plankton 8.5
water chem 8.8
8.7

An Analysis of Forest Service Bog and Inkpot Lake
(located at UNDERC, Michigan)

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Elizabeth Cone
University of Notre Dame

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Forest Service Bog

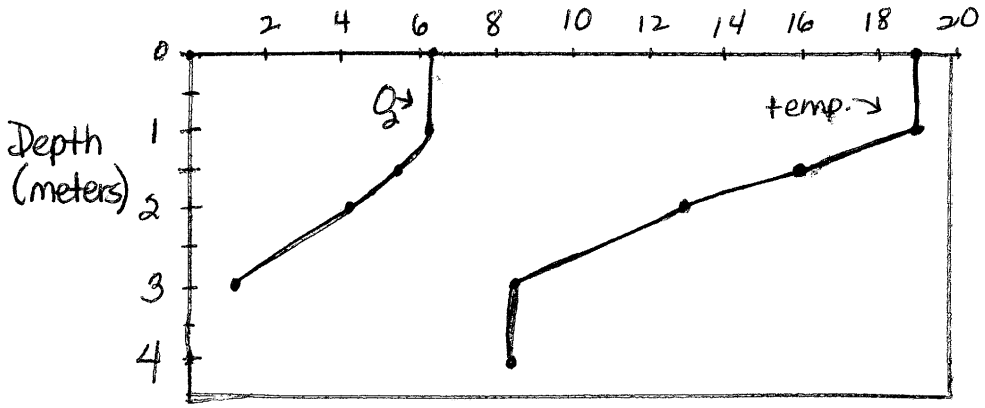
Forest Service Bog is small, with an extensive bog mat surrounding the open water, and contains a tiny floating island. Among the many characteristic bog plants found there are Bog Rosemary, Leatherleaf, mosses, berry bushes, Sundew, and Pitcher Plant. Lots of littoral plants and bushes are growing both on the bog mat and in the water near the edge (for example, water lilies). Numerous tamaracks are scattered around the area. Forest Service Bog is located in a low "valley" between several hills, with the sphagnum mat of the bog quickly giving way to firm ground and evergreen trees (including spruces and pines) as the hills are approached. Tree cover is thick on the hillside, but the bog mat effectively stops any big leafy trees from shading the bog itself - it is sunny and unshaded on clear days. Drainage-wize, Forest Service Bog is close to both Plum and Palmer Lakes. Since Plum Lake feeds to Kickapoo and on to Brown and finally into Palmer Lake, it is probable that Forest Service Bog also drains or seeps into Palmer directly or indirectly through a lake or underground.

Water Sample Analysis - Table I

Test	depth of sample tested	Results
Secchi disc		visible to 2½ m
pH		4.6
Color	1 meter	20 units > apparent color
	3 meters	60 units > apparent color
	3 meters (centrifuged)	40 units - true color
Hydrogen sulfide	(not done in lab)	not smelled although 3½ m. Kemmerer sample hit bottom (negative H_2S)
Acidity	1 meter	methyl orange → 0 phenolphthalein: 105 mg/l
	3 meters	methyl orange → 0 phenolphthalein: 110 mg/l
Alkalinity	1 meter	0 alkalinity
	3 meters	0 alkalinity
Hardness - Calcium	1 meter	5 mg/l
	3 meters	5 mg/l
Hardness - Magnesium	1 meter	0 mg/l
	3 meters	0 mg/l
Hardness - Total	1 meter	5 mg/l
	3 meters	5 mg/l
Nitrates	1 meter	.1 mg/l
	3 meters	.1 mg/l
Phosphates, total	1 meter	.25 mg/l
	3 meters	.25 mg/l
Specific Conductance	1 meter	10.5 micromhos/cm
	3 meters	9.5 micromhos/cm

GRAPH I - OXYGEN / TEMPERATURE VS. DEPTH

(FOREST SERVICE BOG)



Depth	O_2 reading	T. reading (°C)
surface	6.4	19°C
1 meter	6.3	19°C
1 ½ meters	5.5	16°C
2 meters	4.1	13°C
3 meters	1.35	8.5°C
4 meters*		8.5°C

* 3 ½ - 4 meters was taken to be the bottom

(epicline ~ 0-1 meters
hypocline ~ 3 meters)

Forest Service Bog is three and one-half meters deep. The oxygen-temperature graph shows a definite stratification from the surface to the bottom (in temperature). The hypocline is taken to be at three meters. The water itself was very clear, and since the secchi disc reading was taken on an overcast day, on a clear day the water visibility may be even deeper. Since the water was so clear, the sunlight could possibly reach down lower in the water and both lower the thermocline and permit photosynthesizing organisms to live in a lower level of the water than just near the surface. If photosynthesizing plants (phytoplankton) are indeed down there, the presence of oxygen near the bottom of Forest Service Bog may be due to them.

The color of the water must have been due to sediments, organic matter, and organisms in the water sample, since the apparent color at three meters is greater than the recorded true color for the centrifuged sample.

No hydrogen sulfide gas smell was noticed when the bottom water sample was brought up. Oxygen appears to be present even at the bottom of the bog.

The acidity was quite high and the pH reflects this. The zero

alkalinity indicates a low buffering capacity for the bog. This is also suggested by the high acidity - low pH levels. When a body of water has substantial buffering capacity due to a high level of alkalinity which counteracts the acidity, it may show a high pH but still possess a large quantity of acid. This bog does not appear to have such a buffering capacity. However, the alkalinity test as a measure of complete buffering capacity may be incorrect. Bicarbonate, of which the quantity present was measured for the alkalinity test, becomes a buffering agent only at pH 7 to pH 9; in water of greater acidity (such as in Forest Service Bog) with a pH below 5, the free carbon dioxide content of the water may be quite high and become important in buffering. In this case, the carbonate measured was low, but the level of the ~~mmas~~ free carbon dioxide (which was not measured) could be acting as a buffering agent for the bog.

Essential for all green plants, either calcium or magnesium may limit productivity if they're lacking. Thus, the observed level of five mg/l total hardness is very low and may be a limiting factor.

Nitrates and phosphates are also needed nutrients. Not enough means inhibition of phytoplankton and decreased productivity. Both these levels are low for Forest Service Bog.

The specific conductance also indicates biological productivity since it is a measure of the electrolytes in the water. It should coresponld to the water hardness because the calcium and magnesium ions would contribute to the conductivity. The harder the water is, the greater the productivity, and the higher is the conductivity. The measured specific conductance is low just as are the levels for hardness, nitrates, and phosphates. It seems that Forest Service Bog is poor in nutrients and judging by the this water sample analysis, fairly unproductive.

(Sedgwick-Rafter cell)
Plankton count*; A.M. sample - Table II

Name of organism	#
Rotatoria conochilus (colonial)	247
Cladocera	8
Dinobryon colonies	35
Anabaena	1
Keratella	42
Microspora	5
Nauplius larva (copepods)	9
Asterionella	3
Staurastrum	2
Dactylococcus infusonum	4
Ankistrodesmus	3
Mougeotia	4
Polyarthra	4
Senecella calanoides	1
unidentified → (part of plant?)	3

*both counts are at 20X; 1 stripaccross with 20 oculars down.

P.M. sample - Table III

Keratella	9
Asterionella	9
Rotatoria conochilus	167
Ankistrodesmus	1
Polyarthra	3
Nauplius (copepods)	5
Dinobryon	43
Staurastrum	2
Senecella calanoides	7
Ulothrix	2
Tabellaria	1
unidentified	21

In both the A.M. and P.M. plankton counts the number of rotifers was amazing. Since they are animals, however, they would be reducing the amount of oxygen in the water rather than making more available. Thus, the photosynthesizing organisms are the ones to look for - the chlorophyll-bearing phytoplankton. Dinobryon colonies were the most numerous of these. Other than Dinobryon, few phytoplankton were present. Since oxygen is made available in the lower areas of the water often by photosynthesizing organisms, and because plankton constitute the first step in the food chain, the low plankton count seems to indicate that Forest Service Bog is not a very productive body of water.

Discussion and Analysis of Forest Service Bog

Forest Service Bog as a whole appears to be quite an unproductive body of water. The oxygen levels show no bloom of phytoplankton causing high oxygen readings, and although the oxygen is present all the way down to the bottom of the bog, it must be because

the bog is rather shallow, because colder water can hold more dissolved oxygen, and because a few photosynthetic organisms probably do live in the depths. Since Forest Service Bog is so clear, the sunlight could be utilized quite far down by the phytoplankton; thus, they could live at below-surface levels.

The nutrient levels in general seem to be very low and may be limiting the phytoplankton's growth. Further, the high level of acidity makes it difficult for the organisms trying to survive there.

Thus, the productivity of Forest Service Bog as indicated by both the water chemistry data and by the plankton count is not great. The littoral plants on the bog mat seem to be in better shape quantitatively than the numbers of organisms in the bog itself.

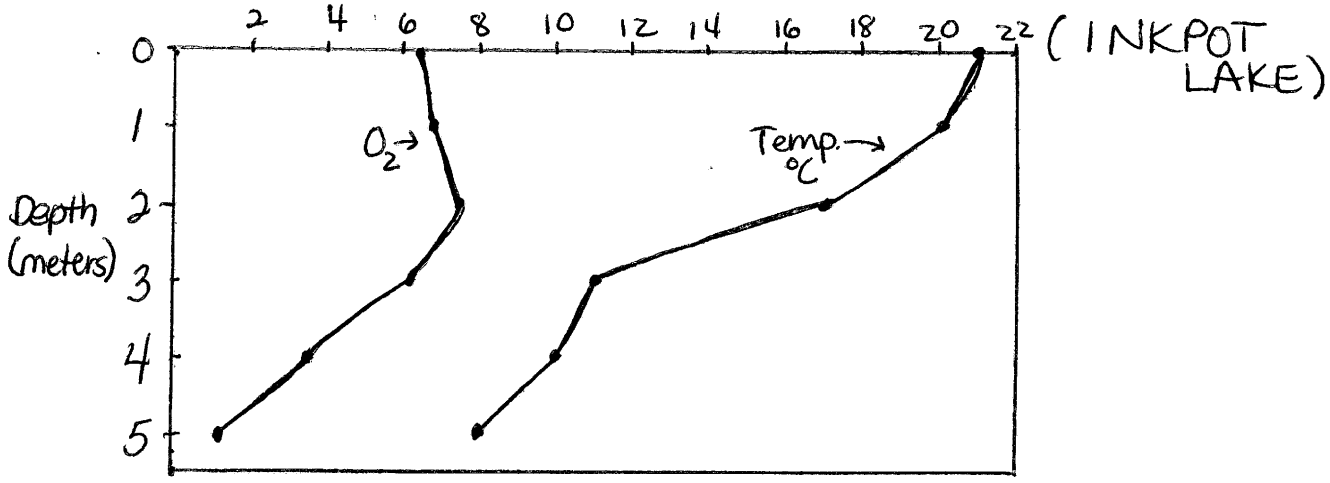
Inkpot Lake

Inkpot Lake is a round, small lake with a surface area of 7.6 hectares. The drainage is from Moccasin Lake into Inkpot, and out of Inkpot into Plum Lake. A big plant littoral zone is apparent in Inkpot, and much brush and a lot of trees are around the lake's edge (pines, spruce, birch). The water is shallow for quite a ways out into the lake, and the deepest area of the whole body of water seemed to be the very middle.

Water Sample Analysis Table IV

Test	depth of sample tested	Results
Secchi disc		Visible for 1.6m
pH		6.6
Color	1 meter 4 meters	60 units 50 units
Acidity	1 meter 4 meters	methyl orange → 0 phenolphthalein 0.8mg/l methyl orange → 0 phenolphthalein 0.75mg/l
Alkalinity	1 meter 4 meters	20mg/l 30mg/l
Hardness-calcium	1 meter 4 meters	35 mg/l 40 mg/l
Hardness-magnesium	1 meter 4 meters	5 mg/l 10 mg/l
Hardness-Total	1 meter 4 meters	40 mg/l 50 mg/l
Nitrates	1 meter 4 meters	.4 mg/l .35 mg/l
Phosphates-total	1 meter 4 meters	.29 mg/l .20 mg/l
Specific conductance	1 meter 4 meters	86 micromhos/cm 75 micromhos/cm

GRAPH II - OXYGEN/TEMPERATURE VS. DEPTH



(INKPOT LAKE)

Depth	O_2 reading	T. reading (°C)
Surface	6.5	21°C
1 meter	6.9	20°C
2 meters	7.4	17°C
3 meters	6.1	11°C
4 meters	3.5	10°C
5 meters*	1.1	8°C

* 5 meters hit bottom.

Inkpot Lake is five meters deep. The water samples were taken from the one and four meter depths to be certain the epilimnion and hypolimnion water layers were analyzed. The striking thing about the oxygen-temperature graph is that a big oxygen rise occurs just under the surface, around 2 meters. This layer of the water is in the thermocline and probably this high oxygen reading is due to photosynthesizing organisms.

The secchi disc was visible to a depth of 1.6 meters, but as the day was overcast and the wind was blowing a little, the visibility might have been deeper on a clear day.

The color of the water was not terribly deep; somewhat brownish-colored, but not dark.

The acidity was very low, and the pH reading was nearly neutral. The alkalinity level indicates that this lake has a substantial buffering capacity.

Calcium and Magnesium, needed nutrients for the phytoplankton, are both present. The water hardness indicates a quite productive lake.

Nitrates and phosphates are limiting nutrients in many aquatic systems. However, both are present.

although in minute quantities.

The specific conductance reading, high, indicates a rich lake. The high levels for specific conductance and for nutrients and water hardness all suggest that Inkpot Lake is a good, productive lake.

(Sedgewick-Rafter cell)
Plankton count*; AM sample; Table V

Name of organism	#
Dinobryon	424
Keratella	128
Asterionella	104
Kellicottia Longispina	2
Polyarthra Frigla	6
Asplanckna	5
Microspora	19
Anaebaena	44
Eudorina	16
Copepods	6
Cladocerans	17
Nauplius	4

* both counts are at 10x; 1 strip across with 10.6 oculars down

P.M. sample; Table VI

Anabaena	9
Dinobryon	449
Keratella	153
Asterionella	101
Kellicottia Longispina	10
Nauplius	17
Ceratium	1
Copepods	21
Cladocerans	36
Microspora	11
Polyarthra Triglia	1
(+ numerous chaoboridae about 100 in PM. sample only)	

Tables V and VI point out the presence of many rotifers in the water, but the great numbers of phytoplankton are the most outstanding feature of the plankton count. Dinobryon is an example of the photosynthesizing organisms which are present in such quantity. Where the oxygen really drops in the lake is also where the temperature really descends, so perhaps the phytoplankton are living in the thermocline or just above it, where the high level of the oxygen was measured, and are causing the high oxygen reading.

Discussion and Analysis of Inkpot Lake

As mentioned earlier, the high oxygen level below the surface of the water and the large quantity of phytoplankton counted seem to correspond beautifully. Further, the pH of the water is relatively neutral (at 6.6) and high pH readings are usual for lakes in which a great amount of photosynthesis is going on. (pH 6.6 could be considered fairly high for lakes around the area since the lakes at UNDERC mostly seem to be on the acidic side).

The nutrient levels as a whole indicate a highly productive lake, and this is emphasized by the plankton count. Therefore, Inkpot Lake appears to be a lake rich in phytoplankton, in zooplankton, and from all the water chemistry data and plankton count data, appears to be quite eutrophic and productive.

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