[illegible] Lake
and Beaver Bog;
a comparison of two dissimilar
bodies of water

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The purpose of this paper is to present and compare data on the water chemistry and plankton populations of two dissimilar bodies of water. The two subjects picked, Bergner Lake and Beaver Bog, are located within the boundaries of the University of Notre Dame Enviornmental Research Center (UNDERC) on the Michigan/Wisconsin border about 25 miles west of Land O'Lakes, Wisconsin. Both subject waters lie within Gogebic County, Michigan proper. All information was gathered on 29 July (Beaver Bog) and 30 July (Bergner Lake), 1992, and during mid-day for both lakes.

The first subject, Bergner Lake, is a fairly large (~18ha) and very productive body of water. It is shallow throughout most of its area, and along its major axis, roughly north to south, it is susceptible to considerable wind-borne wave action. Bergner drains into an adjacent marsh area, which is called Firestone Lake, and then on into Tenderfoot Creek. This is all part of the Ontonagon River watershed that eventually drains into Lake Superior. Bergner is edged by thick mats of shrub growth, especially on the west side towards Firestone Lake, and surrounded by large stands of black spruce, white pine, and jack pine. Bergner is not fed by any stream but is replentished by runoff from the surrounding gentle terrain.

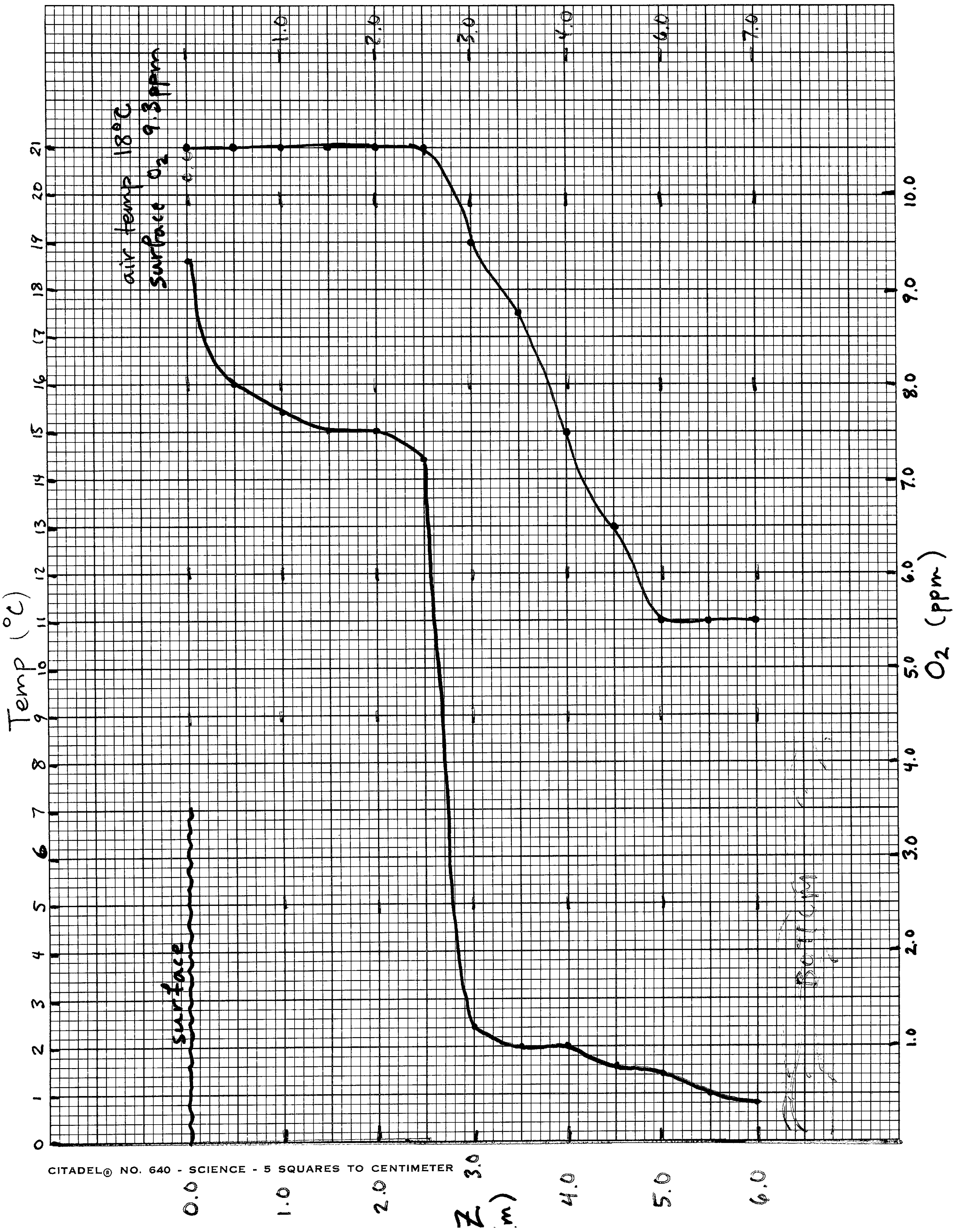
Borgner Lake

Water Chemistry

	Epilimnion	Hypolimnion
Acidity (mg/L)		
Methyl Orange	0	0
Phenolphthalein	5	15
Alkalinity (mg/L)	6	6
Color		
Apparent	86	
True	72	
Hardness (mg/L)		
Ca^{++}	3	3
Mg^{++}	0	0
Total	3	3
Nitrates (mg/L)	0.7	0.5
Phosphates (mg/L)		
Ortho	0.08	0.17
Total	0.20	0.30
Specific Conductance (μmho/cm)	16	18
Sulfates (mg/L)	0.1	0.1
Sulfide	negative	negative
pH		
at lake (indicator paper)	5.0	5.5
in lab (Hach kit)	5.8	6.0
Secchi disk (m)	1.5	
Iron (mg/L)	0.08	0.14

Temperature and Oxygen curves on next page.

BERGNER LAKE O₂ and Temp. curves



Doegner Lake

<u>Plankton</u>

Phytoplankton:	Concentration (from net)
Peridinium	1260/ml
Microcystis	900/ml
Staurastrum	240/ml
Dinobryon	300/ml
Asterionella	40/ml
Anacystis	*
Arthrodesmus	*
Desmidium	*

Zooplankton:	
Keratella	190/ml
Holopedium	120/ml
Diaptomus	120/ml
Cyclops	110/ml
Nauplius larvae	90/ml
Eubosmina	*
Kellicottia	*
Pleuroxus (in live sample 2 weeks later)	

* token samples

Beaver Bog, our second subject, differs a great deal from Bergner Lake. It is a seepage bog, receiving runoff only from the immediate area and losing water only through evaporation and underground seepage. Beaver Bog is surrounded by a large *Sphagnum* mat which supports a characteristic bog-like vegetative cover (mostly leatherleaf, black spruce and tamarack). This dense stand of stunted conifers on the mat and the surrounding maple and aspen forest shut off Beaver Bog from almost all outside wind. The bog does become quite cold and heavily fogged in at times as cooler air sinks into this low spot from the surrounding area.

scientific names?

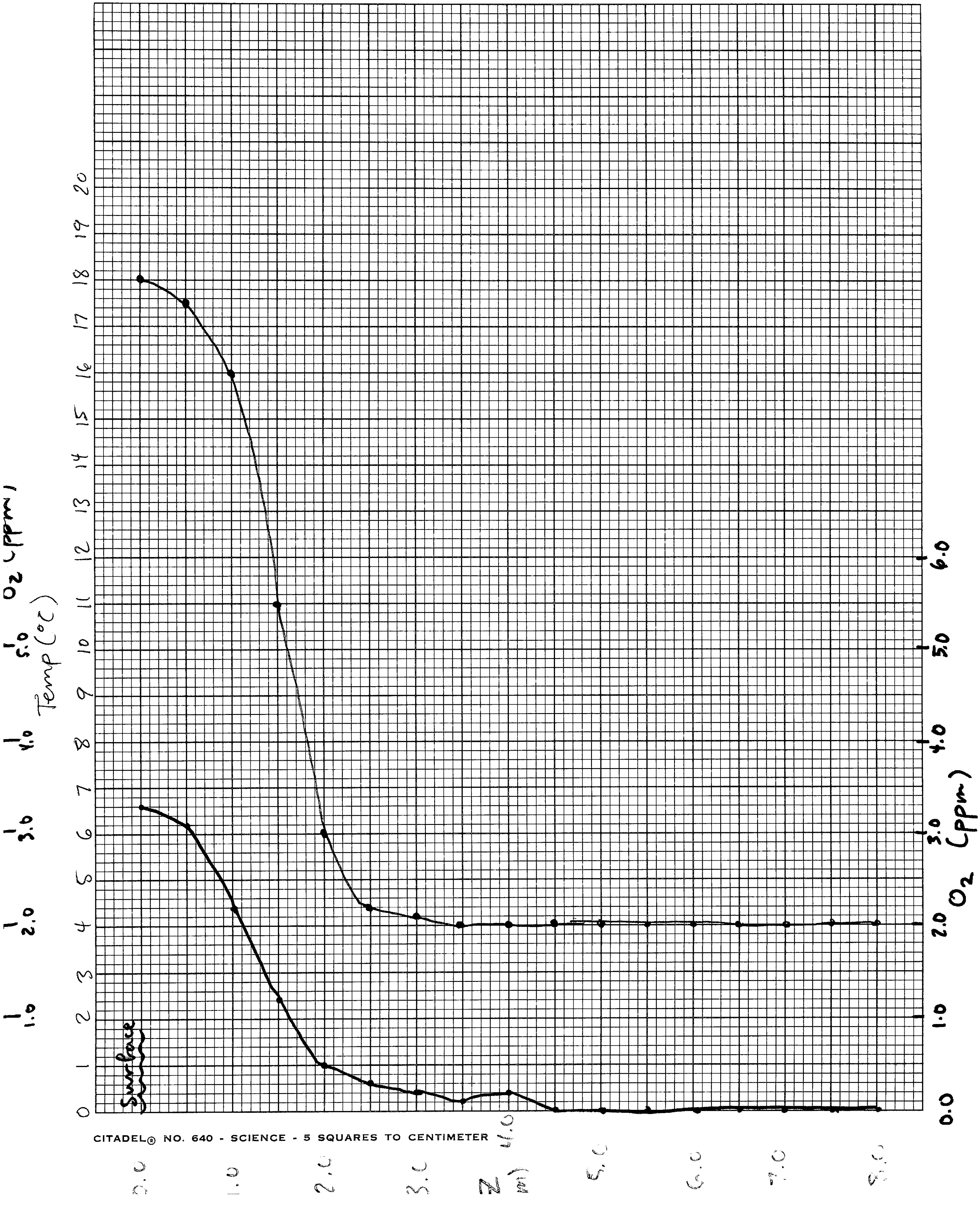
Beaver Bog

Water Chemistry

	Epilimnion	Hypolimnion
Acidity (mg/L)		
Methyl Orange	0	0
Phenolphthalein	50	70
Alkalinity (mg/L)	50	60
Color		
Apparent	210	210
True	170	180
Hardness (mg/L)		
Ca^{++}	50	60
Mg^{++}	10	10
Total	60	70
Nitrates (mg/L)	0.4	2.2
Phosphates (mg/L)		
Ortho	0.02	0.06
Total	0.15	0.06
Specific Conductance	21	22
Sulfates (mg/L)	0	0
Sulfide		positive
pH (in lab)	4.6	5.2
Secchi disk (m)	0.8	
Iron (mg/L)	0.22	0.36

Temperature and Oxygen curves on next page.

BEAVER BOG O_2 and Temp. curves



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Beaver Bog

Plankton

Phytoplankton	Concentration (from net)
Dinobryon	73500/ml
Asterionella	1160/ml
Peridinium	630/ml
Staurastrum	210/ml
Spirogyra	x
Fragilaria	x

Zooplankton	
Bosmina	9240/ml
Polyarthra	1800/ml
Holopedium	840/ml
Nauplius larva	740/ml
Keratella	320/ml
Kellicottia	x

x taken floaters

In looking at and comparing the physical/chemical data from Bergner Lake and Beaver Bog we can notice several differences. Most prominent are the oxygen-temperature profiles of both. Bergner, a relatively shallow lake, is considerably warmer than Beaver. Its surface temperature is three degrees warmer, its thermocline is located roughly two meters deeper, and it never reaches a temperature below 11°C. In contrast to Beaver, most of Bergner's volume is contained within the epilimnion. We might say that Bergner has no true hypolimnion. Its thermocline intercepts the bottom of the lake before it ever reaches 4°C, the point of maximum water density. This formation of a deeper thermocline and general warming of the lake is obviously aided by the better mixing of the lake's larger surface as compared to the relatively calm bog.

Bergner contains considerably more dissolved oxygen than Beaver. This is again partially explained by the lake's greater wind mixing effect, but more importantly by the proliferation of photosynthetic organisms to a much greater depth than in Beaver. (Note that both Secchi disk readings were taken in less than ideal conditions: overcast skies on both, rain dimpled surface on Beaver, and wind driven waves on Bergner.) We found that Beaver was without any dissolved oxygen for much of its depth. This was confirmed by the presence of hydrogen sulfide in the hypolimnion. And interestingly enough, this explains the relatively high concentration of iron in solution. The bivalent, ferrous ion is soluble, but only under anaerobic conditions (1,241).

The relative scarcity of phytoplankton nutrients and pronounced stratification of Beaver Bog lead me to believe that it did not turn over during the previous seasonal change. Note especially the accumulation of nitrate in the hypolimnion of Beaver. Since the concentration of this solute is largely dependent on metabolic factors, its presence is a good indication of the lack of bacterial decomposition in the depths of this bog. The lack of oxygen, combined with the extreme summer stratification and shallow penetration of light would preclude most life from the deep zone of Beaver. And in fact the lack of food and oxygen beneath the ice cover of winter prevents any fish from living there.

Umbra are found in Beaver

Beaver Bog's tea color is the result of the decomposition of allochthonous material, in particular conifer needles. The resultant organic acids are highly soluble in water, such that the centrifuged portion's true color reading was only slightly less than the apparent color which includes suspended particles.

I have covered most of the important chemical differences between these two subjects with the exception of hardness. I can find no explaination for the large amounts of dissolved calcium and magnesium ion in Beaver Bog. Both of these bodies of water rest upon or rather within pockets in the Canadian Shield. This glacier scarred granite bedrock contains very little if any limestone deposits that might contribute calcium to these lakes. Neither of them are well buffered (by bicarbonate salts) as is evident in their respectively high hydrogen ion concentrations. And furthermore, the typical physiological function of a *Sphagnum* mat would be to remove calcium and magnesium ions from the water for metabolic processes, replacing them with hydrogen ions (protons) to restore the water's ionic balance. I would consider these figures to be in error rather than characteristic of Beaver Bog.

I was intrigued by the diversity and abundance of plankton in both of my subject waters. Bergner, in representing a productive, soft water, oligotrophic lake, contained a great number of species and a fairly even numerical distribution. Only two genera were exceedingly numerous. These were *Peridinium*, a dinoflagellate, and *Microcystis*, a blue green. Bergner's microfauna was primarily copepods, which thrive on algae and in turn feed small fish, insect larvae and other aquatic invertebrates.

Beaver Bog provided quite a contrast, containing a virtual profusion of two genera. *Dinobryon*, a flagellate, completely engulfed the counting slide and necessitated a dilution of the sample before I could even begin to estimate its number. A cladoceran, *Daphnia*, also accounted for a huge portion of the sample, suggesting perhaps that a bloom in phytoplankton can be accompanied by a bloom in the primary feeders of that phytoplankton. But whether this is a temporal emerge in the flux of a predator-prey population curve, or a semi-stable relationship that is characteristic of many [illegible] etc, I cannot say.

References:

Reid, George K. and Richard D. Wood,
The Ecology of Inland Waters and Estuaries.
D. Van Nostrand Co. New York, 1976.