The Phytoplankton of Two Artificial Lakes in Hendricks County, Indiana

Grover W. Cook

Follow this and additional works at: https://digitalcommons.butler.edu/botanical

The Butler University Botanical Studies journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology.

**Recommended Citation**
Retrieved from: https://digitalcommons.butler.edu/botanical/vol10/iss1/7

This Article is brought to you for free and open access by Digital Commons @ Butler University. It has been accepted for inclusion in Butler University Botanical Studies by an authorized editor of Digital Commons @ Butler University. For more information, please contact digitalscholarship@butler.edu.
Butler University
Botanical Studies
(1929-1964)

Edited by

Ray C. Friesner
The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana’s vegetation in past decades. Authors were Butler faculty, current and former master’s degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler’s first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal’s publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor’s degrees and 75 master’s degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner, included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master’s students who made active contributions to the fields of botany and ecology include Dwight. W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daubenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

Requests for use of materials, especially figures and tables for use in ecology text books, from the *Butler University Botanical Studies* continue to be granted. For more information, visit www.butler.edu/herbarium.
THE PHYTOPLANKTON OF TWO ARTIFICIAL LAKES IN HENDRICKS COUNTY, INDIANA

By Grover W. Cook

The small artificial lake has become an important and increasingly popular project for conservation groups, sporting clubs, municipalities, farmers, and landowners. Its purpose is often defined as being for the propagation of fish, the prevention of soil erosion, the restoration of wildlife, and recreation. To this might be added: water conservation, flood control, and food production by fish-pond farming. The Conservation Department of the State of Iowa reports nearly 2000 artificial lakes having been constructed in that state since World War II. When one considers the many thousands of acres of fertile farm land save from flooding streams, the hours of leisure time spent by the factory or office worker on the banks of these ponds, and the havens provided for the wildlife, the worthiness of these projects can easily be realized.

However, it has been characteristic that nearly every artificial lake has been a good producer of fish and a clean place for the swimmer in its first two or three years of existence and then became a poor fish pond and practically unfit for swimming, due to the algal blooms. It is apparent that age is a factor in the limnological consideration of an artificial lake. For that reason two lakes were investigated, one ten years older than the other, in the attempt to determine the correlation between a young lake and a comparatively old one with respect to the abundance and occurrence of the genera of phytoplankton and the total phytoplankton.

LOCATION AND CONDITIONS OF INVESTIGATION

This study covers a period of six months (December 13, 1949 to May 24, 1950) in which phytoplankton was collected from two artificial lakes in Hendricks County, Indiana, i.e., Hurst Lake and Conservation Club Lake.

\[ \text{A portion of a thesis submitted in partial fulfillment of the requirements for the Master of Science degree in the Division of Graduate Instruction, Butler University.} \]

53
These two lakes were chosen for the investigation because of their close similarities in many features other than age. Both are approximately seven acres in area, and are fed by numerous small springs which flow through pastureland. The trees and other plant life surrounding the lakes are alike in that beech, maple, sycamore, Ostrya, and the wild grasses typical of this region, predominate. Animal life observed were: a flock of domestic ducks, muskrats, squirrels, many species of birds, and wild ducks during the migratory seasons. Weekly temperature readings for three months showed a variation of not more than one degree centigrade between the two lakes. Tests of the pH were identical.

Hurst lake is the older, having been built in 1938, and is a good example of the artificial lake that has been high in fish production for the first few years of existence and then declined to mediocrity. It was built by federal WPA funds for the purpose of preventing soil erosion, flood control, propagation of game fishes, and preservation of wildlife. The lake lies two miles south of Danville, Indiana, on State Road 39. (T. 15 N., R. 1 W., S. 22).

The Conservation lake was constructed in 1948 by the Danville Conservation Club for the purpose of providing recreation for club members in the form of fishing and boating, and for the purpose of wildlife propagation and preservation. The lake is located one mile northeast of Danville. (T. 15 N., R. 1 W., S. 3).

As this survey was begun in winter, it was necessary at times to chop away the ice to collect samples. In this event, the water was permitted to become settled before sampling. And wherever large amounts of silt prevented microscopic examination, the samples were discarded. For that reason, during a period of heavy rainfall in January, no samples were enumerated.

The samples for plankton counting were collected weekly between 8:00 A.M. and 10:00 A.M. Collections were made at three stations on each lake. The stations on the Conservation Club lake were numbered C-1, C-2, and C-3, and the stations on Hurst lake were numbered H-1, H-2, and H-3. Stations C-1 and H-1 were located near the main inlets of the lakes, the shallowest part of each lake; C-2 and H-2 were on the main body of the lake where the water was three to four feet deep; and C-3 and H-3 were at the end of the dam on each lake at a point furthest from three feet from shore.

One liter of lake water was immediately to the laboratory.

**METHOD**

The following procedure was followed: (1) collection of samples; (2) enumeration of the residuum; (3) enumeration of the water; and (4) transportation of the samples to the laboratory.

The 1000 cc. sample collection and concentration can be done in the field. The Rafter method in which Berkshire sand and silk gauze is used to increase the error factor was not used. When all the water was filtered, the Rafter filter was placed in a small glass jar. A 10-cm. glass slide was used for the concentrated residue. Rafter method in which Berkshire sand and silk gauze was used to increase the error factor was not used. When all the water was filtered, the Rafter filter was placed in a small glass jar. A 10-cm. glass slide was used for the concentrated residue.

The samples for plankton counting were collected weekly between 8:00 A.M. and 10:00 A.M. Collections were made at three stations on each lake. The stations on the Conservation Club lake were numbered C-1, C-2, and C-3, and the stations on Hurst lake were numbered H-1, H-2, and H-3. Stations C-1 and H-1 were located near the main inlets of the lakes, the shallowest part of each lake; C-2 and H-2 were on the main body of the lake where the water was three to four feet deep; and C-3 and H-3 were at the end of the dam on each lake at a point furthest from three feet from shore.

One liter of lake water was immediately to the laboratory.

**METII**

The following procedure was followed: (1) collection of samples; (2) enumeration of the residuum; (3) enumeration of the water; and (4) transportation of the samples to the laboratory.

The 1000 cc. sample collection and concentration can be done in the field. The Rafter method in which Berkshire sand and silk gauze was used to increase the error factor was not used. When all the water was filtered, the Rafter filter was placed in a small glass jar. A 10-cm. glass slide was used for the concentrated residue.
in investigation because of their er than age. Both are approxi-
fe by numerous small springs
the trees and other plant life
che, maple, sycamore, Ostrya,
region, predominate. Animal
ite ducks, muskrats, squirrels,
s during the migratory seasons.
onths showed a variation of
between the two lakes. Tests
en built in 1938, and is a good
been high in fish production
then declined to mediocrity,
for the purpose of preventing
of game fishes, and preserva-
region, south of Danville, Indiana,
). In this event, the water was
ampling. And wherever large-
pical examination, the samples
ing a period of heavy rainfall in
were collected weekly between
ns were made at three stations
ervation Club lake were num-
H-1 were located near the part
 each lake: C-2 and H-2
ere the water was three to four
end of the dam on each lake
at a point furthest from the spillway. Each of the six stations was
three feet from shore.
One liter of lake water was collected from each station and taken
immediately to the laboratory at Butler University for enumeration.

METHODS AND APPARATUS
The following procedure was used in the investigation: (1) collection
of samples; (2) concentration by filtration and preservation
of the residuum; (3) microscopical examination of the concentrate;
(4) enumeration of the phytoplankton.

The 1000 cc. samples were taken immediately to the laboratory
collection and concentrated. The procedure used was the Sedgwick-
Rafter method in which the 1000 cc. sample was filtered through
Berkshire sand and silk bolting cloth. The sides of the Sedgwick-
Rafter filter were washed continuously with distilled water to
decrease the error factor due to the adherence of the organisms to
the glass. When all the water had run through, the stopper was removed
and 10 ml of distilled water was used to wash the residuum into a
small glass jar. A 10-ml pipette with rubber tubing attached proved
very useful for this because the fine stream of water under pressure
made it possible to wash thoroughly out of the filter all remaining
particles.

One ml of this concentrated sample was then placed into a Sedg-
wick-Rafter plankton counting chamber by means of a 1-ml pipette.
It was allowed to stand about five minutes before examination, to
permit most of the organisms to settle to the floor of the chamber.
The counting chamber was then placed on the mechanical stage of
the microscope and examined by using a 20X objective and a 12.5X
ocular. The ocular was fitted with a Whipple plankton counting ocular
micrometer, the outer boundaries of which form a square field and
measure exactly one square mm of the counting chamber when the
draw tube of the microscope is properly adjusted. Since the depth
of the counting chamber is one mm, one cubic mm or .001 ml of the
concentrate was examined. By including ten fields along the linear
axis of the counting chamber from one end to the other, .01 ml was
examined. Thus the total number of organisms in ten fields would
be equal to the number in one ml of the original sample collected. In
order to determine more carefully the genera observed, and since there
was a predominance of Bacillariophyceae, permanent slides were made of all samples where identification was difficult. These were then examined with the oil immersion lens.

Each unicellular organism was counted as one, and each filamentous form was counted once for each of the smaller squares it touched upon.

RESULTS

In the 108 samples collected from Hurst lake and Conservation Club lake (hereafter referred to as H lake and C lake, respectively) 37 genera of algae, representing the following classes, were recorded: Bacillariophyceae, Chlorophyceae, Chrysophyceae, Dinophyceae, Euglenophyceae, Myxophyceae, and Xanthophyceae.

A wide range in the average total number of organisms was displayed between December 13 and May 24. The lowest average for the three stations on each lake was 1.3 organisms per ml on March 16. This was for samples collected on C lake. The highest average for both lakes was the count for May 24 from H lake when the total was 9035 per ml. H lake had no average below 5.7 per ml, which count was on February 15. C lake had no count higher than 1585, on May 3. H lake was consistently higher in average numbers of organisms per ml until April 25. On that day, H lake averaged 111 per ml and C lake averaged 348.7 per ml. On May 3, C lake was again higher with 1585 per ml against 974 per ml for H lake. The May 10 averages were: C lake, 1404 per ml; H lake, 531 per ml. This increase by C lake was due to the sudden occurrence of large numbers of Cyclotella and an increase in the amount of Synedra. After May 10, however, there appeared ever-increasing quantities of Anabaena in H lake, which averaged 4235 per ml on May 17, and 8941 per ml on May 24. The average number of total organisms per ml for those two dates were 4326 and 9035, respectively. C lake in the meantime dropped in total numbers from 660 per ml on May 17 to 107 per ml on May 24.

A correlation between the older H lake and the younger C lake is evident on the basis of total number of organisms. Except for the three weeks from April 25 through May 10, the older lake at all times was shown to be a better producer of phytoplankton. The older lake is a better producer of Myxophyceae as well. Indeed, a “bloom” of Aphanizomenon flos-aquae was observed on H lake by the writer in
Hurst lake and Conservation lake and C lake, respectively) photosynthetic classes, were recorded: cyanophyceae, Dinophyceae, Eustrophiphyceae.

The number of organisms was difficult. These were then counted as one, and each filament of the smaller squares.

S

The lowest average for organisms per ml on March 16 was 24. The highest average for I lake when the total was below 5.7 per ml, which count higher than 1585, on May 24. The May 10 averages 31 per ml. This increase by C of large numbers of Cyclotella edra. After May 10, however, densities of Anabaena in I lake, 7, and 8941 per ml on May 24, as per ml for those two dates, I lake in the meantime dropped May 17 to 107 per ml on May 24.

The May 10 average numbers of organisms 77, and 18941 per ml on May 24, the older lake at all times of organisms. Except for the May 10, the older lake at all times phytoplankton. The older lake as well. Indeed, a "bloomin" of H lake by the writer in
late October 1949, and on that same day, no blue-greens could be found in samples collected at C lake.

If it is possible, as Prescott (6) predicts, to arrive at one or more genera as indicators, it might be well to consider the diatoms, especially Synedra, Gomphonema, Navicula, and Odontidium.

Synedra (fig. 1). The abundance and occurrence of Synedra for both lakes is typical of the total number of organisms for both lakes up to May 10. H lake was higher in Synedra until April 25, and after that date, C lake was higher. It is noted that Synedra reached a peak in early May and declined to a point near the winter averages at the end of the month. Coffing (1) also pointed out Synedra as an important organism in her analysis of the White River Canal. Her results show a peak of Synedra in March. However, her counts of Synedra included Nitzchia, which this writer considered separately.

The C lake average for Synedra ranged from the winter time lows of near zero per ml to a high of 1025 organisms per ml on May 10. Only four collections failed to contain Synedra. The H lake average for Synedra ranged from 0 to per ml to 685 per ml. Only one collection was lacking in Synedra.

Navicula (fig. 2). Navicula again characterizes the total for the two lakes, but here the count for C lake was greater, and then only slightly, on two dates, January 24 and May 24. The lines of the graph, for the most part, run nearly parallel, which might indicate the difference that exists between a lake ten years older than another. It must be admitted, however, that the amount of Navicula was comparatively small. Thus its use as an indicator might be dependent on the amount of material encountered.

Gomphonema (fig. 3). Members of this genus occurred in relatively small numbers, but like Navicula and Synedra, H lake samples contained larger numbers of organisms than did C lake. Here a peak was reached in late March and early April; the peak for C lake coming one week later than the peak for H lake. Gomphonema was present in both lakes represented by many species. This made rapid identification difficult and would probably detract from its value as an indicator.

Odontidium (fig. 4). The frequency of appearance of Odontidium displayed very well the contrast between the two lakes. In just one instance was it that a comparison very similar in April time. And it is si but that C lake ac may not be significa of the present inv things being equal greater in abundance.

In the above investigation show which might be used as an artificial lake. might be useful as is a better produce

Some writers h applying the lake with either of these two exceptionally heavy January, three feet a higher at the same. Still, despite this a to drainage from the increase in total plankton would be expected if organisms into the in the original the

2. Seven classes of Chlorophyceae, Chlorophyceae, and Xanthophyceae, and
3. The Bacillariophyceae [University Library]
same day, no blue-greens could be ke.

5) predicts, to arrive at one or more well to consider the diatoms, espe-
vicia, and Odontidium.

ance and occurrence of Synedra for number of organisms for both lakes her in Synedra until April 25, and r. It is noted that Synedra reached to a point near the winter averages ig (1) also pointed out Synedra as yas of the White River Canal. Her in March. However, her counts of h this writer considered separately. ra ranged from the winter time lows 1025 organisms per ml on May 10. retain Synedra. The H lake average per ml to 685 per ml. Only one a.
again characterizes the total for the r C lake was greater, and then only 24 and May 24. The lines of thefly parallel, which might indicate the lake ten years older than another. It be amount of Navicula was compara-
indicator might be dependent on the bers of this genus occurred in rela-
vicia and Synedra, H lake samples nisms than did C lake. Here a peak ry April; the peak for C lake coming I lake. Gomphonema was present in species. This made rapid identifica-
ly detract from its value as an frequency of appearance of Odonti-
tast between the two lakes. In just one instance was it more abundant in the younger lake. It is peculiar that a comparison of graphs for Gomphonema and Odontidium are very similar in appearance. Peaks were registered at about the same time. And it is singular that H lake reached a peak for Odontidium but that C lake actually never showed a genuine peak. This may or may not be significant. It would be interesting to compare the results of the present investigation with a like study ten years hence. All things being equal, it might be expected that Odontidium would be greater in abundance with increased age.

In the above four diatoms lies the only indication, in so far as this investigation shows, that there could be one or more genera or species which might be used as an index of the phytoplankton abundance of an artificial lake. But regardless of whether or not these diatoms might be useful as indicators, it is clearly evident that the older lake is a better producer of phytoplankton than the younger lake.

Some writers hold that the drainage basin is responsible for sup-
plying the lake with plankton. This apparently was not the case with either of these two lakes. January and February were months of exceptionally heavy rainfall. C lake was, at one time, during Feb-
uary, three feet above the normal level of water, and H lake was higher at the same period than it had been in the previous four years. Still, despite this abnormal high water level, which was due mostly to drainage from their respective feed stream drain regions, no in-
crease in total plankton was evident at any time. And a plankton pulse would be expected if one were to believe that the feed streams carried organisms into the lake. Tables I and II, giving detailed results, occur in the original thesis and are available on loan from the Butler University Library.

SUMMARY

1. A quantitative study of the phytoplankton of the two artificial lakes differing in age by ten years was made from December 13 to May 24.

2. Seven classes of algae were recorded: Bacillariophyceae, Chlorophyceae, Chrysophyceae, Dinophyceae, Euglenophyceae, Myxophyceae, and Xanthophyceae.

3. The Bacillariophyceae were the predominant organisms from December through April. Of the diatoms recorded, four genera oc-
curred in nearly every weekly collection, viz. Synedra, Navicula, Gomphonema, and Odontidium.

4. Anabaena was the predominant blue-green alga.

5. The only genus of the Chrysophyceae found was Dinobryon.

6. Cyclotella was abundant in the Conservation Club Lake during April and May.

7. Taking the averages for three stations on each lake, only twice did the younger lake surpass the older one.

LITERATURE CITED


