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Original: Fish Division
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INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

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July 1, 1954

Report No. 1423

USE OF LIME IN TREATING SOFT-WATER LAKES IN THE UPPER PENINSULA*

By

Thomas F. Waters

Abstract

The use of calcium compounds, such as hydrated lime and limestone, in acid, soft-water lakes was investigated to determine if biological productivity could be increased in this type of lake, a type which is ordinarily found to be of low productivity. Two applications were made to Stoner Lake, in the Upper Peninsula of Michigan; the first, in 1952, consisted of 8.5 tons of hydrated lime and 2 tons of crushed limestone, with a theoretical increase of alkalinity of 16 p.p.m.; the second, in 1953, consisted of 20 tons of hydrated lime, with a theoretical increase of 32 p.p.m. in alkalinity. The 1952 application resulted in an increase in alkalinity of about 3 p.p.m., and the 1953 application in an increase of about 6 p.p.m. At both applications pH increased but returned to original values after a short time. Carbon dioxide decreased slightly after the 1952 application, and disappeared entirely after the 1953 application, but during both years returned to approximately pre-application values after a short time. No changes in oxygen, water color or light penetration were observed. During 1953, several weeks after the lime application, an increase in the abundance of phytoplankton occurred which was much higher

*Progress Report. This is a cooperative project with Michigan State College.

than the maximum for the previous year. No changes in bottom fauna or growth rate of fish have yet been observed.

During 1953, a preliminary survey of smaller, soft-water lakes was made in the vicinity of Stoner Lake, and from these lakes five were selected for further study.

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INTRODUCTION

In Wisconsin, Hasler et al. (1951) postulated that the addition of hydrated lime to colored bog lakes would result in an increased phototrophic zone by a clearing of colloidal color; a release of nutrients from the organic bottom soil by raising the pH; and a higher concentration of carbon dioxide in the bicarbonate form. Hasler's experiments resulted in a clearing of the color, but a later report by Johnson and Hasler (1954) concluded that, although winterkill could be reduced and the oxygenated volume in summer was increased, no increases in production were effected.

In Michigan, Ball (1947) applied 20 tons of pebble-sized limestone in Stoner Lake, T44N, R20W, Secs. 35, 36, and T43N, R20W, Sec. 2, Alger and Delta counties, with no apparent increase in alkalinity. The present program was initiated in the summer of 1952, also on Stoner Lake.

STONER LAKE

Lime application

During the latter part of June, 1952, 8.5 tons of hydrated lime and 2 tons of crushed limestone were applied to Stoner Lake. Application was made by

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distributing the bags by boat around all shores, splitting the bags open and releasing them from the side of the boat; all releases were made in shallow water over hard sand bottom. This application, theoretically, should have effected an increase in alkalinity of about 16 p.p.m. In 1953, 20 tons of hydrated lime were applied during the early part of July, in a similar manner; this should have resulted in a theoretical increase in alkalinity of about 32 p.p.m. However, it was observed after the 1953 application, in shallow water, that much of the lime had not dissolved but was remaining on the bottom in caked piles; furthermore it appeared to be adsorbing organic matter which resulted in a brown-colored coating.

Chemical changes

During 1952, chemical analyses were made of the water for dissolved oxygen, carbon dioxide, alkalinity and pH, throughout the summer, before and after the lime application. Physical characteristics such as temperature, color and light penetration were also measured. During 1953, similar analyses were made, except that determinations of total hardness and conductivity were added for this year.

Total alkalinity increased from about 8 p.p.m. to 12 p.p.m. after the 1952 application, and remained at about 11 p.p.m. at the end of the summer. The pH increased immediately upon the lime application from about 6.8 to 7.3, but returned to original values shortly thereafter. Dissolved carbon dioxide was observed to decrease slightly (temporarily) after the application.

At the beginning of the summer of 1953, total alkalinity had remained at about a level of 10 p.p.m. and pH at 6.8. After the 1953 lime application the alkalinity increased to about 15 p.p.m. and remained at about 16 p.p.m. at the end of the summer. The pH increased to as high as 8.6 immediately after the application but fell almost to original values shortly thereafter. Total hardness increased from about 13 to 20 p.p.m., reaching this maximum, however,

at the latter part of the summer. Electrical resistance (reciprocal of conductivity) decreased from about 85,000 to 55,000 ohms. Dissolved carbon dioxide dropped to zero immediately after the lime application but returned to the original 1 or 2 p.p.m. after a short time.

No changes in dissolved oxygen, color, or light penetration were observed that were attributed to the lime application.

During the early part of August, 1953, a definite increase in the abundance of phytoplankton was visible. Coincident with this increase, certain chemical changes were observed. Dissolved oxygen increased; dissolved carbon dioxide disappeared; total alkalinity remained constant, but changed from the bicarbonate form toward the monocarbonate-hydroxide forms; and pH rose markedly to as high as 8.8 (the figure of 8.8 represents the highest figure on the pH scale at hand; probably the pH was even higher). By the first of September, these conditions had disappeared and the chemical characteristics had returned to "normal."

A preliminary visit to Stoner Lake in May, 1954, showed that the alkalinity was remaining at a high level, namely about 14 p.p.m.

During both 1952 and 1953, samples of pulpy peat were collected from the mud-water interface and analyzed for adsorbed calcium. Although the analysis of the data obtained is not complete, it appears that some adsorption of the calcium, resulting from the lime application, may be demonstrated.

Water samples were also collected during both years and analyzed for total phosphorus. Although the samples collected in 1952 proved to be contaminated and the results discarded, those collected in 1953 failed to show any increase following the application.

Biological changes

During the summers of 1952 and 1953, samples of net plankton, bottom fauna, and fish were taken. Analyses of the data obtained are not yet complete, but a large increase in the abundance of phytoplankton, occurring during the bloom previously mentioned, was clearly evident during the second year. This increase was partly the result of a bloom of Anabaena, a member of the blue-green algae, whose members were scarcely represented the previous year.

No significant changes in the abundance of bottom fauna or the growth rate of fish were evident during 1953.

Discussion

That a definite increase in phytoplankton occurred during the second year (1953) may be encouraging toward accepting lime treatment as an aid to increasing the productivity of a lake, but this conclusion should not as yet be made. It would be just as correct to assign this increase, in the absence of a control or data from previous years, to factors other than the lime application. If the increase in phytoplankton is really due to the increased alkalinity, it may also be encouraging to note that the alkalinity increases effected by the lime application were permanent, or nearly so, having remained over winter. However, it would be inadvisable to conclude that the increases in alkalinity were actually permanent, as this apparent permanency may be due to a slow dissolution of the caked lime still remaining on the sandy lake bottom. Any future lime applications, to Stoner Lake or other lakes, will be made in such a way as to prevent the lime from remaining on the bottom, which should answer the question of permanence of increased alkalinity.

OTHER LAKES

During the summer of 1953, a preliminary survey of small soft-water lakes was made in the vicinity of Stoner Lake to select several smaller lakes of the bog type for further investigation of the lime treatment. Of these, three colored bog lakes and two clear bog lakes were selected. These were:

Colored:

Juanita Lake, T44N, R19W, Sec. 24, Alger County

Starvation Lake, T44N, R19W, Sec. 1, Alger County

Timijon Lake, T44N, R18W, Sec. 19, Schoolcraft County

Clear:

Grant's Lake, T44N, R19W, Sec. 24, Alger County

Irwin Lake, T44N, R19W, Sec. 12, Alger County

From these five lakes, chemical and biological samples were collected during the latter part of the summer of 1953. Fish samples (yellow perch) were taken from only one of these five lakes, namely, Timijon Lake.

It is planned that lime application will be made in two of the colored lakes (Starvation and Timijon), while the third (Juanita) will be held as a control. Lime application will not be made to Grant's and Irwin lakes, but sampling will be continued, for use in making comparisons in case the lime application to the colored lakes results in a clearing of water color.

It is also planned that sampling will be continued on Stoner Lake in order to further evaluate the lime applications previously made.

References Cited

Ball, Robert C.

1947 Report on Stoner Lake, Alger-Delta county, Michigan. (Unpublished report).

Hasler, Arthur D., O. M. Brynildson and William T. Helm

1951 Improving conditions for fish in brown-water bog lakes by alkalization. Jrnl. Wildl. Man., 15:347-352.

Johnson, Waldo E., and Arthur D. Hasler

1954 Rainbow trout production in dystrophic lakes. Jrnl. Wildl. Man., 18:113-134.

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