Twenty-Five Years of Phytoplankton on the West Fork and Main Stem of the White River: 1958-1982

Thomas E. Lauer, John L. Winters, and Harold L. BonHomme
Indiana State Board of Health
1330 West Michigan Street
Indianapolis, Indiana 46206

Introduction

The phytoplankton of the White River has been studied for at least 50 years (1, 2, 4, 8, 9). These early studies were located around Indianapolis in conjunction with the publicly owned treatment works (POTW's). More recent studies have been in response to the environmental control movement of the 1970's and included intensive sampling around major wastewater sources, especially power generating stations (12). These studies, however, were usually limited to a small portion of the river over a relatively short time span. Some of these studies provided much detailed information about riverine flora in Central Indiana. In 1958 a monitoring effort was begun on the White River by the Indiana State Board of Health (ISBH), the objective of which was to provide long term general trends of the phytoplankton community. This presentation will discuss the results of the first 25 years of the program.

Study Area

Sampling stations were concentrated above and below major population centers such as Muncie, Anderson and Indianapolis (Figure 1). Sampling locations have been moved upstream, downstream, added or deleted, based on the needs and resources of the ISBH. Numerals following the station name describe the number of miles that station is located upstream from the mouth. Petersburg 48 and Hazelton 19 are "main stem" stations, located below the confluence of the East and West Forks of the White River.

Results and Discussion

Stations and years sampled are given in Figure 2. Traditional changes in sampling took place in January to retain the calendar year integrity of the program. Samples were collected monthly. In 1958 only 34 samples were gathered over the entire 350 mile stretch of the river. This number gradually grew to a peak of 106 samples in 1975, and 1976. In 1980 sampling was limited to only two stations, Muncie 319 and Petersburg 48. Winchester 350, Centerton 205 and Paragon 185 were sampled only two years, while Martinsville 194 and Edwardsport 80 were sampled during most of the 25 year history. Supportive data include as many as 30 chemical and physical parameters (6).

Exact speciation of the phytoplankton community for the entire period of record is impossible. The original bench sheets from 1958 to 1974 were lost and all that remains for this period are the major grouping values as published in the Annual Water Quality Reports (6). From 1975 to 1982 a more detailed evaluation of the phytoplankton community exists.

Martinsville 194 (Figure 3) had the most samples (226) and the longest period of record (20 years). Approximately 76% of the collections consisted of diatoms, ranging from a low of 58% in 1973 to a high of 93% in 1961. The most abundant genus was the centric diatom *Cyclotella. Navicula, Gomphonema* and *Synedra* were also dominant at times. The green algae was next in abundance at a 16% yearly average ranging

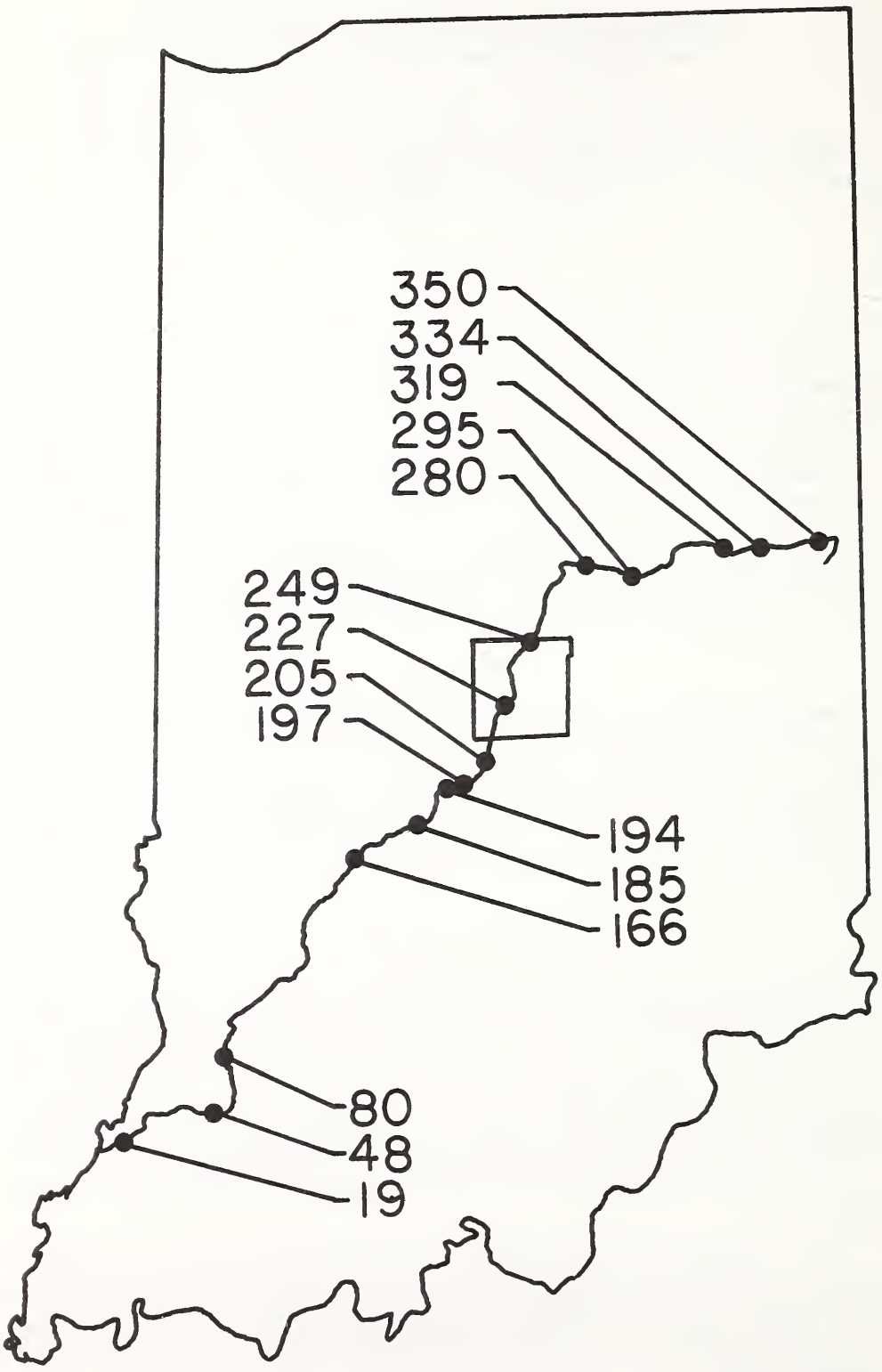

FIGURE 1. *Locations and river miles of the stations sampled on the White River during the period 1958-1982.*

from 1% in 1961 to 27% in 1972. *Scenedesmus* was the most abundant genus, but consisted of a number of unidentified species. No other green alga was consistently dominant during the study. About 2% of the total was blue-green algae with the re-

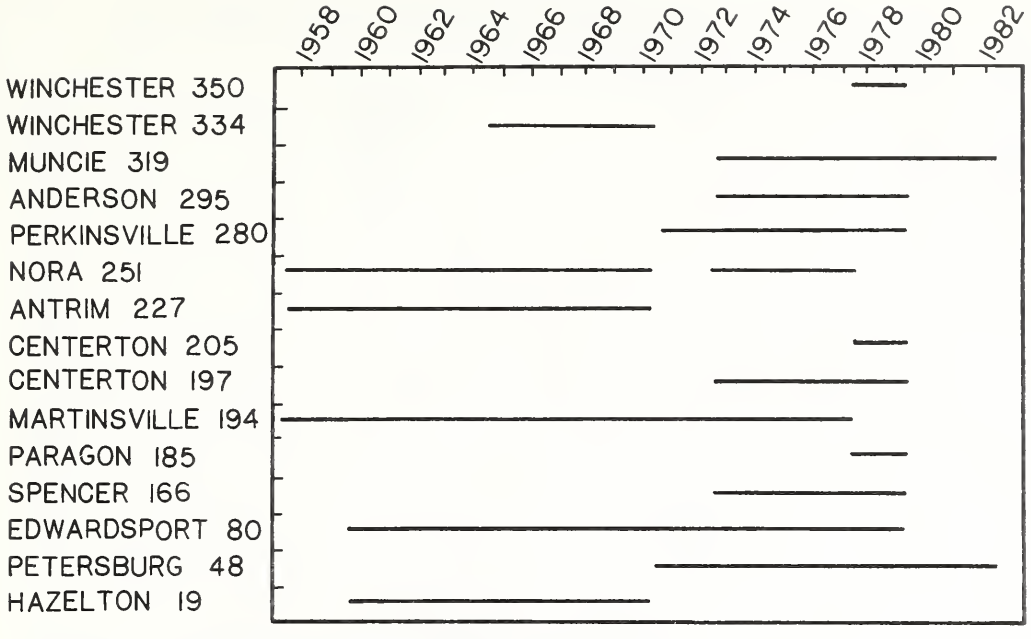

FIGURE 2. *Stations and years sampled for the period of study.*

mainder of the species, primarily flagellates, making up about 6% of the organisms found.

Because of the limited number of samples in a particular year, one or two samples can drastically alter a given mean. This is shown for the Martinsville data using total

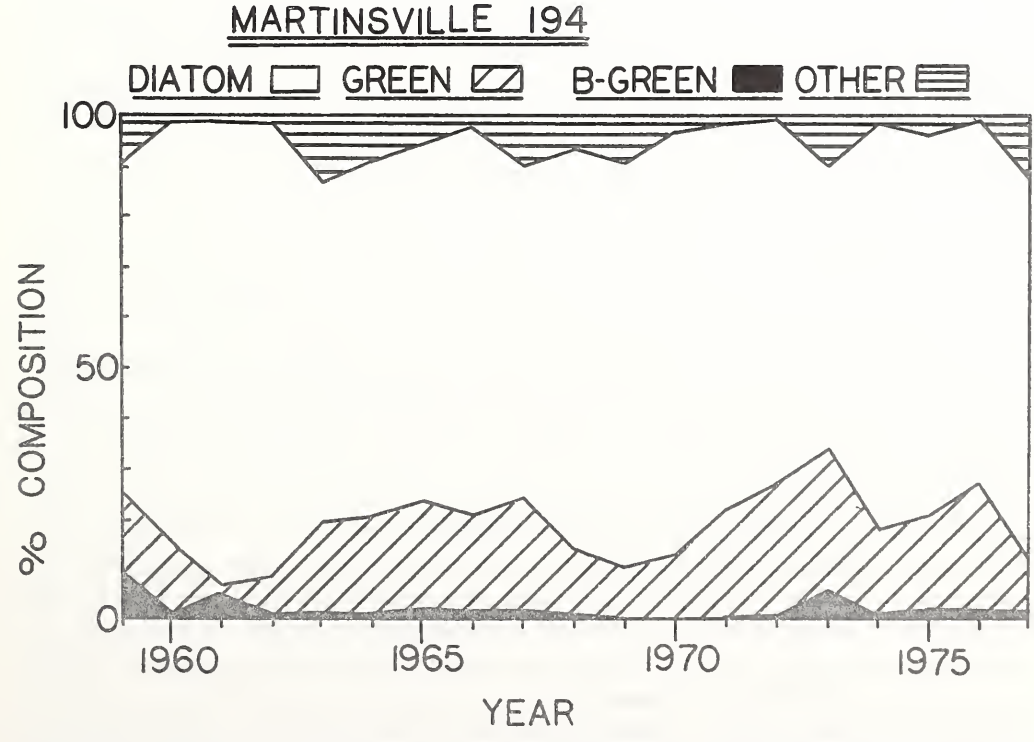

FIGURE 3. *Percent composition of major algae groups at the Martinsville 194 station from 1959-1977.*

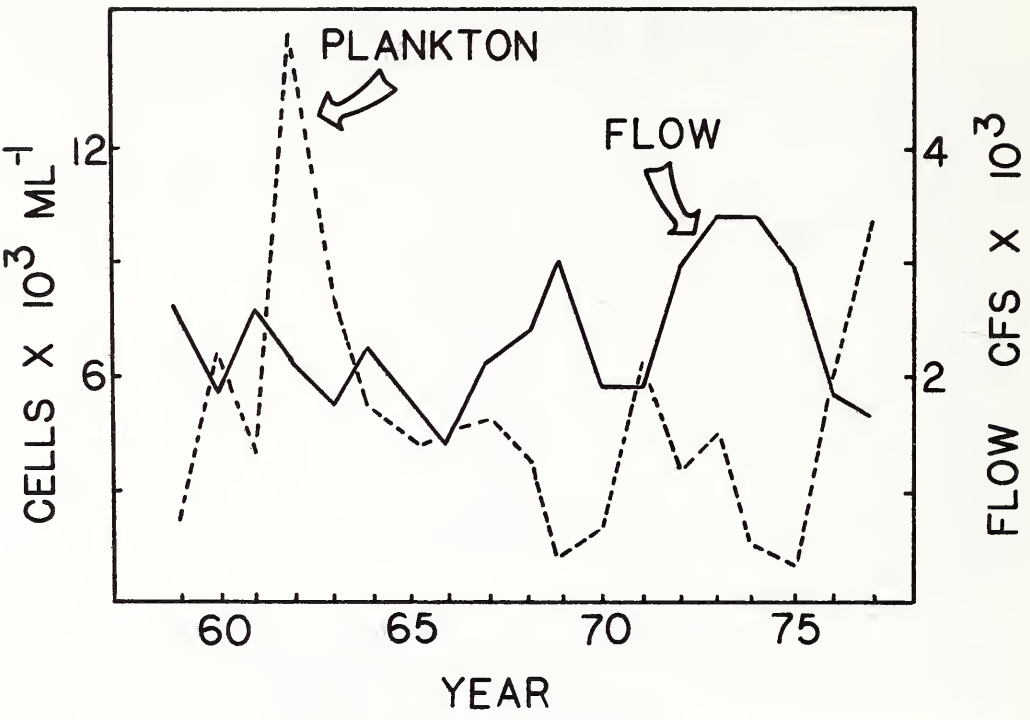

FIGURE 4. *Mean annual phytoplankton densities and flow discharge values at Martinsville 194 station from 1959-1977.*

cell counts with the mean annual averages (Figure 4). The May and June samples in 1962 were 52,610/ml and 49,000/ml respectively with a mean average for the year of 15,233/ml. This is in contrast to the mean yearly low of 1,038/ml in 1975.

This wide range of values cannot be fully explained. Nutrient levels, temperature, and light intensities are fundamental to algal growth (10). However, many of these variables in the White River appear to be directly related to flow. Annual mean discharge as measured at the USGS Gaging Station near Martinsville (11) provides additional information (Figure 4). Low mean phytoplankton densities correspond to high flow years 1959, 1961, 1968, 1969, 1972, 1973, 1974 and 1975. High phytoplankton densities were only found in 1960, 1962, 1963, 1971, and 1977 when flows were reduced. Maximum phytoplankton growth only appears when flow values are lower than approximately five times the $Q_{7,10}$ value. Phytoplankton densities as high as 200,000 cells/ml were found in some portions of the river (Edwardsport 80, August 1976).

The nutrient point source loading comes from many places along the river. The cities of Muncie, Anderson, and Indianapolis contribute the largest amounts. The two POTWs in Indianapolis (Belmont and Southport) alone discharge approximately 150 MGD treated wastewater to the White River (7). The phytoplankton populations appear to be reacting to this nutrient loading. Figure 5 shows a slight decline in plankton densities below Indianapolis, followed by an increase to a peak at Edwardsport 80, and a decline in Petersburg 48. Supportive phosphate and ammonia data indicate an immediate rise in concentration and a gradual decline back to "upstream" Indianapolis levels. Hynes'(5) representaton of a river system sustaining organic pollution (Figure 4) shows a close similarity to the White River system. Zones of clean water (1), organic degradation (2), active decomposition (3), recovery (4) and clean water (1) are indicated for phytoplankton densities, ammonia, and phosphate. Organic loadings from Indianapolis, therefore, are affecting the White River for a length of 150 miles according to Hynes' classification. Other classification schemes (3, 13) show similar results.

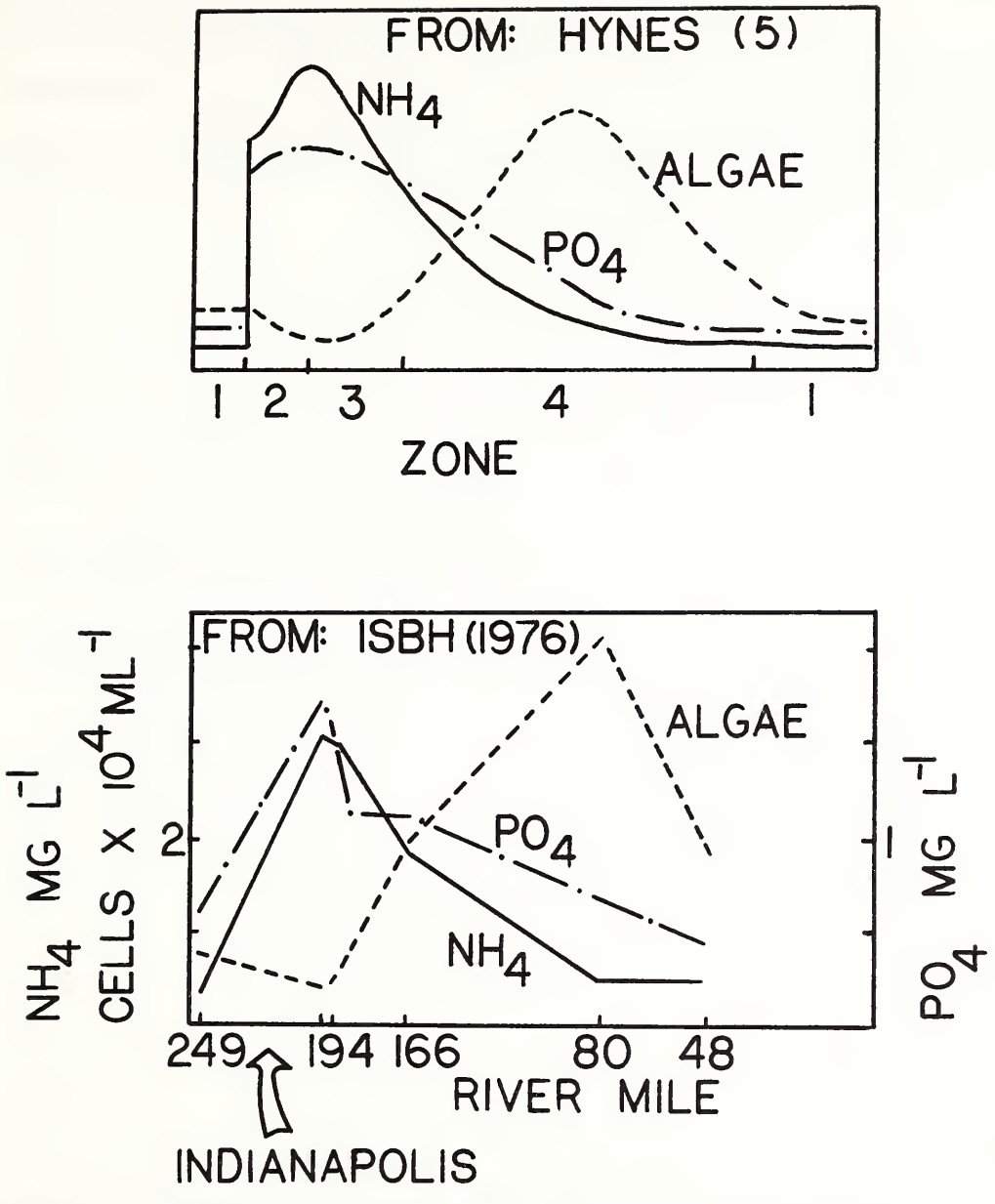

FIGURE 5. *1976 ISBH mean values for phytoplankton, ammonia, and phosphate from river mile 249 to 48. Also pictured is Hynes (5) representation of a river system undergoing organic degredation (see text).*

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