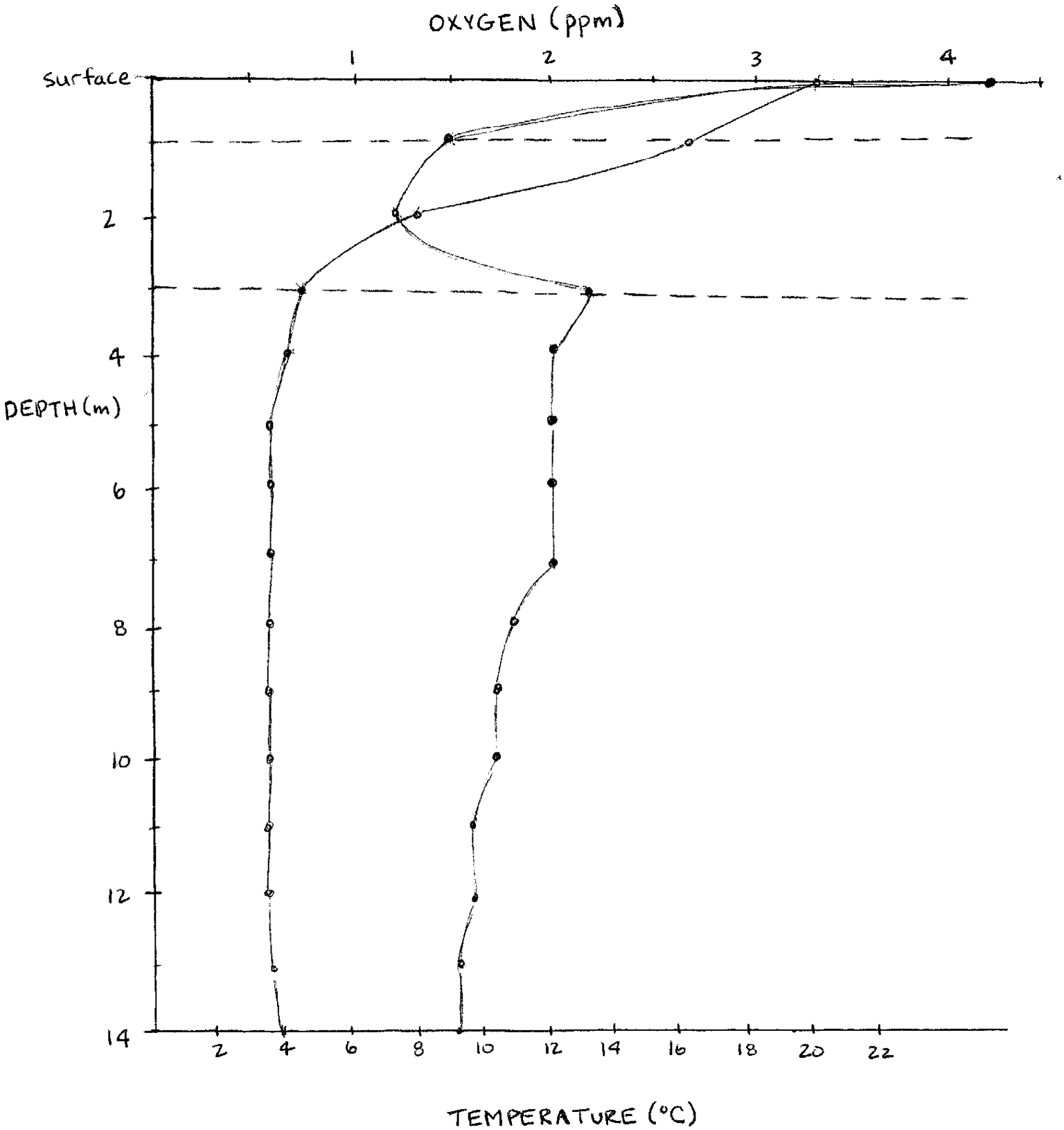
Secchi disc reading (m): 1.2

Beaver (cont.)

	EPILIMNION	HYPOLIMNION
ACIDITY (mg/l)		
Methyl Orange	10.0	10.0
Phenolphthalein	27.5	50.0
Total	37.5	60.0
ALKALINITY (mg/l)	17.5	22.5
HARDNESS (mg/l)		
Calcium	12.5	15.0
Magnesium	22.5	12.5
Total	35.0	27.5
IRON (mg/l)	0.200	0.350
NITRATE NITROGEN (mg/l)	0.55	0.75
PH	4.4	4.6
PHOSPHATE (mg/l)	0.250	0.310
CONDUCTANCE (μmhos/cm)	20	23
SULFATE (mg/l)	-	6.0
HYDROGEN SULFIDE (mg/l)	Negative	Positive - 0.3

Beaver Bog

Temperature / O_2 / Depth Profile



III. PLANKTON DATA

A. Bergner Lake

1. Day tow
Data collection date: 7/29/83 (1:30 - 3:30 pm)

	organisms /ml
ZOOPLANKTON:	
Nauplius larvae	27.50
Diaptomus	16.50
Bosmina longirostris	13.75
Keratella cochlearis	13.75
Asplanchna	11.00
Cyclopoid	5.50
Ostracod	2.75
PHYTOPLANKTON:	
unidentified cyanophyta	401.50
Staurastrum	110.00
Anacystis	71.50
Eudorina	33.00
Peridinium	33.00
Mougeotia	27.50
Ulothrix	16.50
Asterionella	11.00
Closterium	11.00
Zygnema	11.00
Cosmarium	8.25
Oocystis	8.25
Spirogyra	8.25
Synedra	8.25
Anabaena	5.50
Ankistrodesmis	5.50
Micrasterias	5.50
Synura	5.50
Agmenellum	2.75
Ceratium	2.75
Pediastrum	2.75
Tabellaria	2.75

2. Night tow
Data collection date: 7/27/83 (9:30 - 11:30 pm)
(Data collected by Trish Particoski)

	organisms/ml
ZOOPLANKTON:	
Bosmina longinostnis	363.00
Kenatella cochlearis	302.50
Nauplius larvae	176.00
Mesocyclops edax	71.50
Ceriodaphinia megalop	38.50
Diaptomus	33.00
Holopedium	27.50
Eucyclops	22.00
Conochilus	5.50
Trichocerca	5.50
PHYTOPLANKTON:	
unidentified cyanophyta	385.00
Peridinium	291.50
Staurastrum	236.50
Anacystis	71.50
Asterionella	55.00
Anabaena	27.50
Dinobryon	22.00
Micrasterias	11.00
Ulothrix	11.00
Fragilaria	5.50
Spirogyra	5.50

B. Beaver Bog
Data collection date: 7/28/83 (8:30 - 10:30 am)

	organisms/ml
ZOOPLANKTON:	
Bosmina longirostris	1369.50
keratella cochlearis	291.50
Diaphanosuma	209.00
Nauplius larvae	115.50
Paracyclops fimbriatus	71.50
PHYTOPLANKTON:	
Peridimium	214.50
Anacystis	110.00
Staurastrum	93.50
Micrasterias	11.00
Spriogyra	11.00
Ceratium	11.00

IV. DISCUSSION

A. Bergner Lake

Solar radiation disappears exponentially as one passes downward from the surface of a lake. However, thermal stratification, a layering of the water, occurs in the summer months. This stratification is due to wind mixing the heat absorbed in the upper layers of a body of water. The upper warm region, mixed by the wind, is the epilimnion. At the bottom of the lake is the hypolimnion; this colder water is not affected by the wind. The layer of water in between the epilimnion and the hypolimnion is the thermodine. Temperature drops rapidly with increasing depth in this layer.

Dissolved oxygen also disappears as one passes downward in a lake. Biological dehydrogenation of water during photosynthesis and exchanges with the atmosphere at the surface produce the dissolved oxygen in a body of water. At depths where light cannot penetrate the water, respiration and decomposition occur and more oxygen is consummed than produced.

Temperature and oxygen readings were taken at two different sites on Bergner Lake. The temperature readings indicated that both sites had gradual thermoclines beginning at depths around 2m and ending around 5m. The oxygen readings indicated an oxygen bulge at Site 1 between 4 and 7 meters deep. A sample of water taken at this depth did not include an unusually large plankton population which would

explain the increased oxygen concentration. (This discrepancy might be explained by inaccurate oxygen readings or the sample might not have been collected from the bulge.) Site 2 tested positively for H_2S in the hypolimnion demonstrating an absence of oxygen in the layer since H_2S is produced in anaerobic conditions. Secchi disc readings of 1.30m and 1.35m suggest that light does not penetrate much deeper then 2.6m.

It appears that primary productivity must prevail in the upper 2-3m of the lake. Below this depth there is a decreased oxygen concentration, lower temperature and little light penetrance. The temperature difference between the epilimnion and hypolimnion layers suggest that the stratification is stable, since a large amount of energy would be necessary to disrupt the stratification.

Various tests were performed to determine the chemical characteristics of the lakes. The lakes'acidity, pH, alkalinity, hardness and specific conductance were determined. Acidity is a measure of the waters ability to donate hydrogen ions. The pH is a measure of the hydrogen ion concentration ($pH=-\log[H+]$). The buffering capacity of a solution is indicated by alkalinity. And, specific conductance is the solutions ability to act as an electrical conductor.

According to our tests, Berger Lake is not particularly acidic, it's pH is slightly low, it has no buffering ability, and the water is hard and can act as an electrical conductor.

Hard water is usually very alkaline and most water has some buffering ability, therefore, the negative alkalinity readings are questionable despite the fact that two different samples were tested several times with the same results. (Dystrophic bogs and waters rich in humic acids prevent accurate alkalinity measures with some tests. However, Bergner Lake does not necessarily fall into either of these categories.)

The waters were also tested for iron and for the nutrients nitrate, phosphate and sulfate. Iron is usually found in low pH waters otherwise it precipitates out in the form of $Fe(OH)_3$. The nutrients nitrate and phosphate are necessary for life. Limited amounts of these would, therefore, curtail productivity. Sulfate can be a limiting factor in growth, especially for algal populations since their amino acids often contain sulfhydryl groups.

Small amounts of iron were found in Bergner Lake. The nutrients nitrate, phosphate and sulfate were found in greater amounts. Productivity inhibition, due to lack of nutrients, probably does not occur with the amount of nutrients that are present in the lake.

A plankton community composed of phytoplankton, tiny pigmented primary producers, and zooplankton, small animals, can be found in the upper regions of a lake. This community is indicative of its environment.

Two plankton tows were performed on Bergner Lake. One tow was a day tow and one was a night tow. If the materials

collected were diluted to the same extent a comparison between the two tows could be made. This comparison might indicate daily migrations of a particular type of plankton. One would expect the Zooplankton to migrate to the surface at night after avoiding heat by remaining at a depth with cooler temperatures during the day. The phytoplankton population would be expected to be found near the surface during the day in order to receive solar energy necessary for photosynthesis. The data collected does indicate this. However, dilution was not held constant so this cannot be proven. Also, the collection and counts were performed by different people - this introduces another variable preventing accurate comparisons.

A wide variety of plankton was observed in the Bergner samples. This suggests that the water does not posses extreme characteristics which would prevent habitation of a large number of plankton. The plankton which occurs in the greatest quantity can however by utilized to infer certain characteristics of the body of water. Bosmina longingstris, the most abundant type of zooplankton found, is generally found in a classification of lakes known as eutrophic. Keratella, another abundant type of zooplankton, is associated with waters that contain a large amount of organic matter. Cyanophyta, the bluegreens, is the most prevalent type of phytoplankton found in Bergner Lake. It is most often found in the eutrophic classification of lakes.

The soluble nutrients and resultant biotic productivity

of a lake determine it's trophic nature. There are basically two fundamental types of trophic lakes. A eutrophic lake is characterized by water rich in nutrients and high biotic activity. An oligotrophic lake is one in which the water has low levels of nutrients and poor productivity.

Bergner Lake appears to lean towards the classification of eutrophy. While it posseses many eutrophic characteristics it also demonstrates many oligotrophic characteristics so this determination is not distinct. It's strong eutrophic characteristics include shallowness, abundance of plankton, and the most abundant types of plankton inferrences. It's strong contradictory characteristics are the test results indicating no buffering ability and the fact that a wide variety of plankton is found in the water.

B. Beaver Bog

Temperature readings taken at Beaver Bog indicate a shallow epilimnion of 1m and a hypolimnion beginning at a depth of 3m. Oxygen readings predict the lowest concentration of oxygen to occur between 1 and 3 meters deep. However, a sample of water taken from the depth of 3m tested positive for H_2S so oxygen readings recorded below this depth were probably incorrect as H_2S is an indicator of anaerobic conditions. A false bottom was discovered in the bog at 9m while trying to obtain water samples below this depth. A Secchi disc reading of 1.2m suggests that light does not penetrate deeper then 2.4m.

Primary productivity probably occurs in the upper 1-2 meters of the bog. Below this depth the lower temperature, the absence of light and the lack of oxygen would inhibit productivity. The difference between the epilimnion and hypolimnion temperatures suggust that the stratification is stable.

Beaver Bog is an acidic body of water, it has a low pH, it has some buffering capacity, it's water is not extremely hard, and it's specific conductance indicates a small amount of flowing electrons. Sphagnum moss acting as an ion exchanger and humic acids which arise from plant materials lower pH and make water more acidic. This might be the case in Beaver Bog especially since sphagnum moss is found there and decayed vegetable material and plant detritus, which produce humic

material, are possible. If humic acids do occur in the bog the capacity to buffer might actually be higher than the test results conclude because of the fact that waters rich in humic acid do not test for alkalinity accurately.

The amount of iron present in Beaver Bog is minimal. It would not be surprising to find a greater amount of iron since the pH is low enought to prevent precipitation. Phosphates and nitrates are present in both the epilimnion and the hypolimnion layers. Sulfate is not present in the epilimnion, but it is present in the hypolimnion. Productivity might, therefore, be limited. The absence of sulfate could be explained by conversion to H_2S if it was found in the epilimnion but H_2S was only present in the hypolimnion.

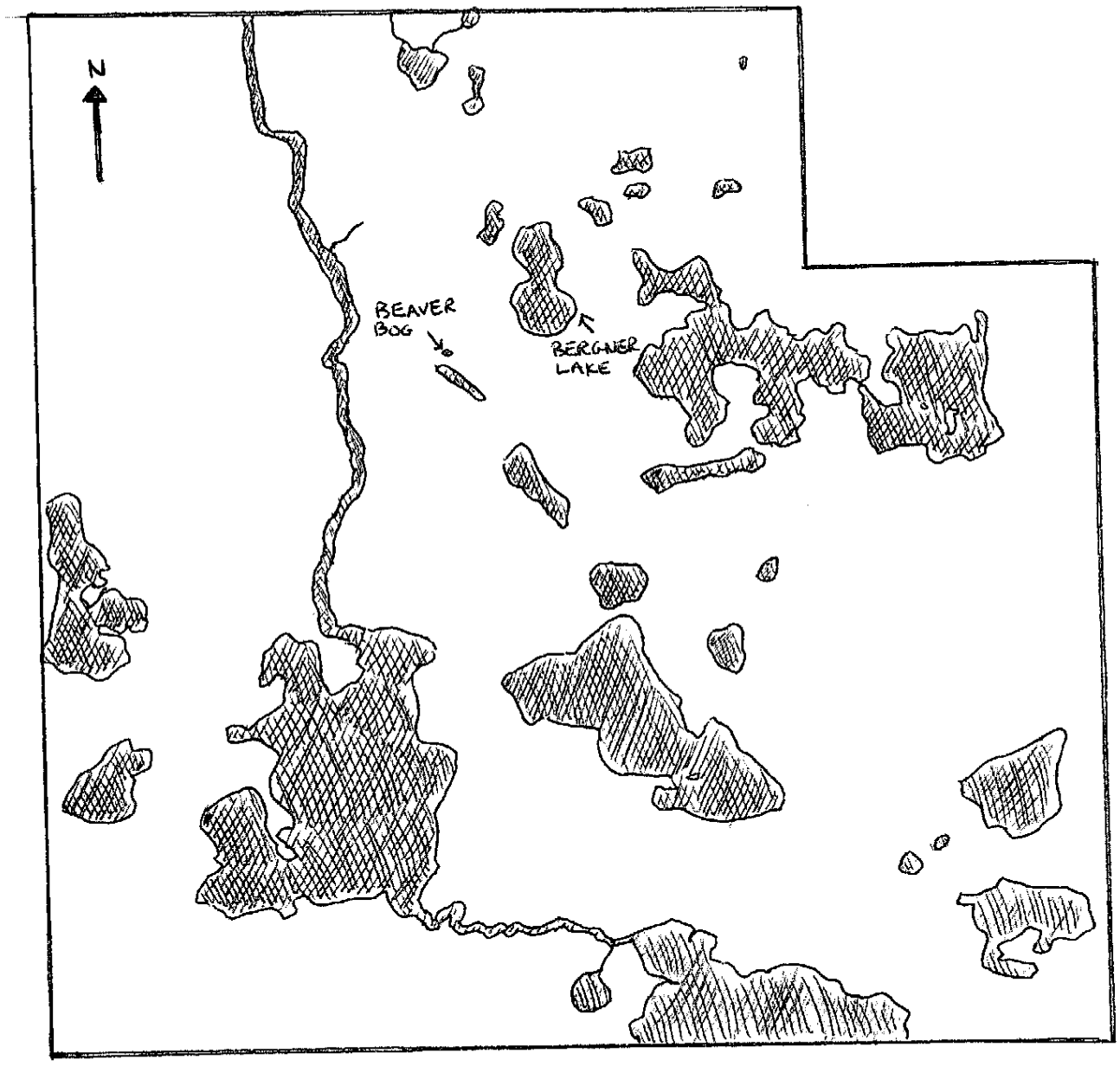
The most abundant type of zooplankton observed in Beaver Bog, Bosmina longirostris, indicates eutrophication. However, most of the characteristics of this body of water suggests dystrophy which probably belongs in the oligotrophic category. A dystrophic lake is characterized by acidic water with reduced transparency due to colloidal and dissolved humus material. Reduced transparency would result in less photosynthetic activity. — The relatively small phytoplankton population accompanies the idea of decreased photosynthesic opportunities. More accurately, Beaver Bog can be classified as a bog lake. Waters protected from wind and poorly drained may become bog lakes which are characterized as dystrophic water fringed by floating mats of Sphagnum.

C. Comparison

Bergner Lake and Beaver Bog represent two different types of lakes. I believe that Bergner Lake most closely fits the classification of a eutrophic lake. Beaver Bog, on the other hand, is in my opinion clearly a bog lake which generally shares few characteristics with a eutrophic lake.

Beaver Bog and Bergner Lake both possessed thermal stratifications. They both contained approximately the same amounts of iron, nitrates, and phosphates. The specific conductances of two bodies of water were roughly the same. Both tested positively for H_2S in the hypolimnion layers (except at Site 1 in Bergner Lake). Beaver and Bergner differed greatly in acidity, alkalinity, hardness and pH. The two subjects while containing some of the same types of plankton demonstrated dramatically different quantities and varieties of plankton. There was a slight difference between the depths of the layers of stratification and the depths of light penetrance. A distinction does seem to exist between Bergner Lake and Beaver Bog. Further research at U.N.D.E.R.C. may provide more information on the actual status of these waters. (Prior to additional study, the construction of a foot path to Beaver Bog would be recommended!)

BODIES OF WATER ON U.N.D E.R.C. PROPERTY



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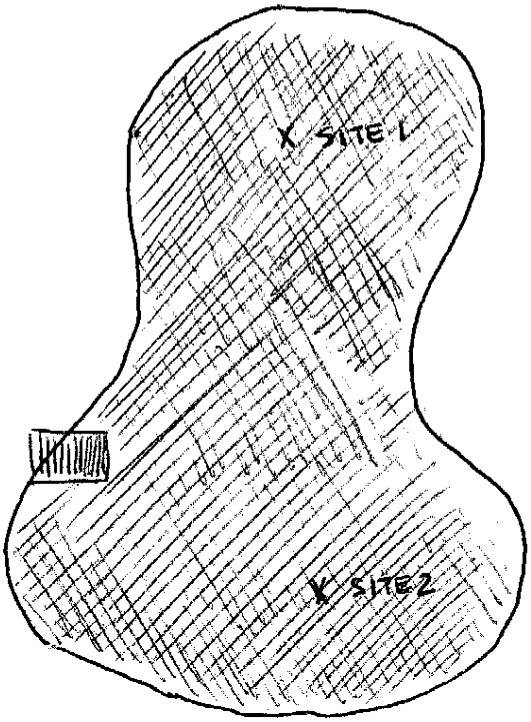
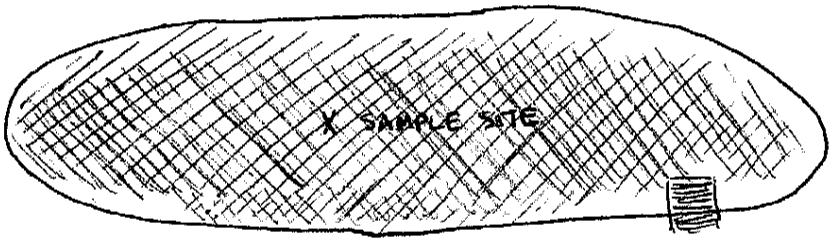
BERGNER LAKE



BEAVER BOG



Note! These drawings are not of the same scale.

REFERENCES

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Cole, Gerald A., Textbook of Limnology. St. Louis: The C.V. Mosby Company. 1983.