1979

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Lake Report from U.N.D.E.R.C.

Bergner Lake and Forest Service Bog

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Bergner Lake drains into Firestone Lake, which is situated Northwest of Bergner. From there, Firestone drains into Tenderfoot Creek, which flows North. The terrain surrounding Bergner contains mostly conifers. The banks around Bergner are very flat and contain a thick shrub mat. Bergner is not a large lake but it is not very small either. It is an extremely open lake, due to the conifers being away from the edge. Thus, the lake is subjected to very rough water on windy days and a small ripple on calm days. Bergner is shaped almost like an ecllipse constricted across the middle forming two lobes. The lobes of the lake are along the North-South parallel. The water samples in Bergner were taken in the Southeast corner where there is a deep spot. The samples were obtained on a rainy morning with winds coming from the Northeast.

Forest Service Bog is an example of a Kettle Bog, as are most bogs at U.N.D.E.R.C. Kettle Bogs have certain characteristics: they tend to be very deep with false bottoms (a few meters of silt) and they have a sphagnum mat growing over the water. Forest Service Bog is very protected and thus it is unusually calm. The sphagnum mat is thick enough to walk on and it supports Tamaracks (conifers that shed leaves) and Pitcher plants. Surrounding the sphagnum mat, which is quite extensive, are many hardwoods with a few conifers. Water samples were taken from the middle of the bog on a rainy morning. The sky was thus very overcast. Due to its being very protected, there was no wind disrupting the water surface.

The different tests used in the water chemistry analysis were acidity, alkalinity, color, hardness, H_2S, nitrates, pH, phosphates, seechi-disc and specific conductance.

The acidity measures the amount of hydrogen ions present in the body of water, whereas the alkalinity refers to the capability of water to neutralize acids. In natural water bodies, the alkalinity occurs when carbonates, and bicarbonates are present. Another affect upon the alkalinity, are hydroxides of calcium and magnesium and sodium metals present in the water. According to the Hach Water Chemistry handbook, at complete neutralization of alkalinity present, the indicator changes color. Below are a few indicators:

Phenolphthalein	
Acid ----------	Alkaline
colorless	pink

Brom Cresol Green	
Alkaline --------	Acid
blue	yellow

Methyl Red	
Acid ----------	Alkaline
red	yellow

The color test is divided into two parts; the apparent and true color. The apparent color is given by the metal complexes, turbidity and phytoplankton within the water sample. The true color is the actual color of the water after centrifugation.

The hardness of the water was originally defined as the ability of water to precipitate soap, however, today calcium and magnesium ions tend to be the main causes. By determining the numbers of calcium and magnesium ions present in mg/l of $CaCO_3$ the hardness can be stated. Most drinking water supplies tend to have approximately 250 mg/l. According to the Hach Water Chemistry handbook, the test for total hardness functions

best when the sample is buffered to a pH of 10.1. The buffering agent is Hardness I Solution, using an organic amine and a salt. The indicator for the test is the organic dye, calmagite (ManVer II Powder Pillow), which reacts with the calcium and magnesium ions to give a red complex. When titrated with EDTA (chelating agent) and potassium hydroxide is added, the magnesium ions are removed and the indicator color changes from red to blue. Thus, the calcium hardness can be determined and when it is subtracted from the total hardness, the magnesium hardness is obtained.

The test for H_2S must be run immediately after the sample from the hypolimnion is obtained. If the test is not run right away, the H_2S will oxidize and no reading will be obtained. Simply by smelling the water sample, it is possible to determine if H_2S (smells like rotten eggs) is present.

Nitrate is the most completely oxidized state of nitrogen which is found in water. Nitrate-forming bacteria convert nitrites into nitrates under aerobic conditions. Lighting is another factor which converts large numbers of atmospheric nitrogen into nitrates. Thus, the nitrate test indirectly measures the amount of nitrate-forming bacteria present in the body of water, and how much light penetrates the water column. 45 mg/l is the maximum amount of nitrates allowable in drinking water supplies.

The logarithm of the reciprocal of the hydrogen ion activity expressed in moles per liter, is commonly referred to as the pH. In other words, pH expresses the tendency to accept or donate hydrogen ions.

Orthophosphates are taken up by the phytoplankton. Metaphosphates are covalent chains of phosphates and ATP is an example of a organic phosphate. Together, these make up the total phosphate level in a freshwater system. Unlike nitrates, phosphates are the limiting nutrient in freshwaters.

Secchi-disc readings must be taken off the shaded or protected side of the boat. The readings can be fouled up by the sun, wind, cloud-cover and conditions on the surface. When taking the reading, your eyes should be about one meter above the water.

The specific conductance test measures the amount of metal material in the water studied. The units of specific conductance are μmhos/cm.

The data below was determined from the samples taken in Bergner Lake on June 6, 1979 and Forest Service Bog on June 7, 1979.

BERGNER LAKE

ACIDITY:

1m -- 170 mg/l
3m - 160 mg/l

ALKALINITY:

1m - <10 mg/l
3m - <10 mg/l

COLOR:

Apparent:

1m - 75
3m - 85

True:

1m - 65
3m - 70

HARDNESS:

Ca^{++}:

1m - 10 mg/l
3m - 10 mg/l

Mg^{++}:

1m - 0 mg/l
3m - 0 mg/l

Total:

1m - 10 mg/l
3m - 10 mg/l

H_2S:

not present

NITRATE:

1m - 1.0 mg/l
3m - 0.8 mg/l

pH:

5.1

SECCHI-DISC:

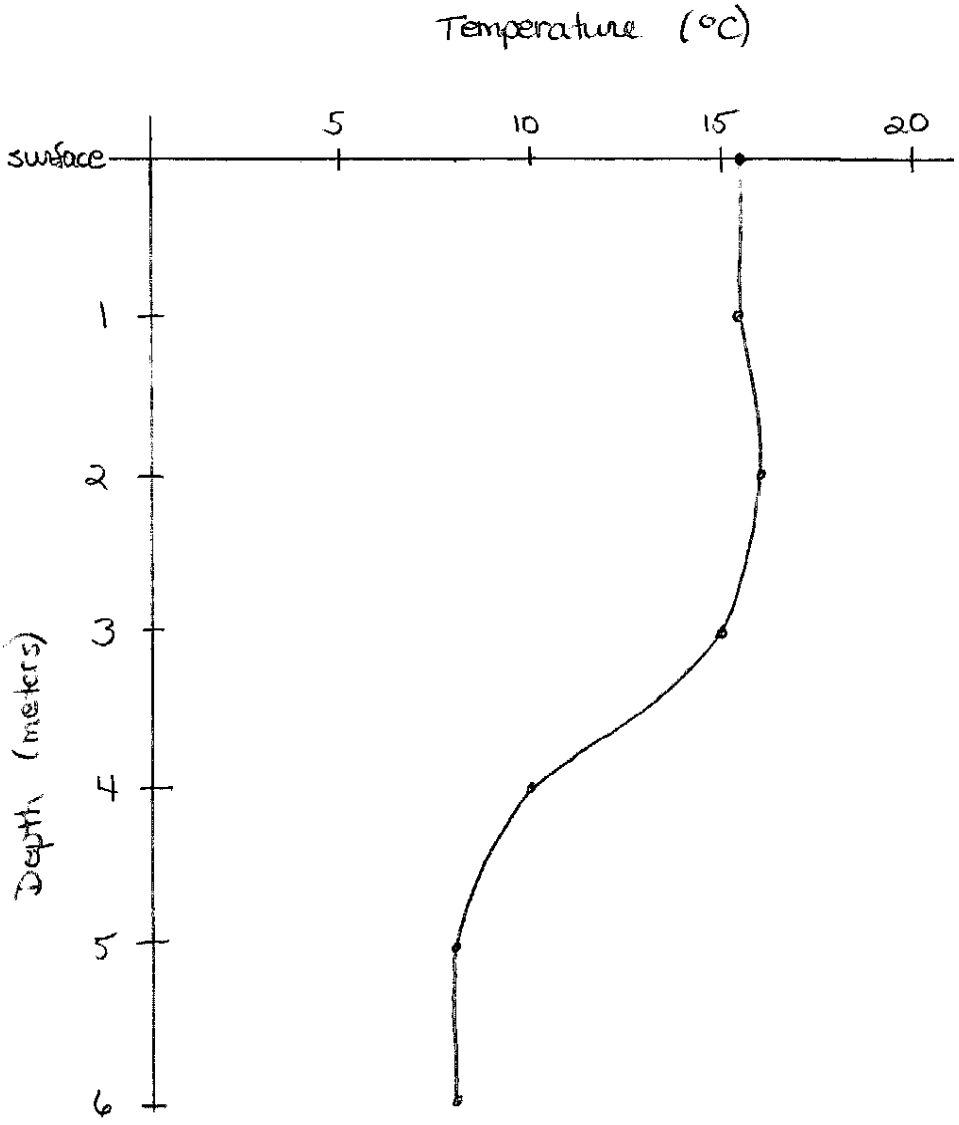
2.0 m

SPECIFIC CONDUCTANCE:

1m - 20 μmhos Range 3
3m - 18 μmhos Range 3

OXYGEN PROBE:

Air temperature - 10.5 °C
surface - 15.5 °C
1m - 15.5 °C
2m - 16.0 °C
3m - 15.0 °C
4m - 10.0 °C
5m - 8.0 °C
6m - 8.0 °C



Temperature Profile for Bergner Lake

With a low pH, such as 5.1, there should be a high acidity and a low alkalinity reading. Also with a low pH, the hardness, nitrate and specific conductance readings should be low. The data corresponds to this pattern very nicely, however, there seems to be an inaccurate seechi reading. For this clear a lake (the color readings suggest a clear lake), it would seem that the disc would be visible beyond two meters. This would be the case, however the reading was taken on a rainy and windy day. Thus the rain and wind kept us from making an accurate reading. The magnesium reading of zero, demonstrates the softness of the water. The graph of the depth vs. temperature shows the slight thermocline existing between the epilimnion (surface waters) and the hypolimnion (deep waters).

FOREST SERVICE BOG:

ACIDITY:

0.5m - 190 mg/l
3m - 200 mg/l

ALKALINITY:

0.5m - <10 mg/l
3m - <10 mg/l

COLOR:

Apparent:

0.5m - 45
3m - 75

True:

0.5m - 25
3m - 35

HARDNESS:

Ca^{++}:

0.5m - 10 mg/l
3m - 10 mg/l

Mg^{++}:

0.5m - 0
3m - 0

Total:

0.5m - 10 mg/l
3m - 10 mg/l

H_2S:

present

NITRATE:

0.5m - 0.4 mg/l
3m - 0.4 mg/l

pH:

0.5m - 2.9
3m - 2.8

PHOSPHATE:

0.5m - 0.15 mg/l
3m - 0.10 mg/l

SECCHI-DISC:

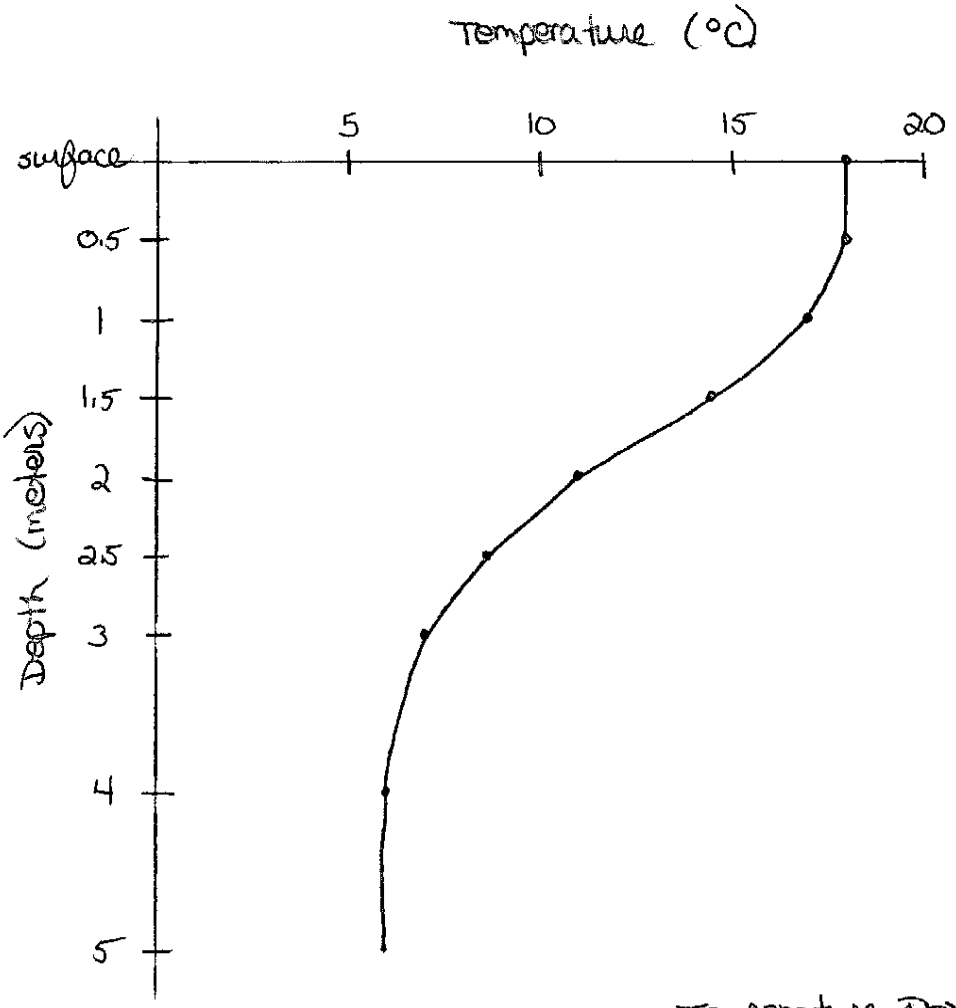
2.0-2.1 m

SPECIFIC CONDUCTANCE:

0.5m - 10 μmhos Range 3
3m - 9.5 μmhos Range 3

OXYGEN PROBE:

Air temperature - 18.5 C
surface - 18.0°C
0.5m - 18.0°C
1m - 17.0°C
1.5m - 14.5°C
2m - 11.0°C
2.5m - 8.7°C
3m - 7.0°C
4m - 6.0°C
5m - 6.0°C



Temperature Profile for Forest Service Bog.

Again the data follows the pattern resulting from a low pH. The acidity is high and the alkalinity low. The hardness (the water is soft-no magnesium present), nitrate and specific conductance readings are low. The color again suggests a clear water column, however the seechi reading was taken on a rainy day. According to the graph of depth vs. temperature an extremely steep termocline exists in Forest Service Bog. This thermocline is due to the deepness of the bog and the small surface-air ratio. Only small amounts of light can penetrate the water column due to the small ratio and thus the temperature decreases sharply going down the water column.

Plankton, a term coined from a Greek word that means "wandering" is divided into two categories: phytoplankton and zooplankton. Phytoplankton is the plant component, which includes a very high proportion of single-celled algae called diatoms and also many chlorophyll-containing flagellates. Sometimes the phytoplankton are so abundant that they give a lake a green color. This is otherwise known as a phytoplankton "bloom." The small animals and animal larvae that graze on phytoplankton are called zooplankton, which obtain their food by filtering methods. Whereas phytoplankton are considered primary producers, the zooplankton are known as primary consumers in an ecological pyramid. The plankton are microscopic drifters which make up the main nutrient concentration in a water body. Due to the vertical drifting mechanisms, it is necessary to take plankton tows in both the lighted portion of the day and the darker portion. Phyto-plankton are most easily caught in the daylight, for they must be in the surface waters to capture the light necessary for photosynthesis. By doubling the seechi-disc reading, you can approximate the depth of light penetration. In the night, zooplankton vertical migrate to feed on the phyto-

plankton in the surface waters. The darkness tends to save them from predation.

The plankton net was used to collect the samples used in the research. One problem with the plankton net is the pressure wave created as it moves through the water. As a result, many minute plankton get pushed aside.

The phytoplankton found in Bergner were:

1. Agmenellum
2. Asterionella
3. Closterium
4. Desmidium
5. Diatoma
6. Dinobryon
7. Fragillaria
8. Mougeotia
9. Staurastrum
10. Tabellaria
11. Ulothrix
12. Zygnema

Asterionella, a centric diatom, was the major phytoplankton component of the daytime sample. There were many Tabellaria and few Fragillaria, both of which are pennate diatoms. Mougeotia, Desmidium, Ulothrix and Zygnema all represent filamentous green algae. There were very few of each of these. Two desmids were present, Staurastrum (one) and Closterium (some). Dinobryon (many) was the only green flagellate present. Agmenellum was the only filamentous blue-green algae present.

The zooplankton found in Bergner were:

1. Cyclops bicuspidatus
2. Cyclops vernalis
3. Nauplii larvae
4. Bosmina coregoni
5. Holopedium
6. Asplanchna
7. Conochiloides
8. Conochilus
9. Kellicottia longispina
10. Keratella cochlearis

There seemed to be just as many Nauplii larvae (Copepod) as Keratella cochlearis (Rotifer) in the night zooplankton sample. The other Rotifers: Asplanchna, Conochiloides, Conochilus and Kellicottia longispina represented only a small part of the zooplankton population. Bosmina coregoni and Holopedium were the only Cladocerans and they too were only a small part of the population. The only other Copepods in the sample were Cyclops bicuspidatus and Cyclops vernalis of which there were one of each. The morning zooplankton sample had no organisms.

The phytoplankton found in Forest Service Bog were:

1. Anabaena
2. Desmidium
3. Dictyosphaeria
4. Tabellaria

Desmidium of which there were two found in the sample, seemed to be the most abundant. The only other filamentous green algae present in the morning sample was Tabellaria. Anabaena (one) was the only filamentous blue-green algae present. Dictyosphaeria (one) represented the only coccoid green algae.

The zooplankton found in Forest Service Bog were:

1. Daphnia longispina
2. Daphnia pulex
3. Nauplii larvae
4. Cyclops vernalis
5. Brachionus
6. Conochiloides
7. Keratella cochlearis

The most abundant zooplankton in the night sample was Nauplii larvae. Otherwise, the insect Chaoborus from the Order Diptera were the most abundant. There were equal amounts of the Cladocerans, Daphnia longispina and pulex. The three Rotifers present, Brachionus, Conochiloides and Keratella cochlearis made up a very small portion of the population.

The only other Copepod found was Cyclops vernalis which only had two members. No zooplankton was found in the morning sample.

The main difference between Bergner Lake and Forest Service Bog is the pH. The pH is much lower in a bog, due to the production of uronic acid from the sphagnum mat. As a result of the uronic acid, there is a increase in the release of hydrogen ions. Since both pH values in the lake and bog are relatively low, there tends to be a low alkalinity, hardness and specific conductance reading. The color values are much higher in Bergner than in Forest Service Bog, thus there is a shallow thermocline. The less color there is, the more the sun can penetrate and the steeper the thermocline. This is the case in Forest Service Bog. All readings of hardness in both the lake and bog show that the water is "soft" (no magnesium ions present). The nitrate level in Forest Service Bog is a little lower than Bergner, which tells us that there is less light reflecting on the surface of the water. Bergner has a higher surface-air ratio than Forest Service Bog. Finally, the specific conductance values are higher in Bergner than Forest Service Bog. From this data, it is determined that Bergner contains more metal material than the water in Forest Service Bog.