fish-B

A Comparison of Morris and Long Lakes (University of Notre Dame Environmental Research Center) Gogebic County, Michigan

Sharon Kolber
7-6-79
Aquatic Biology
UNDERC

The purpose of this study is to attain a general idea of the condition of these two lakes, Morris and Long. Sampling in these lakes included temperature profiles, Secchi disc readings, various water chemistry tests (performed with the Hach water Chemistry Kit), plankton tows (performed with a Wisconsin net), and fish sampling (performed with Fyke nets, minnow traps, and fishing poles).

Morris Lake

Morris lake is a basically circular shaped lake at the northern edge of the Notre Dame Property. It is surrounded by both coniferous and deciduous trees and some of the shoreline exhibits characteristic bog macrophytes. The drainage pattern of which Morris is a part consists of water from Mullahy Lake flowing to Ward Lake, from Ward to Morris and finally to Tenderfoot Creek.

A notable feature of Morris Lake is its over-abundance of Northern Pike. This imbalance is attributed to the stocking years ago of Morris with Walleye. When the Walleye were mostly

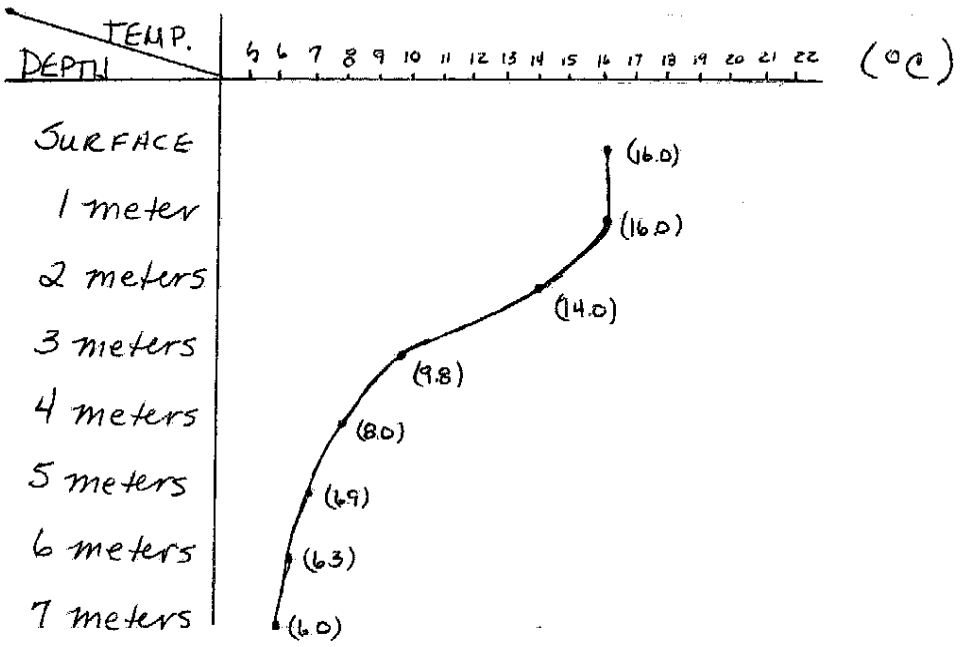
fished out the Northern Pike came to dominate with few other fish populations present and of those present very few in number. Presently some attempts are being made to decrease the number of Northern Pike in Morris Lake.

DATA

On the day Morris Lake was sampled weather conditions consisted of heavy cloud cover, rain, cool air temperature (11.7°C) and a steady moderate wind. The site at which the samples were taken was approximately at the center of the lake. The epilimnion sample was taken at 1 meter depth and the hypolimnion sample at 5 meters depth. The samples were taken at 11:00 a.m.

Temperature Profile

Air Temperature - 11.7°C



WATER CHEMISTRY

Test	Epilimnion	Hypolimnion
Acidity	150 mg/l	150 mg/l
Alkalinity	15 mg/l	* 0 mg/l
Color - Apparent	120 units	272 units
True	100 units	255 units
Hardness - Total	43 mg/l	50 mg/l
- Calcium	30 mg/l	32.5 mg/l
- Magnesium	13 mg/l	17.5 mg/l
Hydrogen Sulfide	———	2mg/l
Nitrate Nitrogen	.1 mg/l	.55 mg/l
Nitrate	.44 mg/l	2.42 mg/l
pH	6.1	5.6
Phosphate	.185mg/l	.29 mg/l
Secchi Disc	1.15m.	———
Specific Conductivity	934 mhos/cm	1154 mhos/cm

* none detected within the limits of the test.

Discussion:

It is apparent that in Morris Lake the temperature differences show the stratification existing. The density of water changes with temperature, the maximum density occurring at 4°C. The density differences allow layers to form with less dense water above greater density water. Seasonal overturn may occur due to

air temperature changes which cause the upper layers of water to become more dense and to sink. This then results in a mixing of the water. In a temperature profile of a lake the plane of the steepest decline in temperature is the thermocline. In some lakes the thermocline is always present and no mixing occurs, trapping in the hypolimnion all of the organic material, nutrients, etc. which rain down from the epilimnion.

In Morris, stratification occurs with the thermocline at 2-3 meters. It appears that this lake did not turnover because 2mg./l. of hydrogen sulfide were found in the hypolimnion. Hydrogen sulfide is quickly oxidized with exposure to the air, therefore, the bottom water has not had exposure to oxygen since the compound is present. This indicates that mixing has not occurred.

The secchi disc reading for Morris was at 1.15 meters indicating light penetration to be to approximately 3.3 meters. This reading is low probably due to the poor weather conditions - low light, turbidity caused by wind and rain. However, the color readings are high indicating that perhaps even under more favorable conditions the light penetration would not be as great as anticipated. The color is exceptionally high for the hypolimnion. Perhaps the shallowness of the lake along with its steady thermocline combine

effects to cause this high color. The difference between true and apparent color is considerable and is probably due to plankton, turbidity, and other particles, iron, and magnesium complexes. The hardness, which is mainly due to the presence of calcium and magnesium salts dissolved in the water, also seems consistent with the rest of the data. Most of the hardness is due to calcium and the hypolimnion has a higher hardness than the epilimnion. The total hardness would be considered relatively high. This data corresponds with the high specific conductivity found, which is also higher in the hypolimnion than in the epilimnion. Specific conductivity is a measure of the conductance due to ionized materials present in the water.

In looking at Morris Lake and its surrounding deciduous and coniferous trees, it would be hypothesized that the pH would be neutral or near so. As compared with the other lakes on the property this is so. The pH is primarily determined by the acidity, which is the ability to release hydrogen atoms, and alkalinity which is the capability of neutralizing acids (buffering capacity). The buffering capacity in Morris Lake is low, the acidity seems high but the pH is still 5.6/6.1. The acidity test and the pH readings were probably the least consistent

of all the tests performed and the resulting conclusions are questionable. Acidity may be increased with time in a lake due to acidic rainfall, sphagnum ion exchange of calcium ions for hydrogen ions, and many other ecological factors

The nitrate and phosphate levels are higher in the hypolimnion than in the epilimnion. This is again consistent with the effects of stratification in a lake. Phosphorous is typically the limiting nutrient in a lake, it is required as ATP for the uptake of nitrogen, and is directly involved in so many processes, it is difficult to make conclusions from its presence and amount. The presence of phytoplankton in the sample on which the phosphate test is run can add to the amount of phosphate detected. The nitrate is high in the hypolimnion due to the decomposition of organic matter. Characteristics of a eutrophic lake include heavy accumulation of organic matter, depletion of oxygen in the hypolimnion, large quantities of nutrients, and high productivity. It seems that Morris Lake is eutrophic or at least in a late mesotrophic stage

The plankton found in Morris Lake included the following in order of declining incidence:
Phytoplankton: Dinobryon, Ceratium, Oscillatoria, Spirogyra, Scenedesmus, Gonium.
Zooplankton: Cyclops, Keratella, Asplanchna, Asplanch-

niopus, Daphnia.

Among the species of phytoplankton, Dinobryon was far more abundant than any other in both the morning and evening samples. The Oscillatoria, Scenedesmus, and Gonium were present in the morning samples and Spirogyra in the evening.

Among the zooplankton, with the exception of Daphnia, all of those found appeared in similar quantities in both the morning and evening samples.

In addition, in the littoral zone some gastropods, Helisoma campanulata and Physa sp along with Pelecypoda, Shaeriidae, Shaerium sp. (clams) were found in abundance. Dragonfly and damselfly nymphs also occurred in good number. The fish present consist of mostly Northern Pike with some Yellow Perch. The Yellow Perch caught in the sampling appeared to be large for its age as compared with other fish. It appears that only the best competitors of Yellow Perch would survive the competition and predation by the Pike. Removal of the Northern Pike from the lake occurred via the opening of the lake to fishing by students.

LONG LAKE

Long Lake is a narrow elongated lake with a shallow center and the greatest depth

at each end. The lake is almost entirely lined with macrophytes characteristic of bogs. The many fallen trees in the water probably aid in the extension of the bog mat over the open water. The trees surrounding Long Lake are almost entirely conifers, which are more resistant to acidic conditions. Long Lake is a seepage lake which means no actual waterways enter of leave the lake. Instead, water enters through rain and run-off and is lost by seepage into the soil and evaporation.

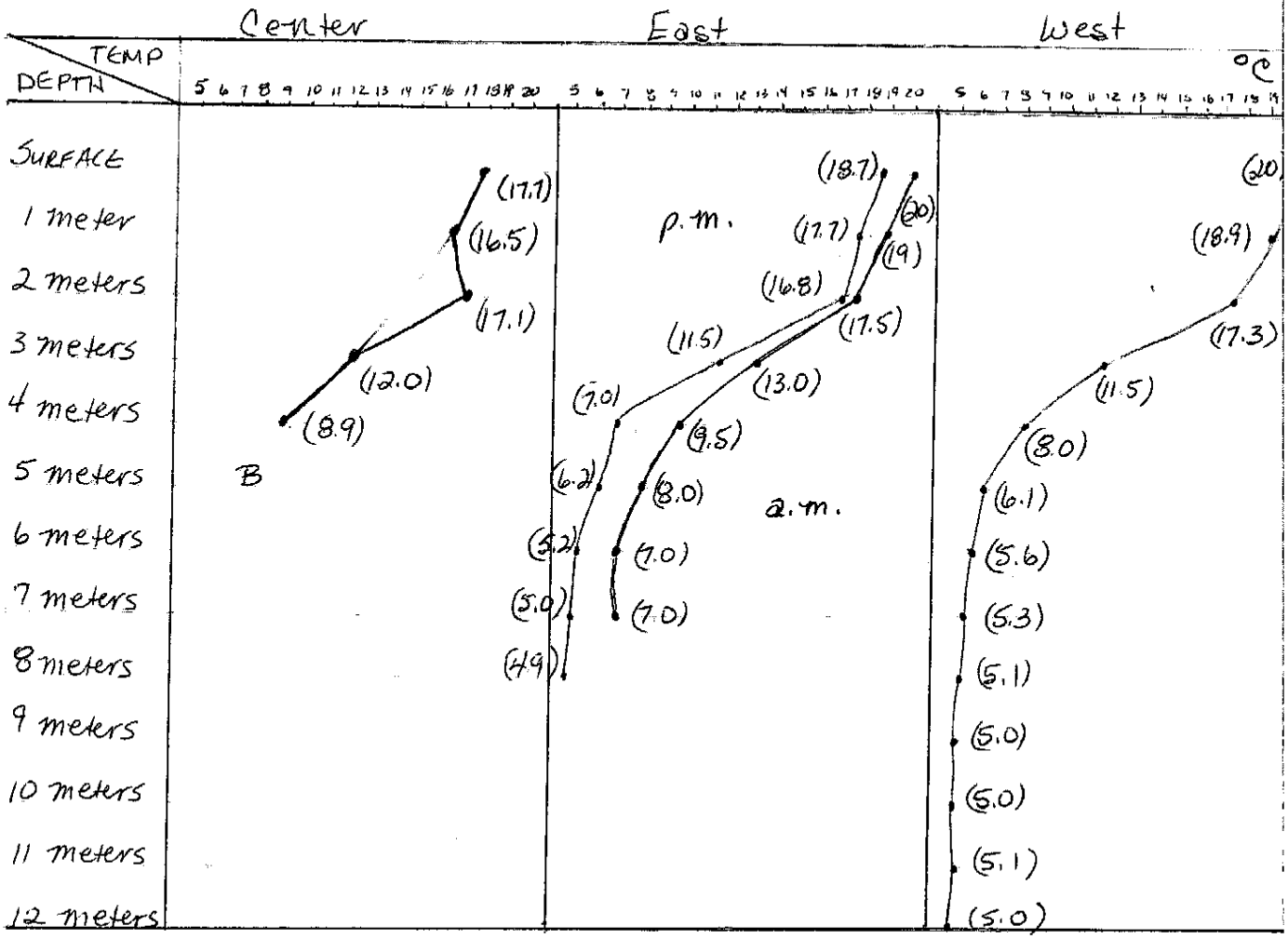
DATA

The weather conditions on the day Long Lake was sampled consisted of partially cloudy skies, warm air temperature (21°C), and light wind from the east. The center sample was taken at 10a.m. and a sample was taken at the east end of the lake at both 10a.m. and 4p.m. The sample at the west end of the lake was taken at 4p.m. The epilimnion samples were taken at 1½ meters and the hypolimnion sample at 6 meters.

Temperature Profile

(on following page)

Air Temperature 21°C



WATER CHEMISTRY

TEST	CENTER	EAST		WEST	
		EPILIMNION	HYPOLIMNION	EPILIMNION	HYPOLIMNION
Acidity	240 mg/l	125 mg/l	115 mg/l	130 mg/l	205 mg/l
Alkalinity	*0 mg/l	*0 mg/l	*0 mg/l	*0 mg/l	*0 mg/l
Color - Apparent	65 units	70 units	100 units	60 units	75 units
True	65 units	70 units	90 units	45 units	68 units
Hardness - Total	88 mg/l	10 mg/l	9 mg/l	11 mg/l	10 mg/l
- Calcium	4 mg/l	5 mg/l	5.5 mg/l	8 mg/l	2.5 mg/l
- Magnesium	4.8 mg/l	5 mg/l	3.5 mg/l	3 mg/l	7.5 mg/l
Hydrogen Sulfide					slight odor

TEST	CENTER	EAST		WEST	
		EPILIMNION	HYPOLIMNION	EPILIMNION	HYPOLIMNIO
Nitrate Nitrogen	.425 mg/l	.33 mg/l	1.35 mg/l	.33 mg/l	.9 mg/l
Nitrate	1.87 mg/l	1.45 mg/l	5.9 mg/l	1.45 mg/l	3.9 mg/l
pH	4.2	4.3	4.3	3.7	4.4
Phosphate	.11 mg/l	.07 mg/l	.08 mg/l	.13 mg/l	.11 mg/l
Secchi Disc	3.4 m.	3.4 m	—	3.4 m	—
Specific Conductivity	28 μmhos/cm	23 μmhos/cm	29 μmhos/cm	27 μmhos/cm	25 μmhos/c

*none detected within the limits of the test.

DISCUSSION

LONG LAKE IS STRATIFIED with the thermocline at 2-3 meters across the entire lake. If the thermocline occurred at a greater depth such as 5 meters, the depth of the center portion of the lake, the thermocline might have also been a barrier between the two ends of the lake. Perhaps this may occur, leading to a division into two lakes at some future time.

The west sample site had a depth of greater than 12 meters and the odor of hydrogen sulfide was detected although the chemical test did not indicate its presence. This site may have a deep hole which remains unmixed

or may have been representative of the west end of the lake. The east end of the lake had a depth of 8 meters and no hydrogen sulfide was detected. However, it can be safely stated that at least some of the deeper parts of Long are not mixed by an overturn.

The Secchi Disc readings were all 3.4 meters, estimating the light penetration to be to about 6.8 meters. The conditions for light penetration were favorable with only light cloud cover and a slight wind. The color readings seemed to be higher at the east end of the lake than at the center and the west end had the lowest color rating. The hypolimnion values were greater than the epilimnion. It seemed that the west sample had more suspended material which was centrifuged out to give the true color reading, possibly due to the effects of the wind. The west end of the lake is larger in surface area than is the east. Perhaps the larger area dilutes the incoming particles and decreases the color. (In addition to the greater surface area the west end also had a greater depth.)

Both the specific conductance and hardness of the lake are low and are similar across the sites. It seems that calcium and magnesium are about equal in amount in Long Lake.

The acidity values are in an extremely broad range from 115-240 mg/l. The alkalinity was so small it was not detected. The pH values were all low 3.7-4.4. Difficulty occurred in reproducibility of pH and acidity values making it difficult to interpret this data. The presence of conifers and the developing bog mat elude to a low pH although the actual values are questionable. It is not unlikely that the pH of this lake is dropping due to these factors and in addition due to the acidic rainfall which is Long Lake's only water source.

The Nitrate concentration is much higher in the hypolimnion than in the epilimnion as would be expected due to the raining down and decomposition of organic material. The phosphate values are all approximately the same for all of the samples. It is difficult to make conclusions based on this data. It does seem that the east end has a considerably greater amount of nitrates present in the hypolimnion than does the west hypolimnion. Perhaps this along with the greater color in the east sample would indicate that it is further along in the eutrophication process. This lake appears to be mesotrophic. The productivity is not exceptionally high, the hardness and specific conductance

are low, it is deep, nitrates have built up in the hypolimnion, at least parts of it did not turnover, the color is moderate, the alkalinity is low etc. In other words, some of its characteristics would indicate an oligotrophic lake and others a eutrophic lake.

The plankton found in Long Lake included the following in order of declining incidence:
Phytoplankton: Tabellaria, Asterionella, Dinobryon sociale, Staurastrum.
Zooplankton: Bosmina coregoni, Daphnia longispina, Cyclops.
Asterionella and Tabellaria were by far the most abundant. A morning and evening sample comparison cannot be made since the data had not been completely tabulated upon departure from UNDERC.

Perch, small and large mouth bass were also caught in Long lake with Fyke nets. The fish caught were in good condition - average or better for their ages. No smaller fish were caught in the minnow traps indicating the lack of available food and harsh conditions for this competitive of a lake. The large fish mostly feed on insects since there are few young fish. The pH, if as low as recorded may not be favorable either.

Summary of LONG LAKE and MORRIS LAKE

Morris and Long Lakes differ in many aspects,

the most notable of which is the physical surroundings and characteristics. Morris is surrounded by a mixture of deciduous and coniferous trees, is circular in shape and water drains in from Ward Lake and out to Tenderfoot Lake. Long Lake is rectangular in shape, surrounded by almost exclusively conifers and is a seepage lake. Long has more bog formation occurring and is more acidic. It appears that Long at least in part is deeper than Morris Lake. Hydrogen sulfide was found in both lakes indicating a strong thermocline, in both lakes occurring at 2-3 meters. In Long Lake the temperature at depth was cooler than that in Morris perhaps due to the greater depth in Long.

Long Lake was sampled on a sunny day and Morris in the rain. This no doubt accounts for some of the distance between Morris' Secchi Disc Reading and that of Long, 1.15m and 3.4m respectively. The color readings were much greater for Morris than Long Lake. The difference between Apparent and true color was much greater for Morris than for Long, probably due to the weather conditions. The specific conductance in Morris & the hardness was higher than in Long and significantly so.

The alkalinity was low in both lakes and the acidity values for Long cover such a broad range it is difficult to compare them with

the Morris values. The pH is much lower in Long lake than in Morris - as would be expected by the surrounding trees. The nitrate content is higher in the hypolimnion and epilimnion of Long Lake than in Morris. The phosphate content is higher in Morris Lake.

From this data it appears that Morris would be further along in the eutrophication process than Long. However, it appears that Long has a greater nitrate content which would be indicative of large amounts of organic matter probably due to high productivity as found in eutrophic lakes. Long's other characteristics, however, point to a more mesotrophic state.

The phytoplankton of Long Lake is dominated by diatoms and that of Morris by green flagellates. As a general rule diatoms are found in more mesotrophic lakes than green algae and flagellates, giving another indication that Morris is more advanced in the eutrophication process.

In Morris Lake the fish community is strongly dominated by Northern Pike, with Yellow Perch also present. In Long Lake, Perch (Yellow), Large and Small-mouth Bass were trapped. It seems that in Morris more food is around, but there are also more fish. In Long, there is not much food for the fish.

Yellow Perch

Yellow perch were caught in Bergner, Long, and Morris Lakes and Bolger Bog. In Morris, the fish was caught on a fishing rod, in Bolger with minnow traps and in Long and Bergner both Fyke nets and minnow traps were set.

Analysis of the stomach contents revealed a wide variety of food types: small fish, young crayfish, snails, scuds, midgefly larvae, mayflies, cladocera, ostracods, chironomid larvae, odonata, and other immature insects. The perch in turn provide food for waterfowl such as loons, and kingfishers and for other fish such as sunfish, bass, walleye, northern pike, muskies, lake trout, and other perch.

Perch prefer clean habitats with shallow bottoms of muck, sand, or gravel and open water with only moderate vegetation. The yellow perch spawning season is from March to May. Too concentrated of a population will bring about stunted growth.

In Bergner Lake, a large number of young perch were caught in the Minnow traps but none were caught in the Fyke Nets. The history of this lake included bass fishing which allowed the yellow perch population to increase in size. The lake is a good habitat for the perch in that the water is clear, open, and with

only moderate vegetation. The abundance of small fish supply plentiful food for the larger fish. The majority of the fish caught were aged at 1+ years and 70-77mm. in length. The age-size class plot seemed to show the majority of fish caught to be the same age. In comparing the age and sizes the perch in Bergner seemed to be average sized.

All of the Yellow perch caught in Long Lake were 4+ years or older and all were larger than the comparison factor for their age. No small fish at all were caught in the minnow traps indicating less food for the larger fish. The clearness of Long Lake is only moderate, the vegetation is moderate and the bottom is mucky. It seems that this habitat is adequate for the perch, but the shortage of food keeps the numbers low and the fish surviving are probably the most fit.

One Yellow perch was caught in Morris Lake and was large (length and weight) for its age. Morris does not appear to be too clear of a lake, although the vegetation is moderate. The Northern Pike present the biggest inhibiting factor on the perch by way of their abundance. The food supply in Morris is plentiful, but so are the fish. Years ago Morris was stocked with ~~Walleye~~ N. Pike which were then fished. This upset the balance in the

lake which resulted in the Northern Pike explosion. Now it seems that only the most fit young perch survive. The fish caught was 4+ years old and in very good condition (265mm and 9.1oz.). No perch were caught in Bolger Bog.

Since all of the yellow perch appeared to be in good condition no recommendations will be made to better the habitat. An increase in the number of perch might be considered desirable in Morris and northern pike are being removed from this lake by opening it to fishing. This may allow the perch population to expand.

References:

A Brief Guide to the University of Notre Dame Environmental Research Center. compiled and edited by Richard W. Greene 1976

Andrews, William A. 1972. Freshwater Ecology Prentice-Hall, Inc. Englewood, New Jersey

Smith, Robert Leo. 1974. Ecology and Field Biology. Harper and Row, Inc. New York, N.Y