Lower Gar Lake in Dickinson County.

The TMDL addressed the Phase 1 goal for Trophic State Index Scores: 70 for Total Phosphorus, and 65 for Secchi Depth. CLAMP data shows that these goals have not been met as of 2006, although total phosphorus TSI did decrease from 2004 to 2006. The complete TMDL for Lower Gar Lake can be found at http://www.iowadnr.com/water/watershed/pubs.html.

Other Monitoring

Iowa DNR - Ambient Lake Monitoring Program. Along with the volunteer monitoring that occurs through the CLAMP program, the lakes are routinely monitored throughout the summer by the Iowa State University Limnology Laboratory (2000-2006) and the University of Iowa Hygienic Laboratory (2005-2006). Through this program, the lakes are monitored for a number of parameters including nutrients, solids, common field parameters, phytoplankton, zooplankton, and microcystin. Results can be found at http://limnology.eeob.iastate.edu/lakereport/ and http://wqm.igsb.uiowa.edu/iastoret/.

Iowa DNR – Beach Sampling Program. Six state-owned beaches (Emerson Bay, Gull Point, Triboji, Pikes Point, Marble, and Sandy) and one county beach (Orleans) are monitored weekly during the outdoor recreation season for bacteria and microcystin. Results of beach monitoring can be found on the DNR website http://wqm.igsb.uiowa.edu/activities/beach/beach.htm.

References

Carlson, Robert E. (1977) A Trophic State Index for Lakes. Limnology and Oceanography, Vol. 22, No. 2 (Mar., 1977), p. 361-369.

Acknowledgements

CLAMP is coordinated by the Iowa Lakeside Laboratory and supported by Friends of Lakeside Lab, the Dickinson County Water Quality Commission, the Okoboji Protective Association, the Spirit Lake Protective Association, and the East Okoboji Improvement Corporation. Data used in this factsheet were provided by Iowa Lakeside Laboratory, Iowa State University Limnology Laboratory, and the University of Iowa Hygienic Laboratory.

The CLAMP program would not be possible without the hard work of the volunteers. Volunteers on Lower Gar Lake include: Dave and Cindi Dather, Charles Gilbert, Darryl Halling, Carol and Norm Herzog, Jane and Ron Kauzalrich, Bob Lathrop, Christie McCoy, Hank Miguel, and Denise and Don Parsons. Thanks also to CLAMP interns: Tasida Barfoot, Ted Klein, Emily Greives, and Laura Guderyahn.

Photo on page 1 from CLAMP Program. Page 4 photo from Iowa State University Limnology Laboratory.

Iowa Watershed Monitoring and Assessment Program Web Site – wqm.igsb.uiowa.edu

Prepared by
Iowa Department of Natural Resources, Geological Survey
109 Trowbridge Hall, Iowa City, IA 52242-1319

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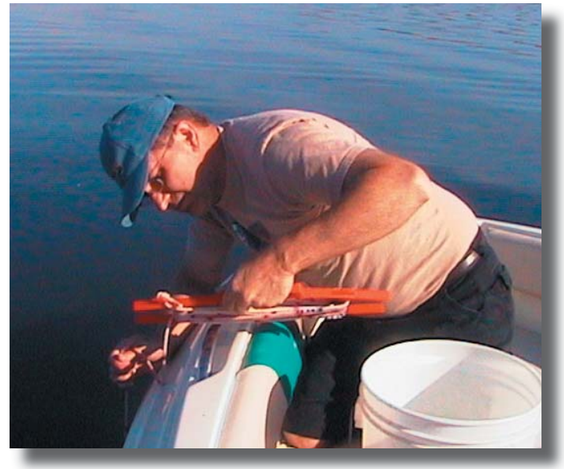
April 2007 Water Fact Sheet 2007-15

IOWA'S WATER
Ambient Monitoring Program

Cooperative Lakes Area Monitoring Project
Lower Gar Lake

The Cooperative Lakes Area Monitoring Project (CLAMP) began in 1999 as a joint partnership between Iowa Lakeside Laboratory and Friends of Lakeside Laboratory to take advantage of a rich tradition of volunteer involvement in the Iowa Great Lakes region. CLAMP combines efforts of multiple organizations into a long-term, unified program for assessing the quality of the lakes in the region. A group of volunteers was organized and trained to monitor water quality on 10 lakes in northwest Iowa. CLAMP focuses on monitoring nutrient levels (nitrogen and phosphorus) as well as chlorophyll *a* (an index of algal abundance) and Secchi depth (an index of water clarity). By monitoring these parameters, CLAMP volunteers provide an integrated measure of each lake's water quality. To address concerns of excessive algae growth, phytoplankton and microcystin were recently added to the program. Phytoplankton are microscopic plants, mainly algae, that live in water. Microcystin is a toxin produced by cyanobacteria, a type of algae.

Since its inception in 1999, over 100 volunteers have participated in CLAMP. These volunteers have taken over 3500 samples on 10 lakes in Dickinson County: Big Spirit, Center, East Okoboji, Little Spirit, Lower Gar, Minnewashta, Silver, Trumbull, Upper Gar, and West Okoboji. By volunteering their time, CLAMP participants are providing a long-term data set that will be useful in protecting these prized resources while learning more about water quality issues and the ecology of the lakes.



A CLAMP *volunteer measures water clarity using a Secchi disk.*

CLAMP Data

Secchi depth in Lower Gar Lake ranged from 0.1 meters (m) to 1.8 m with a median value of 0.4 m. Overall, Secchi depths in Lower Gar were shallower than other CLAMP lakes with the exception of Trumbull and Little Spirit and near the median for other glacial lakes in Iowa (Insert 1).

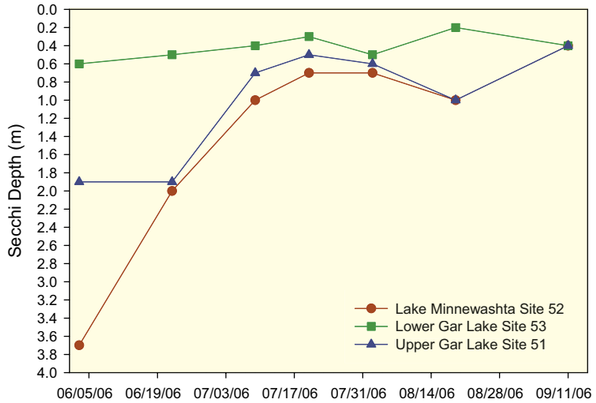
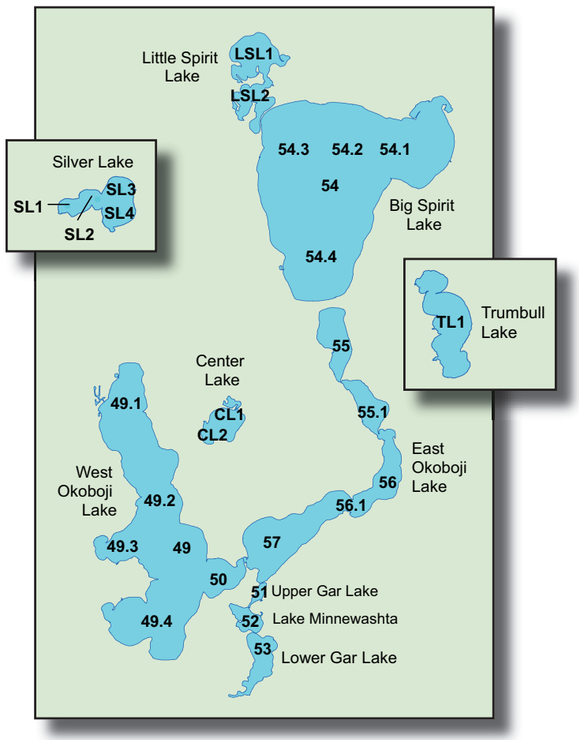


Figure 1. *Seasonal and site variation of Secchi depth in 2006 for Lake Minnewashta, Lower Gar Lake, and Upper Gar Lake.*



CLAMP *sampling locations*. NOTE: *data used for this fact sheet were from the deepest spot in each lake (for comparison).*

Total phosphorus concentrations ranged from 0.04 milligrams per liter (mg/L) to 0.50 mg/L with a median of 0.15 mg/L. With the exception of Trumbull and Little Spirit, Lower Gar had the highest median total phosphorus among CLAMP lakes and was higher than the median for other glacial lakes in Iowa (Insert 1). Lower Gar's median total nitrogen concentration (2.0 mg/L) was also higher than other glacial lakes in Iowa and higher than many other CLAMP lakes (Insert 1).

Chlorophyll *a* concentrations ranged from 7 micrograms per liter (μg/L) (6/3/2006) to 456 μg/L (6/28/2004). Lower Gar's median chlorophyll *a* concentration was similar to Upper Gar and Minnewashta and the median for other glacial lakes (Insert 1). Only Center, Trumbull, and Little Spirit had higher median chlorophyll *a* concentrations.

Microcystin concentrations in Lower Gar ranged from 0.5 nanograms per liter (ng/L) to 5.5 ng/L. Lower Gar's maximum concentration of 5.5 ng/L is below the 20 ng/L threshold the Iowa DNR uses to post warnings at swimming beaches. Overall, microcystin concentrations were similar to other CLAMP lakes and slightly lower than the median for other glacial lakes in Iowa.

Figure 1 shows the seasonal and site variation of Secchi depth for Lake Minnewashta, Lower Gar Lake and Upper Gar Lake in 2006. Secchi depths did not vary greatly in Lower Gar, while Upper Gar and Minnewashta had greater variation in 2006. Secchi depths were deepest in early June and shallowest in the summer months. Lower Gar had the shallowest Secchi depths in general, while Minnewashta had the deepest.

Carlson's Trophic State Index

The large amount of water quality data collected by CLAMP can be confusing and difficult to evaluate. In order to analyze all of the data collected it is helpful to use a trophic state index (TSI). A TSI condenses large amounts of water quality data into a single, numerical index. Different values of the index are assigned to different concentrations or values of water quality parameters.

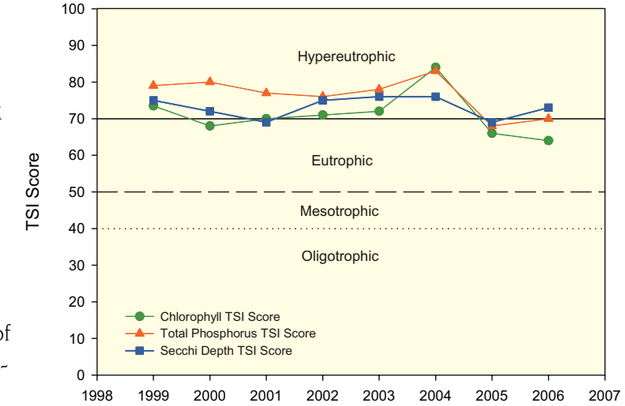


Figure 2. *Average Carlson Trophic State Index (TSI) scores by year for Lower Gar Lake.*

The most widely used and accepted TSI, called the Carlson TSI, was developed by Bob Carlson (1977). Carlson TSI values range from 0 to 100. Each increase of 10 TSI points (10, 20, 30, etc.) represents a doubling in algal biomass. The Carlson TSI is divided into four main lake productivity categories: *oligotrophic* (least productive), *mesotrophic* (moderately productive), *eutrophic* (very productive), and *hypereutrophic* (extremely productive). The productivity of a lake can therefore be assessed with ease using the TSI score for one or more parameters. Mesotrophic lakes, for example, generally have a good balance between water quality and algae/fish production. Eutrophic lakes have less desirable water quality and an overabundance of algae or fish. Hypereutrophic lakes have poor water quality and experience frequent algal blooms and a lack of oxygen in deep water.

Insert 2 shows the TSI scores for Secchi depth, chlorophyll *a*, and total phosphorus for all CLAMP lakes. The median TSI values for Secchi depth and total phosphorus put Lower Gar in the *hypereutrophic* category while the value for chlorophyll *a* falls in the *eutrophic* category. This indicates that non-algal turbidity is causing decreased light and limiting algal growth.

Figure 2 shows the mean or average TSI scores for Lower Gar by year. From 1999-2004 all TSI values generally put Lower Gar in the *hypereutrophic* category. All TSI values decreased from 2004 to 2005 putting the Lower Gar in the *eutrophic* category.

Impairments

Lower Gar Lake was listed on the Iowa Section 303(d) Impaired Waters List as being impaired for turbidity and partial support of aquatic life. The Lower Gar Total Maximum Daily Load (TMDL) was completed in 2002. The purpose of the TMDL is to calculate the maximum allowable turbidity and associated nutrient loading (phosphorus) associated with levels that will meet water quality standards. Data collected by CLAMP was used in creating the TMDL and will also play an important role in determining if the goals of the TMDL are being met.