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FOREST SERVICE BOG

AND

MORRIS LAKE

As studied by a novice.

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Practicium in Aquatic Biology

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Introduction

The study of aquatic ecosystems is one that involves the inter-relationships of many factors. At UNDERC(University of Notre Dame Environmental Research Center) one can see the inter-relationships of aquatic habitats by studying the different environments of the various lakes.

This report will deal with the lake environments of Forest Service Bog and Morris Lake. An attempt will be made to explain the flora and fauna of these two bodies of water in relation to the water chemistry of each respective lake. In addition a short discussion on the differences in the planktonic species between Morris Lake during the day and Morris Lake at night will be discussed.

Furthermore the similarities and differences between Forest Service Bog and Morris Lake will be investigated.

Forest Service Bog is one of the many bogs on UNDERC's property. It is not a very big body of water, but according to previous and present data it is known to be a deep bog with a false bottom.

The bog is like a kettle in shape which is due to its formation during the ice age. The bog mat may quake as one walks around as we experienced when one person (me) fell in a bog at another site.

The surface area of Forest Service is covered densely with Sphagnum moss, and there is also a small floating island. Surrounding it one can find black spruce, tamarack, pitcher plants, and sundew as well as other macrophytes. Trees that surround the bog are stunted in growth, but as one extends beyond the immediate area the growth becomes more dense.

The presence of Sphagnum moss is what begins the bog development process. The surface of the moss acts as an ion exchanger of hydrogen ions (H^+) for metal cations, thereby reducing the availability of metal ions in the lake, and increasing the acidity of the water.

Forest Service is a seepage lake which means it has no inflows of outflows from any lake or to any lake on the property. There is no drainage of water so that minerals and nutrients are taken out before they can reach any open lakes. The water comes from either rain or from deep within the ground, this again is due to the lack of inflows and outflows.

Forest Service would be classified as a dystrophic lake by virtue of the fact it is a bog and bogs in general are considered dystrophic. However Forest Service does not quite seem to fit under this classification. A dystrophic lake is described as brownish in color with a lot of dissolved humic matter, a small bottom fauna and a high oxygen consumption.

According to Secchi disc readings Forest Service's bog water seemed to be quite clear for the reading was measured to be 2.3 meters. This shows that light penetrating to the bottom of the lake is actually twice that because light must be reflected down and then up again. In addition to this there are a large number of species in the water as well as a lack of color which is contrary to what a dystrophic lake means. The lack of color may be due to the fact that humic material has settled to the bottom of the bog thereby allowing light penetration to be relatively deep. This penetration allows productivity to be high as can be seen by the high numbers of planktonic species observed.

In this next part an attempt will be made to relate the different planktonic species found in Forest Service to the water chemistry data that was tested.

Forest Service Bog is a body of water that is low in pH, and in alkalinity as evidenced by the pH of 4.0 in the hypolimnion. It also has a low calcium and Mangesium hardness in both the epilimnion and hypolimnion. A factor adding to the low pH is the presence of Sphagnum moss which acts as an ion exchanger between the H^+ ions and the metal cations in the water making it acidic. Also if free CO_2 is added to the system by respiration once again the pH is lowered.

Under the phylum Chlorophyta the species Mougeotia, Sphaerocystis, and Staurastrum and Zygenma appear to be the most abundant. The appearence of Mougeotia and Zygenma cannot be explained by this writer's limited knowledge as it was not found in the literature except to say that it is a common species during the months of summer. However, the presence of Sphaerocystis seems to show that it may be an improtant factor in the soft water of the lake. Also related

to this is the presence of Staurastrum, a desmid, which is usually associated with very low Ca. and Mg. readings. This is in agreement with the water chemistry data of Forest Service. The phylum Chrysophyta which is represented by the species Dinobryon points to the fact that there must be a low phosphate concentation because it is an obligate factor in order for this species to survive. Once again this seems to be in agreement with the data.

Although there were species represented within the phylums Bacillariophyceae, Chlorophyta, and Cyanophyta since their numbers were relatively small and no exact corelation could be drawn it may be safe to say that under the given conditions of the water these species found a compatible habitat.

The nitrogen, nitrate content of the water in the bog was rather high in the hypolimnion as compared with the epilimnion. This could be due to rainwater from which Foreset Service seems to get its supply from or through photochemical action since the water is relatively clear.

Iron does not seem to be presemt in an appreciable amount this is because high amounts are usually found under anoxic conditions.

The low value of electrolytes isnnot surprising because a large ionic concentration is needed for high conductance, but as can be seen Forest Service has low ion concentrations due to the presence of Sphagnum moss which of course also relate to the pH.

Finally when the water was tested for the presence of H_2S by smell none was found. This may be strange at first glance because one may think highly productive lakes may have H_2S, but in actuality it is in total agreement with O_2 readings in the water. Forest Service had an O_2 reading of 1.2 ppm at the bottom which explains the lack of H_2S, if O_2 is present H_2S is lacking, because one needs anoxic conditions for the H_2S to be apparent.

Forest Service Bog's zooplankton did not come from very many phylums, however their presence is intresting to evaluate.

In the phylum Cladocera, the species Bosmina longirostris, Holypedium, and Polyphemus were found. It is surprising why only one species of Bosmina was found since two do exist, the other one being B. coregoni. An explaination could be that B. longirostris could survive better than B. coregoni.in this water. The presence of Holypedium which is limited to the waters low in Ca. agrees with the chemistry data. Polyphemus is a predator which most likely feeds on the small zooplankton as well as algae.

Under the phylum Copepoda the ~~species~~ genera Diaptomus and Eucyclops are represented. Diaptomus is a filter feeder which can survive low O_2 conditions. It aids the food chain by converting the photosynthetic products into animal tissue. Eucyclops mainly feed on green algae and diatoms.

The species Keretella, Lecane, and Polyarthra , under the phylum Rotifera, seemed to be the most abundant in the waters of Forest Service. These species may be limited by various factors such as pH, CO_2, and HCO_3^-, in spite of such limiting factors they seem to be surviving well.

The presence of Naupluis serves to show that reproduction is occurring among the various species.

This next part will deal with the lake environment of Morris Lake.

Morris Lake is one of the twenty odd lakes on UNDERC's property. It is a shallow, marshy lake with depth going to about six meters. The shores for the most part are level, however some parts of them are steeply banked.

Morris is surrounded by a few evergreens on the outside and contains some bushy growth on the perimeter. There are patches

of lillies that extend from the shore as well as extensive growth on the bottom of the lake.

Water enters Morris form Ward Lake which then flows into Tenderfoot Creek. It is considered to be a eutrophic lake which means it is rich in dissloved nutrients, but shallow and with seasonal O_2 deficiency.

This seems to fit the description of Morris because it is certainly a shallow lake and not very clear by any means. This is evidenced by the Secchi disc readings of 1.3 meters.

The bottom flora and fauna of Morris is extensive which shows that there is a considerable amount of production that occurs. A comparison will be made later on in the paper between the plankton species apparent during the day versus that of the night.

In this next section the planktonic species and how they relate to the water chemistry will be explored.

Morris Lake is one with a pH between 5.5 and 5.7 making it a moderately acidic lake, this is represented by the moderate presence of alkalinity in the water. As would be expected the hardness of the water is comparable to the pH and the alkalinity for the Ca(.) and Mg(.) hardness values are in the median range.

The lake is primarily represented by four planktonic phylums

In the phylum Bacillaripohyceae the species Asterionella, Melosira, and Tabellaria occur in small quantities. These species are the most important in the fresh water phytoplankton, however the planktonic species as compared with the littoral species are in the minority.

Under the phylum Chlorophyta the species Ankistrodesmus, Eudorina, Mougeotia, Sphaerocystis, and Staurastrum were the most abundantly represented. The presence of Eudorina and Sphaerocystis

reflects the fact that these plankton are found most often in shallow and fertile lakes. Sphaerocystis may be an important factor in soft water lakes. Staurstrum is usually associated with low Ca and Mg readings. Although it may seem Morris does not have low readings compared to other lakes in actuality it does.

The species represented by the other phylums were relatively less with respect to those discussed therefore one can assume conditions for survival in Morris are hospitable for them.

Nitrogen and nitrate values in Morris Lake were rather low. This could be due to the presence of Oscillatoria, a nitrogen fixing bacteria, or to the fact that nitrogen is a minute nutrient.

As the ions in the water are present in a moderate amount it is to be expected that specific conductance should also be moderate.

The presence of H_2S was checked by smell and it was found to be present especially in the hypolimnion. This is due to the severe anoxic conditions at the bottom of the lake. Although there seems to be some according to the oxygen reading it is not so because H_2S can give a false O_2 reading. Since H_2S is present, ideally sulfate should not be either. However, in this case there was a sulfate reading, the reason being that the O_2 in the air oxidized the H_2S to sulfate between the time of collection and the reading.

The presence of iron in the lake at 3 ppm strengthens the fact that Morris is anoxic, since iron is present mostly in anoxic environments.

The zooplankton of Morris did not consist of many different phylums, however there were plenty of organisms to study.

Under the Cladocera Bosmina longirostris was found. There is another species of Bosmina, that being B coregoni, but B longirostris overtakes coregoni in lakes passing from oligotrophic to eutrophic phases.

In the ~~phylum~~ Copepoda, Paracyclops was found. This species is mostly benthic and littoral which means that they like to stay in these zones of H_2O, either at the solid-liquid interface or at the littoral zone. They are both carnivores as well as herbivores.

The ~~species~~ genera Peridinium and Ceratium which are classified under the phylum Protozoan were also found in Morris' water. These organisms may require a low total mineral concentration which once again goes back to the lack of high values of hardness as well as the possibility that they may be regulated by a certain temperature.

By far the phylum Rotifera was the most abundant group of all the zooplankton. Keretella which is most likely to occur in the open waters of lakes was in the highest abundance. Also within this class are the species Filinia and Polyarthra. There may be many significant causes of limitations on these species. Among them are pH, CO_2, Ca, and HCO_3^-.

It is interesting to note that the Keretella may eat the Ploesoma which means that Keretella are carnivorous within their own phylum.

Finally one sees that production of new species is certainly present, by noting the presence of different species of Naupluis in the waters.

During the next part comparisons will be made between the planktonic species found during the day versus those found at night on Morris Lake. An attempt will be made to explain either

the rise or the fall of the various numbers of the different species as well as the appearance of a totally different species that appears during the night.

Morris Lake at night seems to take on a totally different character than during the day. The mosquitoes are out full force and it seems Jason is constantly on the watch.

As interesting as listening to the night sounds of Morris it is even more so to examine the planktonic species at night and seeing how they differ from that during the day.

The different numbers of species of phytoplankton that were apparent during the day are considerably reduced. In the Bacillariophyceae the Asterionella, and the Tabellaria are not seen. This could be caused by the increased amounts of some Protozoans as well as Rotifers which may eat them.

In the phylum Chlorophyta the species Staustrum is not seen, perhaps the presence of the various species of Cyclops helped along that line since those species considerably rose in numbers.

As for the appearance of the species Dinobryon and the disappearance of the species Synura in the phylum Chrysophyta. I really have no explaination except that perhaps the Dinobryon was not receognized in the day count, therefore showing up in the night. As to why it is there, maybe it is not quite the right food source for the other planktonic species.

The presence of Oscillatoria stayed about the same whereas Anacystis disappeared suggesting maybe a zooplankton species ate it.

There seemed to be quite an increase in the numbers of Bosmina, Cyclops, Peridinium, and Keretella. This may perhaps be due to the fact that these species come out at night so that fish cannot ~~predate~~ prey upon them.

On the other hand there was a considerable decrease of the species Ploesoma, Polyarthia, and nauplius. This could be caused by Keretella eating the Ploesoma as well as the presence of the carnivorous species of Cyclops.

One very interesting species was seen during the night tow, that being Chaybrous larva. This species spends its day at the bottom (thereby earning the name meroplankton) and becomes planktonic at night. It feeds on plankton of various sorts, microcrustaceans,rotifers and prefers Bosmina over the species of Cyclops.

This comparison between the planktonic species of Morris at night versus day is definetly one that helps complete the picture of the ecosystem of Morris Lake.

As one can see, the chemical tests as well as the planktonic species serve to give a more complete picture in each body of water studied.

The purpose of this entire study between Forest Service Bog and Morris Lake was not only to relate the planktonic species found to the water chemistry, but also to compare the two lakes.

Forest Service Bog, although it is classified as a dystrophic by nature of the fact it is a bog was shown not to fall into that category. On the other hand Morris Lake fit into its classical definition as a eutrophic lake without the ambiguities of Forest Service.

The lakes are similar in that both are acidic, although Forest Service is more acidic than Morris.

In terms of other chemical tests such as alkalinity, hardness, specific conductance, nitrogen, nitrate, sulfate, phosphate, iron and H_2S presence two lakes differed somewhat.

Alkalinity was much greater in Morris Lake as compared to Forest Service. This is to be expected since the hardness in Morris is also much greater.

This higher value of hardness adds to the increase in specific conductance as evidenced by the values in Morris as compared to Forest Service.

As for the presence of nitrogen and nitrate it may be that Morris has a higher count because of a higher number of nitrogen fixing bacteria.

Sulfate presence normally shows that there is O_2 in the lake It is also associated with the presence of H_2S in the water. In Forest Service sulfate readings were low showing that it may be a minor nutrient. In the case of Morris sulfate presence and H_2S presence do not correlate. This can be explained by understanding that if H_2S is oxidized by O_2 then sulfate will be present. In Morris' readings this is what probably happened.

Phosphate readings between the two lakes differed greatly in the hypolimnion of the two. Since phosphate presence is a limiting factor for phytoplankton. Bogs are considered to be more productive than eutrophic lakes however Forest Service's phosphate readings were lower than Morris'. This may be due to the fact that maybe not enough care was taken while doing phosphate readings because contamination by human hands is very likely.

Iron is usually seen in waters that are anoxic in the case of Morris this is true, since O_2 ppm were very low as compared with Forest Service.

The planktonic species of both lakes came from the same phylums however, differences between the numbers and kinds of species did exist.

In both lakes the phylum Cyanophyta, Chrysophyta, and Bacillariophyceae were in minute amounts.

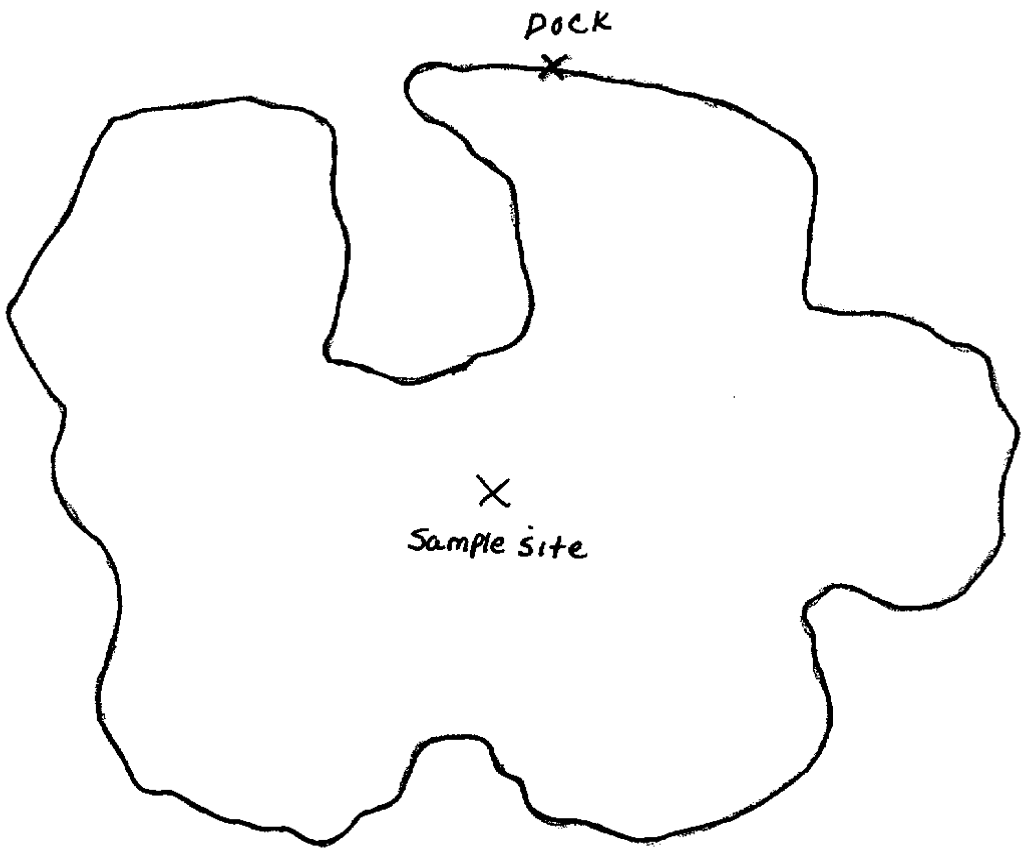
Under the phylum Chlorophyta Forest Service was represented by more species than Morris. In the common species of the two lakes Forest Service had the greater abundance, which would be due to the chemical factors in its waters.

Once again in both lakes Forest Service had the greater abundance of zooplankton between the two lakes. This may be explained by the presence of fish in Morris Lake. Although the same species were available in both lakes Forest Service does not have the great numbers of predatory fish that Morris' does.

One major difference between the zooplankton of the two lakes is that Chayoborus larva was present in the night count. Forest Service did not have any Chayborus. This is so for the daytime, it may have at night, but that data is unknown.

The study of these two lakes serves as an example to show investigators how chemicals in the water effect the planktonic species. In addition it also shows how these species interact in a body of water to give us a more complete picture of an aquatic ecosystem.

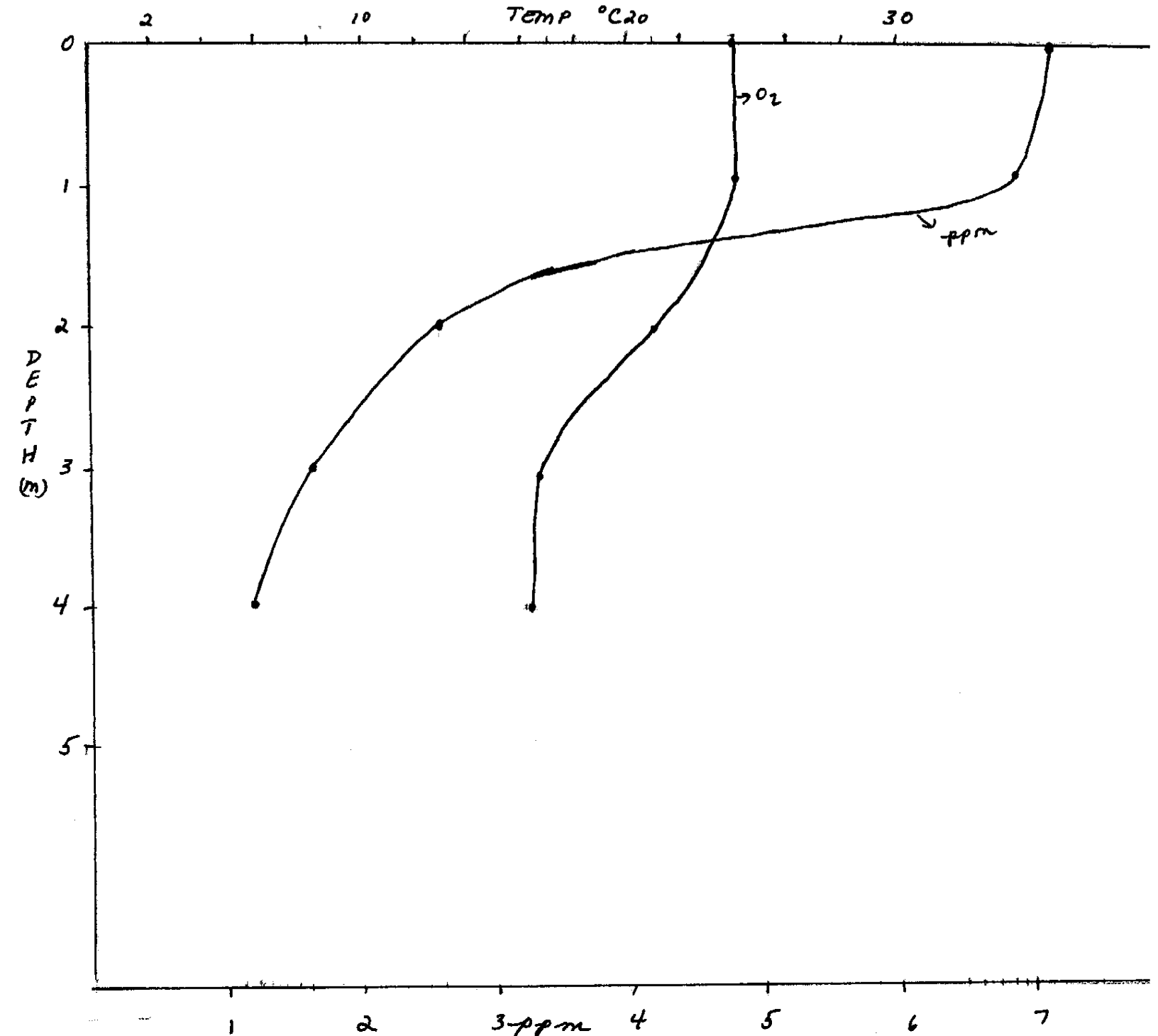
FOREST SERVICE BOG



OXYGEN PROFILE
OF

FOREST SERVICE BOG

Depth	Temperature	parts/million
0meters	24^{c}	7.1
1 meter	24^{c}	6.8
2 meters	21^{c}	2.6
3 meters	17^{c}	1.6
4 meters	16^{c}	1.2



WATER CHEMISTRY

OF

FOREST SERVICE BOG

Results	Epilimnion	Hypolimnion
Acidity		
methly orange	0.0mg/l	0.0mg/l
phenolphthalein	7.5mg/l	17.0mg/l
Alkalinity	2.5mg/l	2.5mg/l
Hardness		
Ca	1.25mg/l	2.5mg/l
Mg	1.25mg/l	2.5mg/l
Total	2.5mg/l	5.0mg/l
Specific Conductance	12 mhos/cm	58 mhos/cm
pH	5.3	4.0
Nitrogen, Nitrate	9mg/l	1mg/l
Sulfate	0.0mg/l	.1mg/l
Phospate	.15mg/l	.21mg/l
	.21mg/l	.20mg/l
	.11mg/l	.15mg/l
Average	.16mg/l	.19mg/l
Fe	.05mg/l	.15mg/l
Secchi Disc	2.3 meters	
H_2S	not present by smell	not present by smell

Meterological conditions: Sunny and hot

PLANKTON COUNTS FOREST SERVICE BOG

NAME	ABUNDANCE	PERCENTAGE
PHYTOPLANKTON		
BACILLARIOPHYCEAE		
Asterionella	10.5	.69%
CHLOROPHYTA		
Mougeotia	133	8.7%
Odeogonium*		
Pleurotaenium	17.5	1.1%
Sphaerocystis	164.5	10.75%
Spirogyra	7	.46%
Staurastrum	66.5	4.3%
Ulothrix	3.5	.23%
Xanthidium	3.5	.23%
Zygenma	63	4.1%
CHRYSOPHYTA		
Dinobryon	17.5	1.1%
CYANPOHYTA		
Oscillatoria	7	.46%
ZOOPLANKTON		
CLADOCERA		
Bosmina	66.5	4.3%
Holypedium	17.5	1.1%
Polyphemus	10.5	.69%
COPEPODA		
Diaptomus	7	.46%
Eucyclops	3.5	.23%

PLANKTON COUNTS FOREST SERVICE BOG CONTINUED

ZOOPLANKTON

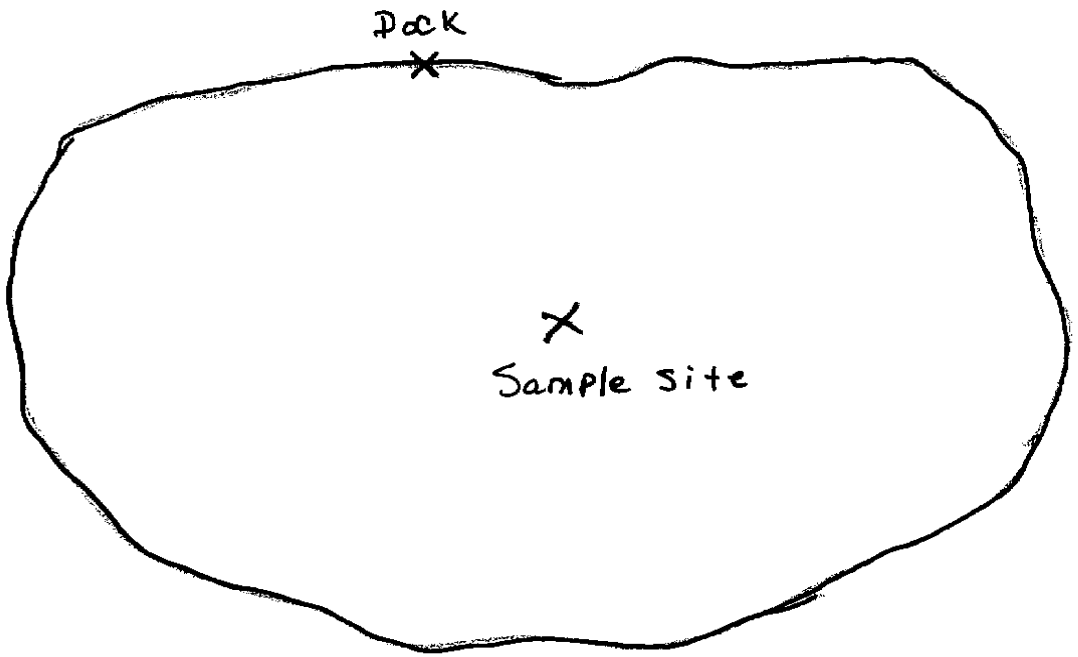
NAME	ABUNDANCE	PERCENTAGE
ROTIFERA		
Keretella	595	39%
Lecane	77	5%
Polyarthra	161	10.5%
Naupluis	98	6.4%

* Odeogonium was seen in identification but was not counted.

Total population according to raw numbers is 1529.5.

Abundance is relative abundance in one preparation of the Sedgwick Rafter Cell.

MORRIS LAKE

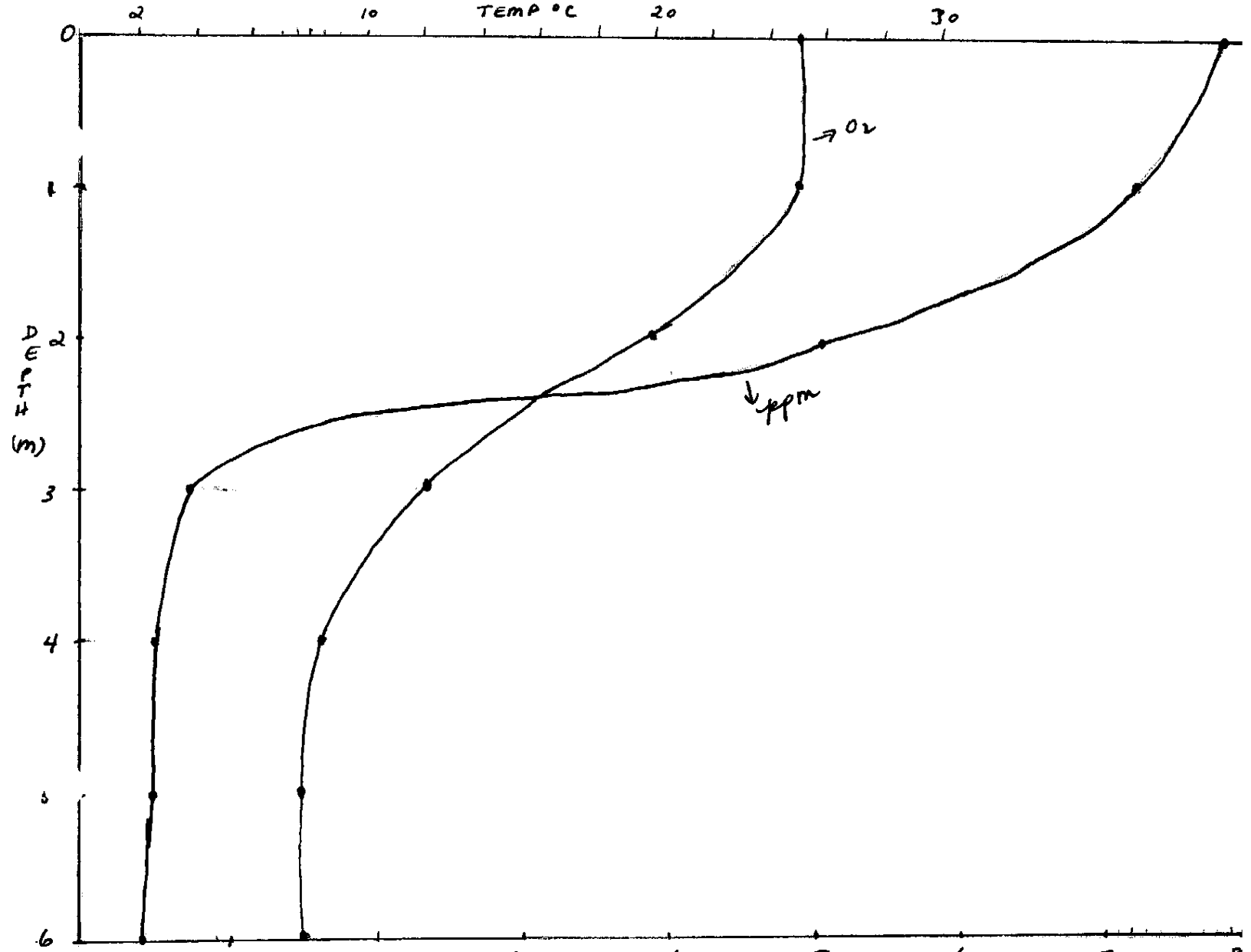


OXYGEN PROFILE

OF

MORRIS LAKE

DEPTH	TEMPERATURE	PARTS/MILLION
0 meters	25^{c}	7.9
1 meter	25^{c}	7.2
2 meters	20^{c}	5.0
3 meters	12^{c}	.7
4 meters	8.5^{c}	.5
5 meters	7.5^{c}	.5
6 meters	7.5^{c}	.4



WATER CHEMISTRY
OF
MORRIS LAKE

RESULTS	EPILIMNION	HYPOLIMNION
Acidity		
methyl orange	0.0mg/l	0.0mg/l
phenolphthalein	20.0mg/l	40.0mg/l
Alkalinity	50.0mg/l	65mg/l
Hardness		
Ca	25.0mg/l	35.0mg/l
Mg	20.0mg/l	30.0mg/l
Total	45.0mg/l	65.0mg/l
Specific Conductance	68 mhos/cm	103 mhos/cm
pH	5.5	5.7
Nitrogen, Nitrate	.6mg/l	.6mg/l
Sulfate	0.0mg/l	1mg/l
Fe	.26mg/l	3.0mg/l
Phospate	.20mg/l	.50mg/l
	.24mg/l	-
	.14mg/l	.43mg/l
Average #1@2	.22mg/l	.47mg/l
H_2S	not present by smell	present by smell
Secchi Disc	1.2 meters	

Meterological conditions: A little cloudy, warm and slightly breezy

PLANKTON COUNTS MORRIS LAKE DAY

NAME	ABUNDANCE	PERCENTAGE
PHYTOPLANKTON		
BACILLARIOPHYCEAE		
Asterionella	10.5	.53%
Melosira	15.75	.79%
Tabellaria	10.5	.53%
CHLOROPHYTA		
Ankistrodesmus	42	2.1%
Eudorina	63	3.2%
Mougeotia	78.75	3.96%
Sphaerocystis	141.75	7.1%
Staurastrum	26.25	1.3%
Ulothrix	5.25	.26%
Zygenma	21	1.05%
CHRYSOPHYTA		
Synura	15.75	.79%
CYANOPHYTA		
Anacystis	5.25	.26%
Oscillatoria	10.5	.53%
ZOOPLANKTON		
CLADOCERA		
Bosmina	36.75	1.85%
COPEPODA		
Paracyclops	21	1.05%
PROTOZOAN		
Peridinium	47.25	3.8%
Ceratium	63	3.2%

PLANKTON COUNTS MORRIS LAKE DAY CONTINUED

ZOOPLANKTON

NAME	ABUNDANCE	PERCENTAGE
ROTIFERA		
Filinia	52.5	2.6%
Keretella	441	22%
Ploesoma	183.75	9.2%
Polyarthra	99.75	5%
Naupluis	210	10%

Total Population according to raw numbers is 1989.75.

Abundance is relative abunance in one preparation of the Sedgwick Rafter Cell.

PLANKTON COUNTS MORRIS LAKE NIGHT

NAME	ABUNDANCE	PERCENTAGE
PHYTOPLANKTON		
BACILLARIOPHYCEAE		
Melosira	5.25	.42%
CHLOROPHYTA		
Ankistrodesmus	47.25	3.8%
Mougeotia	47.25	3.8%
Staustrum	5.25	.42%
CHRYSOPHYTA		
Dinobryon	120.75	9.7%
CYANOPHYTA		
Oscillatoria	5.25	.42%
ZOOPLANKTON		
CLADOCERA		
Bosmina	189	15%
COPEPODA		
Cyclops	215.25	17.3%
Orthocyclops	15.75	1.3%
PROTOZOAN		
Peridinium	435.75	21.9%
ROTIFERA		
Keretella	393.75	31.6%
Lecane	10.5	.84%
Ploesoma	26.25	2%
Polyarthra	47.25	3.8%
Trichocera	52.5	4.2%
Naupluis	63	5%

PLANKTON COUNTS MORRIS LAKE NIGHT CONTINUED

There was a high abundance of Chaoborus larva, but due to their large size it was impossible to count them in the Sedgwick Rafter Cell.

Total population according to raw numbers is 1244.25.

Abundance is relative abundance in one preparation of the Sedgwick Rafter Cell.

PLANKTON PRESENCE

MORRIS LAKE DAY VS. MORRIS LAKE NIGHT

DAY	NIGHT
PHYTOPLANKTON	
BACILLARIOPHYCEAE	
Asterionella	Not Present
Melosira	Present
Tabellaria	Not Present
CHLOROPHYTA	
Ankistrodesmus	Present
Eudorina	Not Present
Mougeotia	Present
Sphaerocystis	Not Present
Staustrum	Present
Ulothrix	Not Present
Zygenma	Not Present
CHRYSOPHYTA	
Synura	Not Present
Not Present	Dinobryon
CYANOPHYTA	
Anacystis	Not Present
Oscillatoria	Present
ZOOPLANKTON	
Bosmina	Present
Ceratium	Not Present
Not Present	Cyclops
Not Present	Chaoborus
Filinia	Not Present
Keretella	Present

PLANKTON PRESENCE

MORRIS LAKE DAY VS. MORRIS LAKE NIGHT CONTINUED

ZOOPLANKTON

Day	Night
Not Present	Lecane
Naupluis	Present
Not Present	Orthocyclops
Not Present	Cyclops
Paracyclops	Not Present
Peridinium	Present
Ploesoma	Present
Polyarthra	Present
Not Present	Trichocera

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