

ance. It is equally important to provide the correct temperature (blue-greens require warmer water) and limited turbidity. In other words, the emphasis on an average annual phosphorous limit bespeaks a lack of understanding of the situation.

Carbon dioxide can trigger a bloom. This occurs in waters high in carbonates which are shallow and have organic material on the bottom which can be activated by sunlight to release carbon dioxide.

High concentrations of phosphorous occur when the municipal sewage treatment plant draws down the digester—from 100 to 1000 ppm in solution hits the stream or lake as a slug. Also, the first rains in the spring wash tremendous quantities of phosphates and at high concentrations from land where the farmer spreads manure through the winter.

Nitrates added to the soil as fertilizer are soluble and tend to percolate to underground water. Phosphates attach to the soil and are carried to the stream with sediment loss from the land. Land management practice revision is needed.

Deliberately changing fish populations in lakes in Europe resulted in changes in zooplankton which in turn changed the phytoplankton. In other words not all changes in fish species result from changes in bottom organisms due to pollutional effects. If the commercial fishing is selective over the years and if there are changes in fish species due to accidental or deliberate introductions, the food chain will change to adapt. Both of these conditions have occurred in the Great Lakes. Commercial fishermen effectively eradicated the sturgeon (by 1895) because of their damage to the whitefish nets and concentrated on the whitefish, pike, etc. Meanwhile, the smelt was introduced in 1912 and the lamprey and alewife entered via the St. Lawrence and Welland Canal. Thus, comparisons of types of bottom organisms prevailing 40 years ago with those today is not the whole story. But this could explain why there were changes reported in western Lake Erie in 1930 when pollution was expressly denied as a factor.

Changes in Lake Michigan fisheries coincided with changes in Lake Erie fisheries. The exploding alewife population portends further changes unless there are controls on the alewife. Pollution is the ready excuse but actually it is an almost total lack of fish management with advocates of sports fishing interfering with efforts to intelligently manage the commercial potential. Even if the hoped-for adaptation of coho salmon becomes a reality, the alewife will be more than enough to be food for coho and, from all indications, enough to wipe out the other species. But this is another example of how some conservationists can carry a flag with no more objective than a personal selfish interest.

The "Standard Methods Syndrome" gives many a false sense of security. The errors in analysis for phosphorous and nitrogen are many but too little appreciated. So also is the error in comparing data collected in different years. Simply assuming that data are comparable because *Standards Methods* were used is an error of magnitude. Actually, there is also a lack of appreciation of the requirement to separate the fractions which are available, not immediately available or not available. And there are errors resulting from commonly accepted procedures for preserving samples. For example, chloroform results in cell rupture and gives orthophosphate if there is much algae.

It is doubtful if chemical analysis of water can give an accurate appraisal of controlling or limiting concentrations of elements as such analysis can do for productivity of soils. Certainly no procedure has been developed to date to measure the controlling concentration of nitrogen or phosphorous in the aquatic environment. There is, however, encouragement in data developed to date from analysis of plant tissue. This approach has paid dividends in plants and flowers (terrestrial) and should in aquatic plants. It reduces the analytical work to measurement of cell content. Plotting of yield against concentration of nitrogen and phosphorous defines critical concentrations—the point where increase in absorption is not accompanied by increase in yield.

Productivity of algae is not bad. What is bad is productivity of the wrong kind. With a growing population productivity is needed and should be planned. But so far we don't know how to guide such direction. However, if there is to be effective guidance, the present approach of assessing arbitrary concentration limits must be changed. In place of this prohibitive approach the effort should be to take advantage of eutrophication—not just to control it but even to exploit it to provide fish productivity and manipulate that productivity by controlling additions of nutrient in places where it will do good.

Intelligent fish management in lakes or in pens in lakes at points where tributary additions have a significant effect could result in a harvestable crop