IOWA'S WATER
Ambient Monitoring Program

Assessment of Iowa Lakes

Iowa lakes are some of the most productive lakes in the world. Because of their relative scarcity, Iowa lakes represent some of the most valuable real estate in the state. Iowa lakes are characterized by shallow depths, high nutrient concentrations, and frequent algal blooms. Most of Iowa's lakes are eutrophic and contain high levels of nitrogen and phosphorus.

Natural Lakes. Iowa has 48 glacial or natural lakes that trace their origin to the last glacial advance into the state some 14,000 years ago. Glacial ice covered the north-central part of Iowa, and lakes such as Clear Lake, Storm Lake and the Iowa Great Lakes mark the former boundary of the ice. Iowa's natural lakes cover approximately 32,000 acres.

Artificial Lakes/Reservoirs. The remaining 148,000 acres of lakes represent impounded water. Most reservoirs are located outside the reach of the last glacial advance. Compared to natural lakes, artificial lakes are deeper on average, have greater ratios of watershed area to lake surface area, and are located in areas with greater topographic relief.

Previous Studies

Viking Lake, Montgomery County (both photos)

Bachmann and Iowa State University completed a 1980 study of 115 significant publicly owned lakes. States were required by the U.S. Environmental Protection Agency to conduct a survey of their public lakes in need of restoration and/or protection and to develop a priority ranking of the lakes for restoration projects. Significant publicly owned lakes are those lakes which are principally maintained for public use, contain a minimum surface area of 10 acres, and are capable of supporting fish stock of at least 200 pounds per acre. Information from this 1980 study has served as a basis for selecting lakes for restoration in Iowa.

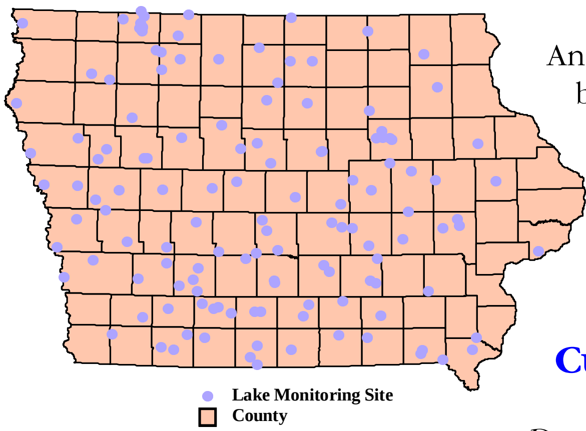


Figure 1. *Locations of the 132 lake monitoring sites.*

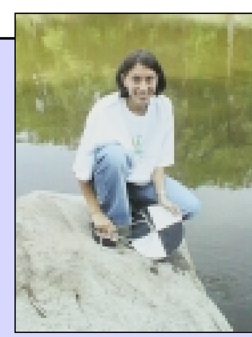
An additional survey was completed in the early 1990s by Bachmann, and the information was used to revise the priority list of lakes for restoration. Each lake was monitored three times during the period May through August. Secchi depth measurements (see sidebar) were collected, as were samples for nutrient and chlorophyll analyses.

Current Lake Monitoring

Data from the lake surveys completed in the 1980s and 1990s serve as a baseline for current lake monitoring. Beginning in 2000, 132 lakes throughout Iowa are monitored annually as part of a five-year project to assess their condition and measure the temporal variability in water quality (Figure 1). All 115 lakes assessed in earlier studies are being sampled as well as 17 additional lakes. Each lake is sampled three times during the year to assess seasonal variability. Samples are taken at the deepest point in each lake basin. Vertical probes are lowered through the water column to determine the thermocline and develop a vertical profile for temperature, dissolved oxygen, specific conductivity, pH, turbidity and chlorophyll.

In addition to parameters monitored in previous Bachmann studies, concentrations of pesticides and metals in both water and bottom sediments will be analyzed from each lake. Many pollutants concentrate in lakes, and information gathered from lake sediments will allow us to assess the build-up of contaminants through time.

This lake monitoring is spurring concurrent studies by the Iowa Department of Natural Resources on fish populations and sediment accumulation in Iowa's lakes.



What is a Secchi Disk?

The movement of soil, or sediment, into Iowa waters is the primary cause of water impairment in Iowa. One way to demonstrate this problem is to measure the turbidity of water using a Secchi disk. A Secchi disk is a black and white circle, weighted so that it can be lowered into the water by a string. The depth at which you cannot see the disk is called the Secchi depth. The clearer the water, the greater the depth at which the disk can be seen.

Father Pietro Angelo Secchi, a scientific advisor to the Pope, first tested the Secchi disk (pronounced: seck '- ee) in the Mediterranean Sea on April 20, 1865. Since then, scientists (and many volunteers) have used the Secchi disk to measure turbidity (water clarity) all around the world.

2000 Data

Results from the year 2000 monitoring (Downing and Ramstack, 2001) showed that many of Iowa's lakes can be thermally stratified despite their shallow nature. Previously, many professionals had assumed that shallow Iowa lakes were mixed by the wind and uniform top to bottom.

Water quality in Iowa's lakes is strongly influenced by climatic conditions. Interpretation of data collected during the Iowa Lake Survey project needs to consider this climatic variability to avoid misleading conclusions. Rainfall in 2000 was close to or above normal for June and July, while August and September were below normal.

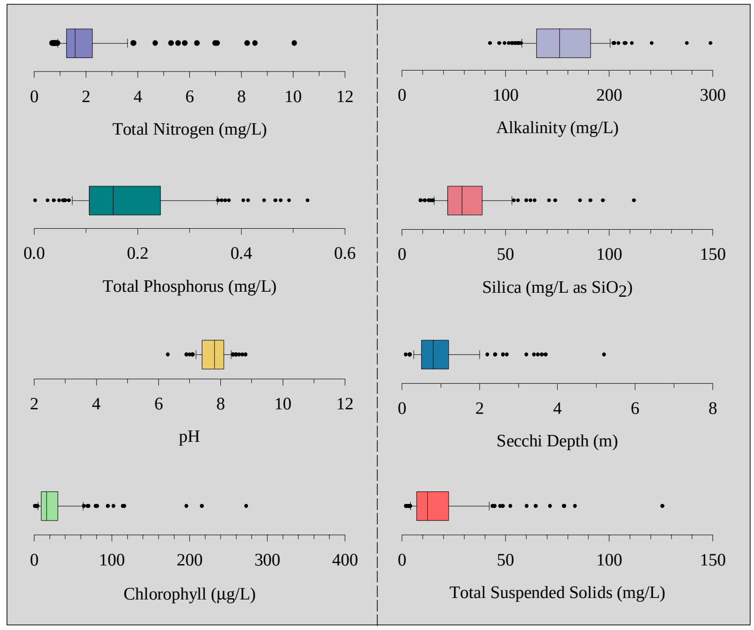


Figure 2. *Lake water quality from 2000. The boxplots represent data collected during 2000 for total nitrogen, total phosphorus, silica, pH, alkalinity, secchi depth, total suspended solids, and chlorophyll.*

Figure 2 shows preliminary results from the 2000 lake monitoring. The boxplots are visual summaries of the data collected. The "box" gives an indication of the data range by highlighting the 75th percentile (defined as the number where 75% of the values fall at or below) and the 25th percentile with the median line through the center of the box (median is equivalent to the 50th percentile – 50% of the values are above this number, 50% are below this number).

One of the concerns with Iowa's lakes is water clarity. Fifty percent of secchi depth measurements were below 1 meter during the 2000 field season. Water clarity is influenced by the amount of sediment and algae held in suspension in lake water. Figure 2 illustrates the amount of total suspended solids and chlorophyll values (indicator of algal growth). The median of total suspended solids was 11.1 mg/L while chlorophyll was 12.3 mg/L.

Nutrient concentrations are key to understanding the eutrophication of Iowa's lakes. Figure 2 shows the range of concentrations for total nitrogen, total phosphorus, and silica. The median total nitrogen value was 1.5 mg/L while total phosphorus was 0.15 mg/L and silica was 26.7 mg/L (as SiO_2). Alkalinity and pH values are also shown in Figure 2. These values are partially determined by the natural setting of the lake including the soil and

Lake Icaria, Adams County

underlying geology, but are also influenced by biological processes in the lake. Median pH was 7.9 and alkalinity was 151.0 mg/L.

These values are just a first glance at water quality in Iowa's lakes; the coming years will allow researchers to begin assessing how these variables interact and what they say about the health of Iowa lakes.

Future Plans

Lake monitoring during the next four years will continue to fill in gaps in our knowledge on Iowa's lakes. Determination of the amount of sedimentation and its quality will provide critical information on the accumulation of metals and pesticides, which can be harmful to aquatic life. Data on nutrient concentrations will help researchers understand the nutrient cycling in lakes and provide information on how to lessen the impacts of human activity on lake quality and restore Iowa's lakes.

References

Bachmann, R.W., and others, 1980, Clean Lakes Classification Study of Iowa's Lakes for Restoration (715p.), and 1994, A Classification of Iowa's Lakes for Restoration (517p.), Iowa State University, Ames, Iowa.

Downing, J.A. and Ramstack, J.M., 2001, Iowa Lakes Survey Summer 2000 Data, Department of Animal Ecology, Iowa State University, Iowa, 314p.

Acknowledgements

The DNR would like to acknowledge and thank John Downing and Joy Ramstack (Department of Animal Ecology, Iowa State University) for the coordination and management of the Iowa Lakes Survey. Thank you to all of the Iowa State University field and laboratory personnel involved in this project.

Funding

Water monitoring activities of the Iowa Department of Natural Resources are funded by Iowa Infrastructure and State General Fund appropriations, as well as grants provided by the U.S. Environmental Protection Agency from Sections 106 and 319 of the Clean Water Act.

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Photos by Clay Smith (pages 1 and 4) and IDNR photo file (page 2)