2010/2011 Environmental Monitoring for Indian Lake

Prepared for:

Indian Lake Borough

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Sampling Procedures and Analytical Methodology

Water samples and water quality data were collected on August 27 and October 15, 2010 and February 17, 2011. The sampling event in February was done through the ice. The parameters that were used for the monitoring are listed in Table 1 below. There were three sampling locations on each of the visits. One site was near the dam and one was located further down each side of the lake. (See attached map)

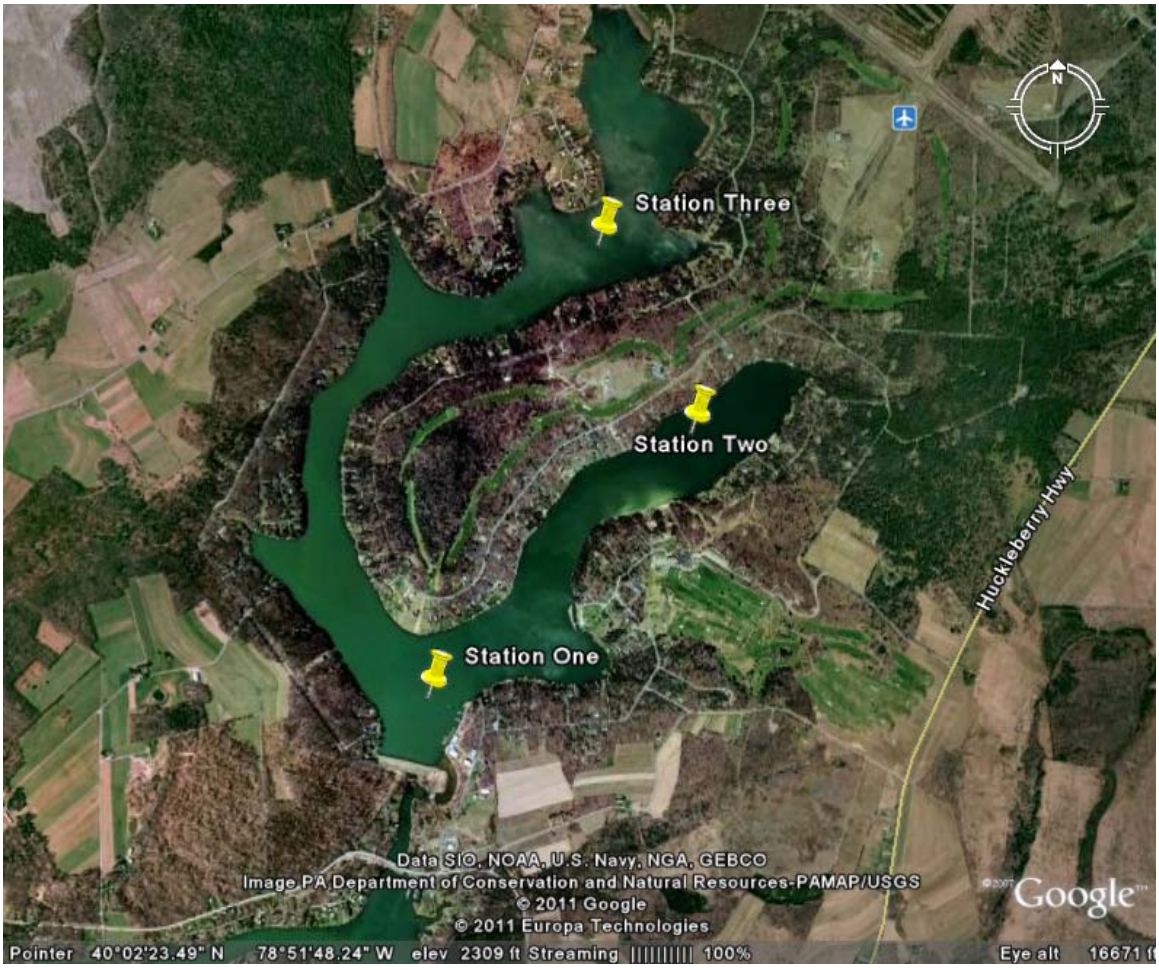
Table 1 – Water Quality Parameters Measured for 2010/11

Dissolved Oxygen (DO)	Total Phosphorus
Dissolved Oxygen Saturation (%)	Secchi Disk Transparency
Temperature	Chlorophyll *a*
pH	Total Nitrogen
Conductivity	Total Suspended Solids

The parameters in Table 1 are indicators of the health of a water body and the ability to support aquatic life. These parameters also help to determine a lake's trophic state and relate interactions between the chemical and biological components of a lake and the ecosystem. The analyses performed during the monitoring process were conducted in accordance with Standard Methods, 1995. Dissolved oxygen and temperature were measured using a YSI Model 57 meter at half meter depths to the lake bottom at each site. Conductivity was measured using an ExStik EC 500 meter at one meter depths. An Oakton BNC pH meter equipped with a silver chloride electrode was used to measure pH at one meter depths. Water samples taken from incremental depths were collected with a Wildco beta plus horizontal water sampler equipped with a stainless steel messenger.

Total phosphorous concentrations were measured from composite samples taken in the epilimnion of the lake at depths of 0, 1, 2 and 3 meters. Water samples for total phosphorous were placed in sample bottles containing preservative and then stored on ice while in the field. The samples were delivered to the lab for analysis the day of sampling. The samples were analyzed using the colorimetric ascorbic acid method (Standard Methods, 1992, Method 4500-P E). Total nitrogen samples were also composite samples that were collected in a similar manner as the phosphorus samples, stored on ice and delivered to the lab for analysis on the day of sampling. The samples were analyzed using EPA methods 353.2 and 351.4 for nitrate/nitrite nitrogen and total Kjeldahl nitrogen (TKN).

One biological characteristic of the lake was ascertained through the analysis of chlorophyll *a*. The composite water taken for the total phosphorous and nitrogen samples was also used to take samples for the chlorophyll *a* analysis. A determined volume of water was filtered in the field for chlorophyll *a* analysis. The filter papers were then placed in glass vials and stored on ice while in the field until they could be frozen. Once frozen, the samples were shipped to Dr. Gregory Boyer of the Biochemistry Department, SUNY-ESF for analysis using the Welschmeyer fluorometric method (Welschmeyer, N.A. 1994).



Sampling Locations for Indian Lake

Parameters Measured During the 2010/2011 Monitoring Program

Dissolved Oxygen (DO)

The amount of oxygen present in the water and the profile of this oxygen throughout the water column are important indicators as to the health of a lake. By studying this one parameter, a large amount of information can be determined. The DO content of water results from photosynthesis, diffusion at the air-water interface and distribution by wind-driven mixing. The amount of oxygen produced through photosynthesis is related to the amount of plant and algal life and thus the productivity of the lake. The profile of the DO in the water column can give insight into the mixing patterns and effectiveness of mixing processes in a lake. The DO will fluctuate with changes in temperature and changes in photosynthetic activity and diffusion. Surface waters are often supersaturated with DO during daylight hours. Oxygen is used continuously by the pond biota in respiration, but during the day photosynthesis normally produces oxygen faster than it is used in respiration so that DO concentrations remain high. Phytoplankton die-offs and sudden destratification of the water body can cause rapid oxygen depletion. If the DO falls below 4.0 mg/L, most desirable aquatic organisms will be stressed and may even die.

Dissolved Oxygen Saturation

Water containing the amount of DO which it should theoretically hold at a given temperature, pressure, and salinity is said to be saturated with oxygen. Likewise, waters containing less than or more than the theoretical concentration are said to be undersaturated or supersaturated with oxygen, respectively. The degree of oxygen saturation of water is expressed as percent saturation and water that is saturated with oxygen is at 100 percent. The amount of oxygen that can dissolve in water decreases with increasing temperature and salinity and with increased dissolved solids, therefore, dissolved oxygen saturation provides a better means of comparing oxygen concentrations from different sampling dates and depths in the water column.

Temperature

Sufficient and accurate temperature data are important. Temperature directly and indirectly exerts many fundamental effects on limnological phenomena such as lake stability, gas solubility and biotic metabolism. One of the most important relations of the temperature to water is the decrease in the solubility of oxygen in water as the temperature increases. Temperatures in a lake are a function of ambient air temperatures and the physical characteristics of the water itself. The turbidity of a

water body can inhibit light from passing through the water column and warming the water. Light energy or the heat generated from the light is absorbed exponentially with depth, so most heat is absorbed within the upper layer of water. Since heat is absorbed more rapidly near the surface of a water body and the warm upper waters are less dense than cool lower water, bodies of water may stratify thermally. This occurs when differences in density of upper and lower strata become so great that the two cannot be mixed by wind action.

pH

The pH of a solution is a measure of its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion concentration. It is important to remember that a change of one pH unit represents a tenfold change in hydrogen ion concentration. The pH scale ranges from 1.0 to 14.0 standard units. A pH of 7.0 indicates neutral conditions, while waters with a pH less than 7.0 are said to be acidic and those with a pH greater than 7.0 are said to be basic. The pH of most natural waters falls in the range of 4.0 to 9.0, and much more often in the range of 6.0 to 8.0. The desirable range for fish production is 6.5 to 9.0. The acid death point for fish is around 4.0 or less. In water bodies, deviation from the neutral pH 7.0 is primarily due to the hydrolysis of salts of acids and bases. Dissolved gases such as CO_2, H_2S, and NH_3 also have a significant effect on pH values. The majority of natural water bodies have a somewhat alkaline or basic pH due to the presence of carbonates. Values for pH and the changes in these values are important, since they may reflect biological activity and changes in natural chemistry of waters, as well as pollution.

Conductivity

Conductivity or specific conductance is a measure of water's capacity to conduct an electric current. Conductivity is the reciprocal of resistance for which the standard unit is an ohm. Since conductivity is the inverse of resistance, the standard unit for conductivity is the *mho*. In low-conductivity natural waters, the standard unit is the *micromho*. Because the measurement is made using two electrodes that are one centimeter apart, conductivity is generally reported as micromhos per centimeter (µmhos/cm). Different ions vary in their ability to conduct electricity, but, in general, the greater the concentration of ions in natural water, the higher the conductivity. Temperature also affects conductivity. Conductivity will generally increase two to three percent per degree Celsius. For comparison of values, conductivity is usually corrected to one standard temperature which is most often 25°C. The most useful information that can be gathered from conductivity readings is the estimation of the total concentration of dissolved ionic matter in the water, which in turn relates to water fertility.

Total Phosphorus

Phosphorous is a key metabolic nutrient and the supply of this element often regulates the productivity of natural waters. Total phosphorous is the sum of all forms of phosphorous present. Phosphorous is present in water in several soluble and particulate forms, including organically bound phosphorous, inorganic polyphosphates and inorganic orthophosphates. Orthophosphates, which are ionized forms of orthophosphoric acid (H_3PO_4), are the simplest forms of phosphorous present. The pH of the water will affect the degree of ionization and thus the amount of orthophosphates present. The natural source of phosphorous to waters is from leaching of phosphate containing rocks and from organic matter decomposition. Additional sources are found in manmade fertilizers, domestic sewage and detergents. Inorganic and organic phosphates may reach waters through effluent and runoff. Phosphorous is lost from the water by chemical precipitation to sediment and by adsorption on clays or sediment with high pH and carbonate levels. Phosphorous is usually found in low concentration in natural waters, but is used readily by plants for growth. The element present in the lowest concentration relative to demand is the element limiting the process at a given time. This is why phosphorous is usually said to be the limiting factor of plant and algal growth and if found in excess is most likely to cause excessive plant or algal "blooms".

Secchi Disk Transparency

Visibility is a measure of the depth to which one can see into the water. The Secchi disk is a simple device used to estimate this depth. The disk is a weighted circular plate, 20 cm in diameter, with a painted surface consisting of alternate opposing black and white quarters. The disk is attached to a depth-calibrated chord attached to a ring in the center of the disk, so the disk is horizontal when lowered into the water. To determine the Secchi disk visibility, the disk is lowered into the water until the disk disappears and the depth is noted. The disk is lowered further then slowly raised until it is visible again and this depth is noted. The final Secchi depth is the average of these two readings. Secchi depth corresponds to the depth where light penetration is ten percent or less and approximates the lower level of photosynthetic activity. The transparency is based on the transmission of light through the water and is related to the amount of natural light, amount of inorganic suspended solids and the amount of organic suspended solids. The Secchi disk measures the turbidity of water. Plankton is usually the major source of turbidity, so Secchi depth can give an estimate of plankton density. When compared with data on chlorophyll *a*, particulate organic matter and phytoplankton counts, Secchi depth correlates most with particulate organic matter. Particulate organic matter is a measurement which includes living zooplankton and phytoplankton as well as dead organic particles. For northern lakes, a Secchi depth of greater than 30 feet is considered oligotrophic while the eutrophic lakes may have a reading of 3 to 4 feet or less during summer algal blooms (Moore, 1988). Secchi depths of less than two meters

are usually considered undesirable for recreational lake uses and even lower values may indicate the onset of an algal bloom.

Chlorophyll *a*

Chlorophyll is a green pigment in algae and other green plants that is essential for the conversion of sunlight, carbon dioxide and water to sugar that may then be used as food. Chlorophyll *a* is a type of chlorophyll present in all types of algae, sometimes in direct proportion to the biomass of the algae. The values may also be used to characterize the age, structure, quantification of the phytoplankton and photosynthetic rates.

Total Nitrogen

Total nitrogen is a measure of all the various organic and inorganic forms of nitrogen that are found in a water sample. Inorganic forms include nitrate (NO_3^-), nitrite (NO_2^-) and ammonia (NH_3). Total Kjeldahl nitrogen is the sum of organically bound nitrogen, ammonia and ammonium (NH_4^+). To determine Total Nitrogen (TN), the concentrations of nitrate/nitrate nitrogen and TKN are determined and added together. Total nitrogen in water comes from the atmosphere, stormwater run-off, fertilizers and animal/human waste (sewage, dairies, feedlots, waterfowl, etc.). Nitrogen is a necessary nutrient for the growth of aquatic plants and algae, but not all forms of nitrogen can be used by aquatic plants and algae. Either nitrogen or phosphorus is referred to as the limiting nutrient depending on the element present in the lowest concentration relative to demand. Nitrogen limitation occurs most commonly when the ratio of total nitrogen (TN) to total phosphorus (TP) is less than 10. In other words, the TN concentration divided by the TP concentration is less than 10 ($TN/TP<10$).

Total Suspended Solids

Total suspended solids (TSS) are solids in water that are measured by filtering a determined volume of water then drying and weighing the filter paper to determine the increase in weight. TSS can include materials such as silt, decaying plant and animal material, industrial waste and sewage. High TSS will reduce the amount of light that passes through the water and thus reduce the photosynthetic rate of plants. Reduced photosynthesis can then lead to lower oxygen levels. High TSS can also cause an increase in water temperature as suspended particles absorb sunlight.

Trophic State Indices

The trophic state of a lake is a relative expression of the biological productivity of the lake. The Trophic State Index (TSI) developed by Carlson (1977) is among the most

commonly used indicators of lake trophic states. This index is actually composed of three separate indices based on concentrations of total phosphorous, chlorophyll *a* and the Secchi depth readings from a variety of lakes.

Mean values of total phosphorous, chlorophyll *a*, and Secchi depth for an individual lake are logarithmically converted to a scale of relative trophic state ranging from 1 to 100. A TSI of less than 35 indicates oligotrophic conditions, a TSI between 35 and 50 indicates mesotrophic conditions and a TSI greater than 50 indicates eutrophic conditions. Oligotrophic comes from the Greek for "poorly nourished" and describes a lake of low plant productivity and high transparency. Mesotrophic comes from the Greek for "moderately nourished" and describes a lake of moderate photosynthetic activity and transparency. Eutrophic comes from the Greek for "well-nourished" and describes a lake of high photosynthetic activity and low transparency. Hypereutrophic, or excessively productive lakes, have TSI values greater than 70. Higher numbers are associated with increased probabilities of encountering nuisance conditions such as aesthetic problems i.e. algal scums.

Values for the trophic state indices based on total phosphorous, Chlorophyll *a* and Secchi depth are calculated for Indian Lake using the surface water data. The current trophic state indices are listed in the tables and can be compared in the charts.

Discussion

After reviewing the data from each of the sampling events and calculating the trophic state indices, the results show that Indian Lake is a lake with low to moderate nutrients, lower plant growth and good clarity. The lowest trophic state was 22.1 for chlorophyll a at station one during February and the highest trophic state was 55.4 for total phosphorus at station three during October. Overall the average trophic state for all four months at all three stations was as follows: Total Phosphorus was 42.5; Secchi Depth was 43.2 and Chlorophyll a had an average of 32.5 for all values. The total phosphorus and Secchi trophic states would fall into the mesotrophic category and chlorophyll a would be considered oligotrophic.

Indian Lake Monitoring Data

Date: 8-27-10 Location: Station One Weather: Sunny
Observer: B. Kirkpatrick Secchi Depth: 7.9m Time: 0900

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	7.0	82.1	22.0	7.6	284
0.5	7.0	82.1	22.0		
1.0	7.0	82.1	22.0	7.5	283
1.5	7.0	82.1	22.0		
2.0	7.0	82.1	22.0	7.5	277
2.5	7.0	82.1	22.0		
3.0	7.0	82.1	22.0	7.5	282
3.5	7.0	82.1	22.0		
4.0	7.0	82.1	22.0	7.4	285
4.5	6.9	80.9	22.0		
5.0	6.9	80.9	22.0	7.4	270
5.5	6.9	80.9	22.0		
6.0	6.9	80.9	22.0	7.5	268
6.5	5.5	62.0	19.8		
7.0	5.5	58.7	17.0	7.4	241
7.5	5.4	55.4	15.1		
8.0	5.3	52.7	13.7	7.3	238
8.5	4.8	47.0	12.9		
9.0	4.5	43.1	11.9	7.2	227
9.5	4.3	40.5	11.2		
10.0	4.0	37.0	10.5	7.2	218
10.5	3.8	35.0	10.2		
11.0	3.2	29.2	9.8	7.1	210
11.5	2.6	23.7	9.0		
12.0	2.3	20.4	8.8	7.1	215
12.5	2.1	18.5	8.5		
13.0	1.6	14.0	8.2	7.1	231
13.5	1.3	11.4	8.2		
14.0	1.1	9.6	8.0	7.1	244
14.5	0.9	7.8	7.9		
15.0	0.8	7.0	7.9	7.1	250

Indian Lake Monitoring Data

Date: 8-27-10 Location: Station Two Weather: Sunny
Observer: B. Kirkpatrick Secchi Depth: 5.2m Time: 0950

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	8.1	95.7	22.5	7.5	284
0.5	8.0	94.6	22.5		
1.0	7.9	93.4	22.5	7.5	280
1.5	7.5	88.7	22.5		
2.0	7.2	85.1	22.5	7.5	279
2.5	7.2	85.0	22.4		
3.0	7.0	82.6	22.4	7.4	278
3.5	7.0	82.6	22.4		
4.0	7.0	82.6	22.4	7.4	298
4.5	7.0	82.6	22.4		
5.0	6.9	81.5	22.4	7.4	310
5.5	6.9	81.3	22.3		
6.0	6.0	69.8	21.6	7.4	321
6.5	5.4	60.4	19.4		
7.0	3.8	40.5	16.9	7.3	333
7.5	3.8	38.9	14.9		
8.0	2.6	26.2	14.2	7.3	330
8.5	1.2	11.8	13.2		

Indian Lake Monitoring Data

Date: 8-27-10 Location: Station Three Weather: Sunny
Observer: B. Kirkpatrick Secchi Depth: 4.6m Time: 1045

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	7.5	88.7	22.5	7.5	252
0.5	7.5	88.7	22.5		
1.0	7.4	87.5	22.5	7.5	250
1.5	7.4	87.5	22.5		
2.0	7.4	87.5	22.5	7.5	243
2.5	7.3	86.3	22.5		
3.0	7.1	83.6	22.3	7.4	245
3.5	7.0	82.4	22.3		
4.0	7.0	82.4	22.3	7.4	251
4.5	7.0	82.4	22.3		
5.0	6.9	81.3	22.3	7.4	250
5.5	6.8	80.0	22.2		
6.0	6.0	69.9	21.7	7.4	247

Indian Lake Monitoring Data

Date: 10-15-10 Location: Station One Weather: Sunny, changing to overcast
Observer: K. Laite Secchi Depth: 2.6m Time: 1000
R. Stumbaugh

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (ºC)	pH	Conductivity (µmhos/cm) @25ºC
0.0	9.4	94.2	14.0	6.8	288
0.5	9.1	91.2	14.0		
1.0	9.0	90.2	14.0	6.9	280
1.5	9.0	90.2	14.0		
2.0	9.0	90.2	14.0	6.8	278
2.5	9.0	90.2	14.0		
3.0	9.0	90.2	14.0	6.8	277
3.5	9.0	90.2	14.0		
4.0	9.0	90.2	14.0	6.8	276
4.5	9.0	90.2	14.0		
5.0	8.8	88.2	14.0	6.9	269
5.5	8.8	88.2	14.0		
6.0	8.7	87.2	14.0	6.9	262
6.5	8.7	87.2	14.0		
7.0	8.7	87.2	14.0	6.9	265
7.5	8.7	87.2	14.0		
8.0	8.5	85.2	14.0	6.9	265
8.5	8.4	84.2	14.0		
9.0	7.0	69.4	13.5	6.9	266
9.5	5.8	56.9	13.0		
10.0	4.1	39.4	12.1	6.9	270
10.5	2.2	20.6	11.0		
11.0	1.1	10.1	10.0	6.5	270
11.5	0.9	8.2	10.0		
12.0	0.6	5.4	9.2	6.5	246
12.5	0.5	4.5	9.0		
13.0	0.4	3.6	8.9	6.5	239
13.5	0.4	3.5	8.4		
14.0	0.4	3.5	8.2	6.5	238
14.5	0.4	3.5	8.0		
15.0	0.4	3.5	8.0	6.6	239

Indian Lake Monitoring Data

Date: 10-15-10 Location: Station Two Weather: Overcast, drizzle
Observer: K. Laite Secchi Depth: 3.0m Time: 1120
R. Stumbaugh

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	8.6	87.1	14.5	6.8	279
0.5	8.6	87.1	14.5		
1.0	8.6	87.1	14.5	6.9	268
1.5	8.6	87.1	14.5		
2.0	8.6	87.1	14.5	6.8	268
2.5	8.5	86.1	14.5		
3.0	8.5	86.1	14.5	6.9	267
3.5	8.5	86.1	14.5		
4.0	8.5	86.1	14.5	6.9	262
4.5	8.5	86.1	14.5		
5.0	8.5	86.1	14.5	6.9	264
5.5	8.5	86.1	14.5		
6.0	8.7	88.1	14.5	6.9	261
6.5	8.7	87.8	14.3		
7.0	8.8	88.4	14.1	6.9	258
7.5	8.9	89.2	14.0		
8.0	8.9	89.2	14.0	6.9	260
8.5	7.0	70.1	14.0		

Indian Lake Monitoring Data

Date: 10-15-10 Location: Station Three Weather: Overcast, drizzle
Observer: K. Laite Secchi Depth: 2.8m Time: 1205
R. Stumbaugh

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	9.5	95.0	13.9	7.0	263
0.5	9.4	94.0	13.9		
1.0	9.3	93.2	14.0	6.8	260
1.5	9.1	91.2	14.0		
2.0	9.1	91.2	14.0	6.9	255
2.5	9.1	91.2	14.0		
3.0	9.1	91.2	14.0	6.9	250
3.5	9.1	91.2	14.0		
4.0	9.1	91.2	14.0	6.9	248
4.5	9.0	90.2	14.0		
5.0	9.0	90.2	14.0	6.9	246
5.5	9.0	89.8	13.8		
6.0	9.0	89.6	13.7	6.9	245

Indian Lake Monitoring Data

Date: 2-17-11 Location: Station One Weather: Sunny, 0-5mph NW wind, warm
Observer: K. Laite Secchi Depth: 4.5m Time: 1105
B. Kirkpatrick

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (ºC)	pH	Conductivity (µmhos/cm) @25ºC
0.0*	10.5	77.3	1.5	6.9	218
0.5	10.5	77.3	1.5		
1.0	10.0	74.2	1.8	6.8	211
1.5	9.9	73.5	1.8		
2.0	9.5	72.8	3.0	6.7	269
2.5	9.4	72.8	3.4		
3.0	9.2	71.8	3.7	6.7	231
3.5	9.1	71.4	3.9		
4.0	8.8	69.3	4.0	6.7	270
4.5	8.7	68.5	4.0		
5.0	8.7	68.5	4.0	6.7	268
5.5	8.7	68.5	4.0		
6.0	8.7	68.5	4.0	6.7	265
6.5	8.7	68.5	4.0		
7.0	8.5	66.9	4.0	6.7	264
7.5	8.4	66.1	4.0		
8.0	8.3	65.4	4.0	6.7	276
8.5	8.2	64.4	3.9		
9.0	8.2	64.4	3.9	6.7	280
9.5	8.2	63.9	3.6		
10.0	8.2	63.5	3.4	6.7	305
10.5	8.2	63.3	3.3		
11.0	8.2	63.5	3.4	6.7	341
11.5	8.2	64.2	3.8		
12.0	7.8	60.9	3.7	6.6	356
12.5	7.7	59.3	3.2		
13.0	8.1	62.4	3.2	6.6	364
13.5	8.2	63.0	3.1		
14.0	8.2	63.0	3.1	6.6	384
14.5	8.2	63.0	3.1		
15.0	8.0	61.4	3.1	6.7	397

*Sampling done through approximately 16" of ice. Surface readings taken from water at surface of hole.

Indian Lake Monitoring Data

Date: 2-17-11 Location: Station Two Weather: Sunny, 0-10mph NW wind, warm
Observer: K. Laite Secchi Depth: 3.0m Time: 1250
B. Kirkpatrick

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0*	11.5	86.0	2.1	7.0	254
0.5	11.5	86.0	2.1		
1.0	11.1	84.6	2.8	6.9	247
1.5	11.0	84.0	2.9		
2.0	10.7	82.0	3.0	6.8	255
2.5	10.6	81.7	3.2		
3.0	10.2	78.6	3.2	6.8	260
3.5	10.1	78.4	3.5		
4.0	9.9	77.1	3.6	6.8	274
4.5	9.8	76.5	3.7		
5.0	9.6	75.2	3.8	6.7	279
5.5	9.4	73.6	3.8		
6.0	9.4	73.6	3.8	6.7	278
6.5	9.3	73.0	3.9		
7.0	9.2	72.2	3.9	6.7	285
7.5	9.2	72.2	3.9		
8.0	9.2	71.7	3.6	6.7	290
8.5	9.1	71.3	3.8		

*Sampling done through approximately 16" of ice. Surface readings taken from water at surface of hole.

Indian Lake Monitoring Data

Date: 2-17-11 Location: Station Three Weather: Sunny, 0-10mph NW wind, warm
Observer: K. Laite Secchi Depth: 3.0m Time: 1205
B. Kirkpatrick

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (ºC)	pH	Conductivity (µmhos/cm) @25ºC
0.0*	10.0	74.4	1.9	6.7	220
0.5	10.0	74.4	1.9		
1.0	10.1	77.2	2.9	6.7	235
1.5	8.9	69.9	3.9		
2.0	8.1	63.9	4.1	6.7	264
2.5	7.9	62.7	4.3		
3.0	6.7	53.4	4.5	6.7	220
3.5	6.6	52.6	4.5		
4.0	6.5	51.8	4.5	6.6	274
4.5	6.4	51.0	4.5		
5.0	6.5	51.8	4.5	6.6	233
5.5	6.4	51.0	4.5		
6.0	6.4	51.0	4.5	6.6	245

*Sampling done through approximately 16" of ice. Surface readings taken from water at surface of hole.

Indian Lake Monitoring Data

Date: 4-26-11 Location: Station One Weather: Sunny, 0-10 mph NW winds
Observer: J. Pinkerton Secchi Depth: 2.2 m Time: 1215

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (ºC)	pH	Conductivity (µmhos/cm) @25ºC
0.0*	8.8	82.5	11.0	6.5	252
0.5	8.8	82.2	10.9		
1.0	8.4	78.5	10.9	6.7	271
1.5	8.4	78.5	10.9		
2.0	8.2	76.3	10.7	6.8	274
2.5	8.2	75.6	10.3		
3.0	8.2	74.9	9.9	6.8	274
3.5	8.2	73.5	9.1		
4.0	8.2	73.1	8.9	6.8	275
4.5	8.2	73.1	8.9		
5.0	8.2	72.6	8.6	6.8	275
5.5	8.2	72.4	8.5		
6.0	8.2	72.2	8.4	6.8	275
6.5	8.2	71.9	8.2		
7.0	8.2	71.5	8.0	6.8	275
7.5	8.2	71.5	8.0		
8.0	8.2	71.5	8.0	6.8	275
8.5	8.2	71.3	7.9		
9.0	8.2	71.3	7.9	6.8	275
9.5	8.2	71.1	7.8		
10.0	8.2	71.1	7.8	6.8	275
10.5	8.2	70.9	7.7		
11.0	8.2	70.9	7.7	6.7	275
11.5	8.2	70.6	7.5		
12.0	8.2	70.6	7.5	6.7	275
12.5	8.2	70.4	7.4		
13.0	8.2	70.1	7.2	6.7	275
13.5	8.2	69.9	7.1		
14.0	8.2	69.9	7.1	6.7	275
14.5	8.2	69.7	7.0		
15.0	8.2	69.7	7.0	6.7	275

Indian Lake Monitoring Data

Date: 4-26-11 Location: Station Two Weather: Sunny, 0-10 mph NW winds
Observer: J. Pinkerton Secchi Depth: 2.1 m Time: 1030

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0*	10.0	98.2	13.1	6.6	225
0.5	10.0	98.2	13.1		
1.0	10.0	97.2	12.6	6.8	252
1.5	10.0	93.9	11.1		
2.0	10.0	93.3	10.8	6.9	243
2.5	10.0	92.6	10.5		
3.0	10.1	92.5	10.0	6.8	230
3.5	10.0	90.0	9.3		
4.0	10.0	89.4	9.0	6.8	226
4.5	10.0	89.1	8.9		
5.0	10.0	88.3	8.5	6.8	260
5.5	10.0	87.6	8.2		
6.0	10.0	87.4	8.1	6.8	263
6.5	10.0	87.2	8.0		
7.0	9.8	85.4	8.0	6.8	271
7.5	9.8	85.4	8.0		
8.0	9.5	82.8	8.0	6.8	277
8.5	9.2	80.2	8.0		

Indian Lake Monitoring Data

Date: 4-26-11 Location: Station Three Weather: Sunny, 0-10 mph NW winds
Observer: J. Pinkerton Secchi Depth: 1.5 m Time: 1130

Depth (m)	Dissolved Oxygen (mg/L)	Dissolved Oxygen % Saturation	Temperature (°C)	pH	Conductivity (µmhos/cm) @25°C
0.0	10.9	109.4	14.1	7.0	165
0.5	10.5	105.2	14.0		
1.0	9.8	94.1	12.1	6.9	210
1.5	9.8	93.5	11.8		
2.0	9.2	87.0	11.4	6.8	212
2.5	9.2	86.6	11.2		
3.0	9.1	85.3	11.0	6.8	225
3.5	9.1	85.0	10.9		
4.0	9.0	82.9	10.3	6.7	224
4.5	9.0	80.8	9.2		
5.0	9.0	79.9	8.7	6.7	246
5.5	9.0	79.4	8.5		
6.0	9.0	77.9	7.7	6.6	249

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 2 – Station One

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
8-27-10	Epilimnion	22.0	81.7	7.5	278
This data was for **Station One**	Hypolimnion	11.0	31.8	7.2	230
	Lake	15.6	52.8	7.3	251

Table 3 – Station Two

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
8-27-10	Epilimnion	22.4	86.3	7.5	288
This data was for **Station Two**	Hypolimnion	16.7	41.3	7.3	328
	Lake	20.5	71.3	7.4	301

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 4 – Station Three

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
8-27-10	Lake	22.3	83.7	7.4	248

This data was for the **Station Three Sampling in August. There was no distinct thermocline, so the data is for the entire water column at the site.

Table 5 – Station One

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
10-15-10	Epilimnion	22.0	81.7	7.5	278
This data was for **Station One**	Hypolimnion	11.0	31.8	7.2	230
	Lake	15.6	52.8	7.3	251

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 6 – Station Two

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
10-15-10	Lake	14.4	86.2	6.9	265

This data was for the **Station Two Sampling in October. There was no distinct thermocline, so the data is for the entire water column at the site.

Table 7 – Station Three

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
10-15-10	Lake	13.9	91.5	6.9	252

This data was for the **Station Three Sampling in October. There was no distinct thermocline, so the data is for the entire water column at the site.

Table 8 – Station One

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
2-17-11	Lake	3.4	67.1	6.7	294

This data was for the **Station One Sampling in February. There was no distinct thermocline, so the data is for the entire water column at the site.

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 9 – Station Two

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
2-17-11	Lake	3.4	77.7	6.8	269

This data was for the **Station Two Sampling in February. There was no distinct thermocline, so the data is for the entire water column at the site.

Table 10 – Station Three

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
2-17-11	Lake	3.8	61.2	6.7	241

This data was for the **Station Three Sampling in February. There was no distinct thermocline, so the data is for the entire water column at the site.

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 11 – Station One

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
4-26-11	Lake	8.5	72.9	6.7	273

This data was for the **Station One Sampling in April. There was no distinct thermocline, so the data is for the entire water column at the site.

Table 12 – Station Two

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
4-26-11	Lake	9.6	89.9	6.8	250

This data was for the **Station Two Sampling in April. There was no distinct thermocline, so the data is for the entire water column at the site.

Indian Lake Monitoring Summary – 2010/11 Water Column Data

Table 13 – Station Three

Date	Zone	Temperature (ºC)	Dissolved Oxygen (% Sat)	pH	Conductivity (µmhos/cm) @ 25ºC
4-26-11	Lake	10.8	88.2	6.8	219

This data was for the **Station Three Sampling in April. There was no distinct thermocline, so the data is for the entire water column at the site.

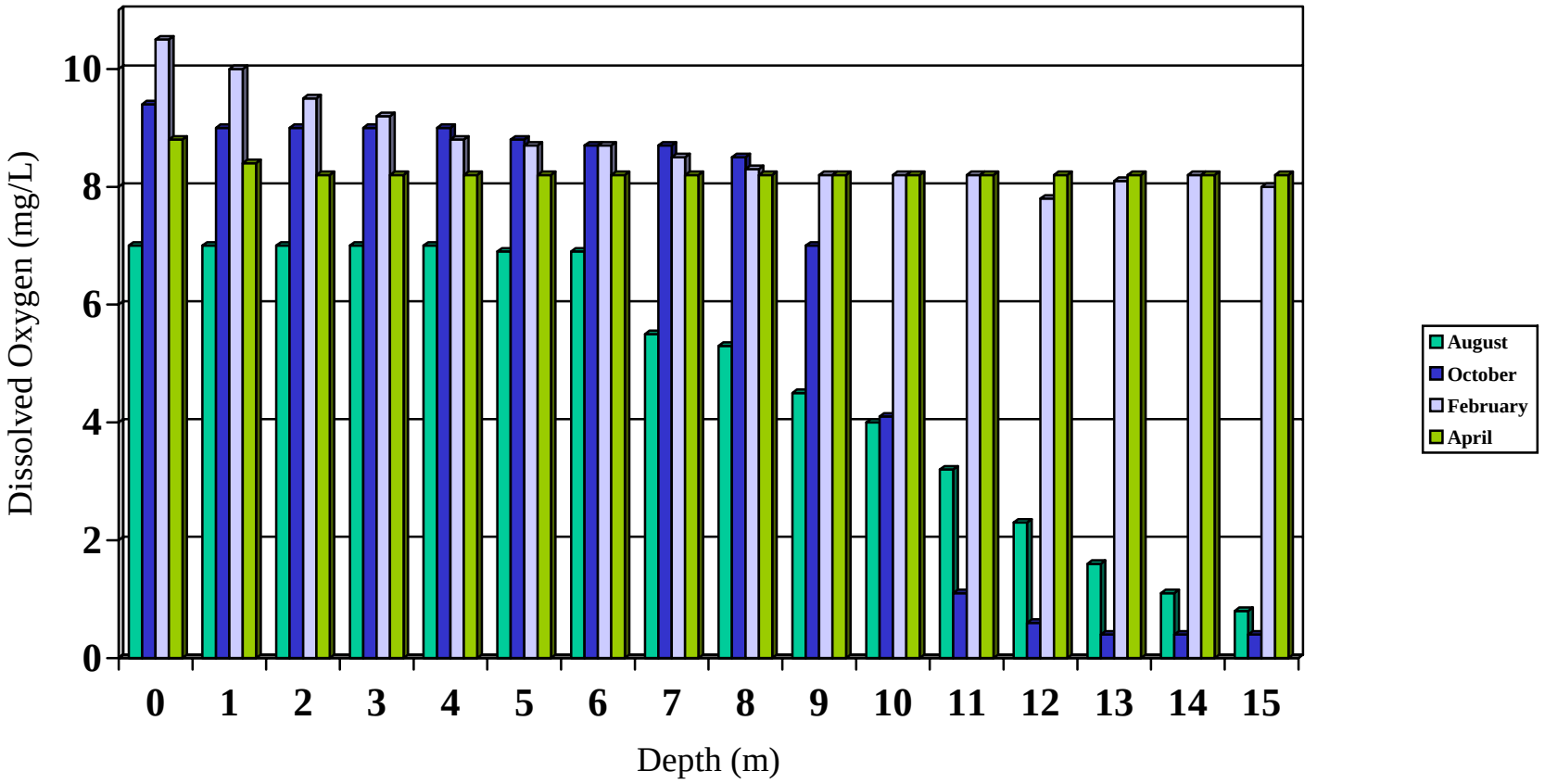
Table 14 – Indian Lake Monitoring Summary – 2010/11 Mixed Layer Data

Date	Sampling Location	Total P (mg/L)	Secchi Depth (m)	Chlorophyll *a* (µg/L)	Total N (mg/L)	Total Suspended Solids (mg/L)
8-27-10	Station One	0.007*	7.9	0.56	1.60	1.0
	Station Two	0.007	5.2	0.76	0.91	1.5
	Station Three	0.007	4.6	0.74	1.06	2.0
10-15-10	Station One	0.034	2.6	3.43	0.45	3.5
	Station Two	0.032	3.0	2.96	0.55	4.0
	Station Three	0.035	2.8	4.68	0.44	4.0
2-17-11	Station One	0.013	4.5	0.42	0.84	2.0
	Station Two	0.020	3.0	1.09	0.70	1.0
	Station Three	0.015	3.0	1.05	0.87	1.5
4-26-11	Station One	0.018	2.2	1.25	2.35	4.0
	Station Two	0.011	2.1	0.77	0.69	6.0
	Station Three	0.007	1.5	1.55	0.76	2.5

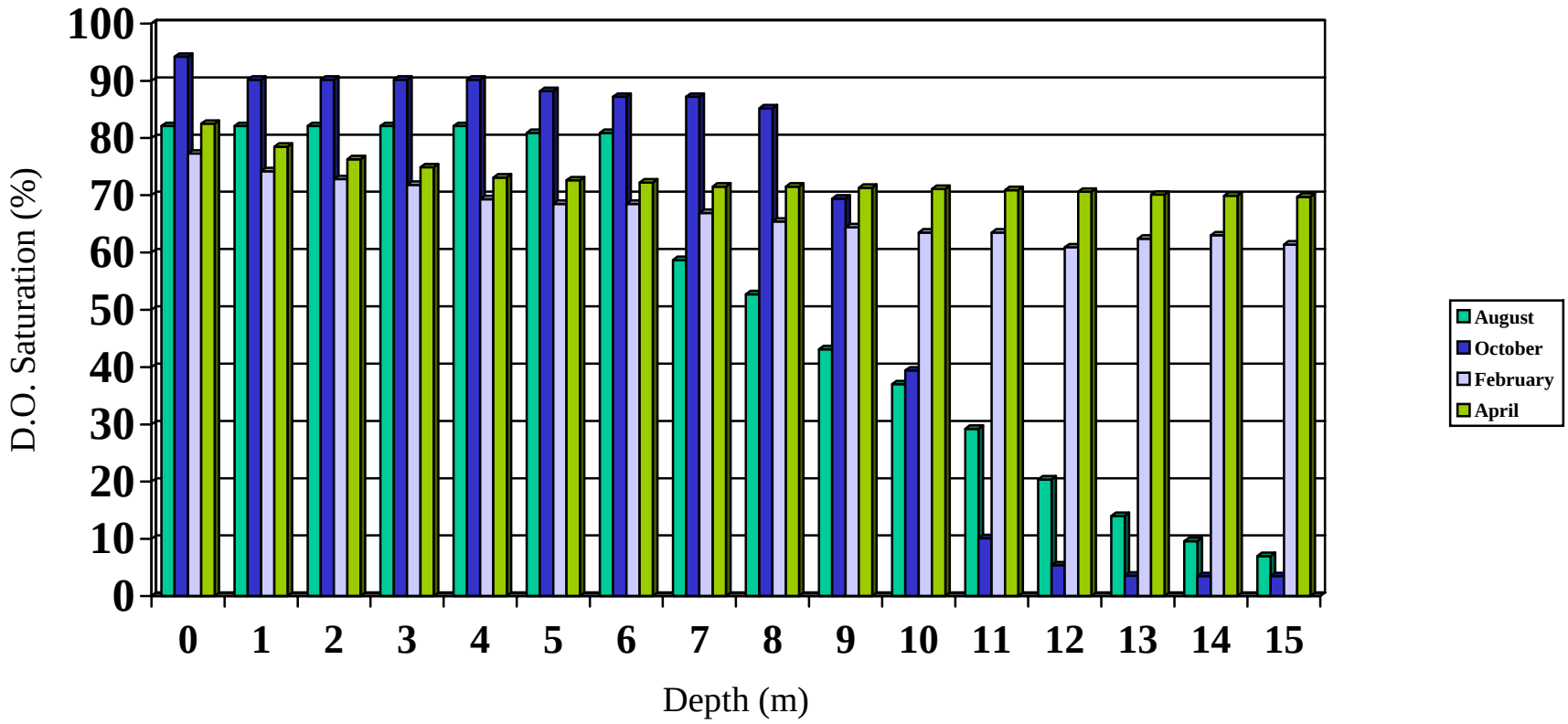
*Total phosphorus below detection limit of 0.010 mg/L, value of 0.007 mg/L used for trophic state calculation.

Table 15 - Trophic State Indices for Indian Lake

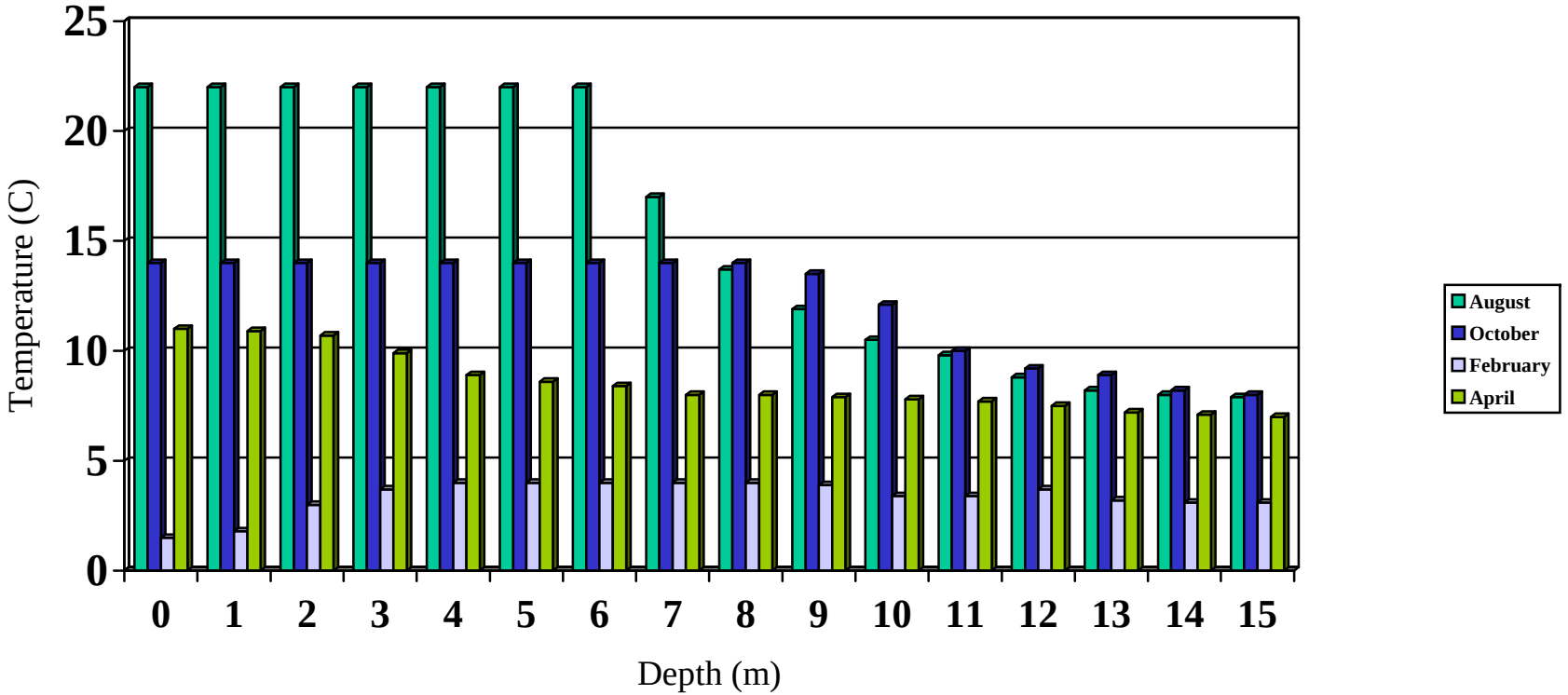
Date	Sampling Location	Total P TSI	Secchi Depth TSI	Chlorophyll *a* TSI
8-27-10	Station One	32.2	30.2	24.9
	Station Two	32.2	36.2	27.9
	Station Three	32.2	38.0	27.6
10-15-10	Station One	55.0	46.2	42.7
	Station Two	54.2	44.2	41.2
	Station Three	55.4	45.1	45.7
2-17-11	Station One	41.2	38.3	22.1
	Station Two	47.4	44.2	31.4
	Station Three	43.2	44.2	31.0
4-26-11	Station One	45.8	48.6	32.8
	Station Two	38.7	49.3	28.0
	Station Three	32.2	54.2	34.9



Dissolved Oxygen Data Station One



Dissolved Oxygen Percent Saturation Data Station One



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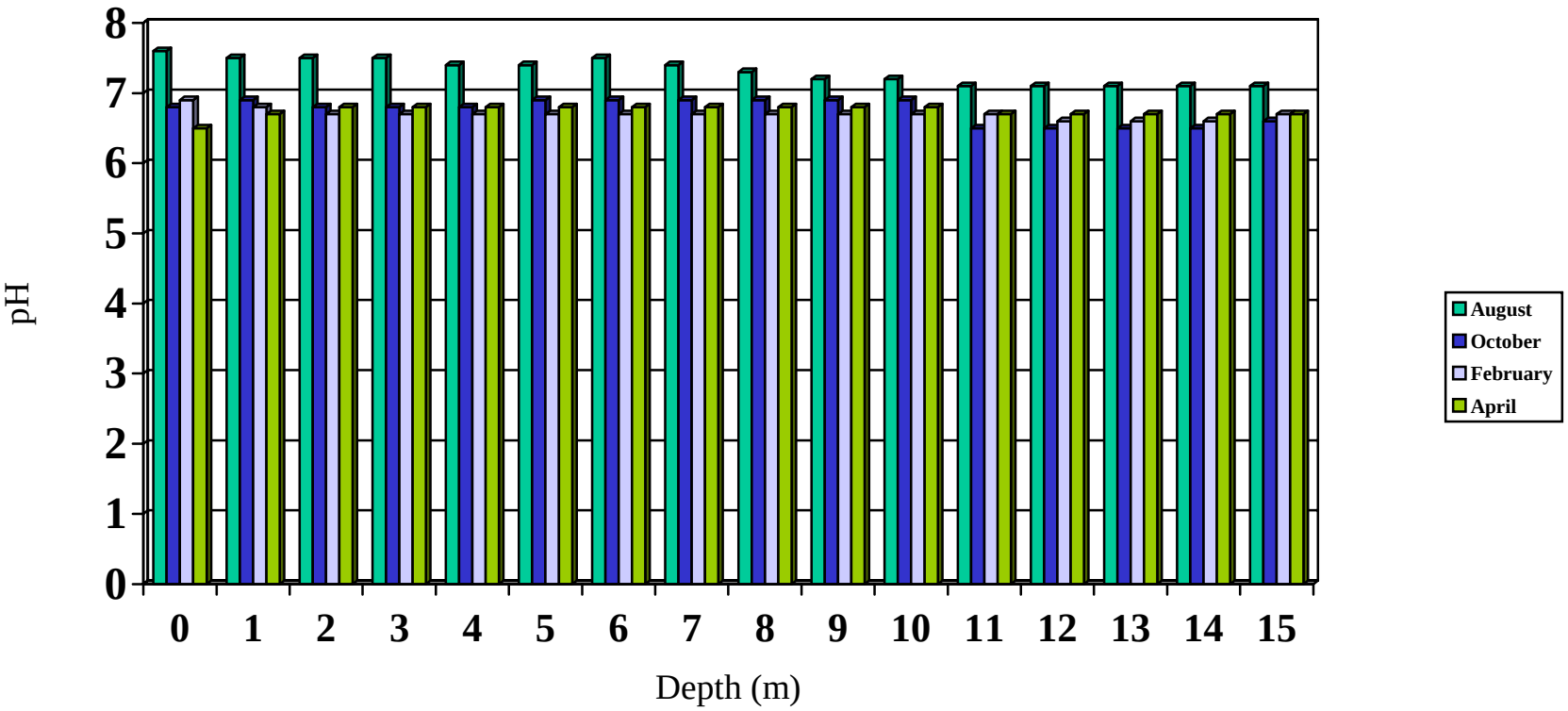

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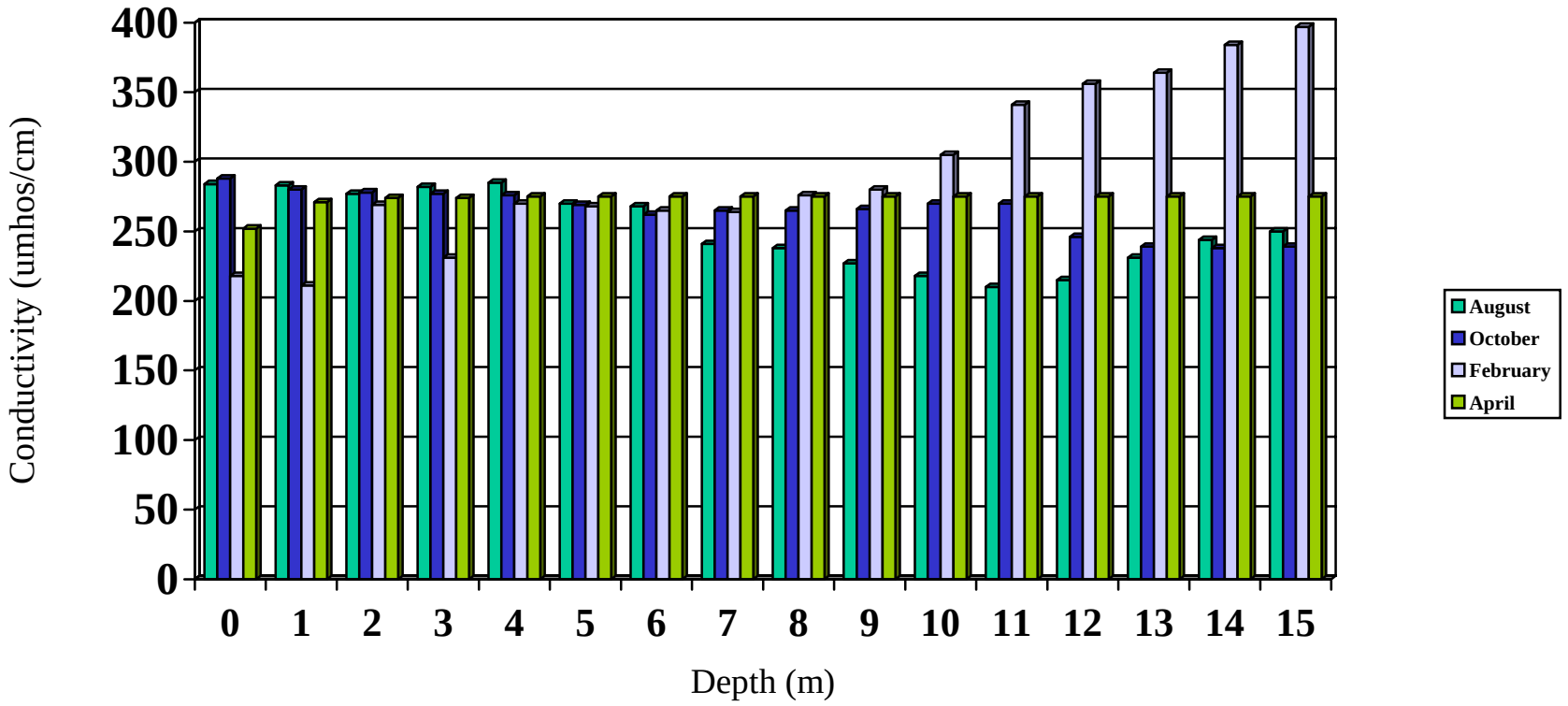
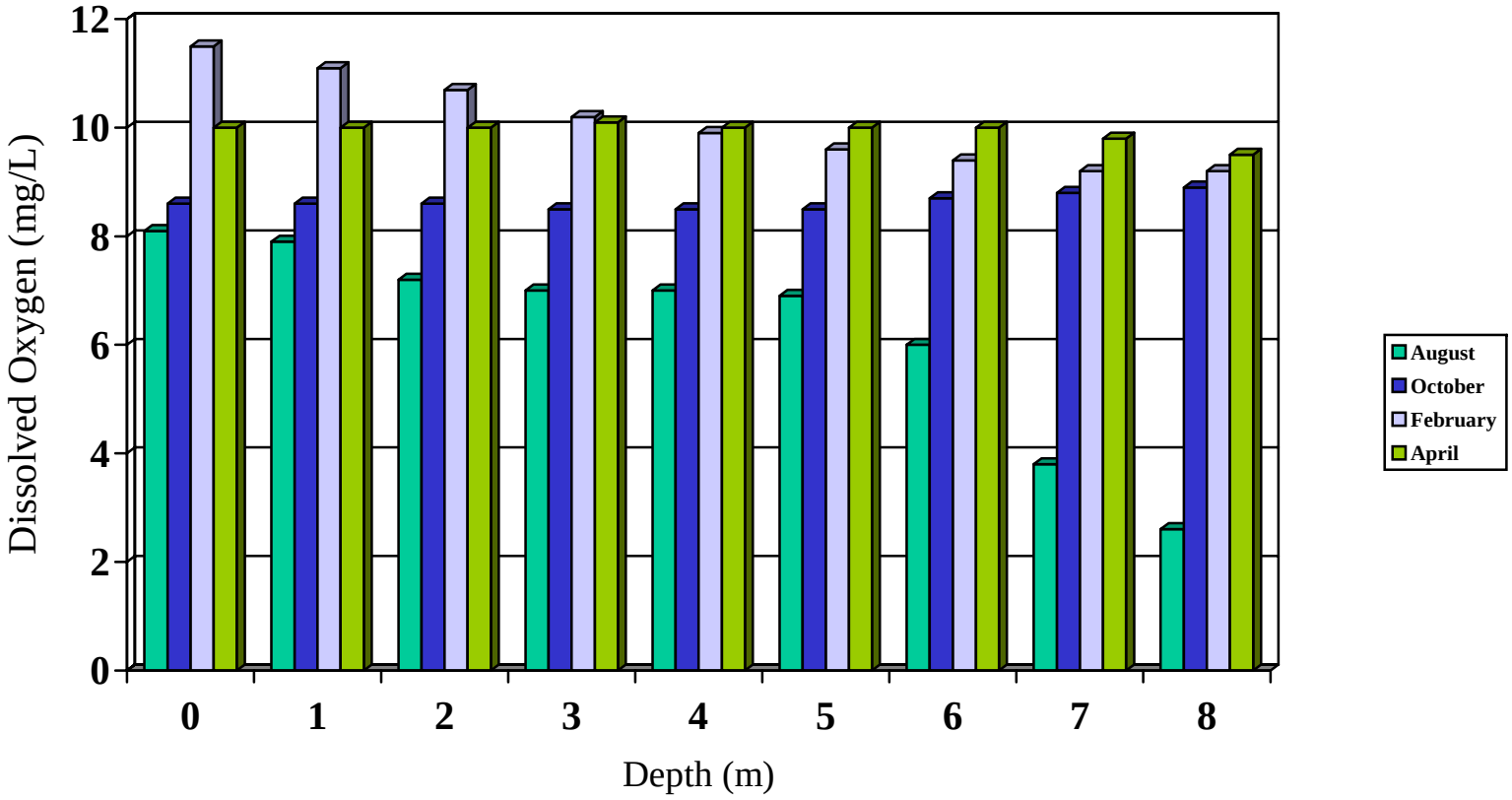
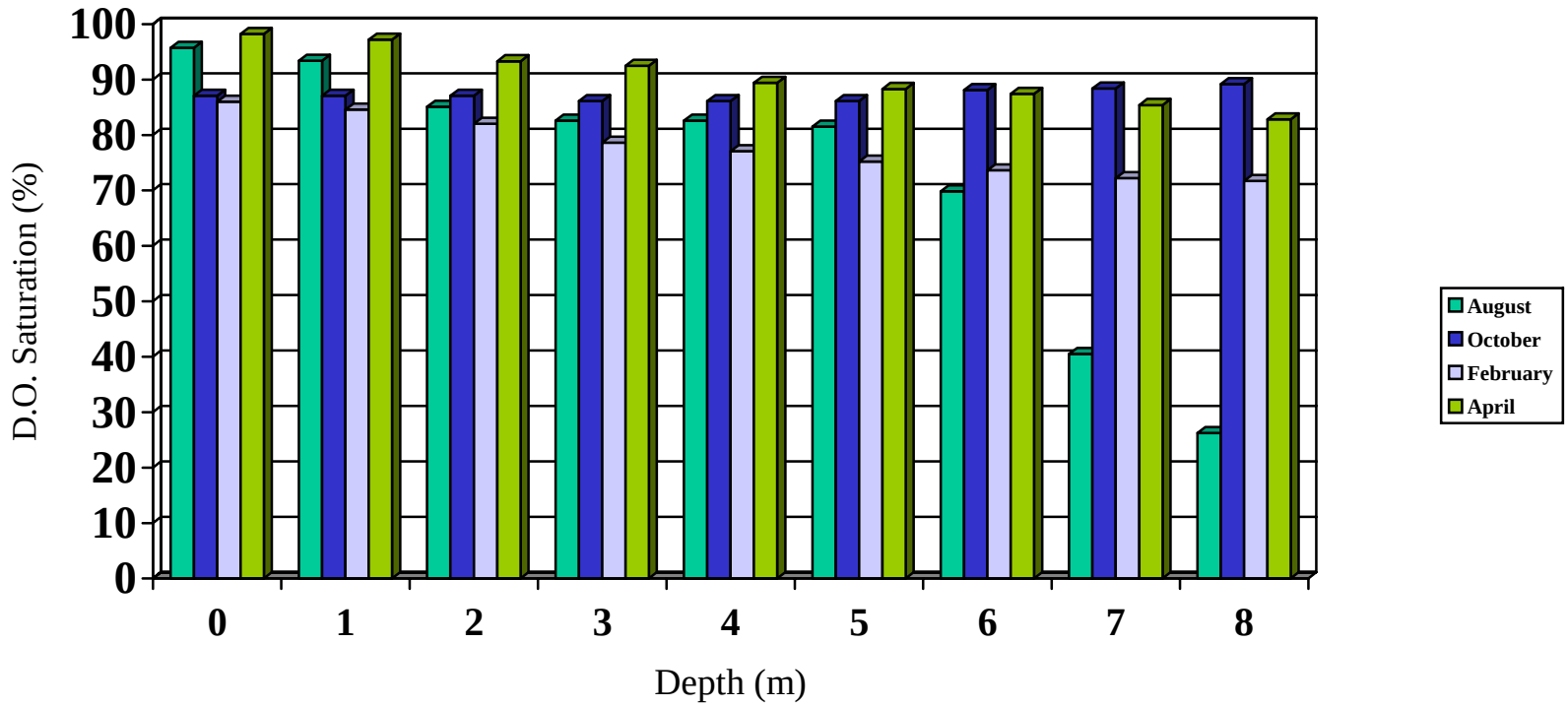


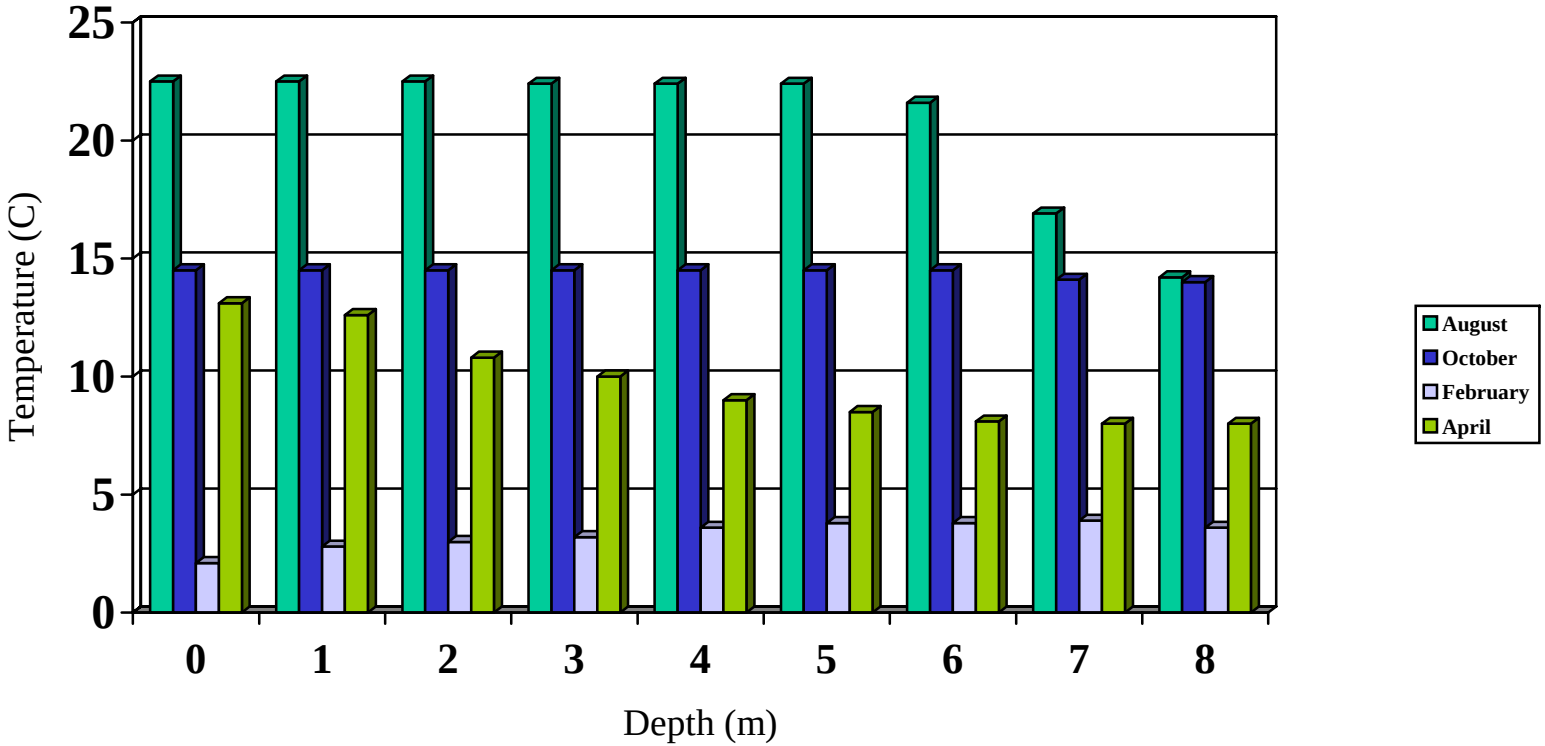
Conductivity Data Station One



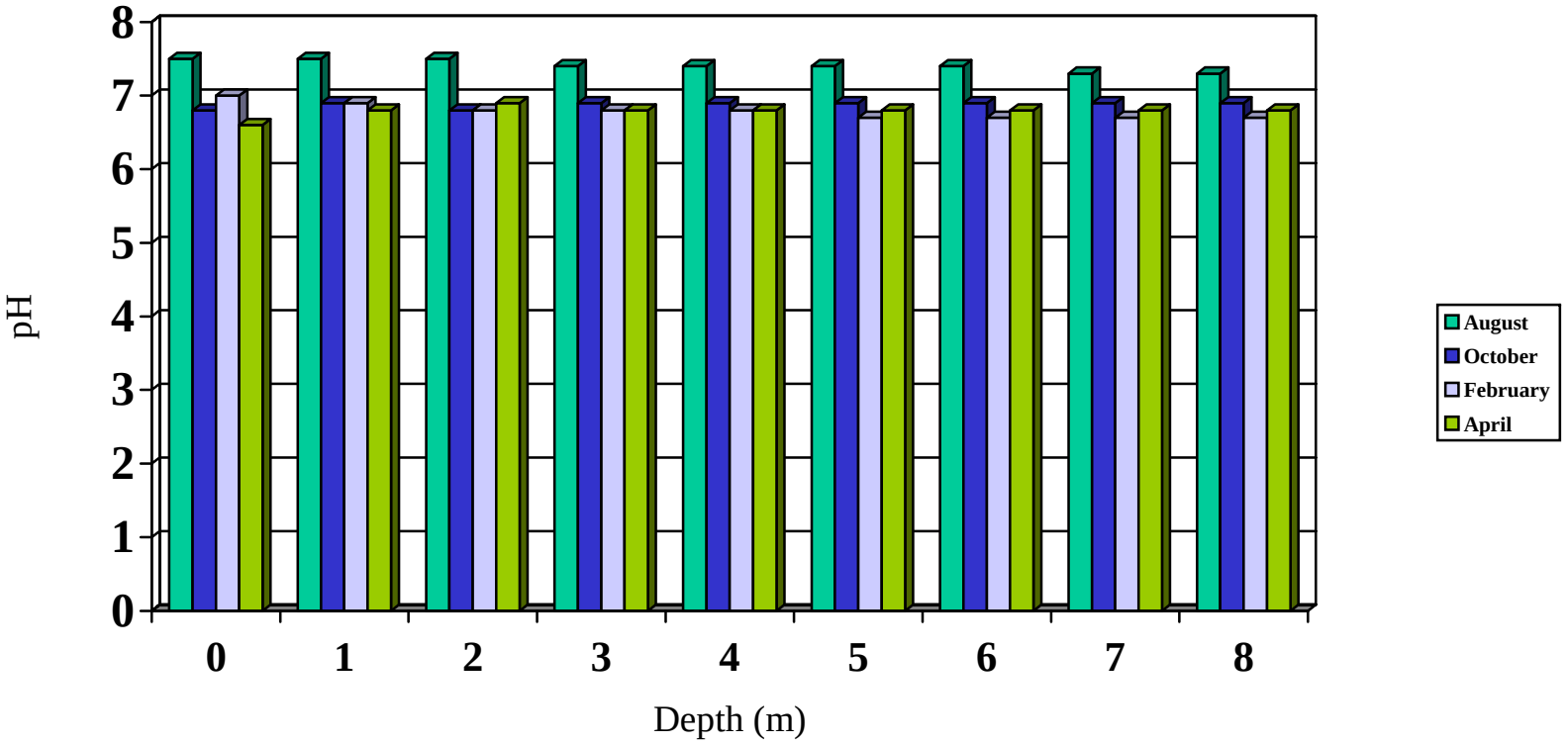
Dissolved Oxygen Data Station Two



Dissolved Oxygen Percent Saturation Data Station Two



Temperature Data Station Two



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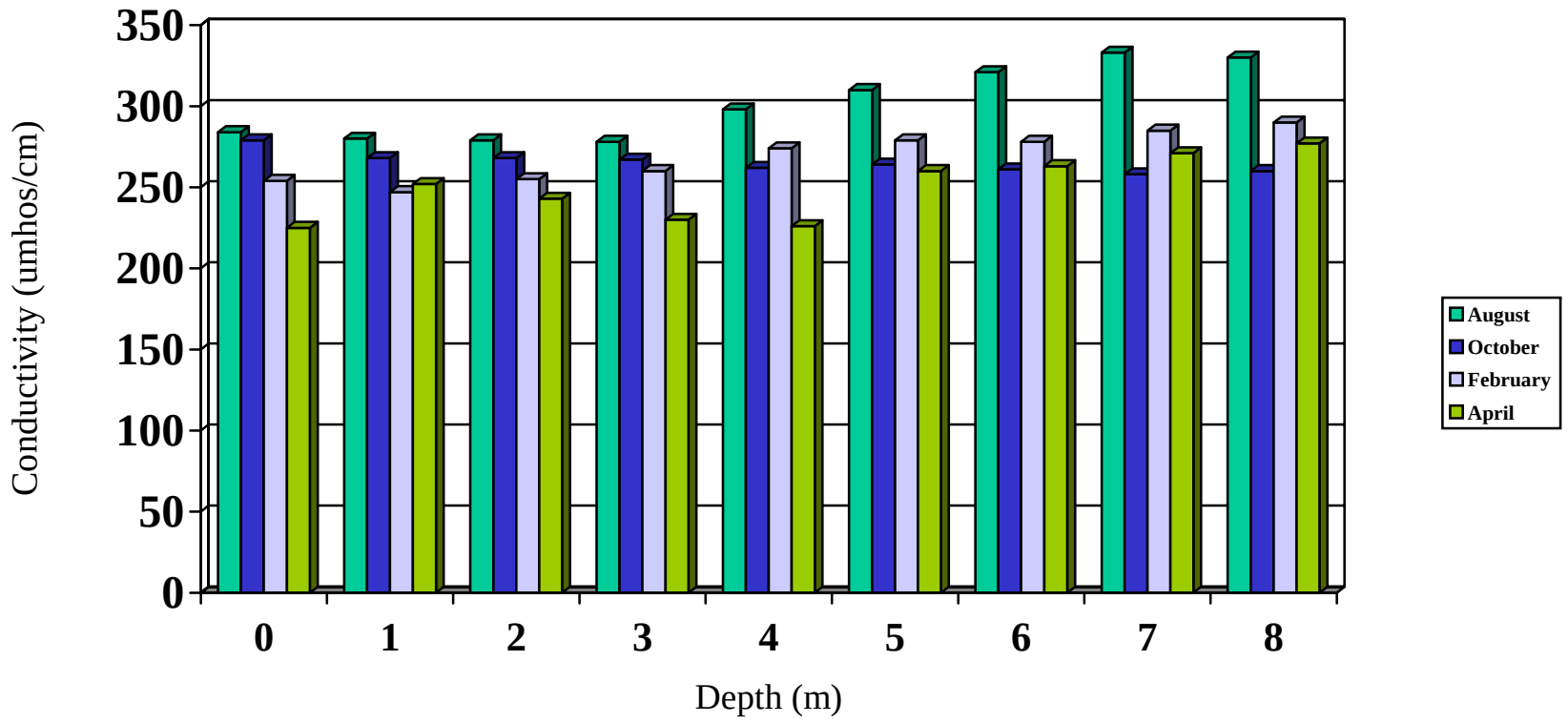
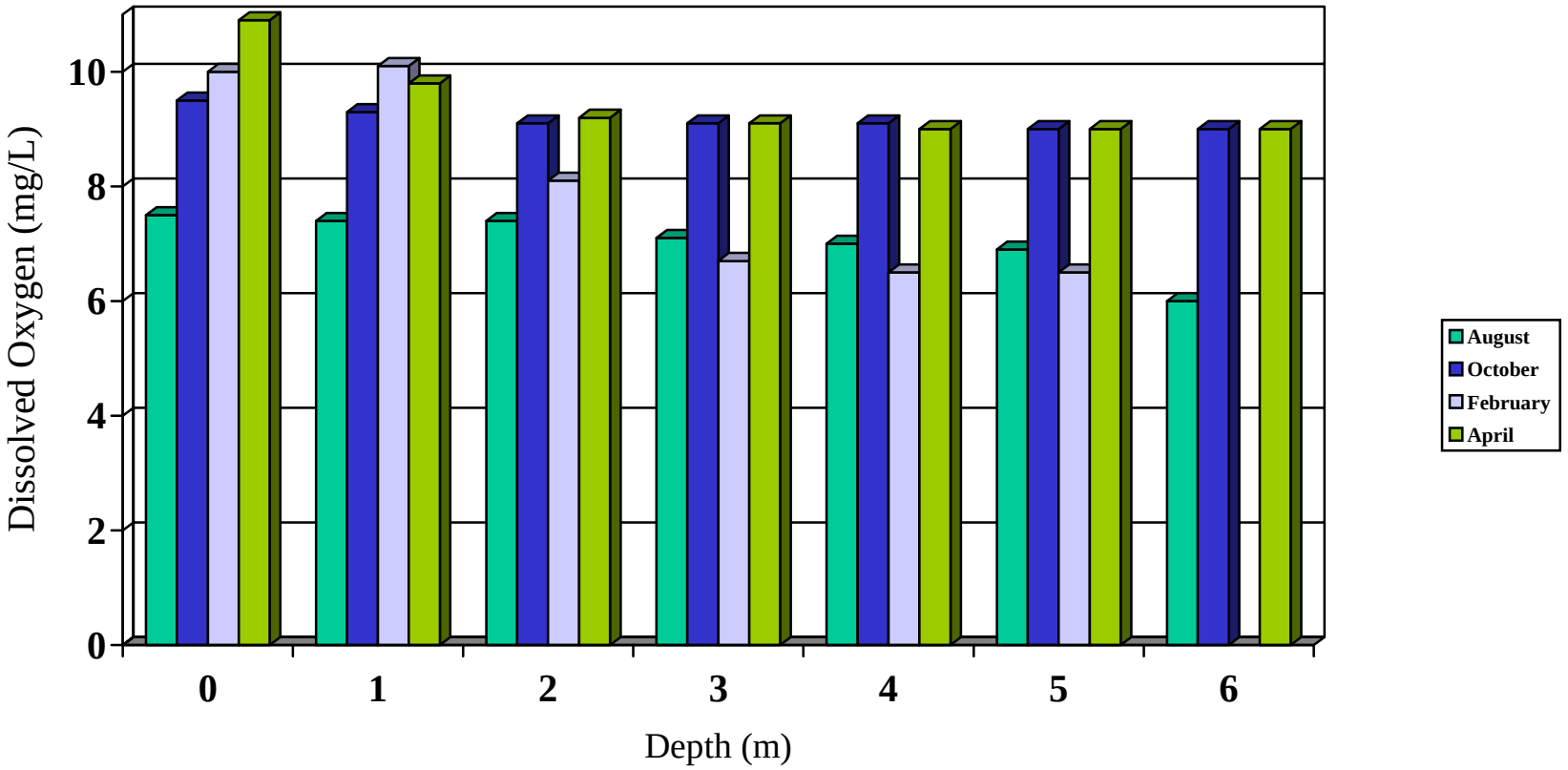
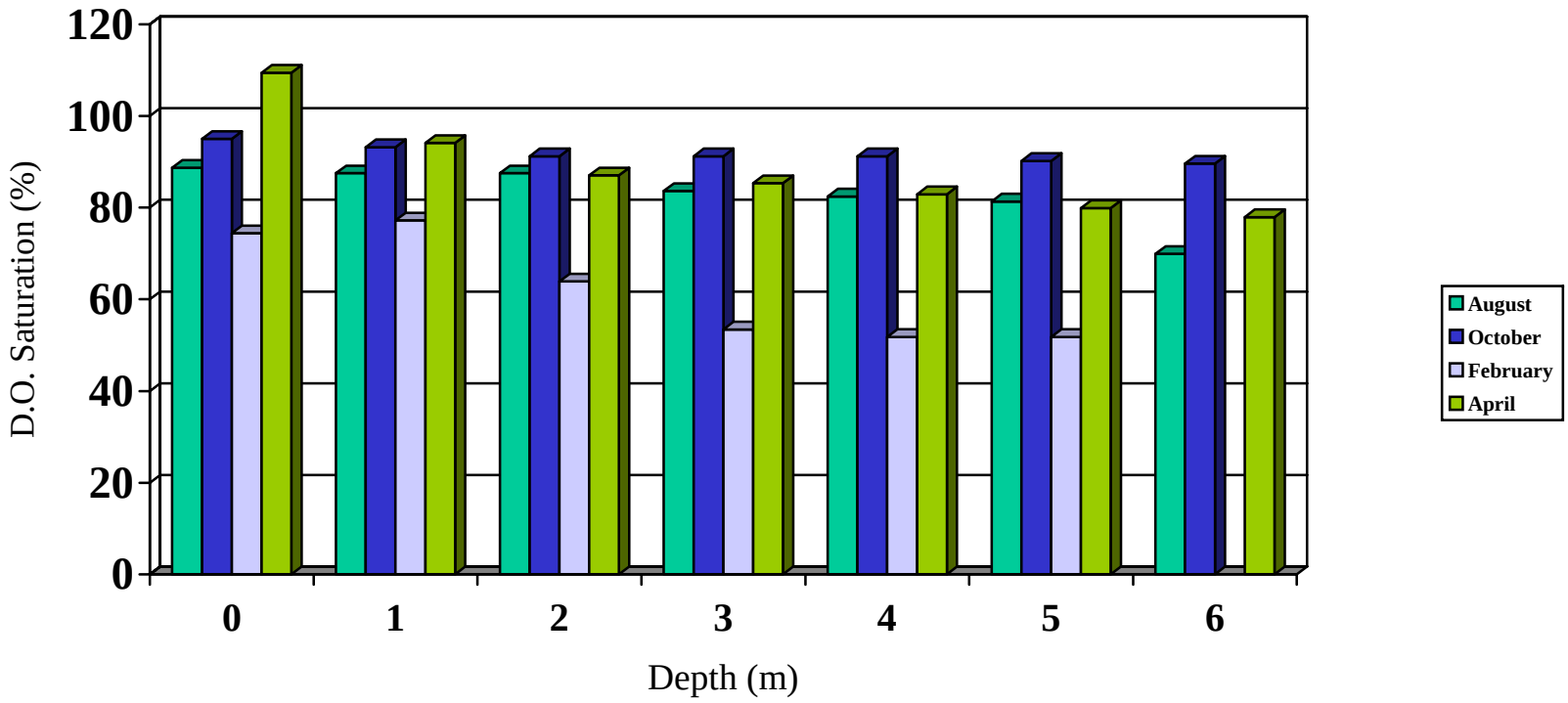


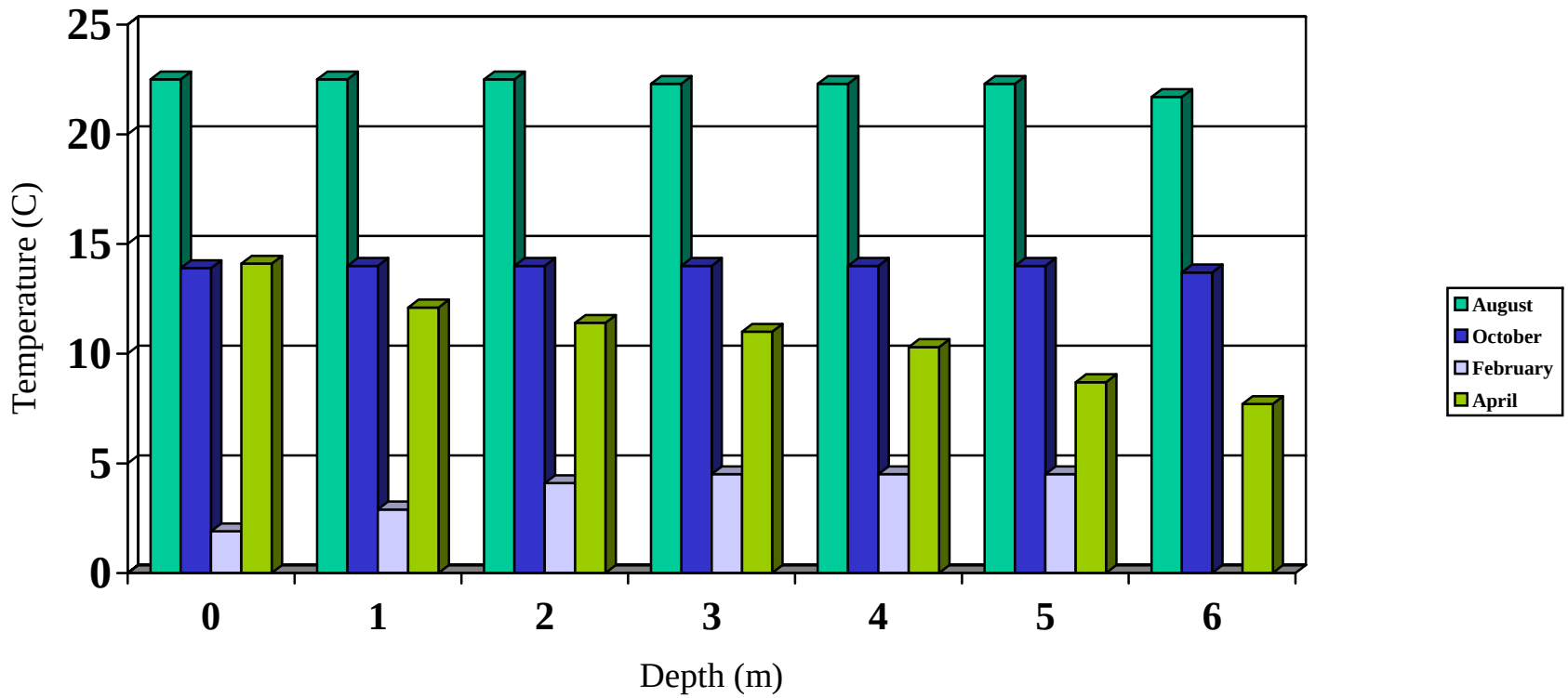
Conductivity Data Station Two



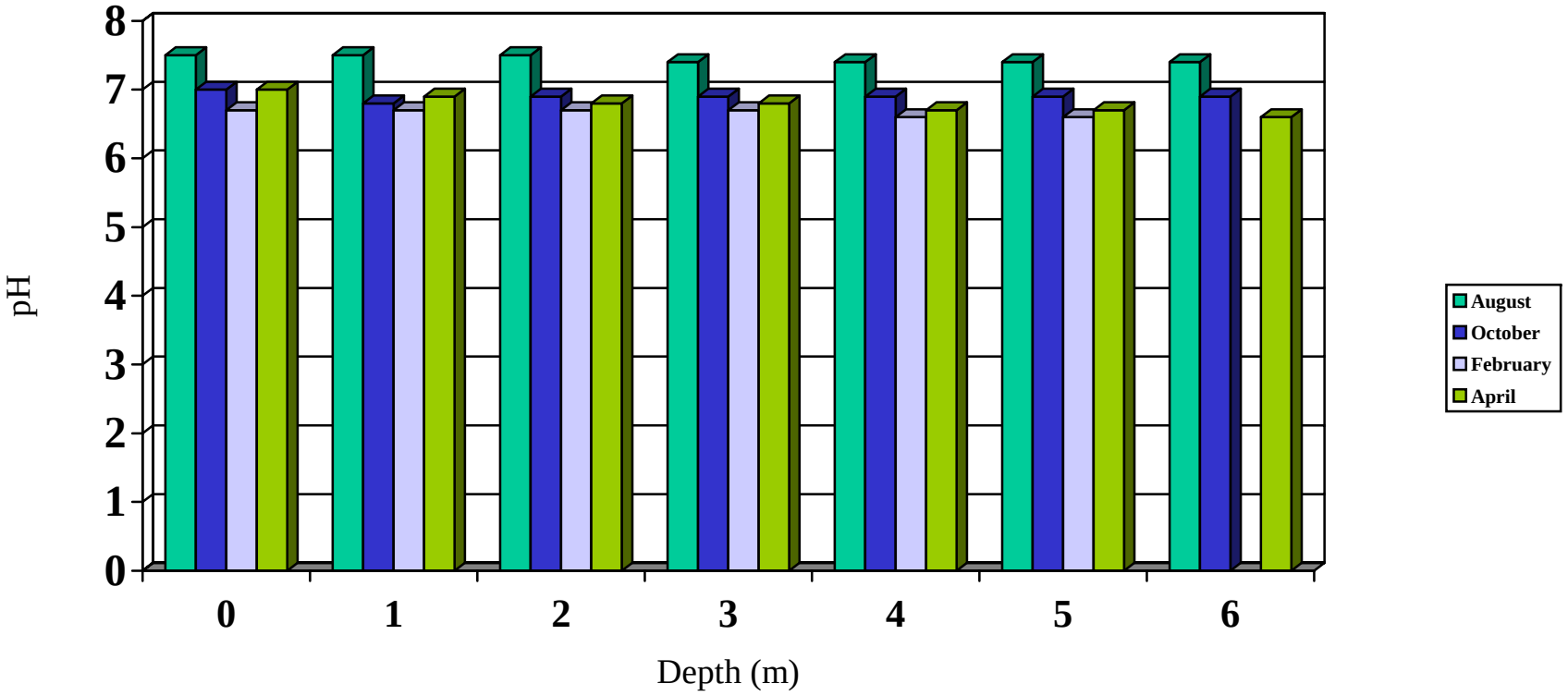
Dissolved Oxygen Data Station Three



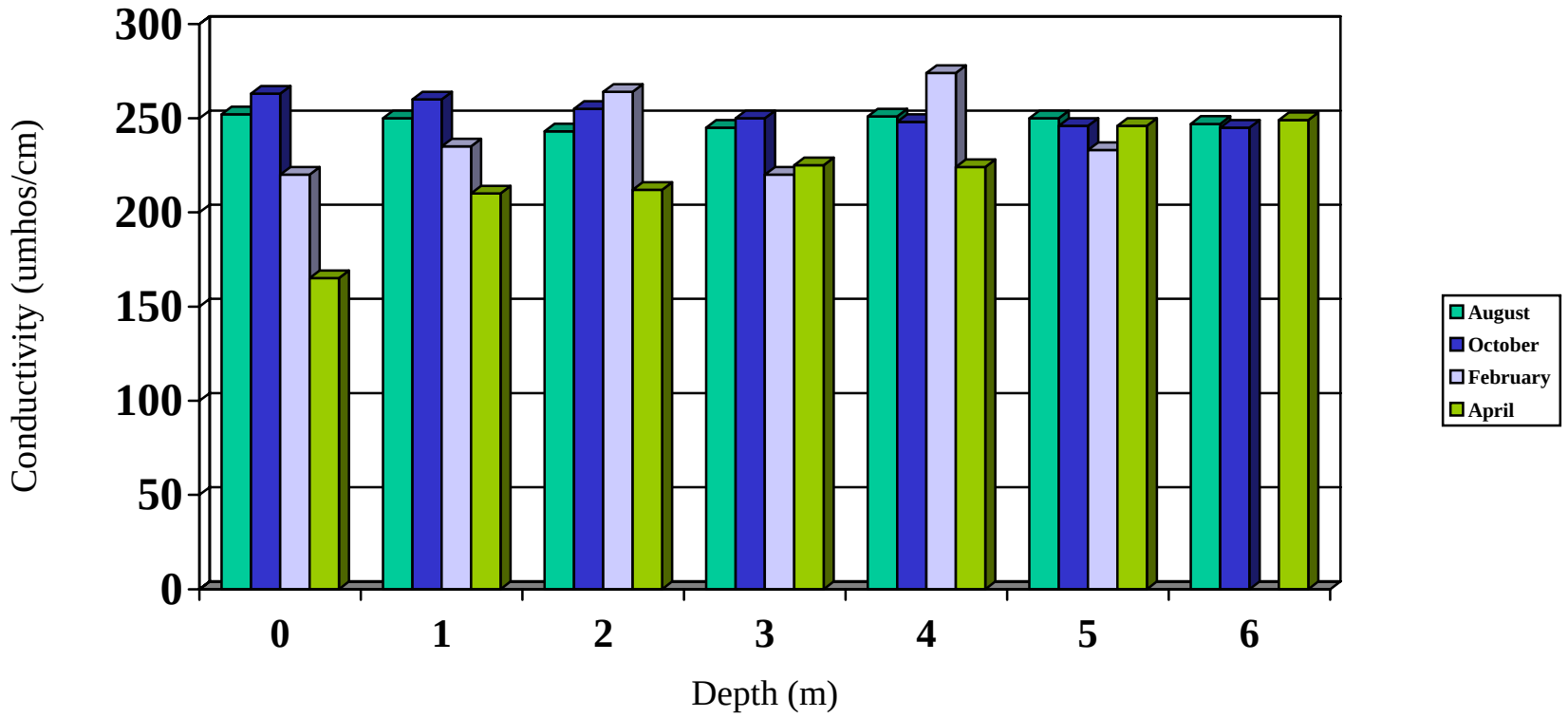
Dissolved Oxygen Percent Saturation Data Station Three



Temperature Data Station Three



pH Data Station Three



Conductivity Data Station Three