Tropic Status of Lakes

(Excerpts from the NYS Citizens Statewide Lake Association Program. Scott Kishbaugh, New York State Department of Environmental Conservation April 2007.)

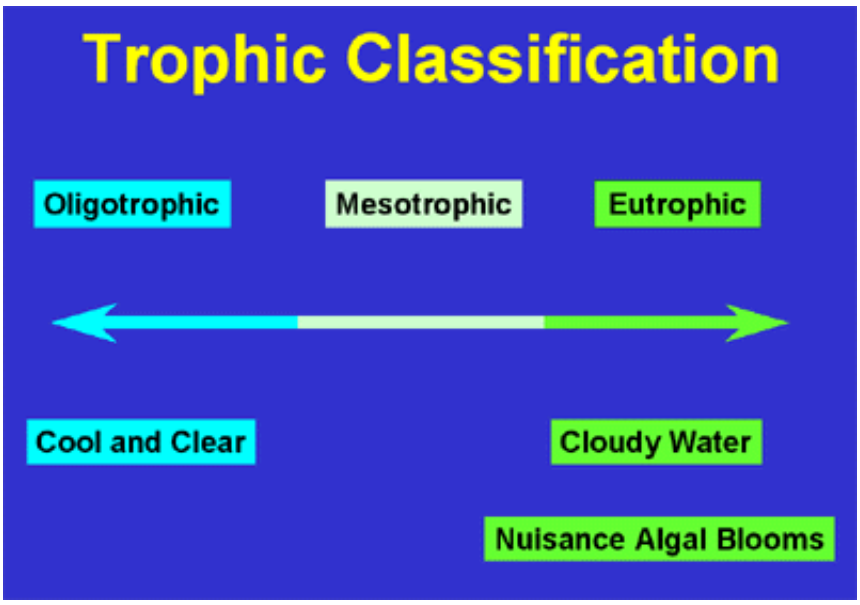
Introduction

Lakes are dynamic and complex ecosystems. To better understand the water quality conditions of a lake scientists and concerned citizens in New York State conduct water quality monitoring programs. Water quality monitoring can assist scientists in determining whether a lake is undergoing changes that might impair the uses of the lake for drinking, swimming or recreation. As water quality changes, so too will the plants and animals that live there, and these changes in the food web also may affect water quality. Water quality monitoring provides a window into the numerous and complex interactions of lakes. Even the most extensive and expensive monitoring program cannot completely assess the water quality of a lake. However, by looking at some basic chemical, physical, and biological properties, it is possible to gain a greater understanding of the general condition of lakes.

Understanding Trophic States

All lakes and ponds undergo **eutrophication,** an aging process that involves stages of succession in biological productivity and water-quality. Limnologists (scientists who study freshwater systems) divide these stages into **trophic** states (Figure 1).

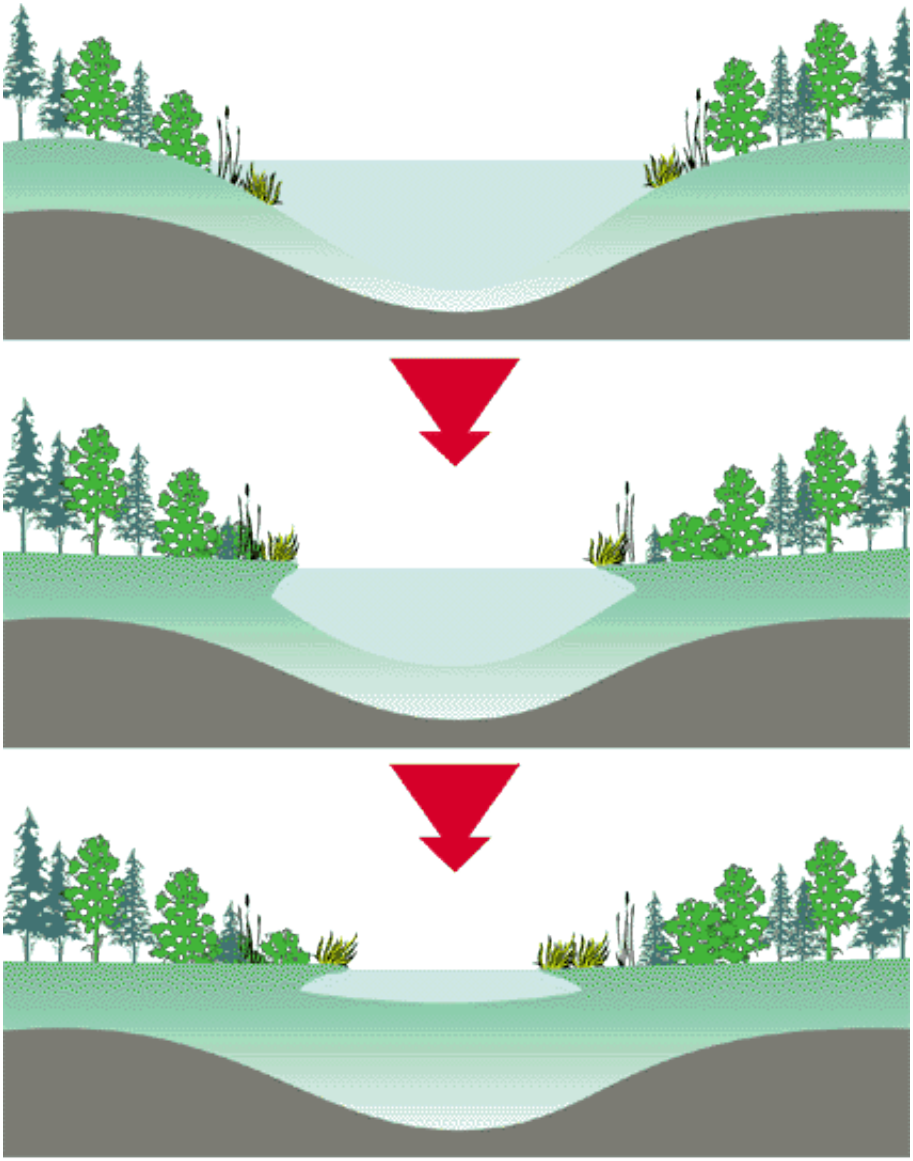
Figure 1 – Trophic State Classification



Source: Environmental Protection Agency

Each trophic state can represent a wide range of biological, physical, and chemical characteristics and any lake may be categorized within any of these trophic states. In general, the increase in productivity and decrease in clarity corresponds to an enrichment of nutrients, plant and animal life. Lakes with low biological productivity and clear water are considered **oligotrophic** . Highly productive lakes with low clarity are considered **eutrophic** . Lakes that are **mesotrophic** have intermediate or moderate productivity and clarity. It is important to remember that eutrophication is a natural process and is not necessarily indicative of man-made pollution. Over a period of hundreds of years a lake will eventually fill with sediment due to natural erosion processes. Streams carry sediments to lakes; trees and other vegetation along the water's edge drop their leaves and add nutrients to the lake. Over time this provides habitat for other vegetation until the lake changes from an open water system to a wetland. Figure 2 shows this natural eutrophication process.

Figure 2 – Natural Eutrophication



When human activities accelerate lake eutrophication, it is referred to as **cultural eutrophication** . Cultural eutrophication may result from shoreline erosion, agricultural and urban runoff, wastewater discharges or septic seepage, and other non-point source pollution sources. These can greatly accelerate the natural aging process of lakes, cause successional changes in the plant and animal life within the lake, shoreline and surrounding watershed, and impair the water-quality and value of a lake. They may ultimately extend aquatic plants and emergent vegetation throughout the lake, resulting in the transformation of the lake into a marsh, prairie, and forest. The extent of cultural eutrophication and the corresponding pollution problems can be signaled by significant changes in the trophic state over a short period (decades versus centuries). For most lakes in New York , cultural eutrophication represents the most significant source of pollutants and threat to water-quality. As a result, water-quality indicators related to eutrophication comprise the foundation of most water-quality monitoring programs.

Classifying a Lake 's Trophic Status

Trophic classifications are not interchangeable. People's perceptions of a lake may not coincide with the trophic status. Water quality degradation from the perspective of one user may contrast with the perception

of favorable conditions by a different lake user. For example, a eutrophic lake may support an excellent warm-water fishery because it is nutrient rich, but a swimmer may describe that same lake as polluted because it is too weedy.

A lake's trophic state is important because it provides lake managers with a reference point to view changes in a lake's water quality and they begin to understand how these changes may cause use impairments (threaten the use of a lake for swimming, drinking water or fishing) **.**

Three important measures of eutrophication in most New York lakes are: **total phosphorus, chlorophyll *a*** (estimating the amount of algae), and **Secchi disk transparency** . Because these parameters are closely linked to the growth of weeds and algae, they provide insight into "how the lake looks" and its suitability for recreation and aesthetics. Table 1 shows the parameters used to measure a lake's trophic status and the measurements for three Finger Lakes in New York State .

Table 1: Trophic Status Indicators*

	Eutrophic	Mesotrophic	Oligotrophic	Seneca Lake (2005)**	Canandaigua Lake (2005)**	Honeoye Lake (2005)**
P μ g/l	>20	10-20	<10	0.8	0.4	9.1
Chl a μ g/l	>8	2-8	<2	2.6	1.5	3.6
Secchi depth (m)	<2	2-5	>5	3.8	6.2	4.4

*Source: NYS Citizens Statewide Lake Association Program. 2006 Interpretive Summary for Lake George . Scott Kishbaugh, New York State Department of Environmental Conservation April 2007.
**Source: John Halfman, A Preliminary Water Quality Study of Selected Finger Lakes, New York .

Lesson Objectives

In this lesson you will be investigating the trophic status of three Finger Lakes in New York State using charts and figures provided. At the end of this lesson you should have completed:

- Questions 1-5.
- Completed a report or power point presentation about one of the Finger Lakes .

Activity 1:

Questions:

- Using the data from Table 1 identify the trophic status of each of the lakes listed.
- Define cultural eutrophication.
- What changes in the lake environment would you expect to see as a result of cultural eutrophication?
- How would the size and volume of lake affect the trophic status?
- What is the difference between natural and cultural eutrophication? List examples of natural lake eutrophication and cultural eutrophication using a time scale.

Activity 2:

Pick one of the lakes listed and conduct research about that lake, one place to start is the Finger Lakes Institute's website. Make sure you cite your sources. Write a report and/or develop a power point for the class describing the following:

- The trophic status of the lake.
- List and describe the major pollution sources to the lake.
- Describe the types of land use around the lake and how this landuse might impact the lake's water quality.
- What management options are there to protect the lake?
- Why should we protect the lake?