PHYTOPLANKTON PRODUCTIVITY AND GROWTH RATE KINETICS IN THE CEDAR RIVER LAKES

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Sample collection to define the phytoplankton biomass and productivity in Lakes Findley, Chester Morse, and Sammamish was conducted according to the schedule in Figure 1. Methods and procedures are the same as those used in 1972 (Welch et al. 1972). The purpose of such sampling is to provide validation data of productivity, biomass and growth rate (P/B) of phytoplankton to evaluate the fit of models constructed from experimentally determined parameters. Also, productivity and biomass on a seasonal mean basis serve as a measure of lake response to the incoming nutrient supply rate. Such information will contribute to a data base for management of the trophic state of lakes. Such a relationship for the Cedar drainage lakes must await nutrient income values for Chester Morse and Findley. Data have not yet been plotted to determine if the seasonal pattern of phytoplankton in 1973 was any different than reported for 1972 (Welch et al. 1972).

Growth kinetic experiments with natural phytoplankton in the lakes, except Lake Washington, were conducted in 1973 following the first peaks in biomass. These were late May in Sammamish, late June in Chester Morse, and late July in Findley. Growth kinetics experiments were preceded by limiting nutrient experiments and as in 1972 (Hendrey 1973) phosphorus was found to be the most singly important nutrient, although the response was not as clearly defined in Sammamish. This will be reported on further. Nucleapore filters (5 μ) were used this year instead of Millipore which should show more information on the ultraplankton.

Additional experiments are planned for September at three times the light intensities previously used and at three intensities (only one intensity, 2600 lux, was used in the spring tests). This alteration resulted from attempts to simulate the *in situ* growth rate in Findley by four separate models. In order to obtain a fit with field data, maximum growth rate (μm) was increased several fold from the maximums determined in the laboratory. Because the fit of laboratory and field data improved with depth (lower light), an even better fit may possibly be expected if higher experimental intensities are used. At that, it was clear that some models fit the data better than others; this point will be explored in the final report.

Light was shown to be the most important factor determining the pattern of productivity in Chester Morse and Findley Lakes in 1972 (Hendrey 1973, Hendrey and Welch 1973). Because of the clarity of Findley water, average maximum productivity occurs at 10% of the surface intensity at 15 m depth (Hendrey and Welch 1973). This is hypothesized to be caused by light inhibition at the surface. In Sammamish and Chester Morse, average maximum productivity occurs at 60% and 30% of surface intensity and at mean depths of 2 and 3.5 m, respectively.

Maximum growth rates *in vitro* for the 1972 season increased with increasing trophic status (productivity) in the four lakes as well as the half saturation constants (Hendrey 1973, Hendrey and Welch 1973). K_t (half saturation concentrations of limiting nutrient) values for Findley, Chester Morse, Sammamish, and Washington, respectively were, 0.17, 0.36, 0.42, 2.83. To the authors' knowledge this was the first time such a correlation has been shown for freshwater ecosystems. These findings will be illustrated and discussed further in the final report. They serve to suggest that Michaelis Menton type parameters determined by laboratory procedures with natural phytoplankton give precise enough values that allows separation of trophic state. Similarly one should be able to predict from these parameters, along with other submodels, at least the average biomass of phytoplankton in the four lakes. Average productivity in mg C/m^2 day in Findley, Chester,Morse, Sammamish, and Washington was, respectively, 220, 262, 499, and 1,070, while average biomass in µg/ℓ chl *a* in the four lakes was, respectively 0.6, 1.1, 7.1, and 9.5.

The 1972 *in situ* data are appendixed in (Hendrey 1973) and have been entered in the data bank. The 1973 data are mostly in field data books with the authors.

References

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Fig. 1. Sampling Schedule during 1973 growing season. Collections were less frequently in Findley and Chester Morse and Findley during winter and often more frequently in Findley in summer.

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
week 1		Chester Morse Plankton		Findley Plankton ^{14}C	Sammamish ^{14}C - Plankton	
week 2		^{14}C Chester Morse Plankton		Findley Plankton		
week 3		Chester Morse Plankton		^{14}C Findley Plankton	Sammamish ^{14}c - Plankton	
week 4		^{14}C Chester Mose Plankton		Findley Plankton		

Grazing experiment

10 April, 20 ", 6 Sept. — Sammamish

1 May, 11 Sept. — Chester Morse

27 Aug. Findley

Diel studies

22-23 Aug. Sammamish

1 - 2 May, 5 - 6 July, 24-25 Sept. — Chester Morse

8-9 Aug., 27-28 Sept. — Findley

Phytoplankton growth exp.

Sam. - 8 May, 17 Sept.
C. M. - 12 June
Find. - 1 Aug.
2 samples each

^{14}C includes; pH, alkalinity, temp., chl. a, DO (Winkler), light, secchi.

plankton include; chl. a, secchi, phytoplankton, zooplankton in photic zone and total water column for abundance and biomass