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Project Summary

Phytoplankton Abundance, Species Distribution, and Community Structure in Saginaw Bay and Southern Lake Huron in 1980

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Summarized herein are studies conducted during 1980 to assess the effects of reductions in phosphorus loading to Saginaw Bay on phytoplankton in the bay and the adjacent waters of Lake Huron. Quantitative estimates of phytoplankton abundance were developed from an array of stations sampled during the ice-free season. Distribution and abundance of major species and multivariate statistical representations of associations were compared to similar data collected during 1974, prior to phosphorus loading reductions. Results show a substantial reduction in the abundance and range of distribution of eutrophication tolerant and potentially nuisance-producing phytoplankton populations in Saginaw Bay and reduced export of such populations to the main Lake Huron system.

This Project Summary was developed by EPA's Environmental Research Laboratory, Duluth, MN, to announce key findings of the research project that is fully documented in separate reports (see Project Report ordering information at back).

Objective and Scope

The primary objective of this investigation was to determine the effect of phosphorus loading reductions on phytoplankton communities in the study area. Secondary objectives include determination of regions of biological similarity, which could furnish a rational basis for segmentation of ecosystem models, and provision of a reliable biological data base to assess long-term changes in the Lake Huron ecosystem.

The scope of the project conducted during cruises from April to October, 1980, included the sampling stations shown in Figures 1 and 2. Quantitative estimates of phytoplankton abundance at stations sampled were developed from replicate counts of permanent slide preparations. Data is displayed in the form of computer-generated plots of distribution and abundance of major populations of interest, statistical summaries of abundance by region and comparison with 1974 results, and plots of regional associations based on multivariate statistical analyses.

The final reports document the methods used in sample and data analysis, summarize the objective and inferential conclusions of the study, and provide a key to the data and sample archives resulting from this work.

Results

The main results of the study are summarized in Figures 1 and 2, which show regional phytoplankton associations based on multivariate analysis of composition and abundance averaged over season.

Saginaw Bay (Figure 1) has a graded series of associations, ranging from those dominated by eutrophication tolerant taxa (region A) to increasingly more oligotrophic associations at stations

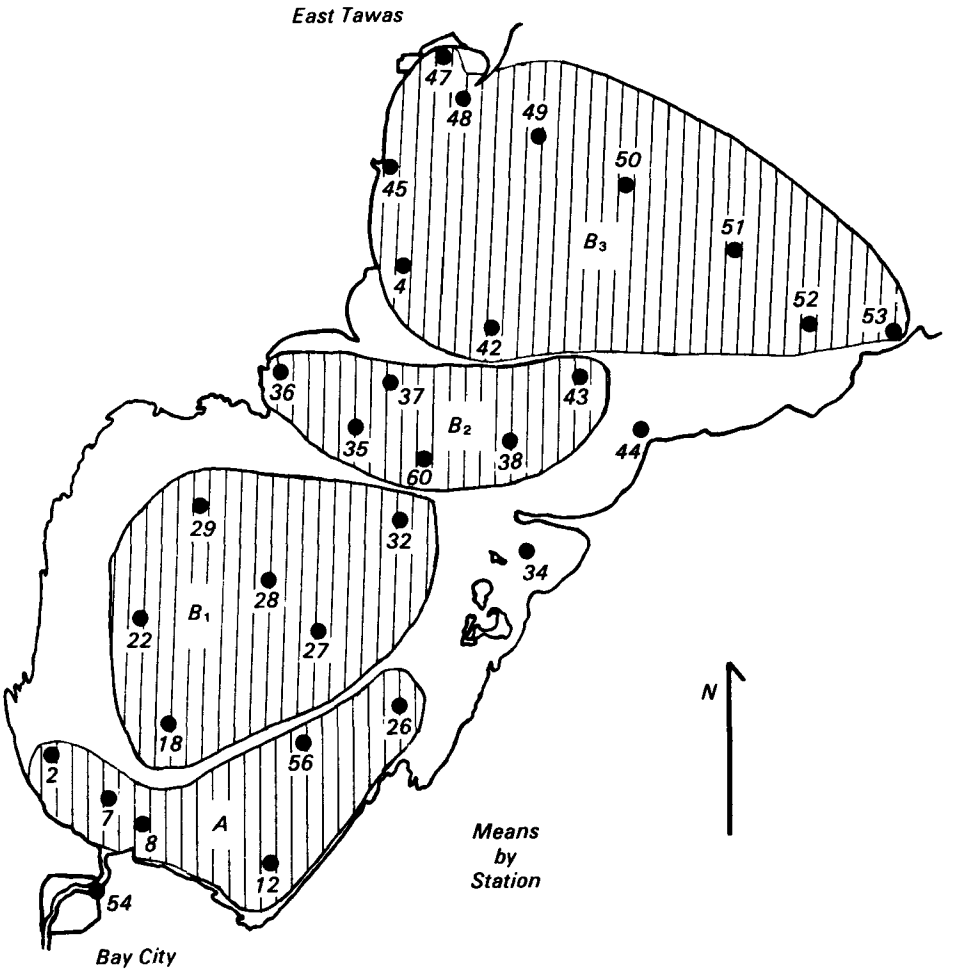

Figure 1. Regional phytoplankton associations in Saginaw Bay in 1980.

further out the bay (regions B_1-B_3). Stations 34, 44, and 54 are extreme outliers, compared to associations in the rest of the bay. Assemblages at station 54 are dominated by populations associated with polluted river conditions. Stations 34 and 44 are apparently affected by local shoreline loadings and maintain phytoplankton communities characteristic of hypereutrophic conditions similar to those which dominated wide areas of Saginaw Bay before phosphorus loading reductions.

The area sampled in Lake Huron (Figure 2) has three discrete nearshore associations (A,B,C) apparently influenced by differing types and quantities of shoreline loadings. Most perturbed regions are indicated by subscript 1 and regions of similar, but less pronounced effects are indicated by subscript 2. Associations most characteristic of oligotrophic environments are found in regions labeled D. A wide area extending northeastward from Saginaw Bay (AD) supports associations dominated by populations usually found in oligotrophic environments but also containing other populations found in Saginaw Bay and nearshore region A. Although the influence of nutrient loadings from Saginaw Bay are detectable in this region, they are much less than found in 1974.

Conclusions

The following conclusions were drawn on the basis of this study:

1. Phosphorus loading reductions have resulted in a significant decrease in phytoplankton abundance in Saginaw Bay.

2. There has been a significant change in the qualitative composition of the phytoplankton flora in the bay. There has been a general shift toward populations with smaller cell size and certain large, colonial blue-green algae have been virtually eliminated from wide areas of the bay.

3. The remaining areas of severely degraded water quality are in the southern region of the bay, which is directly influenced by the Saginaw River, at certain stations on the southern shore, particularly stations 34 and 44.

4. The extent and severity of modification of phytoplankton associations in the open waters of Lake Huron by loadings from Saginaw Bay has been reduced between 1974 and 1980.

5. There appears to a continuing long-term trend toward replacing diatom dominated associations in the offshore waters of Lake Huron with communities dominated by microflagellates and other populations in the nanoplankton and picoplankton size range.

6. Regions of phytoplankton similarity are variable seasonally, but there are coherent regions of time-averaged similarity which could serve as basis for model segmentation.

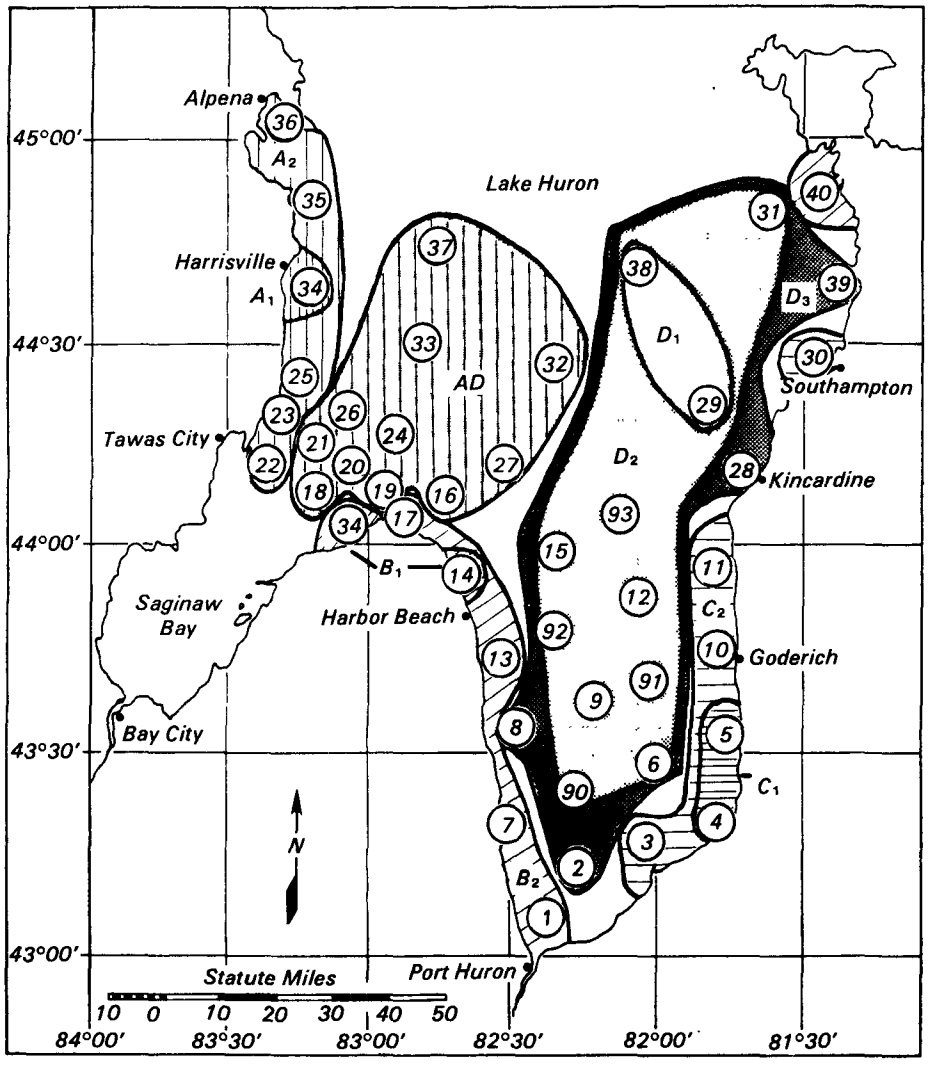

Figure 2. Regional phytoplankton associations in southern Lake Huron in 1980.

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The Project Summary is based on the two reports listed below:
"Phytoplankton Species Composition, Abundance and Distribution in Southern Lake Huron, 1980; Including a Comparative Analysis with Conditions in 1974 Prior to Nutrient Loading Reductions," (Order No. PB 83-261 107; Cost: $22.00)
"Phytoplankton Composition and Distribution in Saginaw Bay," (Order No. PB 83-261 735; Cost: $19.00)
The above reports are available only from: (costs subject to change)
National Technical Information Service
5285 Port Royal Road
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