8.25

ANALYSIS OF

WARD LAKE AND ED'S BOG

1977

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W.C 8.5

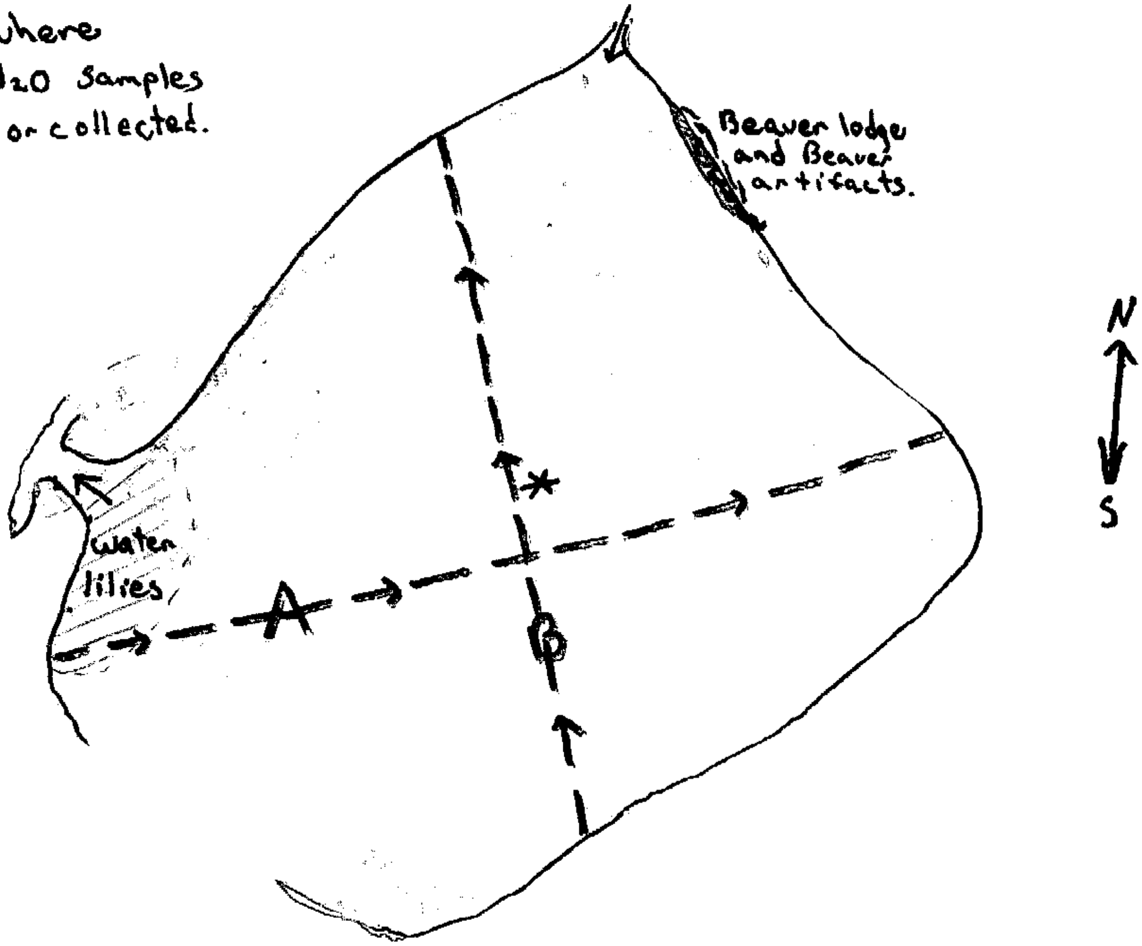
A General Description

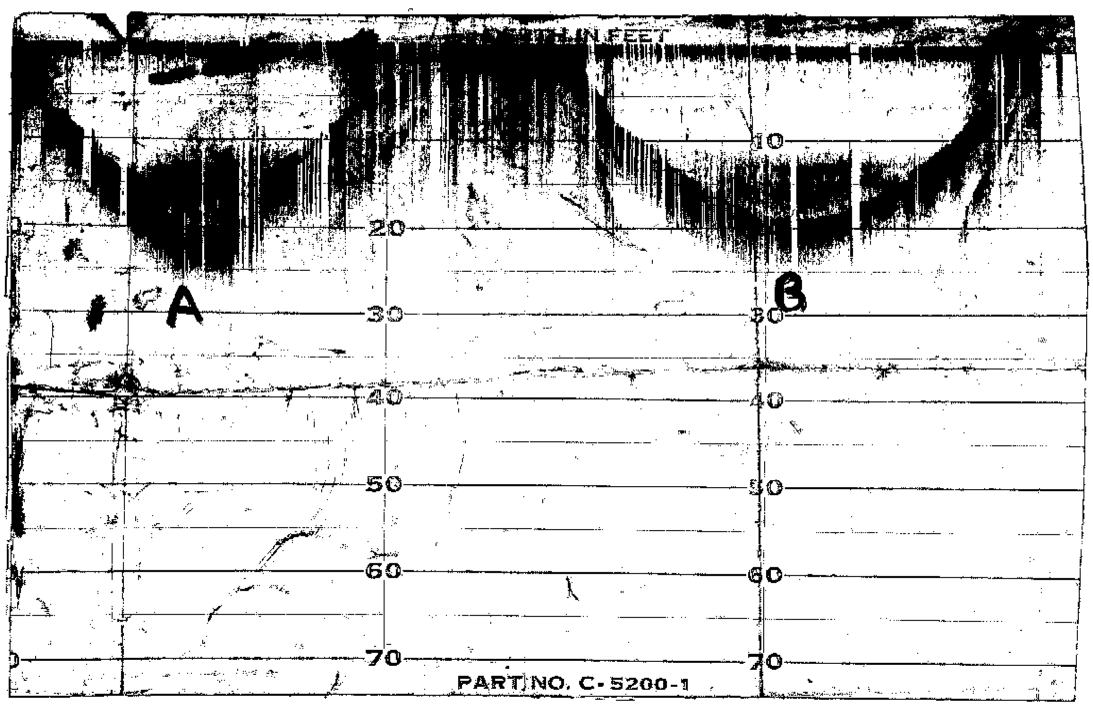
Of Ward Lake

The surface area is 1.1 ha. and the depth reaches 20 feet in spots. There is an inlet from Mullany Lake on the north-east end, and an outlet to Morris Lake on the west end. There are beaver works concentrated near the north-east end. There are ferns, grass, and some Sphagnum around the lakes edge. There are some tamarak, cattails, and a few live birch also, however the nearest trees were almost all evergreens. There is one patch of water lilies around the outlet at the west end.

Ward Lake

* location where
O_2, temp. and H_2O samples
c re recorded or collected.

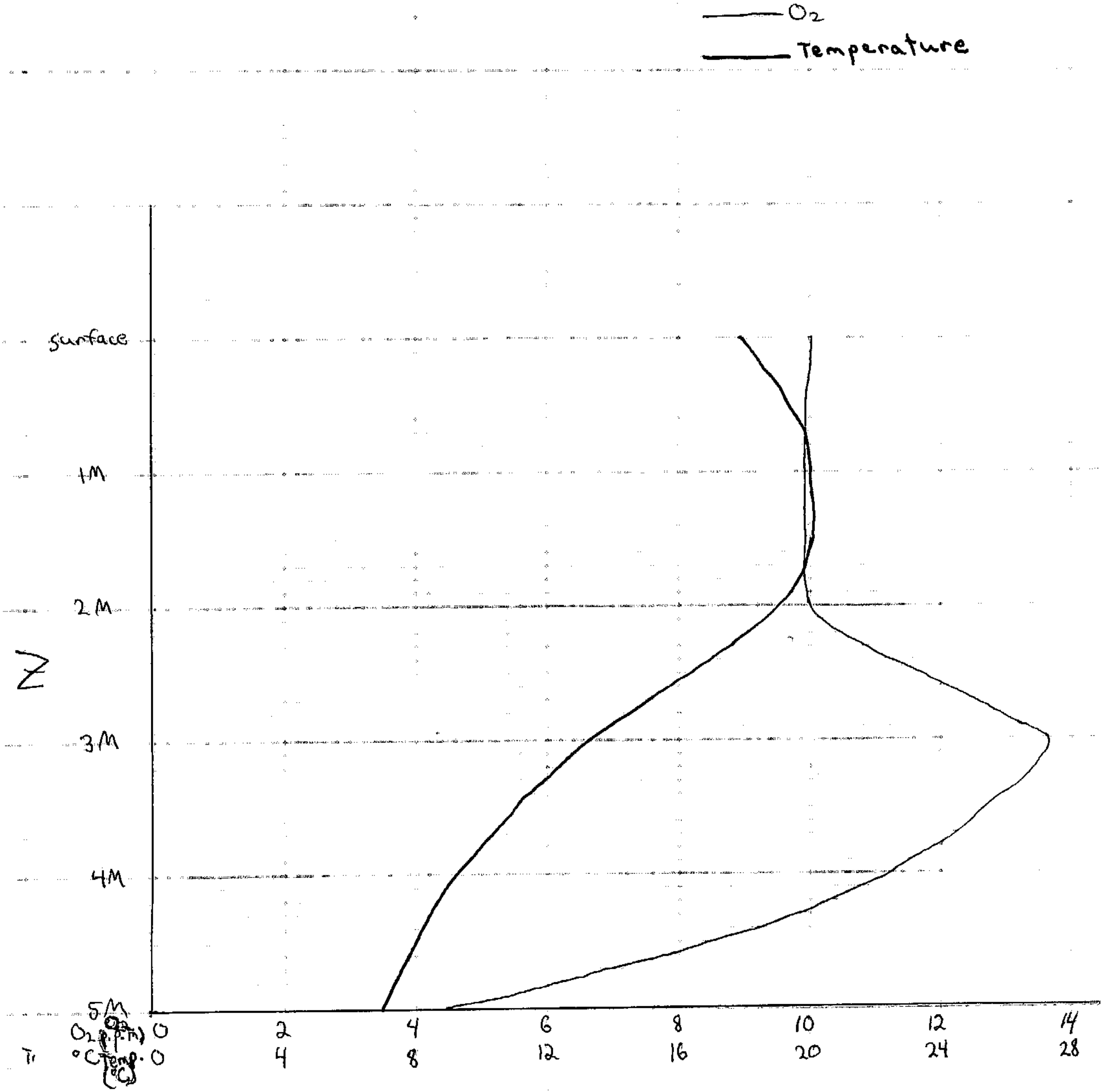




Temperature and O_2 Data For Ward Lake

Depth (meters)	Temperature (°C)	O_2 (p.p.m.)
Air	13	—
Surface	18	10
1	20	9.9
2	19	10
3	13	13.6
4	9	10.8
5	6	4.5

Temperature and O_2 profile for Ward Lake.



Ward Lake-water chemistry

	1M	5M
apparent color	70 units	440 units
true color	40 "	90 units
sulfate	10.5 mg/L SO_4	2.5 mg/L SO_4
hydrogen sulfide	-	-
nitrate	.25mg/L N	4 mg/L N
methyl orange acidity	0mg/L CaCO3	0mg/L $CaCO_3$
phenol-pthalein acidity	5 "	0 "
alkalinity	80 "	135 "
p.H.	7.2	6.6
hardness(Ca)	65 mg/L$CaCO_3$	105 mg/L$CaCO_3$
hardness(total)	100 "	152.5 "
specific conductance	185μMhos	270μMhos
ortho phosphates	.185 mg/L PO_4	.8 mg/LPO_4
total phosphates	.22 "	1.5 "

An Analysis of The Water Chemistry

Of Ward Lake

The O_2 data and temperature was taken using an oxygen and temperature meter. A maximum O_2 reading of 13.6 p.p.m. was recorded at a depth of 3 meters. The minimum oxygen reading was at 5 meters where 4.5 p.p.m. were recorded. In analyzing this data it was noted that the water sample from 5 meters was tinted green. Additional samples were taken from 3 and 5 meters, centrifuged, and then the sludge was observed under a microscope. The sludge from the 3 meter sample consisted almost entirely of _Euglena_ and the sludge from 5 meters consisted primarily of green bacteria. Photosynthesis by the Euglena appears to be responsible for the elevated oxygen reading at 3 meters (temperature 13°C). At 5 meters there is a sudden drop in the dissolved O_2 accomanied by a change from _Euglena_ to the Green bacteria in the water. This phenomenon also explains other unusual chemical data. Due to the cold air temperature (13°C) the surface temperature (18°C) was less than the maximum temperature at 1 meter (20°C). The temperature from 2 to 3 meters drops from 19 to 13°C, and continues to drop until at 5 meters, a temperature of 6°C is reached. The lake is not yet well stratified, with the thermocline extending from 2 meters nearly to the bottom.

The apparent color at the bottom (5 meters) was much higher (440 units) than it was at 1 meter (70 units). This difference seems to be due to the green bacteria at 5 meters since when this sample was centrifuged for ten minutes a reading of only 90 units was recorded, and the sample was no longer tinted geen. The difference in the true color data for the two samples may be due to some still uncentrifuged off bacteria in the 5 meter sample.

The phosphate levels at one meter are lower than those at 5 meters with the total phosphates being extremely high at 5 meters. The high level of ortho phosphates (.8 mg/L PO_4) at 5 meters may be due to the decomposition of Euglena that have died in the middle layers of the lake and settled at the bottom, along with the algae from the surface. The high total phosphate reading appears to be the result of hydrolysis of the organic phosphates contained in the green bacteria found in the 5 meter sample. The low 1 meter levels of phosphates is probably due to depletion by the phytoplankton of the epilimnion.

The nitrate level at 5 meters was 16 times higher than that at 1 meter. This once again appears to be the result of the green bacteria. They give off ammonia which is oxidized to nitrites and then nitrates. (.25 mg/L N at 1 meter; 4 mg/L N at 4 meters)

Little acidity was recorded, and at 1 meter 80 mg/ L $CaCO_3$ were recorded for alkalinity, and 135 mg/L were recorded at 5 meters. The p.H. was higher on the surface than at 5 meters(7.2 and 6.6 respectively) The differences in p.H. are probably the result of photosynthesis uptake of CO_2 driving the equilibrium $CO_2 \leftrightarrow H_2CO_3 \leftrightarrow HCO_3^- + H^+$ in the direction of CO_2 formation, and higher p.H.

In addition to the higher alkalinity at 5 meters, the hardness levels, and specific conductance were higher at the bottom, (5 meters) than at 1 meter. The hardness level (total) 152.5 mg/L $CaCO_3$ at 5 meters is compared to 100mg/L at 1 meter, and the specific conductance of 270µ Mhos at 5 meters as compared to 185µMhos. It should be noted that Ward lake has the highest specific conductance of the lakes at UNDERC and despite Mullahy lakes high specific conductance, its flowing into Ward could lower the amounts of dissolved Mg, Ca, and other dissolved ions in the epilimnion. The presence of some Sphagnum could also be part of the reason for these differences between the hypolimnion and epilimnion since most of the Sphagnum would be found nearer the surface.

Ward lake has both an inlet and an outlet, and is fairly shallow, thus it appears unlikely that it will progress to a bog. The reduced p.H. from the 1975 data recorded in A Brief Guide to UNDERC and the presence of Sphagnum indicates that eventually between acid percipitation and ion exchange by the uronic acids of the Sphagnum, the pH will reach a level uncompatable with fish reproduction, and eventually will become a Marsh.

Ward Lake-Phytoplankton: Sedgwick-Rafter Cell Method.

Organism	# counted	#/ml concentrate	#/L lake water
<u>Scenedesmus</u>	11	73	3350
<u>Volvox</u>	1	7	367

note: the concentrate was 105 ml from 2 L of filtered lake water, 32 strips were counted.

Ward Lake-Phytoplankton: Sedgwick-Rafter Cell Method, AM

Organism	# counted	#/ml concentrate	#/5 min tow.
Navicula	30	200	17,800
Gonium pectorales	335	2236	199,000
Dinobryon	411	2742	244,000
Scenedesmus	241	1601	14,200
Staurastrum	29	193	17,200
Anacistus	177	1180	105,000
Frustulia	19	127	11,300
Peridinium	25	166	14,800
Cocconeis	7	47	4150
Anabena	19	127	11,300
Monostyla	25	166	14,800
Chlamydomonas	13	87	7710

note: 3 strips were counted, the sample was collected in a five minute net tow from a row boat.

Ward Lake-Phytoplankton: Sedgwick-Rafter Cell Method, PM

Organism	# counted	#/ml concentrate	#/5 min. tow.
<u>Anacistus</u>	146	487	33,090
<u>Dinobryon</u>	84	280	19,040
<u>Micrasterias</u>	10	33	2270
<u>Frustulia</u>	2	7	453
<u>Scenedesmus</u>	6	20	1360
<u>Peridinium</u>	1	3	227

note: 6 strips were counted, the sample was collected by a 5 minute net tow from a row boat.

Ward Lake-Zooplankton: Sedgwick-Rafter Cell

Method, AM

organism	# counted	#/ml concentrate	#/5 min. tow
Naupilus larvae	36	240	21,400
<u>Kerntella</u>	276	1840	164,000
<u>Ploesoma</u>	12	80	7120
<u>Cyclops</u>	12	80	7120
<u>Bosmina</u>	48	320	28,500
<u>Asplanchnopus</u>	11	73	6530
<u>Diaptomus</u>	7	47	4150
<u>Sinatherina</u>	24	160	14,200

note: The sample was collected by a five minute tow from a row boat, 3 strips were counted.

Ward Zooplankton: Sedgwick-Rafter Cell

Method, PM

organism	# counted	#/ml concentrate	#/5 min. tow
Diaptomus	118	393	26,700
Bosmina	42	140	9520
Ploesoma	54	180	12,200
Asplanchna	11	37	2490
Naupilus larvae	16	53	3630
Keritella	20	67	4530
Daphnia-	5	17	1130
Cyclops	15	50	3400
Sinatherina	1	3	227
Asplanchnopus	3	10	680
Ceriodaphnia	1	3	227

An Analysis of the plantonic samples of
Ward Lake

It should be noted at the beginning of this section that differences in numbers between AM and PM tows should be viewed with the qualitative nature of the tows in mind. Speed in rowing, water level the net is towed at, and removal of the sample from vial to the collecting jar are areas in which differences could occur. What is more important than direct numerical comparisons is a consideration of which organisms are most prevalent within each sample.

In the 2 liter phytoplankton sample little was found, although Scenedesmus was found to some extent. Scenedesmus was also found in moderate numbers in both the AM and PM tows, but considering the small size of the organism, it makes up a relatively small amount of the biomass collected. More Scenedesmus were probably found in the 2 L filtered sample due to the finer mesh of the filter. Dinobryon was found in fair numbers, consistent with the moderately low phosphate levels in the epilimnion, but in no where near the levels that were seen in samples from other bodies of water at UNDERC. Anacistus was also found in high numbers in both the AM and PM tows. Frustulia and Peridinium were also found in both tows, but the dynoflagelate Peridinium was in much lower relative numbers in the PM tow. It is possible that this algae migrates down at night and back near the surface when it is light. Navicula, Gonium pectorales, Staurastrum, Cocconeis, Anabena, Monostyla, Che

Cocconeis, Anabena, Monostyla and Chlamydomonas were found in the AM tow and not in the PM tow. Since in general larger numbers were found during the AM tow some of these species may have been missed by statistical chance, however it seems probable that at least some of these algae undergo vertical migration. Gonium pectorales was found in large numbers, however the count resulted from 2 individual colonies plus isolated individuals from broken up colony, therefore the large number counted is not as important as it seems at first glance.

In contrast to the reduced numbers of species of algae seen in the PM tow more species of zooplankton were found in the PM tow than in the AM tow. Ceriodaphnia, Daphnia and Asplanchna were all seen in the PM tow and not in the AM tow. The two cladocerons plus the fairly large rotifer are all of a size that would make them good foods for planktivorous fish, and it seems likely that they undergo vertical migration to help avoid predation. Diaptomous, although found in both tows is found in much larger relative numbers in the PM tow, another organism apparently avoiding predation by vertical migration. Keratella, Ploesoma, Asplanchnopus, and Bosmina were found in fair numbers in both tows as would be expected for these smaller zooplanktors that would not derive as much benefit from vertical migration, being less prone to predation by planktivorous fish. Sinatherina was found in larger numbers, relativly, in the AM tow, but this is statistically of questionable importance since this rotifer is found in colonies...

the phytoplanton included blue greens, greens,desmids, diatoms, and dynoflagellates, with no specific group dominating. The Zooplankton include several species of cladocerons, calonoid copepods, cyclopoid copepods, and 5 different rotifer species. The fish population appears to make Ward lake better suited for the smaller rotifers, and Bosmina, but has not completely eliminated the larger zooplankton.

A General Description Of

Ed's Bog

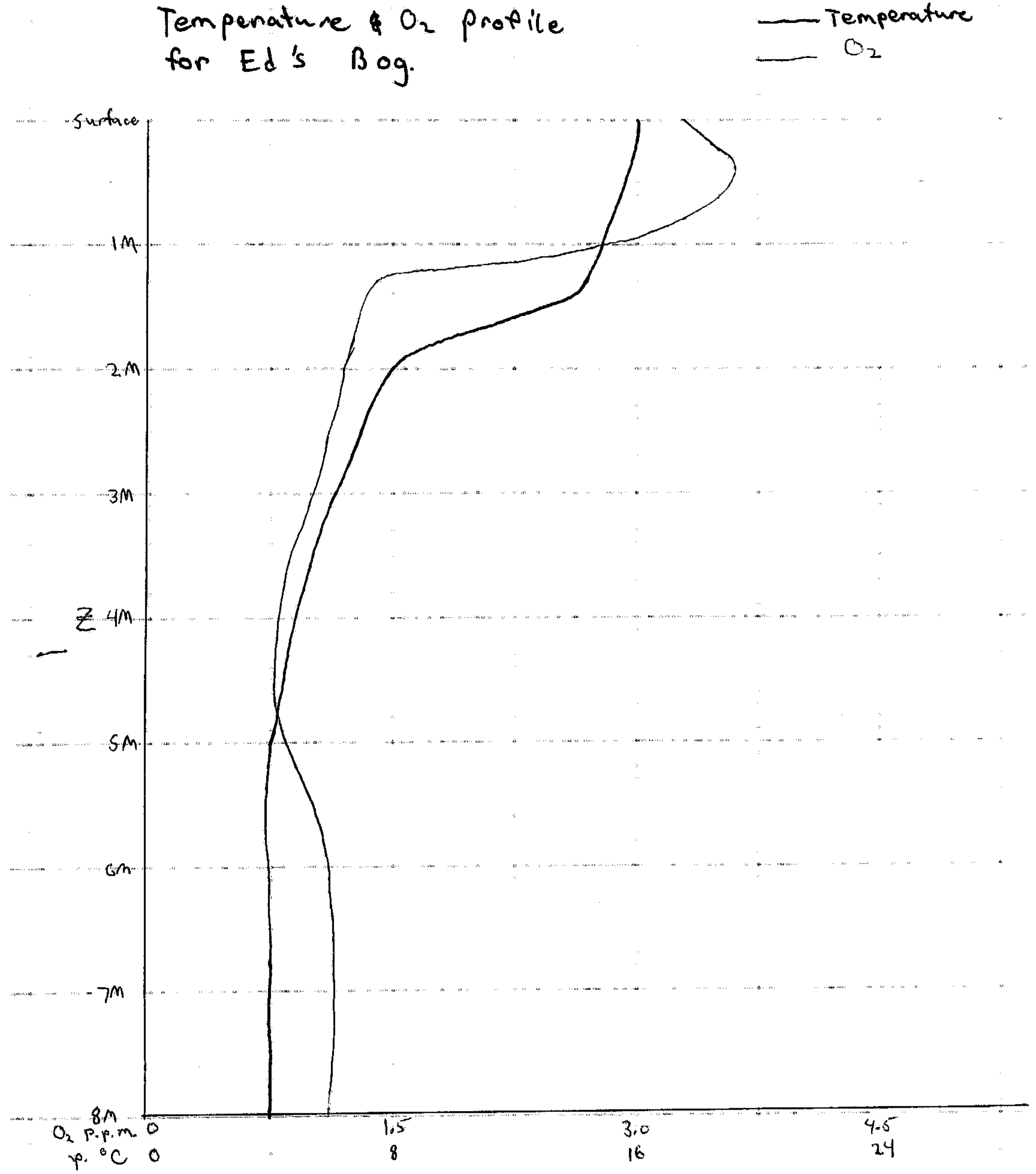
Ed's bog is almost entirely covered with a Sphagnum mat, with a very low ratio of open water surface area to volume ratio. The depth reaches over 8 meters. Tamarak, leather leaf,,pitcher plants, and sundew were found on the mat. Further back, fir and other similar trees were seen, and even farther from the mats edge hard woods could be seen. The expected number of tadpoles were not seen, although numerous turtles were sighted.

temperature and O_2 data for Ed's Bog

Depth(meters)	Temperature(° C)	O_2(p.p.m.)
Air	23.5	—
Surface	16.2	3.4
1/4	15.5	3.6
1/2	15.2	3.2
3/4	15.0	2.8
1	15.0	2.9
1¼	14.0	1.0
1½	13.5	.8
1¾	10.5	.7
2	8.2	.8
3	6.8	.9

Depth(meters)	Temperature(°C)	O_2(p.p.m.)
4	5.0	1.1
5	4.3	1.1
6	4.4	1.1
7	4.0	1.1
8	4.0	1.11

Temperature & O_2 profile for Ed's Bog.



Ed's Bog-water chemistry

	1M - Epi-	5M - Hypo- [illegible]
apparent color	130 units	180 units
true color	130 "	170 "
sulfate	7 mg/L SO_4	0 mg/L SO_4
hydrogen sulfide	0 "	>6 "
nitrate	.4 mg/L N	3.45 mg/L N
methyl orange acidity	3.75 mg/L$CaCO_3$	0 mg/L $CaCO_3$
phenol pthalein acidity	61 "	56.5 "
alkalinity	0 "	"
p.H. pH	3.8 "	4.1 "
hardness(Ca)	<2 "	<2 "
hardness(total)	<2 "	<2 "
specific conductance	28μMhos/cm	21μMhos/cm
ortho phosphates	.02 mg/LPO_4	.115 mg/LPO_4
total phosphates	.145 "	.225 mg/LPO_4

An Analysis of The Water Chemistry Of Ed's Bog

The air temperature was 23.5°C and the surface temperature was warmed .7°C (16.2°C) over the water at ¼ meter. The thermocline begins at just above 1¼ meter. The temperature drops the most from 1 ½ meters to 2 meters and begins to level off at 2 meters. In comparison to other lakes studied, in particular, Ward lake, the thermocline is at a shallow depth and most of the temperature change occurs through an extremely short distance.

The O_2 readings roughly parallel the temperature readings, decreasing as the temperature decreases, with the big drop in O_2 coming about ½ meter before the big drop in temperature. Below 5 meters a slight increase in O_2 is recorded, however this apparent increase in oxygen is most likely due to H_2S which is also picked up by the meter. High levels of H_2S were found in the hyplimnion sample from 5 meters, while no sulfate was recorded, indicating that nearly no oxygen was present at this depth.

In comparison to Ward lake, the true color was high, but since there was not as much suspended bacteria the apparent colors nearly matched the true colors. (true color: 130 units at 1 meter, 170 at 5 meters) The high degree of stratification in temprature and oxygen indicates that the bog did not turn over. Thus leaves and rotting vegitative matter would remain on the bottom, leach out tannins and other stains, coloring the water.

The nitrate levels are much higher at 5 meters(3.45 mg/L N) than at one meter(.4 mg/L) which is not suprising in a bog that did not turn over. Nitrates would continue to accumulate in the hypolimnion as phytoplankton and zooplankton would take up nitrate in the epilimnion, die and settle to the hypolimnion, and decompose, creating the high level of nitrates at 5 meters.

The phosphate level (ortho) in the epilimnion is very low, since the Sphagnum and the phytoplankton utilize this, and it is not replenished by turning over, the low level is expected. (.02 mg/L PO_4) The Ortho phosphates at 5 meters are higher, but not as much higher as they were in Ward which does turn over. This apparently incongruous data is probably caused by the close vicinity to the bottom that the sample was taken in Ward Lake. The total phosphates were also low (.145 mg/L) in the epilimnion. Since the bog must rely on outside sources of phosphosphates, and the Sphagnum mat also utilizes phosphates, it is not suprising that the total phosphates are low in the epilimnion. The total phosphates, although still low in the hypolimnion(.225 mg/L) are higher than in the epilimnion. This is probably the result of settling of dead organic matter.

The p.H. is low, 3.8 mg. in the epilimnion, 4.1 in the hypolimnion. There was some methyl orange acidity recorded at 1 meter(the epilimnion) and the phenolpthalein acidity was 61 and 56.5 mg/L $CaCO_3$ in the epilimnion and the hypolimnion respectively. The total hardness was less than 2 mg/L $CaCO_3$ and the specific conductance was low, 28 Mhos in the epilimnion.

All this is explained by ion exchange in the Sphagnum mat which entirely covers the edge of the bog, and restricts the surface area severely. Mg^+, Ca^+ and other ions are exchanged with H^+ ions of the carboxyl group of the uronic acid sugar residues present in the Sphagnum. The addition of the H^+ while removing Mg^+ and Ca^+ creates the acid, soft waters of the bog. Some of the H^+ released, instead of remaining free or as the hydronium ion would react with OH^- to form water, thus the net result of the ion exchange would also be to reduce the numbers of ions in the water and therefore the specific conductance.

Ed's Bog appears to be well on its way to being entirely closed over, and the Sphagnum may eventually fill it in entirely. however this is a long time in the future because despite its small surface area, Ed's bog is at least 8 meters deep.

Ed's Bog- Phytoplankton: Palmer Cell Method

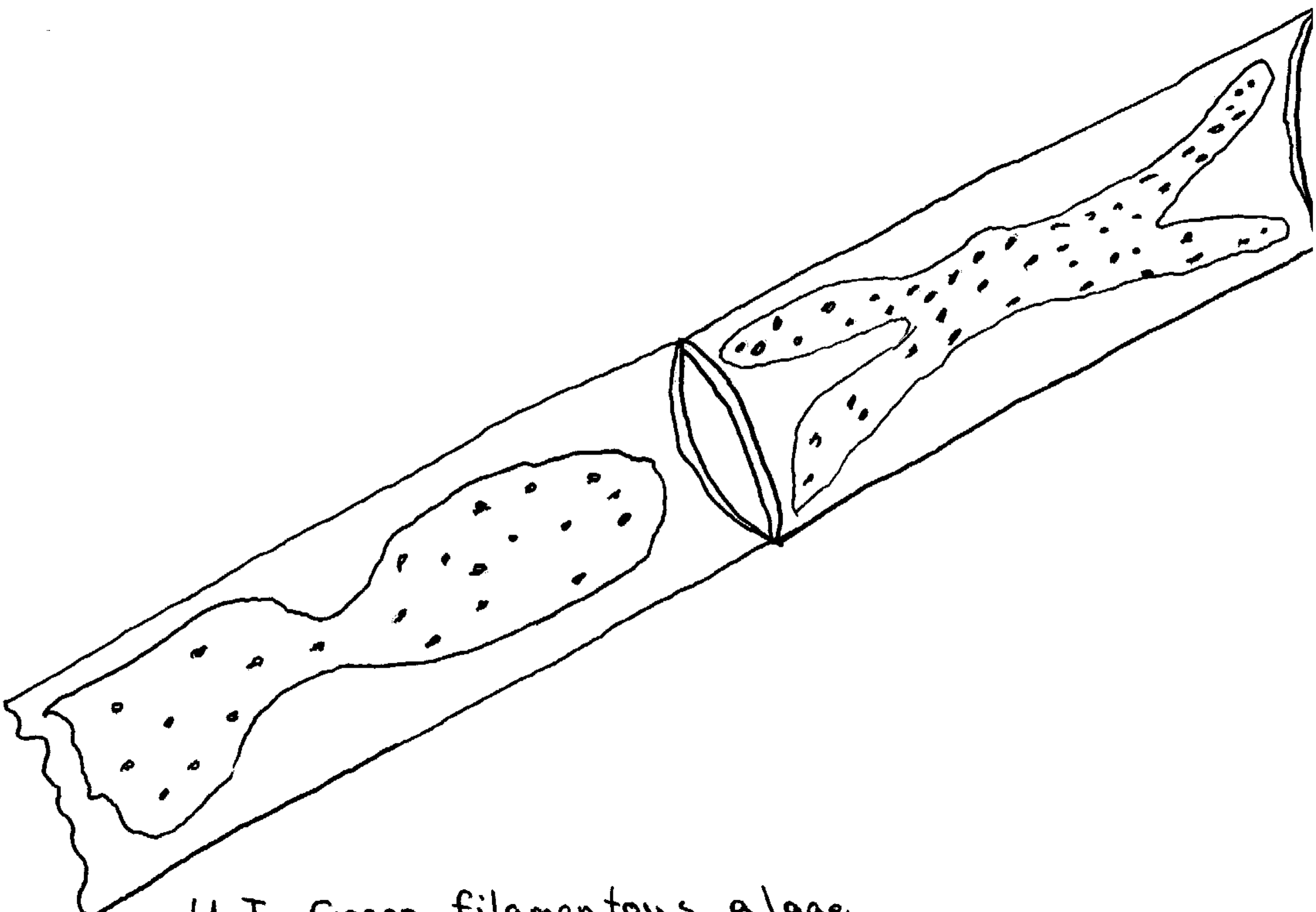
Organism	# counted	#/ml concentrate	#/L lake water.
Dinobryon	8	53	4270
Eudorina	20	133	10,700
Staurastrum	1	7	1130
Chlamydomonas	3	21	1690
Ulothrix	8	53	4265

note: the concentrate tested was 161 ml from 2 L of lake water.

Ed's Bog-Phytoplankton: Sedgwick-Rafter Cell Method, AM

Organism	# counted	#/ml concentrate	#/5 min. tow
Frustularia	11	11	462
Gymnozyga	820	820	34,400
UI green filamentous algae	9	9	378
Cosmarium	4	4	172
Micrasterias	2	2	84
Dinobryon	41	41	1722
Fragilaria	3	3	126
Netrium	26	26	1090
Staurastrum	10	10	420
Navicula	61	61	2562
Ankistrodesmus	55	55	2310

note: A picture of the unidentified algae is attached, The concentrate sampled was obtained by a 5 minute tow from a row boat. 20 strips were counted.



U.I. Green filamentous algae.

Ed's Bog-Phytoplankton: Sedgwick-Rafter Cell Method, PM

organism	# counted	#/ml concentrate	#/5 min. tow
Scenedesmus	2074	13,820	898,000
Scenecella	4	27	1730
Dinobryon	1110	7400	481,000
Anacistus	1	7	434
Euastrum	1	7	434
Netrium	14	93	6070
Staurastrum	5	33	2170
Anabena	9	60	3900
Ankistrodesmus	600	4000	260,000
Navicula	22	147	9530
Gymnozyga	450	3000	195,000
Peridinium	1	7	434
Pediastium	1	7	434

note: The sample counted was collected in a 5 minute tow from a row boat. 3 strips were counted.

Ed's Bog Zooplankton: Sedgwick-Rafter Cell Method, AM

organism	# counted	#/ml concentrate	#/5 min tow
Daphnia sp.(big)	31	31	1300
Daphnia longispina	105	105	4410
Bosmina	45	45	1890
Alona	50	50	2100
Ceriodaphnia	178	178	7480
Keritella	110	110	4620
Naupilus larvae	74	74	3100
UI Cladocerans	21	21	882
Diaptomus	11	11	462
Chaoborus	189	189	7940
Cyclops	15	15	630

note: The sample was collected by a 5 minute tow from a row boat, 20 strips were counted.

Ed's Bog Zooplankton: Sedgwick-Rafter Cell
Method, PM

organism	# counted	#/ml concentrate	#/5 min. tow
Ceriodaphnia	24	160	10,400
Keritella	2	13	867
Daphnia longispina	14	93	6070
Alona	6	40	2600
Diaptomus	6	40	2600
Cyclops	15	100	6500
Chaoborus	15	100	6500
Lecane	1	7	434
Naupilus larvae	5	33	2170

note: The sample was collected by a 5 minute tow from a row boat. 3 strips were counted.

An Analysis of the Plantonic Samples of Ed's Bog

In both the AM and PM tows, desmids appeared to dominate the phytoplankton. Among the most common species were *Gymnozyga*, *Scenedesmus*, *Ankistrodesmus*, and *Staurastrum*. Desmids and particuallarily *Gymnozyga* are typical of bogs. (*How to know the Fresh Water Algae*). This appears to be the case in Ed's Bog both in numbers and in number of species. Nearly half the phytoplankton species were desmids.

In the 2 liter filtered sample the concentration of organisms was again low, so low as to question the quantitative validity of the counts. *Dinobryon*, *Eudorina*, *Staurastrum*, *Chlamydomonas*, and *Ulothrix* were identified.

Examples of greens blue greens, diatoms, and dynoflagellates were seen, but in relativly low numbers, and comparatively few species.

Ankistrodesmus and *Scenedesmus* were both found in much larger number in the PM tow indicating that they probably underwent some sort of bloom during the day.

A decrease in the number of species found at night was not noted as it was for Ward lake, perhaps the extremely low O_2 and cold temperatures in the relativly large hypolimnion prevents their vertical migration.

The number of rotifers in the bog was much less than in Ward lake. Larger Cladocerons including Daphnia, Ceriodaphnia, and Alona; Copepods including Lecane,Cyclops, and Diaptomus along with Chaoborus dominate. The rotifers are represented only by Keritella. On the basis of the low number counted in the P.M. tow, it is hard to make a comparison between the two tows, however an attempt will be made. The low numbers of zooplankton as far as numbers go gives some indication of the low productivity of the bog. Although larger numbers of the phytoplankton were counted, organisms such as Dinobryon, Ankistrodesmus, and Scenedesmus would have to be present in huge quanities to make up an appreciable amount of the biomass. Ceriodaphnia, and Chaoborus are present in comparativly large numbers in both AM and PM tows. This indicates that the principle Chaoborus species is probably C. americanus since this specie does not undergoe vertical migration. The data seems to indicate that Cyclops may vertically migrate in Ed's bog, but more counts would have to be made to be sure. The same is true for Diaptomus, but this seems more likely since the same phenomenon was seen for this organism in Ward Lake.

Desmids tended to dominate the phytoplankton, although other groups are present. Among the zooplankton, the larger cladocerons and copepods, along with Chaoborus tended to dominate, although the numbers of zooplanktores was reduced. The larger zoo plankton is probably the result of the absence of fish in the bog.

Jim Bence A

Good grasp of aquatic systems.

Characterize, give your impressions, the U.N.D.E.R.C. fish community-species interactions, fish communites present, etc. Based on your chemical knowledge of U.N.D.E.R.C. waters what species are most suitable to bogs, eutrophic lakes, etc. and why. Why did we get so many smaller fish from the river than from the lakes.

In the more productive lakes that have a shallower shore area, there is some diversity among the fish life. Smaller fish, and fry of large fish, feed upon the phyto- and zoo- plankton. Larger carnivres feed upon these fish, as well as insect larvae, tadpoles, frogs, and even the crayfish. There is specialization of feeding habits, with some plaktivores preferring organisms of only a certain size and some carnivores preying mainly on one type of organism, for example, pike feed almost exclusively on smaller fish. In an environment with these shallow areas, spawning can occur on the bottom substrate, among emerging vegitation, or as floating eggs.(live bearing and mouth brooding variations are also possibilities.) Around the shallow areas where much of the fish population is concentrated, scavenger fish would also be expected to be found.

Less productive waters, especially the bogs, limit the types of fish that may live in them severely. Bogs are typically deep, acid, and do not turn over. The temperature below the thermocline, which is uasually found at a shallow depth is near 4°C, and the O_2 levels in the hypolimnion aproach zero.

The *Sphagnum* mat surrounding these bogs, removes calcium and magnesium ions and replaces them with H^+ ions via ion exchange of its uronic acids, thus these waters are extremely soft. Fish living and reproducing in these waters would have to be adaapted to the soft, acid waters. These fish would need to remain near the surface and could not rest on the bottom which is often 60 feet below,covered by oxygen poor water. An efficient swimming bladder would be a necessity. The fish in a bog must have developed a method to take up calcium, possibly by feeding upon the Sphagnum mat, or possibly have adapted to the low levels of calcium by developing a reduced bon bone system. Other sources of food available are phyto- and zoo-plankton especially, *Chaoborus*, cladocerons, and for smaller fish, and fry, desmids, and rotifers. Feeding would occur on the surface, because of the cold anareobic enviroment. below. Bottom scavengers would be out of the question. In order to reproduce in a bog, a fishes egg would have to remain near the surface, where O_2 is present, and the temperature is tolerable. This could be acheived by foating, adhering,(To the mat) or internal eggs. Those fish requiring a hard substrate would not be found in a bog.

Those bodies of water with a large surface to volume ratio, and that are fairly productive, like Tenderfoot lake, would have some fish populations in the deeper waters of the lake because the lake would be more stirred up by the weather and some oxygen would be found in deeper water.

Although some species of small fish are only found in streams and rivers and some species of fish are only found in lakes, it is evident that some large fish are present in streams and rivers, and some small fish are present in lakes. Further since smaller fish are more likely to be further down "the food chain" meaning planktivores rather than piscevores, and would have a larger supply of food, more smaller fish than larger fish were probably present in both environments. The difference in the sizes of fish we collected most likely stemmed from our methods of collection. In the lakes, we used gill nets with a fairly large mesh, and a phyke net which was unproductive. In the river we used seine nets with a much finer mesh. In the river when fish were collected with a seine net drawn though a culvert towards a stationary seine net, some larger fish were caught, including one fish aproximately 13" in total length. Possibly larger fish are better able to avoid a single seine net drawn through more open water, explainging why large fish were not caught in other areas of the river. Regardless of the effectiveness of hand drawn seine nets in catching bigger fish, it seems obvious that gill nets with mesh sizes running from about an inch, to over 5 inches would not capture smaller fish. Since gill nets were the only way that fish were caught in the lakes, this explains why smaller fish were not caught. In the river when a phyke net was used, some larger sized fish were also caught. If a gill net were used in the river, it would only catch larger fish.

Starting with the plantonic communities explain why the Pike in Morris are 20" at 4 yrs. age. Also, why only large perch.

The large Zooplankton species provide food for most of the smaller fish, and their quantity is limited by the rate of the smaller phytoplankton which provides food for the larger zooplankton. This in turn limits the numbers of the planktivorous fish which the pike feed upon.

Four years ago was a good spawning year, and the large numbers of pike that resulted can not feed adequately upon the planktivorous fish population that Morris Lake can support. Therefore the pike became stunted.

Most of the perch found in Morris were about afoot long, which is large for perch, and about 4 yrs old, the same age as the pike. The good spawning year also seems to have affected the perch population, but not to the extent of stunting the perch. Since perch utilize other sources of food besides small fish,(worms, insect larvae, and cray fish, for example) they were not stunted as a result of the pike population.explosion. Young, smaller, perch were not found, because the pike prey on the fry of the large perch and none or few survived to the smallest size that would be caught in the gill nets used in Morris lake. The large perch were spared this since they grew up as the pike did, and became to large for the pike to feed upon before the pike population, and predation pressure became to great for the younger perch to survive.