plankton
fish - B

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A Study of Bog Pot and Hummingbird Lakes

Limnology is the study of relationships in the biotic communities as they are affected by the physical and chemical properties of the system. The purpose of this report is to compare those properties of two bodies of water, Bog Pot and Hummingbird, determine the condition of each lake, and point out the various relationships.

Materials and Methods

Tests were done on Bog Pot and Hummingbird between 10:00 AM and 12:30 PM. Weather conditions and general descriptions of the lakes were noted. A YSI meter was used to take the air temperature and water temperature at various depths. Kemmerer water samples were taken in the epilimnion and hypolimnion layers determined from the temperature probe; the pH of each sample was measured by using a pH meter and probe at Bog Pot and by using pH tape at Hummingbird. A Secchi Disk test for light penetration was taken on Bog Pot. None was taken on Hummingbird. Water samples were taken back to the lab for Hach Kit analysis. Simple titration tests were used for acidity, alkalinity, and hardness while color (apparent and true), phosphate (Organic and total), and nitrate results were found with a spectrophotometer. A probe and meter for specific conductivity were used. See the Hach Kit instruction manual for details of each experiment; see the data table for results.

Five minute plankton tows were taken, once during the day and once at night, using the Wisconsin net and wash bottle. A species diversity list was made.

Temperature was plotted against depth in order to determine whether stratification existed or not. Graphs are with the data.

General Description

Both Bog Pot and Hummingbird are small lakes about the same size. Bog Pot has a bank made of peat and small bushes around much of it and further back from the water are a lot of conifers. A road runs by one end of the lake; the other end is very marsh-like with several tree stumps and logs in very shallow water. Drainage of Bog Pot is by seepage. Hummingbird has condiers and deciduous trees right up to the edge of the water; many of them are fallen and stick into the lake. Drainage is over a small strip of land that separates Hummingbird from Bay Lake.

Results

See data tables for results.

Discussion of Water Chemistry

The temperature-depth graphs are an attempt to show possible stratification of the water into layers of higher and lower densities. Because both Bog Pot and Hummingbird are well sheltered from the wind, which tends to wipe out stratification by mixing the layers, each forms an epilimnion and hypolimnion. The layer separating the epilimnion from the hypolimnion is the thermocline. It is defined as any slope equal to or greater than 45 degrees from the vertical. Looking at the graphs, one can see that Bog Pot has a steeper thermocline, and the layers are better defined. Hummingbird's thermocline is not as steep, and the epilimnion is not well shown. One factor that may be keeping Hummingbird from developing the layers is indicated by its apparent and true colors, which are much higher than those of Bog Pot. From this data it may be concluded that light penetration is not as good in Hummingbird as it is in Bog Pot, and only the surface is being warmed.

Hummingbird might also be affected by the waters from Bay Lake, which is connected to Hummingbird when the lakes overflow their banks. The water from Bay Lake is cooler because the heat is spread throughout a greater volume, and this cooler water perhaps keeps Hummingbird from becoming fully stratified.

Acidity, pH, hardness, alkalinity, and specific conductivity are all related in water chemistry according to the following equations:

$$CO_2 + H_2O \rightleftarrows H_2CO_3 \rightleftarrows HCO_3^- + H^+ \quad HCO_3^- \rightleftarrows H^+ + CO_3^=$$

The reactions represented by the equations above are all dynamic; this explains how a body of water is able to maintain its equilibrium.

Deviation from the neutral pH 7.0 is primarily the result of the hydrolysis of salts of strong bases and weak acids, or weak bases and strong acids. However, a dissolved gas such as the CO_2 in the above reaction has a significant effect. When CO_2 enters water, a small portion of it is hydrated to form carbonic acid. Some of this carbonic acid dissociates into bicarbonates and hydrogen ions, bringing about a lowering of the pH. The bicarbonates further dissociate into carbonate ions and more hydrogen ions.

At low pH values, such as that of Bog Pot and Hummingbird, free CO_2 and carbonic acid will predominate. That is, the reaction will proceed to the left in order to restore equilibrium. As a result, there will be less carbonate ions, which means less calcium and magnesium carbonates and lower hardness. Waters with a concentration of 10 mg of calcium or less per liter are usually oligotrophic; Bog Pot measured 9mg/l and Hummingbird measured 3mg/l.

The alkalinity of water is actually a measure of the buffering capacity of water. A measurement of alkalinity is a measure of bicarbonate and carbonate ion concentrations. Bog Pot and Hummingbird had low alkalinity; Hummingbird's alkalinity was too low for the test to measure. Therefore, the lakes do not have very good buffering capacities, although Bog Pot's would be greater.

Specific Conductance, which is a measure of water's capacity to conduct an electric current, is used to estimate the total concentration of dissolved ionic matter in the water. This, in turn, is related to water fertility. Because Bog Pot and Hummingbird both had low hardness and therefore low concentrations of carbonate ions, the specific conductances were low.

Acidity is a measurement of the ability of certain compounds to donate hydrogen ions. There are several sources of acidity. For example, calcium sulfate, which is common in runoff water and sometimes present in rain, can exchange the bivalent cation Ca^{++} for hydrogen ions and form strong sulfuric acid. This exchange is common where water trickles through peat, calcium is absorbed, and plant material yields hydrogen ions. Organic acids, collectively called humic acids, are abundant in peaty materials. Uronic acids are common acids which donate hydrogen ions from carboxyl groups and replace them with calcium ions. The result is higher acidity, lower pH, and lower water hardness because of the loss of calcium ions.

Acidity and pH are related to each other; a higher acidity lowers the pH. However, in some cases a body of water may be able to keep the pH constant by buffering the system. Bog Pot and Hummingbird have approximately equal acidities, but because Bog Pot has a higher alkalinity and therefore larger buffering capacity, the pH is not as low as that of Hummingbird.

Hummingbird and Bog Pot are affected by seasonal fluctuation in chemical conditions. During the winter when the photosynthetic activities of the plants and phytoplankton are at a minimum, the total alkalinity of a pond or lake can increase enormously as the amount of stored carbonate increases. In the summer, due to increased photosynthesis, there is depletion in the amount of CO_2 and carbonates are precipitated as the temperature rises, further reducing the total alkalinity.

A study of the phytoplankton of Bog Pot and Hummingbird revealed that phytoplankton are definitely more abundant in

Bog Pot. This might be expected, however, because color tests showed Bog Pot to be more suitable for light penetration and photosynthesis. Bog Pot is also less shaded than Hummingbird, another reason why phytoplankton are more abundant there. Because of the photosynthesis, there is a depletion of more CO_2 in Bog Pot and a reduction in acidity. This might further account for the higher pH in Bog Pot.

Discussion of Plankton

Plankton are organisms that, because of their size, immobility, or both, are at the mercy of the water movement. For this reason there is often research of species diversity such as different phytoplankton and zooplankton. Information of this type is helpful in studying evolutionary time, ecologic time, year-to-year climatic stability or predictability, productivity, degree of competition among species, predation, and natural disturbances.

On the basis of information gathered on the water chemistry and species diversity, generalities can be made. One example is that on the basis of existing reports in the literature, Williams (1969) generalized that the phytoplankton of oligotrophic lakes includes such members as the desmid Staurastrum, the chrysophyte Dinobryon, and the diatom Tabellaria, all of which were found in Bog Pot. Williams points out that Dinobryon is known for its intolerance of anything but low phosphate concentrations. Bog Pot has a low phosphate concentration. Other reports show that Desmids are typically found in acid bogs and in very dilute water low in electrolytes. Although Bog Pot was not too low in pH, it was low in electrolytes.

Past studies of the kinds of seasonal morphologic changes in Bosmina suggest evolutionary adjustments to two principle types of predators: visual invertebrates and blindly grasping invertebrates. The decrease in the relative size of the structures in smaller Cladocera serves to minimize fish predation by reducing "conspicuousness." This strategy evolves in the presence of visual planktivorous fishes such as perch, bluegill, and crappie. Because of the abundance of Bosmina in Bog Pot and Hummingbird, one might conclude that these predators could be there. Studies of Bog Pot have revealed large numbers of sticklebacks; fish studies have not been made in Hummingbird, but the pH would most likely reduce the number of fish.

no verts.?

The "blindly grasping invertebrates"that feed on the Bosmina are the Copepods. Because of the large numbers of Bosmina in Bog Pot, there are large numbers of Cyclops (Copepods) to feed on them. Copepods generally search randomly in a restricted horizontal plane, grasping prey when contacted. However, long mucrones and antennules often break off when Bosmina are seized by the larger predatory Copepods, allowing the prey to escape. The parts of the Bosmina will re-generate later. This survival technique of the Bosmina and others like it are important to population and community ecology.

One possible explanation for the presence of large numbers of Asterionella in both lakes is that through cell elaboration and colony aggregation, two devices to increase buoyancy, the phytoplankton can retain high position in the water, thereby ensuring photosynthesis. This is particularly important in water such as that of Hummingbird where light penetration is limited because of the dark color. Tows were done at day and night because a lot of the plankton have these buoyancy techniques, and their position in the water varies with the daylight. Many are closer to the surface at night when there is little light and lower in the day when the light is abundant.

If the majority of the phytoplankton migrate to the surface when light is scarce, the night samples should show an increase in number. However, samples on Bog Pot showed more in the day and less at night. A Hummingbird night sample was not taken.

Conclusions

Bog Pot and Hummingbird lakes are oligotrophic lakes. However, Bog Pot is closer to mesotrophic and more productive than Hummingbird.

Data that were not consistant are the specific conductances and hardnesses. Bog Pot had higher hardness and a lower specific conductivity. The pH of Bog Pot was probably a little too high.

Bibliography

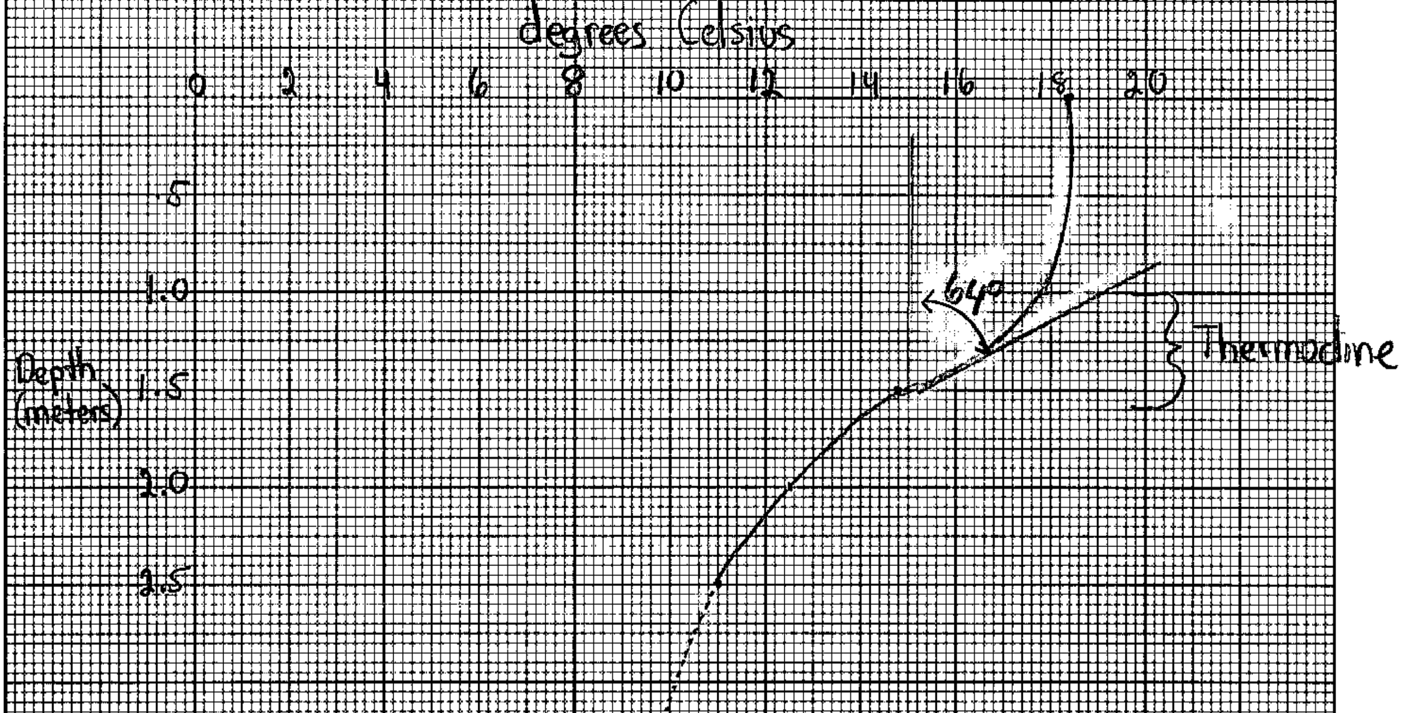
Brown, Alison Leadley., Ecology of Fresh Water, Harvard University Press, 1971. pp. 1-24.

Cole, Gerald A., Textbook of Limnology, C. V. Mosby Company, 1979.

Willoughby, L. G., Freshwater Biology, Pica Press, 1977. pp. 9-15, 21-26.

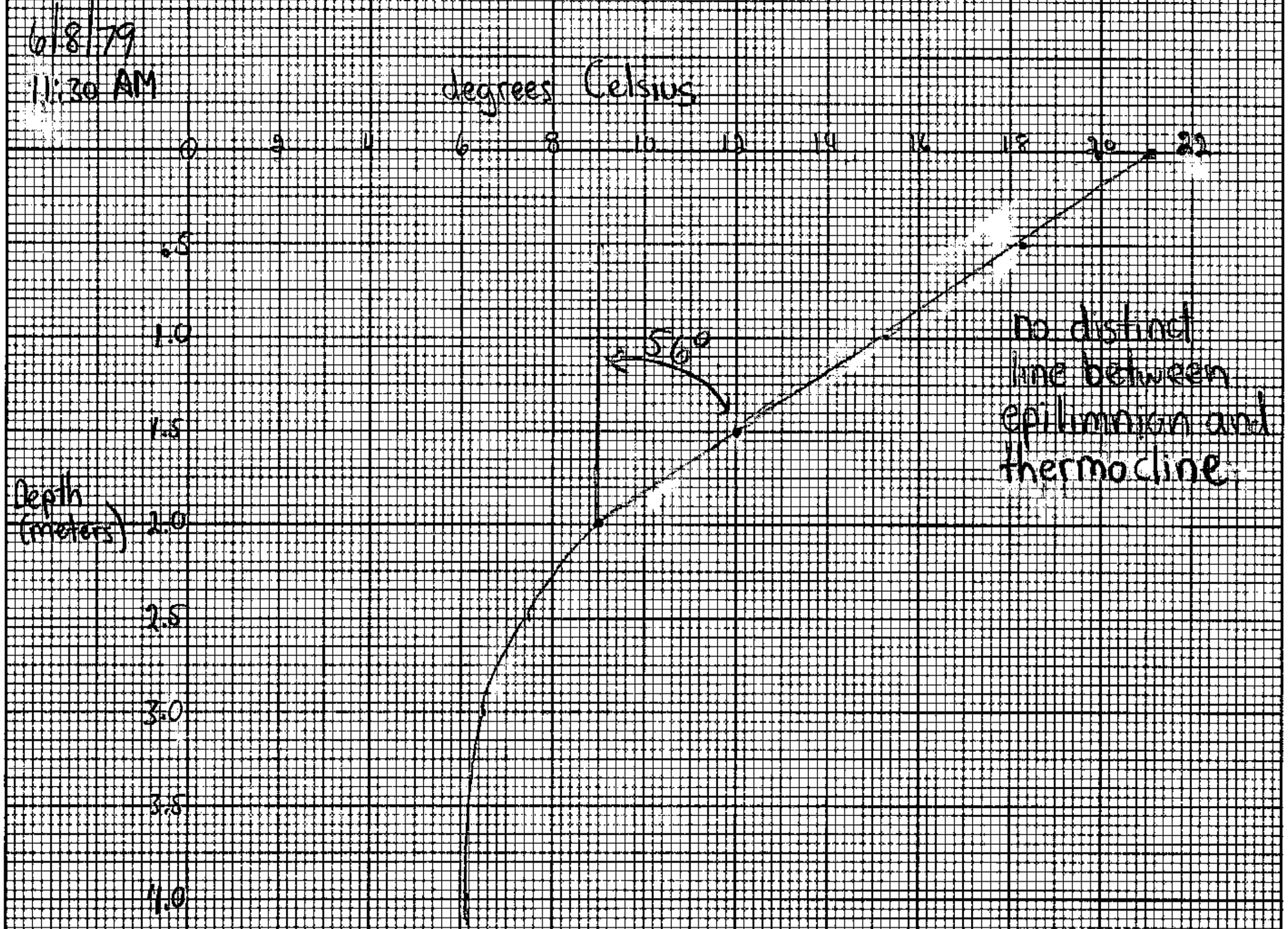
Bog Pot Lake

6/5/79
10:30 AM



Depth	Temperature
air	21°C
surface	18.4°C
1.0 m	17.8°C
1.5 m	14.8°C
2.0 m	12.5°C
2.5 m	11.0°C

Hummingbird Lake



Depth	Temperature
air	24°C
surface	21°C
.5 m	18.3°C
1.0 m	15.3°C
1.5 m	12.0°C
2.0 m	9.0°C
2.5 m	7.5°C
3.0 m	6.5°C
4.0 m	6.2°C

Data from tests

		Bog Pot		Hummingbird	
1.	conditions-	partly cloudy; little breeze to the West		very sunny; occasional breeze	
2.	time-	10:30 AM		11:30 AM	
3.	pH-	6.5 epilimnion 6.4 hypolimnion		4.8 epilimnion 4.7 hypolimnion	
4.	Secchi Disk	1.5m		not taken	
5.	H_2S Presence	no		no	
6.	Acidity	Methyl Red	Phenol.	Methyl Red	Phenol.
	epilimnion	0	140 mg/l	20 mg/l	170 mg/l
	hypolimnion	0	140 mg/l	5 mg/l	140 mg/l
7.	Alkalinity				
	epilimnion	75 mg/l		0 (less than test could measure)	
	hypolimnion	75 mg/l		0	
8.	Color (Apparent)				
	epilimnion	155 units		450 units	
	hypolimnion	180 units		325 units	
	(true)				
	epilimnion	130 units		440 units	
	hypolimnion	130 units		320 units	
9.	Hardness				
	epilimnion				
	Ca^{++}	9 mg/l		3 mg/l	
	Mg^{++}, total	15 mg/l		11 mg/l	
	Mg^{++}	6 mg/l		8 mg/l	
	hypolimnion				
	Ca^{++}	9 mg/l		5 mg/l	
	Mg^{++}, total	15 mg/l		14 mg/l	
	Mg^{++}	6 mg/l		9 mg/l	
10.	Specific Conductivity				
	epilimnion	23 mhos/cm Range 3		28 mhos/cm Range 3	
	hypolimnion	23 mhos/cm Range 3		25 mhos/cm Range 3	
11.	Nitrate				
	epilimnion	.25 mg/l		0	
	hypolimnion	.25 mg/l		0	

12. Phosphate
Organic and Total (mg/l)

epilimnion	.075	.175
	.375	0
	.21	.01
hypolimnion	.06	.06
	.20	0
	.125	0

Plankton results ranked in order of abundance

Zooplankton

(AM)

Bog Pot	Hummingbird
1. Bosmina longirostris	1. Peridinium tabulatum
2. Bosmina coregoni	2. Keratella
3. Cyclops	3. Bosmina longirostris
4. Keratella	4. Asplanchnopus
5. Asplanchnopus	5. Trichocera
6. Nauplii (of Copepoda)	

(PM)

Bog Pot	Hummingbird
1. Brachionus	No PM samples.
2. Bosmina coregoni	

Phytoplankton

(AM)

Bog Pot	Hummingbird
1. Asterionella	1. Asterionella
2. Dinobryon	
3. Chodatella	
4. Staurastrum	

(PM)

Bog Pot	Hummingbird
1. Asterionella	No PM samples.
2. Dinobryon	

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Bass Fish Survey Data

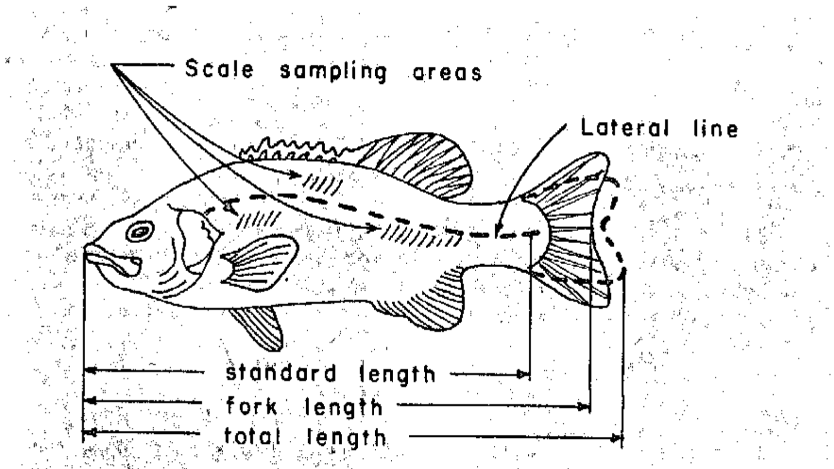

FIGURE 1. - Common fish measurements and areas of scale sampling (from Lagler)

1. Large Mouth Bass - from Long Lake

Total Length	Fork Length	Age
315 mm	306 mm	3+
205 mm	197 mm	2+
205 mm	147 mm	2+
216 mm	209 mm	2+
205 mm	199 mm	2+
209 mm	203 mm	2+
220 mm	212 mm	2+

2. Small Mouth Bass - from Long Lake

Total Length	Fork Length	Age
420 mm	405 mm	5+

3. Rock Bass - from Tenderfoot Creek

Total Length	Fork Length	Age
203 mm	200 mm	2+

The average total length for Large Mouth, age 2+, is 210 mm in this survey.

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Discussion of Fish Data   UNDERC 1979

The Large Mouth Bass (2+) from Long Lake have an average total length exactly equal to the mean size for that region, according to Scott and Crossman (date). For a Small Mouth Bass (5+) the average total length is 422 mm; the one Small Mouth caught had a total length of 420 mm. Information on mean sizes for Rock Bass was not available, but Scott and Crossman did say that Rock Bass are often found in rocky streams, alkaline water, high pH, and high carbonate water. Tenderfoot Lake has these qualities, and it flows into Tenderfoot Creek, a rocky stream.

Food types found in the fish stomach analysis included midgefly larvae, mayflies, and in one case a small fish. Other possible food types found in the lake and creek that the fish could eat include young crayfish, snails, scuds, and cladocera.

Long Lake minnow traps yielded very little. Perhaps this scarcity of small fish to feed on was a reason for low numbers of bass taken in the Fyke nets. Predators of the fish that may be responsible for the low numbers include loons, king fishers, and larger fish such as Muskies and Walleye that were too large for the nets. — wrong note.

To increase the number of bass, there will have to be an increase in food. Lake fertilization is a possibility as well as introduction of new food organisms. Long Lake seemed to have plenty of shelter for small fish, but increasing this shelter is always another possibility.