

A STUDY OF THE WATER CHEMISTRY AND PLANKTON
OF PAUL LAKE AND BEAVER BOG

by

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References?

A STUDY OF THE WATER CHEMISTRY AND PLANKTON
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Beaver Bog is an acid body of water. A Sphagnum mat surrounds the open body of water, measuring approximately fifteen meters by fifty meters. The bog is located in a valley-like area, the surrounding hills providing runoff waters for the bog.

Hardwood and conifer trees grow on the hills surrounding the bog. The mat of Sphagnum supports a variety of plants, including sarsaparilla trees, sundew, Labrador tea shrubs, pitcher plants, and swamp myrtle. Minnows[?] and tadpoles[?] were observed near the edge of the mat near the dock. One frog[?] was spotted on the dock.

Beaver Bog has no apparent inlet or outlet. It receives water from rain and runoff from the hill.

Paul Lake, on the other hand, drains into Peter Lake. The surrounding hills of Paul, especially the higher ones on the north and west shores, provide runoff water to the lake. There is no apparent inlet to the lake.

Hardwoods grow around Paul Lake. A small stand of conifers was noted on the eastern shore. The southern shore is a dam separating Peter and Paul. A reed bed has grown in the southwest corner of the lake.

Fish were observed shoaling in the shallow waters near the dam. Minnows were seen swimming near the edges of the 1.6 hectare lake.

Paul Lake

Verhalen 2

Date recorded: June 2, 1981, 10:30 am

Team: Mary Janni, John Paraskos, Frances Verhalen

	1 meter	3.5 meters	7 meters
Acidity - Phenolphthalein	50 mg/l	47 mg/l	47 mg/l
pH	5.5	5.5	5.5
Alkalinity	0 mg/l	0 mg/l	0 mg/l
Ca	5 mg/l	7.5 mg/l	7 mg/l
Mg	3 mg/l	1.5 mg/l	5 mg/l
Total Hardness	8 mg/l	9 mg/l	12 mg/l
Specific Conductivity	17.5 μ mhos	18.0 μ mhos	28.0 μ mhos
Phosphate - Ortho	0.08 mg/l*	0.07 mg/l	0.075 mg/l*
- Total	0.04 mg/l*	0.075 mg/l	0.05 mg/l*
H ₂ S	not present	not present	not present
Sulfate	1.5 mg/l	3.0 mg/l	2.5 mg/l
Nitrate	0.9 mg/l	0.9 mg/l	0.8 mg/l
Color - Apparent	65 units	50 units	80 units
- True	65 units	50 units	80 units
Secchi Disc	3.4 meters		

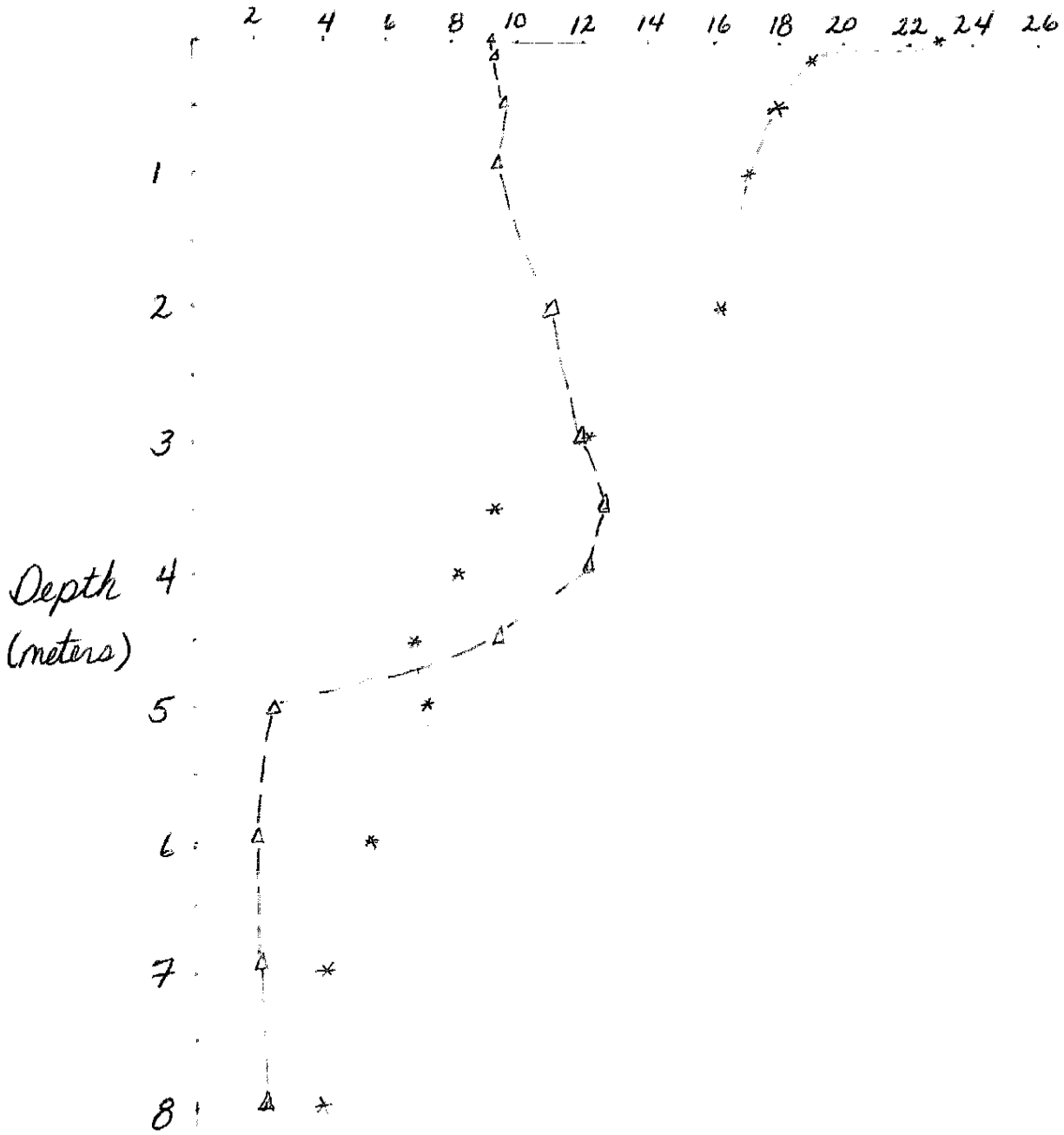
Oxygen and Temperature Data

Depth (meters)	Temperature (°C)	O ₂ Concentration (ppm)
air	23	9.2
surface	19	9.4
0.5	18	9.8
1	17.8	9.7
2	16	10.6
3	12	12.0
3.5	8.8	12.8
4	8	12.4
4.5	6.2	9.8
5	6.5	2.4
6	5.2	1.8
7	4.5	1.8
8	4.2	1.8

Paul Lake

Verhalen 4

Oxygen and Temperature Charts



△ — Oxygen (ppm)
* — Temperature (°C)

Beaver Bog

Date recorded: June 4, 1981, 10:30 a.m.

Team: Mary Janni, John Paraskos, Frances Verhalen

	1 meter	2.5 meters
Acidity - Phenolphthalein	190 mg/l	300 mg/l
- Methyl Orange	10 mg/l	10 mg/l
pH	4.75	4.75
Alkalinity	0 mg/l	0 mg/l
Ca	2.5 mg/l	4.5 mg/l
Mg	2.5 mg/l	5.5 mg/l
Total Hardness	5.0 mg/l	10.0 mg/l
Specific Conductivity	24 μ mhos	27 μ mhos
H ₂ S	not present	present
Sulfate	2.75 mg/l	2.5 mg/l
Nitrate	0.8 mg/l	0.7 mg/l
Color - Apparent	185 units	240 units
- True	165 units	210 units
Secchi Disc	1.5 meters	

Beaver Bog

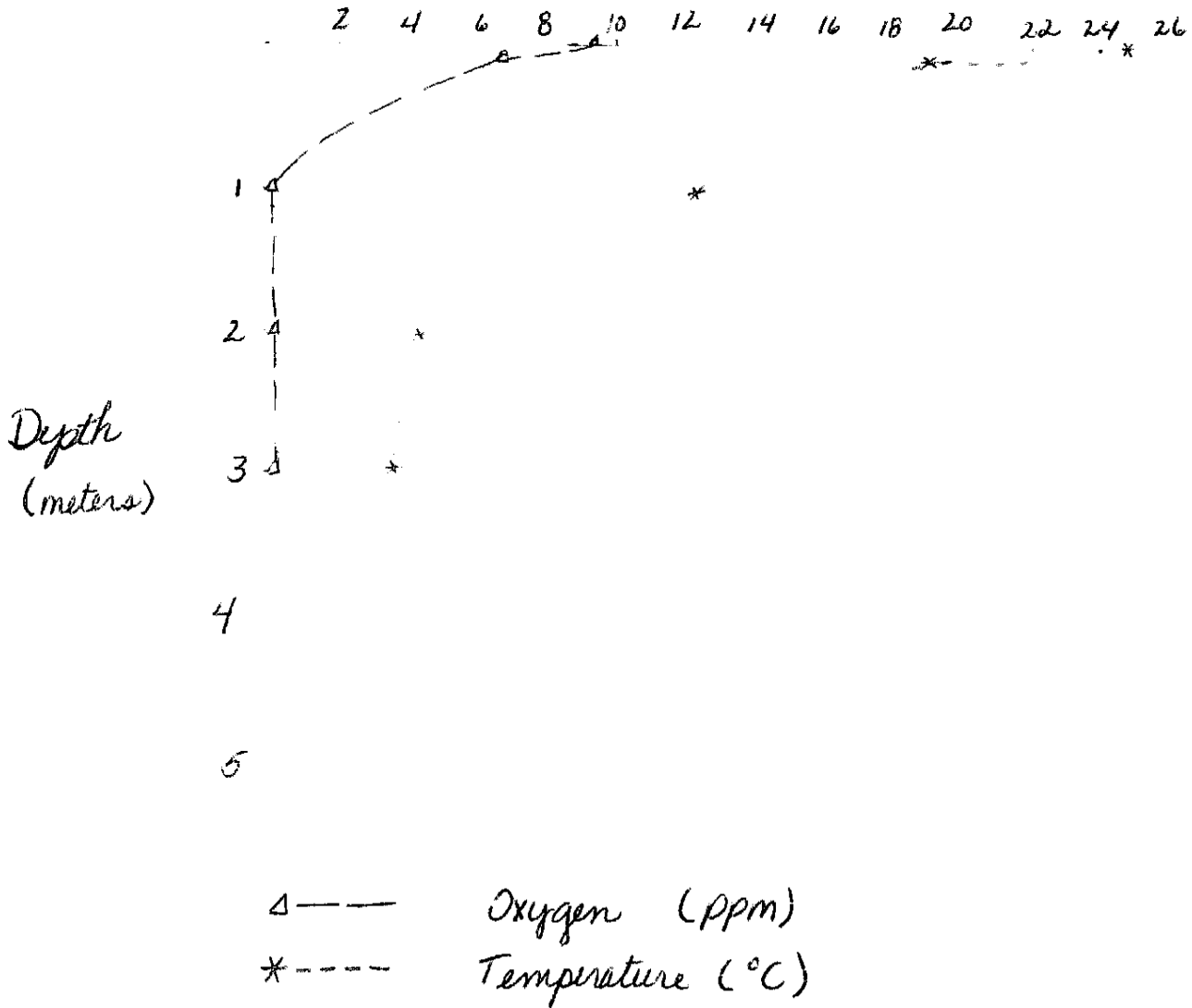
Verhalen 6

Oxygen and Temperature Data

Depth (meters)	Temperature (°C)	O ₂ Concentration (ppm)
air	25	9.4
surface	19	6.8
1	12.5	0.0
2	4.4	0.0
3	4	0.0

Beaver Bog

Oxygen and Temperature Chart



WATER CHEMISTRY

A study of the water chemistry on Paul lake and Beaver Bog was undertaken on June 2, 1961, and June 4, 1961, respectively. The team of Mary Faini, John Paraskos, and Frances Verhalen set out at 10:30 a.m. on each day to collect water samples, oxygen concentrations of the water, and temperatures of the water. The oxygen concentrations and temperature readings were taken with a YSI instrument. From the data obtained, the depths at which the water samples would be taken were determined. The first sample was taken at the one meter mark, while the second sample was taken at the depth where the temperature and oxygen concentrations stabilized. If there was an oxygen bulge, a third sample would be taken at the depth where this was recorded. (An oxygen bulge is a marked deviation from the fairly continual decline of the oxygen concentration curve. Example: 3.5 meters reading of Paul Lake.)

Once the water samples were taken with a Kemmerer, they were stored in plastic containers until we returned to the lab. At the lab, the water was analyzed using a Höch chemical kit. Tests which were run on the water included acidity, pH, alkalinity, hardness, specific conductivity, phosphate, hydrogen sulfide, sulfate, nitrate, and color. (After June 2, the phosphate tests were discontinued because of a lack of chemicals to perform the test.)

Compared to Paul Lake, Beaver Bog is highly acidic. As the depth increases in both bodies of water, the acidity also increases. In the bog, this is

more apparent as the acidity increases from 150mg/l to 300 mg/l. Bogs are highly acidic because of a lack of drainage which causes a slow decomposition of organic matter. The incomplete breakdown of organic matter accumulates to form peat. The peat releases humic acid. At lower depths in the water column, the acid becomes more concentrated as more acid settles down. The lake is less acidic than the bog because it is drained into another lake. The organic matter is broken down by microbial activity and does not accumulate.

In both Beaver Bog and Paul Lake the alkalinity proved to be 0 mg/l. There were only small amounts of calcium and magnesium found in either set of samples. Because ions tend to settle out in the water, total hardness - calcium concentration plus magnesium concentration - increased with depth. The specific conductance was slightly higher in the bog than in the lake.

The nutrients which are present in the lake and which we tested for are phosphate, sulfate and nitrate. Phosphate tests were run on the sample from Paul only. The total phosphate at 1 meter and 7 meters resulted in less milligrams per liter than the ortho phosphate tests. The total phosphate tests measure all the phosphate in the water, releasing bound phosphates from organisms by the sample preparation. The ortho phosphate tests measure the phosphate which is free in the water only. Obviously something is incorrect. Unfortunately, there were no more chemicals to redo the phosphate tests, so no retest was performed. At the 3.5 meters sample, the total phosphate was larger than the ortho phosphate. Not much information is obtained

from this test because the true meaning of phosphate concentration is not well understood.

The results from the nitrate concentration tests were similar from Beaver Bog and Paul Lake. Both bodies of water exhibited low concentrations of this substance. The concentration of sulfate was also similar in both areas. Hydrogen sulfide was smelled in the 2.5 meter sample from Beaver Bog, indicating its presence there. It was not noticed in Paul Lake or in the 1 meter sample from Beaver Bog. (As with the phosphate tests, the true meaning of the results of the sulfate and nitrate tests are unclear. The amount of nitrate and sulfate held bound and the forms in which they are held bound are not known.)

The color of the water in the bog was very dark compared to the lake. The basic acid of the water caused the water to become tea colored. As depth increased, the color of the water lightened. In the lake, the color of the water darkened as depth increased. The true color was less than the apparent color because the apparent color contained particles which settled out when centrifuged to give the true color. The depth at which light could penetrate was measured with a Secchi disc. In the bog, the Secchi disc reading was 1.5 meters. In the lake, the reading was 3.4 meters. Both readings were taken on sunny days.

OXYGEN AND TEMPERATURE PROFILES

Beaver Bog exhibited no oxygen content below the surface of the water? From the YSI readings, no oxygen was recorded. Even in the presence of hydrogen sulfide which gives a false oxygen reading, no oxygen was reported. The temperature of Beaver Bog dropped from 19°C at the surface to 4°C at three meters.

Paul Lake exhibited oxygen contents down to eight meters. The lake water ranged from 9.4 parts per million (ppm) at the surface to 12.8 ppm at 3.5 meters to 1.8 ppm at six meters. The temperature steadily declined from 19°C at the surface to 4.2°C at eight meters.

The lack of oxygen in the bog is typical of bogs. The high rate of peat production causes a decrease in the availability of oxygen. The lack of phytoplankton to produce oxygen is evident by the lack of any oxygen present at the shallow depths. The sharp decrease in temperature is caused by the inability of the sunlight to pass to the lower depths. Without the sunlight at the lower depths, the water has one other way to heat itself - to turn over. In the bog, because it is protected, the wind cannot get at the water to cause a mixing of the water, allowing oxygen and warmer waters to be moved to lower depths.

In the lake, the water is able to turn over in the spring and fall as the winds blow the water around. By causing the surface waters to become cooler than the underlying waters and by physical mixing of the water by the wind, the lake water is mixed. The increase in the oxygen content at three

and one half meters is probably due to an algal bloom at that depth.

The sunlight is able to reach that depth and the temperature is warm enough to provide a good medium for the algae to grow. From the temperature curve it appears that the lake has turned over as the decline in temperature is gradual. If the lake was in the process of turning over, the temperature would be constant down the gradient.

PAUL LAKE

Plankton Studies

107	<u>Keratella sp.</u>
7	<u>Eucyclops sp.</u>
7	<u>Ceratium sp.</u>
4	<u>Bosmina sp.</u>
4	<u>Aphanizomenon sp.</u>
3	<u>Daphnia sp.</u>

The number of organisms is figured in one milliliter of water per sample.

BEAVER BOG

Plankton Studies

420	<u>Rosmina</u> sp.
96	<u>Mesocyclops</u> sp.
40	<u>Polyphemus</u> sp.
20	<u>Keratella</u> sp.
8	<u>Dinobryon</u> sp.
2	<u>Asterionella</u> sp.

The number of organisms is figured in one milliliter of water per sample.

PLANKTON STUDIES

Plankton was collected from Paul Lake and Beaver Bog on June 2, 1981, and June 4, 1981, respectively. The plankton were collected into a plankton net which was pulled along the surface of the water for four minutes at Paul Lake and two minutes at Beaver Bog. The plankton was transferred from the collecting cup and returned to the lab where it was mixed with formalin. (The mixing of formalin with the plankton sample preserved the sample until it was analyzed.)

Beaver Bog appeared to be more productive at the surface of the water than did Paul Lake. Most of the plankton found at the surface in the bog were cladocerans. Larger invertebrates were not found. This may be due to the population of minnows and tadpoles which are found in the bog and which feed upon the larger plankton. In the lake, the low plankton population at the surface may be due to the presence of the plankton at deeper depths than was sampled. The light penetrated to 3.4 meters and the organisms could have been located lower in the water column than the 0.5 meters that was sampled in the plankton tow.

Most of the plankton identified was zooplankton. The phytoplankton may not have bloomed, though this is not the case in the lake. There seemed to be an algal bloom at 3.5 meters as shown in the oxygen bulge. The phytoplankton may be assumed to be at deeper depths in Paul Lake. However, the bog does not show any indication of phytoplankton at the surface or in the water column.

DISCUSSION

Beaver Bog and Paul Lake are two distinct types of bodies of water. Beaver Bog is characteristic of bogs. Located in its hollow, the bog has acidic water, is surrounded by a Sphagnum mat, has low oxygen content in the water below the surface, and has low temperatures below the depth at which light can penetrate. The mat surrounding the bog supports various plants which are commonly found in bogs. The plankton of the bog are small but numerous. Predators, such as the minnows and tadpoles found, keep the larger plankton at a minimum number.

Paul Lake has a moderate acidity. The oxygen concentrations and warmer temperatures at lower depths help support the plankton in the water column. The small amount of plankton collected in the plankton could be caused by the movement in the water column of the plankton. Algae is assumed to be present at 3.5 meters because of the oxygen bulge at that depth. The presence of fish in the lake indicates that there is enough oxygen in the water and that the acidity is not too severe to support a population of fish.

Peter Lake
6-2-81 10:30am

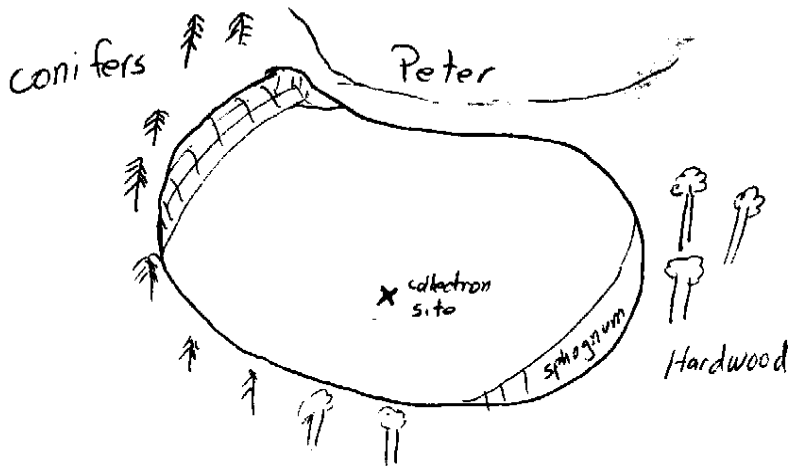
Jaini, Parashar,
Verhalen

Test	1 meter	3.5 meter	7 meter
acidity	50	60	60
pH	5.1	5.0	5.0
alkalinity	25	20	40
Ca	10	15	20
Mg	5	4	1
Total Hardness	15	19	21
Nitrate	.7	.8	.8
Phosphate - ortho	.08	.06	.09
- total	.04	.03	.04
Sulfates	1	3	3
Conductivity	36	37	42
H ₂ S	0	0	0
secchi disc		5.1 meters	
color - apparent	55	55	55
- true	55	55	55

	Depth (m)	Temperature (°C)	O ₂ Concentration (ppm)
air		24	8.6
surface		19.5	10.5
1		18.5	9.8
2		17.8	9.8
3		15.2	11.8
4		12.5	11.0
5		9.5	8.4
5.5		8.0	6.2
6		7.3	2.4
7		6.0	0
8		5.3	0
9		5.0	0

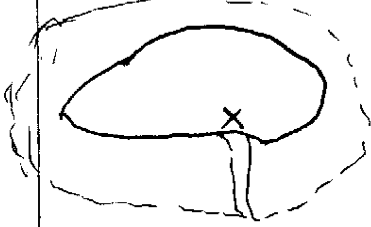
Paul Lake

Paul has a sphagnum mat that is just beginning.
The south side is a combination of conifers and hardwoods



The weather was fair with relatively no wind

Tender Bog



Tender Bog is well protected from wind by a forest of conifers. A thick sphagnum mat, populated with small, scraggly shrubs, ringed the open water.

The water sample and O_2 and temperature data were collected near the dock. The day was sunshiny.

Kickapoo Lake 23



Kickapoo Lake is surrounded by a marsh mat. Conifers line one side of the lake, while hardwoods dominate the other side. Kickapoo has inlets from Plum and Emeline Lakes, and drains into Brown Creek.

The water sample and O_2 and temperature data were taken from the middle of the lake. The day was sunny and there was no wind.

Jender Bog
 6-1-81 2 pm

Mary Fini
 John Paradise
 James Verhalen

Test	1 meter	3 meters
acidity	115	115
pH	4.5	4.5
alkalinity	0	0
Ca	5	5
Mg	15	15
Total Hardness	20	20
Nitrate	.8	.9
Phosphate - ortho	.077	.210
-total	.025	.020
Sulfates	0	0
Conductivity	62	30
H ₂ S	0	0
Secchi disc		1.5m
Color - apparent	190	190
-true	190	190

Depth (m)	Temperature (°C)	O ₂ Concentration (ppm)
air	25.0	8.4
surface	16.8	4.5
1/4	16.3	4.3
1/2	14.8	2.6
3/4	13.6	2.47
1	11.3	2.3
1 1/2	7.5	1.2
2	5	0.7
3	4	0.6
4	3	0.6

Kickapo' Lake

6-3-81 8:30am

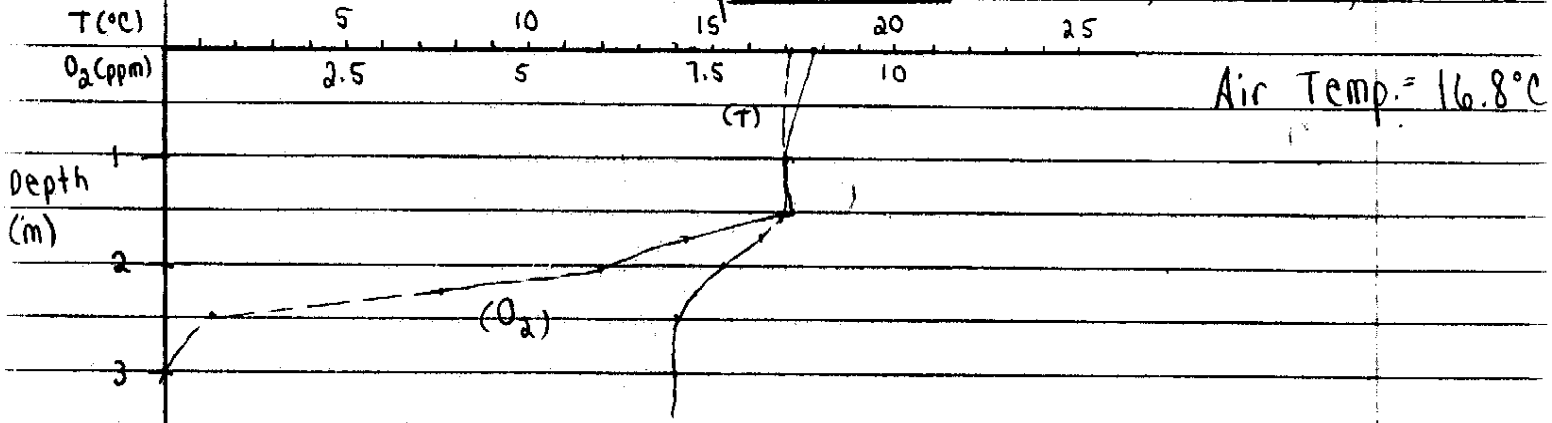
Juni, Parados, Verhalen

Test	1 meter	2.5 meter
acidity	30	20
pH	5.5	5.5
alkalinity	23	29
Ca	27	30
Mg	13	20
Total hardness	40	50
conductivity	45	45
nitrate	0.4	0.3
sulphate	9.5	2.5
H ₂ S	0	0
Secchi disc	1.8 meter	
Color - apparent	80	115
- true	75	90

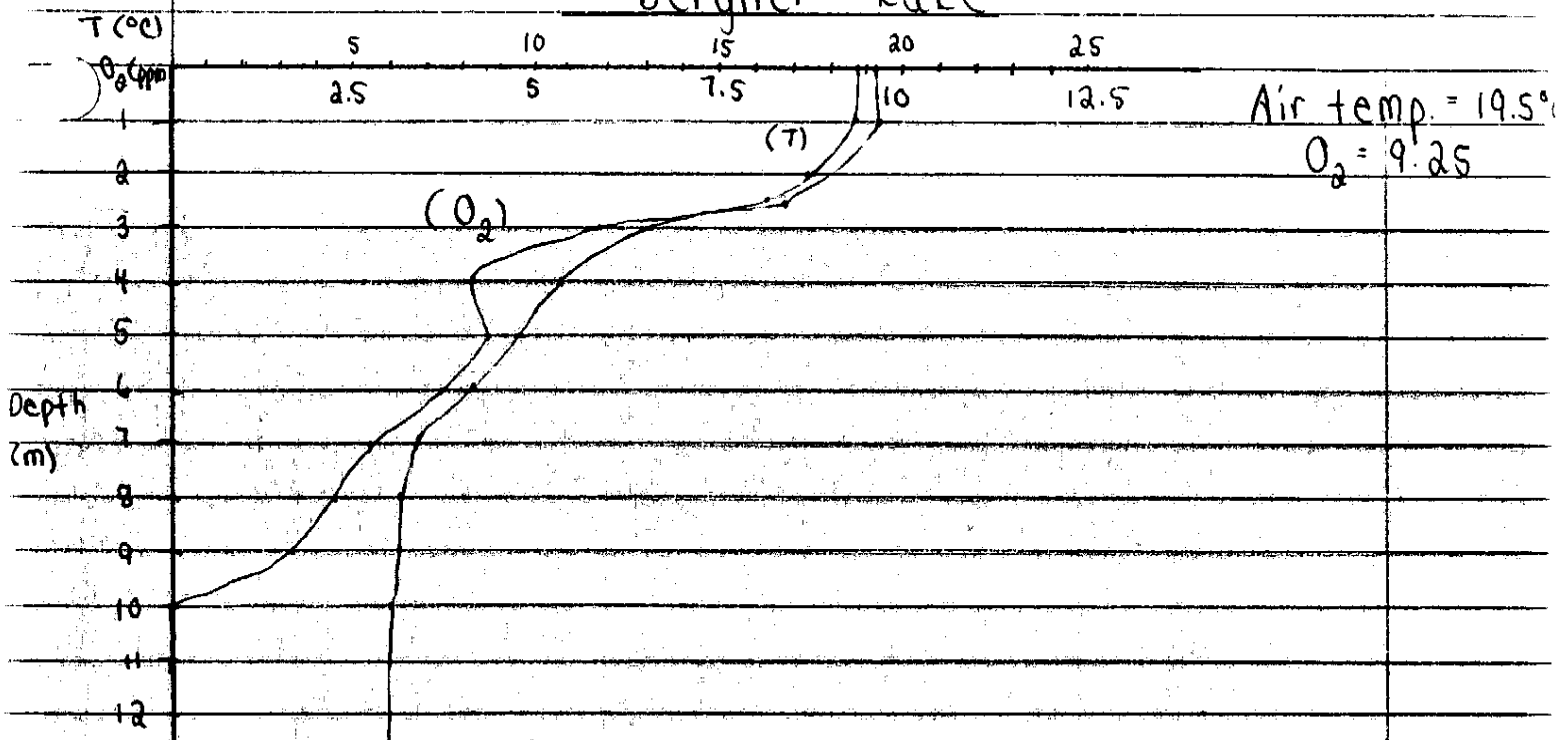
Depth (m)	Temperature (°C)	O ₂ concentration (ppm)
Air	16.8	
surface	17.1	8.8
1.00	17.0	8.6
1.50	17.0	8.7
1.75	16.2	7.2
2.00	15.2	6.0
2.25	14.5	3.8
2.50	14.0	0.7
3.00	14.0	0.0

Kickapoo Lake

Faini, Verhalen, Paraskos



Bergner Lake



Paul Lake

6-2-81 10:30am

Zinni, Paraska, Verbalen

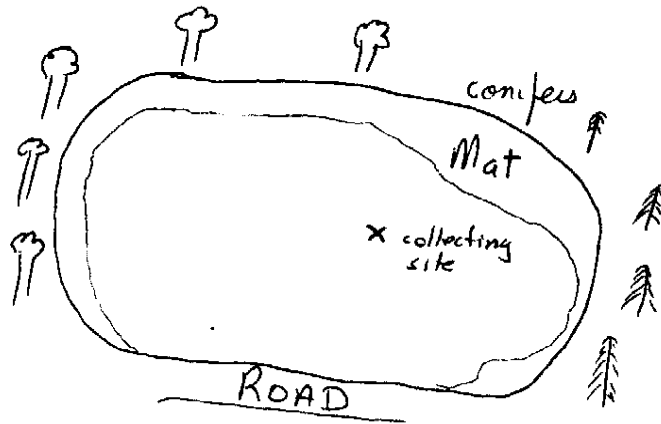
Test	1 meter	3.5 meter	7 meter
acidity	50	47	47
pH	5.5	5.5	5.5
alkalinity	0	0	0
Ca	5	7.5	7
Mg	3	1.5	5
Total Hardness	8	9	12
Titrates	.9	.9	.8
Phosphates - ortho	.08	.07	.08
- total	.04	.08	.05
sulfates	1.5	3.0	2.5
conductivity	17.5	18.0	28.0
H ₂ S	0	0	0
Secchi disc	3.4 meters		
Color - apparent	65	50	80
- true	65	50	80

Depth (m)	Temperature (°C)	O ₂ concentration (ppm)
air	23.0	9.2
surface	19.0	9.4
0.5	18.0	9.8
1.0	17.8	9.7
2.0	16.0	10.6
3.0	12.0	12.0
3.5	8.8	12.8
4.0	8.0	12.4
4.5	6.2	9.8
5.0	6.5	2.4
6.0	5.2	1.8
7.0	4.5	1.8
8.0	4.2	1.8

Verhalen
Faini
Paraskos

Peter Lake

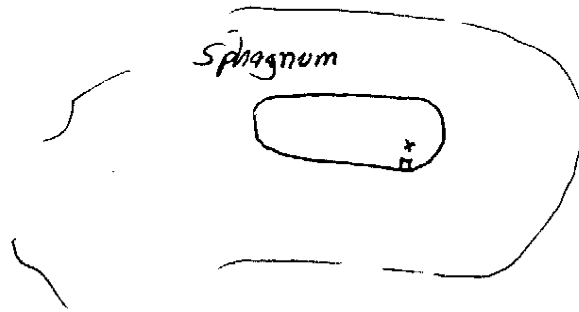
The sphagnum mat on Peter is starting to take hold
Conifers line the east and north shores while hardwoods and
a road line the south and west.



The weather was fair (sunny) with a mild wind but nothing appreciable.

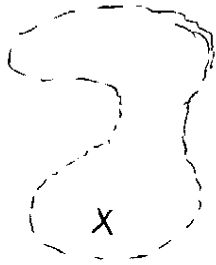
Beaver Bog

Beaver Bog is very small with only a 15 m by 50 m oval with open water



The weather was sunny and warm. The bog was well protected from any wind. There was an abundance of tadpoles swimming around.

Berquer Lake



Berquer Lake is an open lake. The shores are flat and covered with shrubs. Conifer trees surround the shrubs.

The lake is relatively shallow. However, the water samples and O_2 and temperature data were collected from a hole extending eleven meters deep.

The sun was shining. The wind was blowing, and the water was choppy.

Beaver Bog

6-4-81

10:30 am

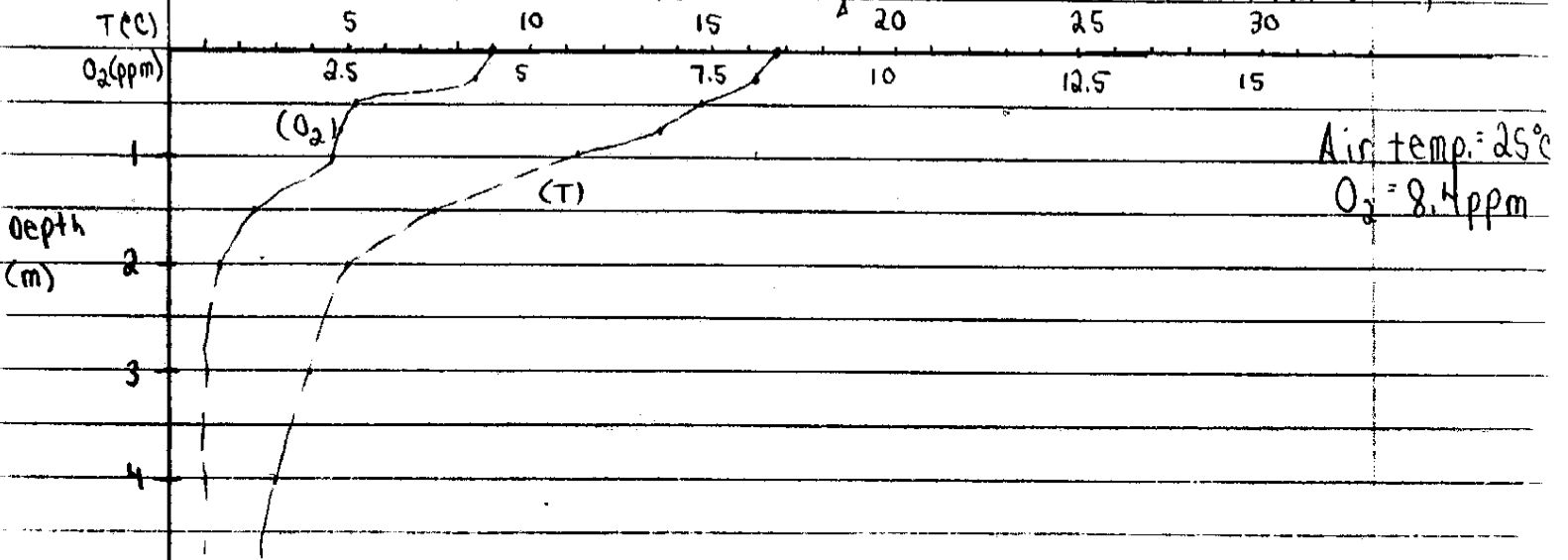
Fair, Partly, Vechalen

Test	1 meter	2.5 meter
Acidity - phenolphthalein	190	300
- methyl orange	10	10
pH	4.75	4.75
alkalinity	0	0
Ca	2.5	5.5
Mg	2.5	4.5
total hardness	5.0	10.0
conductivity	24	27
H ₂ S	0	yes
nitrates	0.8	0.7
sulfates	2.75	2.50
color - apparent	185	240
- true	165	210
secchi disc	1.5 meters	

Depth (m)	Temperature (°C)	O ₂ concentration (ppm)
air	25.0	9.4
surface	19.0	6.8
1	12.5	0.0
2	4.4	0.0
3	4.0	0.0

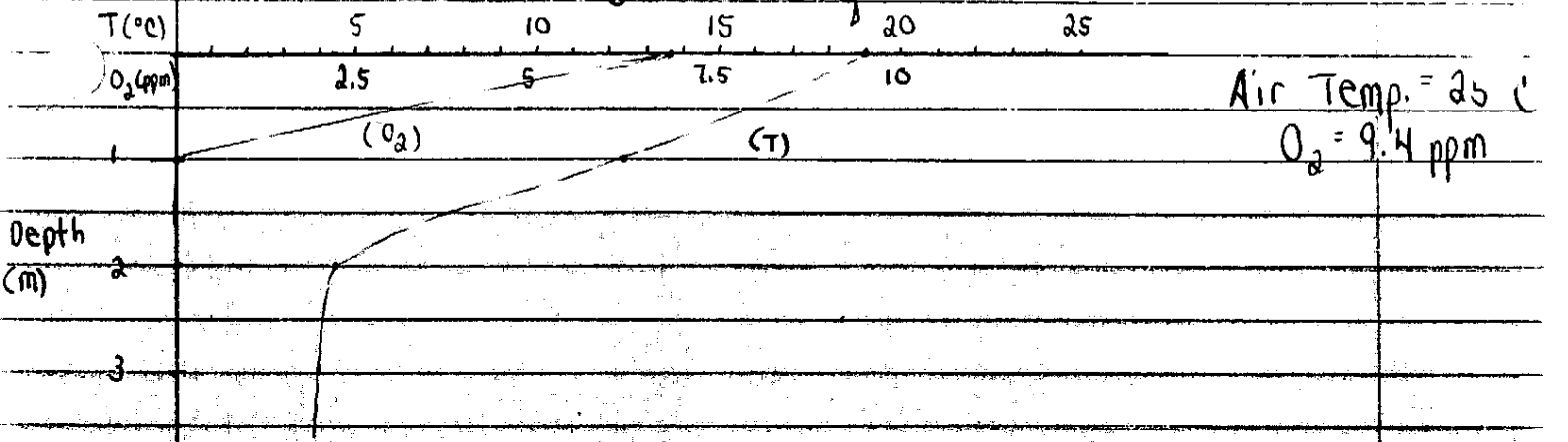
Tender Bog

Faini, Paraskos, Verhaler



Beaver Bog

Air Temp. = 25 $^{\circ}C$



Bergner Lakes

6-5-81

8:30am

Jaini, Paraske, Verhalen

Test	1 meter	7 meters
acidity - phenolphthalein	60	80
methyl orange	10	10
alkalinity	0	0
Ca	7	10
Mg	3	7.5
total hardness	10	17.5
conductivity	33	120
pH	5.0	5.0
nitrate	0.6	0.7
sulfate	10.0	19.5
H ₂ S	no	no
secchi disc	2.6 meters	
color - apparent	77.5	77.5
- true	60.0	57.5

Depth (m)	Temperature (°C)	O ₂ concentration (ppm)
air	19.5	9.25
surface	18.8	9.60
1.0	18.8	9.70
2.0	17.8	8.80
2.5	16.5	8.10
3.0	13.3	6.00
4.0	11.0	4.30
5.0	9.8	4.60
6.0	8.4	4.10
7.0	7.0	2.80
8.0	6.5	2.30
9.0	6.5	1.70
10.0	6.3	0.00
11.0	6.3	0.00