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PLANKTON STUDY OF LAKE RAYSTOWN

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ABSTRACT

In Juniata Bay of Raystown Lake (Pennsylvania), plankton abundance and diversity at four depths were compared between November 1999 and March 2000. We hypothesized that plankton abundance and diversity would vary with time of year in this monomictic lake because it has spring algal blooms and other seasonal differences in temperature, oxygen and light. The March 2000 data revealed no significant relationships between plankton abundance and water depth, presumably because of extensive inter-depth mixing of water at this time. Further studies are required to precisely determine when and if plankton abundance and diversity are affected by seasonal changes in stratification in Raystown Lake.

Keywords: Oxygen, plankton, Raystown Lake, temperature, water depth

INTRODUCTION

Lake Raystown is a monomictic lake that is never completely covered with ice. The lake undergoes mixing in late winter and early spring. During this period, there is a bloom of phytoplankton and later on of zooplankton. During summer and fall, the lake is thermally stratified into three layers: epilimnion, metalimnion, and hypolimnion. The purpose of this study was to test whether depth-specific plankton abundance and diversity differed between November 1999, when the lake was clear and strongly stratified, and March 2000, when the lake was weakly stratified and experiencing an algal bloom. It is important to understand the factors controlling plankton abundance and diversity in lakes, since phytoplankton are important primary producers, and the zooplankton that feed on them are major prey organisms for fishes and other animals higher in the food web.

FIELD SITE

All sampling was carried out in Juniata Bay located near the Juniata College Field Station (Entriken, Pennsylvania). This sheltered bay is 505.2 m long and 237.7 m wide, with an average depth of 18.5 m. At one end it is fed by a small wooded stream, and at the other it is protected from intrusion by boaters. The March 2000 sampling took place on a relatively warm, but very windy day when an algal bloom was obviously present.

METHODS AND MATERIALS

Sampling was done from a houseboat anchored in the bay just before it connects to the main channel of the lake. When the boat was stationary, we took oxygen and temperature readings at several depths by lowering the probe of a YSI oxygen meter every 0.5 m or more depending on the rate of change in readings. Water clarity was also estimated by taking secchi disk readings on the shady side of the boat. We also estimated light penetration with a LI-Cor, Inc. Photon Light Sensor (Model LI-185B) light photon meter. Plankton samples were obtained at five depths (four of which were the same depths as those sampled in November 1999) using a Birge Closing Net. The depths sampled were chosen based on the depth profile in temperature and oxygen concentration. We collected these samples in plastic bottles and used de-ionized water to wash the net to get the maximum amount of sample. Compound microscopes (40x magnification) were used to identify and count the plankton. We used 10 fields of view per slide, totaling 10 slides per sample. After identifying all plankton in each field of view, the density of each plankton species per liter was calculated, as follows:

1.)

$$\left(\frac{fovdiameter(mm)}{2}\right)^2 \pi \times 1.0mm = mm^3$$

2.)

$$\frac{\#ofplankton}{\#ofFOV \times {mm^3}/{FOV}} = {\#ofplankton}/{mm^3}$$

3.)

$$collectedvolume(cm^2) \times 1000\,{mm^3}/{cm^2} \times {\#ofplankton}/{mm^3} = \#ofplankton$$

4.)

$$\frac{\left(\frac{netdiameter(cm)}{2}\right)^2}{1000\,{cm^3}/{liter}} \pi \times towlength \times 100\,{cm}/{m} = {plankton}/{liter}$$

We compared plankton numbers among the four depths sampled during fall 1999 and spring 2000 by using chi-square tests (Minitab).

RESULTS

Plankton densities at different water depths in Juniata Bay during the fall of 1999 and the spring of 2000 are displayed in Tables 1-3. During both times, plankton abundance varied significantly with water depth (Table 4). The depth profiles for temperature, dissolved oxygen concentration and light penetration differed between the fall of 1999 and the spring of 2000 (Figs. 1, 2).

Table 1. Plankton densities at four depths in Juniata Bay during the fall of 1999.

Fall 1999 Data		
meters	observed	expected
1---4	126	79
5---8	46	79
9---13	97	79
14---16	47	79
total	316	316

Table 2. Plankton densities at five depths in Juniata Bay during the spring of 2000.

Spring 2000 Data		
meters	observed	expected
1---4	104	642
5---8	1187	642
9---12	428	642
13---16	1007	642
17---20	487	642
total	3211	3211

Table 3. Densities of the most common phytoplankton at five depths in Juniata Bay during the spring of 2000.

Three most common Species of Plankton							
depth/species	Ast-0bs	Ast-exp	Frag-obs	Frag-exp	Uloth--ob	Uloth--exp	total obs.
1---4	57	38.97	2	2.72	0	17.31	59
5---8	1120	754.32	13	52.57	9	335.1	1142
9---12	77	237.13	45	16.53	237	105.34	359
13---16	326	379.14	30	26.43	218	168.43	574
17---20	70	240.43	25	16.76	269	106.81	364
totals	1650	1650	115	115	733	733	2498

Table 4. Chi-square comparisons of phytoplankton densities at different depths in Juniata Bay, Raystown Lake during the fall of 1999 and the spring of 2000.

sample	df	P-value	Actual value	Critical Values
Fall 99	3	0.000	29.456	7.81, 11.34
Spring 00	4	0.000	695.262	9.49, 13.28
Common phyto*	8	0.000	1265.644	15.51, 20.09

*The three most common phytoplankton were *Astrionella*, *Flagilaria*, and *Ulothrix*.

Figure 1. Lake depth profiles for temperature and oxygen, comparing fall 1999 with spring 2000

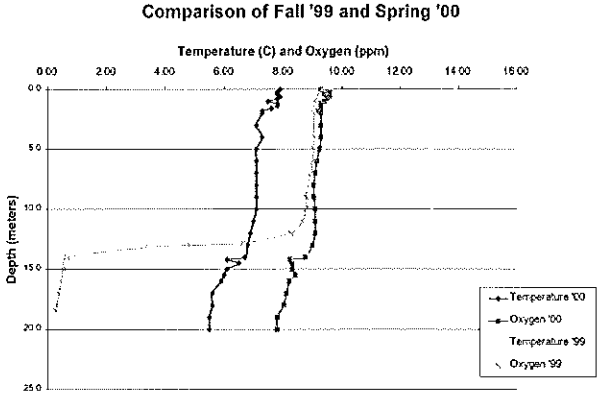
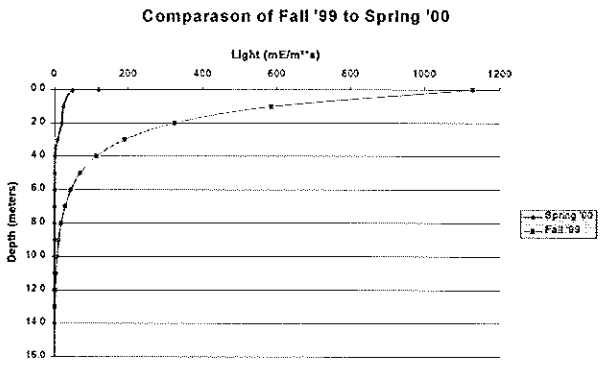


Figure 2. Lake depth profiles of light dissolved penetration, comparing fall 1999 with spring 2000



DISCUSSION

The data taken on March 29, 2000 indicated a relative constancy of temperature and dissolved oxygen concentration with depth in Juniata Bay. This vertical constancy may have permitted the plankton to live at any depth in the lake, so they are only limited by the amount of light they need. During the time of this study there was a phytoplankton bloom, and therefore the light penetration was relatively limited, thus presumably inhibiting photosynthesis below the top 6 m. The plankton was in abundance throughout the whole water column because the lake was mixing from top to bottom. Surprisingly, however, depth differences in plankton abundance were more apparent during the spring of 2000 when the lake was mixing, than during the fall of 1999 when the lake was stratified. However, sample sizes were very limited in our study. More sampling is needed to better discern possible relationships between lake stratification and vertical patterns in plankton abundance in Raystown Lake.

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