Lake Bellaire Algal Survey

Summer, 1981

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Detailed seasonal information on algal dynamics in Lake Bellaire is scarce (Bennett, 1968; Lawrenz, 1971; Boyd, 1976; Witzerman, 1978). The lake, located in the townships of Forest Home, Kearney, Custer and Helena (T. 29-30 N., R.7-8 W.) of Antrim County, Michigan, is susceptible to possible inputs of eutrophying nutrients (nitrogen, phosphorous) from the following sources: 1) riparian lawns and septic systems; 2) the Intermediate River, flowing in from the town of Bellaire; 3) Wilson Creek, which drains a wetlands presently used to receive treated wastewaters from the town of Bellaire. Although there is a substantial amount of data on the water chemistry of the lake over the past 10 years or more (most recently, Witzerman, 1978; Miller, 1981) studies monitoring the biota have been less frequent. Perhaps the first ecological group (trophic level) to respond to enrichment situations in temperate area lakes are the algae and aquatic vascular plants (hydrophytes) (cf. Vallentyne, 1974). The algae, especially, are rapid to respond to changes in nutrient levels. The response usually occurs in terms of a change in major species and growth rate (or productivity; it is an increase in this parameter that leads to the nuisance algal blooms so obvious to riparians). Indeed, an algal bloom has been noted by riparians in the northeast bay of Lake Bellaire in past years and was observed again in July and August of 1981. The main components of the bloom (as investigated by Central Michigan University biologists) were the net-like green alga, Hydrodictyon reticulatum, and the filamentous green genera, Spirogyra sp. and Zygnema sp. These algae indicate warm, still, enriched water conditions and the localization in the northeast bay suggests a problem arising from probable nutrient inputs in that area along with water currents and prevailing winds which tend to keep the bloom localized.

Such a situation prompts further investigation of algal communities, especially in the vicinity of the northeast bay, where Intermediate River and Wilson Creek enter the lake. Due mainly to the concern of the Three Lakes and Bellaire Riparian associations and Dr. LaVerne Curry, biology-graduate students from Central Michigan University have carried out yearly monitoring of the three lakes, Torch, Clam and Bellaire. Reports -- unpublished -- are on file with the Bellaire Water Quality Lab. Results of studies of nutrients and algae are especially salient to public discussions and DNR involvement regarding the use of the wetlands draining through Wilson Creek. Presently the site of wastewater treatment, any plans for further (nutrient) loading should be approached with extreme caution. Certainly, any further input of nutrients at the northeast bay will only aggravate the situation of mid-summer algal blooms.

The 1981 Study

Algal sampling was conducted in mid-May, mid-July, late July and the second week of August, with the purpose of describing algal trends in different parts of Lake Bellaire over the summer growing season. The May sampling trip involved three workers (Miller, Tallent and Tom Pienkowski of CMU) and was funded through lake association contributions of $200.00 through the Environmental Fund of CMU. This spring study included a survey of the attached (periphytic) algae along the lakeshore, as well as sampling of the suspended algae (phytoplankton). A report of the findings was presented to the Lake Bellaire Association (Ms. D. Becker) as well as to Mr. R. Anderson, of the Three Lakes Association. Further funding ($500.00) was provided for algal studies in mid-summer, 1981. This was marked for the summer sampling program through August. Such a program was developed to concentrate on the phytoplankton, which may change composition dramatically in as little as a week's time in temperate lakes and serve well as indicator organisms. The main

trends are summarized here, and they are compared to information from the spring study.

Methods

Suspended algae (phytoplankton) were collected by tow net (50-60 um mesh) at six to eight stations in Lake Bellaire (Figure I) on 18 and 30 July and on 11 August, 1981. Sites were chosen so as to evaluate algae in different sections of the lake and by the inlets of Intermediate River and Wilson Creek. All samples were preserved in Lugol's solution and aliquots of each were examined by light microscopy (250X for counts; 400 and 1000 X for identifications) at Central Michigan University. Enumeration procedures followed the methods described by Clark (1981). Approximately 500 cells from each sample were counted and species were identified, as far as practical, enumerated and tabulated. Many of the algal species, especially diatoms (Bacillariophyta), green algae (Chlorophyta) such as those mentioned from the northeast bay, and blue-green algae (Cyanobacteria) are of value in describing the water quality, the main goal of the study. Permanent slides of diatom species are presented for deposit in the Bellaire Water Quality Lab for future reference, as are those of the May, 1981, study (see appended reference sheets).

In association with algal studies, personal observations of the species, abundances and distribution of various aquatic plants were recorded. These are being compiled, as supplementary data for water quality records, and will also be submitted to the Water Lab and Three Lakes Association. Increased densities of aquatic vascular plants (e.g., water millefoil, Myriophyllum, and pondweeds, Potamogeton spp.) would indicate accelerated enrichment. Baseline information along these lines is of value to riparians and the water lab.

Algal species data were compiled by Ray Tallent and diversity indices are being developed and interpreted by Wolfgang Miller.

Results and Discussion

Secchi disk depths at mid-summer were about 3.5 feet, compared with a spring mean of 5.0 feet. This change suggests the degree of algal growth which is occurring. Witzerman (1978) noted that summer water temperatures reach ca. 22° C., which is conducive to growth of green and blue-green algae. Not only the algae grew to high numbers in mid-summer; aquatic vascular plants were present around the lake, and certain species were especially abundant around the north to northeast shore (also, high percentages of the attached alga, Cladophora glomerata, were noted in the spring survey). These included the pondweeds, Potamogeton richardsonii, P. nodosus, and P. pectinatus. In the Intermediate River, arrowhead, Sagittaria sp. (cf. S. cuneata) and tape-grass, Valisneria americana were especially dense. Senescence and decay of these plants in late summer may contribute to a significant oxygen demand on the lower waters (hypolimnion) of the lake, especially when combined with algal blooms (and subsequent die-off), such as occurred in the northeast bay. A cursory check of the oxygen concentration at 25 m. depth in Lake Bellaire yielded an oxygen concentration of ca. 3 mg/litre. This is a low value, close to the critical value required by game fish, and Storet data complies with these findings. It should be noted that Witzerman's data (1978) show a low value of 3.8 mg/l for the lake, but there does not seem to be a consistent over the years. Further monitoring of hypolimnetic oxygen concentrations is highly recommended. Oxygen concentration is a very important parameter of lake waters and it is directly related to algal quantities and the O_2 consumed by bacteria in decomposition of the algae.

The most distinctive algal populations were those of green algae -- Hydrodictyon reticulatum, Spirogyra sp. and Zygnema sp. -- which developed in the northeast bay of the lake in late July. Such populations are unique to that sector of the lake and the latter two algae may be linked to the

abundance of pondweeds (Potamogeton sp.) and bulrushes (Scirpus sp.) as substrate for initial development, as well as to nutrient inputs in that area.

High diatom diversity in the Intermediate River indicates that nutrient inputs are probably moderate, here. Diatoms found at nearly all sites included Synedra delicatissima, Melosira granulata, and small Cyclotella spp. (to ca. 5 um diameter !). Rhizosolenia was present, but always in low relative abundance. Diatoms are a major constituent of the phytoplankton well into the summer, being overshadowed by green algae only in the northeast bay in mid to late summer.

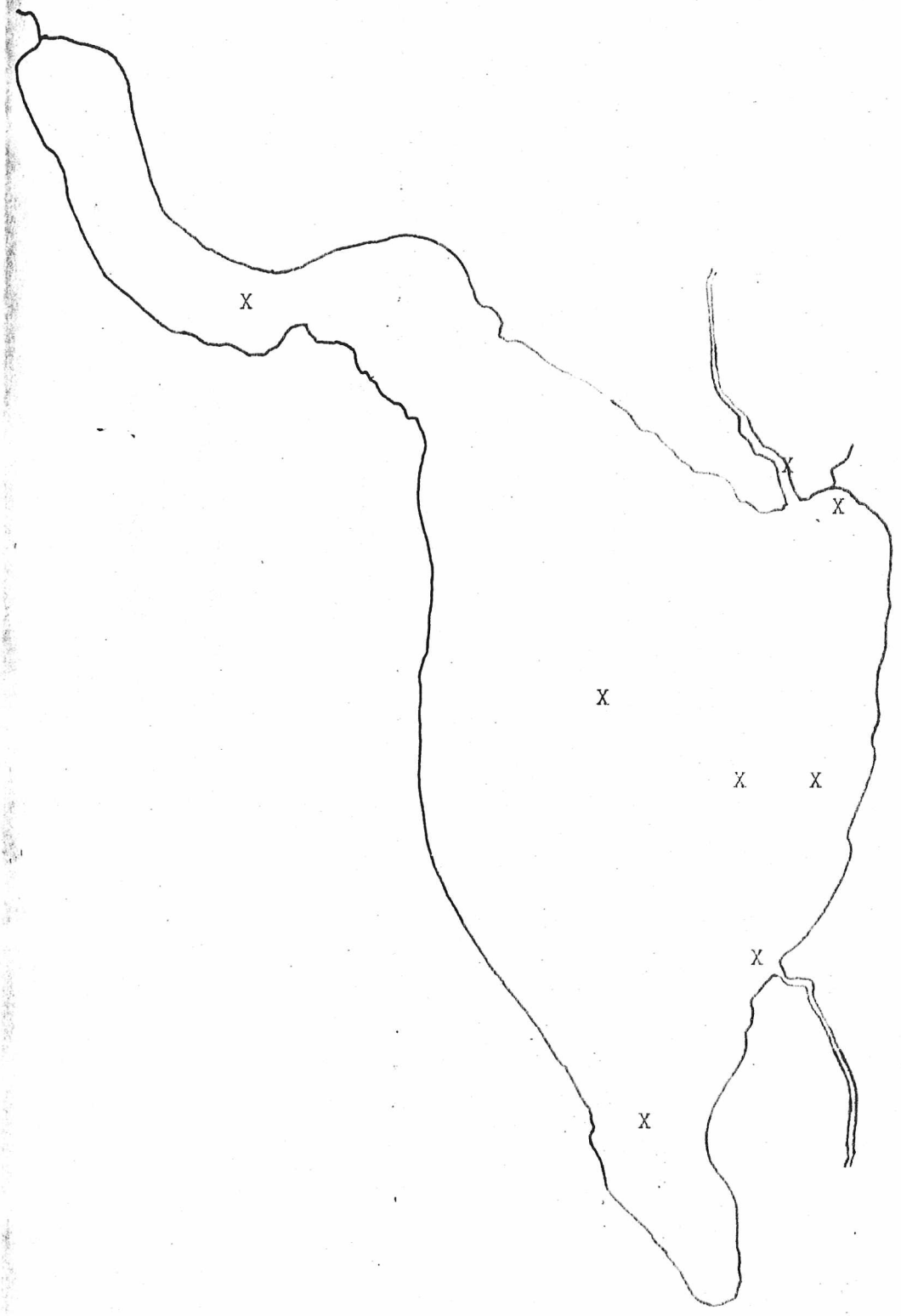
Other ubiquitous algae included Ceratium hirudinella, three species of Dinobryon, and Chrysosphaerella longispina (the assistance of Dr. D. E. Wujek in identification of this chrysophyte to species is gratefully acknowledged). Slightly higher amounts of blue-green algae were noted, than were expected. These included Anabaena sp., Merismopedia punctata, Oscillatoria limosa and Microcystis aeruginosa. Initial analysis shows no distinct relationship of these species to the northeast bay, but the fact that these species are not noted in earler reports (Witzerman, 1978) and their present occurrence prompts further sampling and documentation of the species.

Analysis of the dominant species indicates that the nutrient status of Lake Bellaire is presently in meso-eutrophic condition. Again, the northeast bay is indicated as the area most susceptible to detrimental effects of any further nutrient inputs, as it already displays green filamentous algal blooms in mid-summer and high densities of aquatic vascular plants.

Recommendations for further monitoring include continued nutrient analysis; at least one mid-summer, multiple station phytoplankton sampling, and sampling for oxygen concentration in the hypolimnion. Wolfgang Miller is presently developing a computer program to generate species diversity data to better resolve differences in algal communities within the lake.

Lake Bellaire

Figure I. Sampling sites for phytoplankton, summer, 1981.



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*Biological reports on file at the Bellaire Water Quality Lab; unpublished.

RECOMMENDED:

Vallentyne, John R. 1974. The Algal Bowl: Lakes and Man. Misc. Special Publication 22. Dept. Environment, Canada. 185 pp. -- a clear, non-technical discussion of lake eutrophication and alleviation.

Reference Sheet, Burnt Mounts of Diatoms, Lake Bellaire, Summer, 1981.

The following provides a reference to collection sites for diatoms of Lake Bellaire (collected by 50-60 um plankton tow net) which were prepared as burnt mounts and labelled for date and reference number with diamond pencil. The quality of the mounts is passable at best, but it is hoped that they may be of some use for semi-quantitative and identification reference. If time and resources allow, it is recommended that future reference mounts be prepared by nitric acid-potassium dichromate clearing of frustules followed by drying on coverslips, mounting in Hyrax (Tm) medium and sealing the slides with parafin or nail polish. All slides, of course, should be fully labelled, and it were best if collections were made with a volumetric device (Van Dorn or Kemmerrer) and the bacillariophytes concentrated by settling so that quantitative assays could be performed.

Ray Tallent, June, 1982

18 July, 1981

#1	southwest arm, Bellaire Lake
2	mid-lake (on a line from Shanty Creek to the southern rd. on w. shore)
3	northwest arm
4	northeast bay, by outlet of (Wilson's) creek from wetlands
5	Intermediate River near outlet to lake

30 July, 1981

#1	50 m. off Grass R. outlet
2	southwest arm
3	mid-lake
4	northwest arm
5	mouth of Intermediate R. "E" sample from submerged wood, Int. R.
6	northeast bay by Wilson Crk. outlet from wetlands
7	500 m. off Fisherman's Paradise Public Access
8	200 m. " "

11 August, 1981

#1	mid-lake
2	northwest arm
3	Intermediate R. mouth
4	northeast bay by Wilson's Crk.
5	500 m. off Fisherman's Paradise Public Access
6	200 m. " "
7	At Grass R. outlet
8	southwest arm of lake
10,11	samples from filamentous clumps in northeast bay