

Understanding Lake Aging (Eutrophication)

by: **Robert Craycraft** Educational Program Coordinator,
New Hampshire Lakes Lay Monitoring Program
University of New Hampshire
G18 Spaulding Hall, Durham, NH 03824
603-862-3696 FAX: 603-862-0107
email: bob.craycraft@unh.edu

and **Jeff Schloss** UNH Cooperative Extension Water Resources Specialist

A common concern among **New Hampshire Lakes Lay Monitoring Program (NH LLMP)** participants is a perceived increase in the density and abundance of aquatic plants in the shallows, increases in the amount of microscopic plant “algae” growth (detected as greener water), and water transparency decreases; what is known as **eutrophication**. Eutrophication is a natural process by which all lakes age and progress from clear pristine lakes to green, nutrient enriched lakes on a geological time frame of thousands of years. Much like the fertilizers applied to our lawns, nutrients that enter our lakes stimulate plant growth and culminate in greener (and in turn less clear) waters. Some lakes age at a faster rate than others due to naturally occurring attributes: watershed area relative to lake area, slope of the land surrounding the lake, soil type, mean lake depth, etc. Since our New Hampshire lakes were created during the last ice age, which ended about 10,000 years ago, we should have a natural continuum of lakes ranging from extremely pristine to very enriched.

Classification criteria are often used to categorize lakes into what are known as **trophic states**, in other words, levels of lake plant and algae productivity or “greenness” Refer to Table 6 below for a summary of commonly used eutrophication parameters.

Table 6: Eutrophication Parameters and Categorization

| Parameter | Oligotrophic “pristine” | Mesotrophic “transitional” | Eutrophic “enriched” |
|---|----------------------------|-------------------------------|-------------------------|
| Chlorophyll a (ug/l) * | <3.0 | 3.0-7.0 | >7.0 |
| Water Transparency (meters) * | >4.0 | 2.5-4.0 | <2.5 |
| Total Phosphorus (ug/l) * | <15.0 | 15.0-25.0 | >25.0 |
| Dissolved Oxygen (saturation) # | high to moderate | moderate to low | low to zero |
| Macroscopic Plant (Weed) Abundance | low | moderate | high |

* Denotes classification criteria employed by Forsberg and Ryding (1980).

Denotes dissolved oxygen concentrations near the lakebottom.

Oligotrophic lakes are considered “unproductive” pristine systems and are characterized by high water clarities, low nutrient concentrations, low algae concentrations, minimal levels of aquatic plant “weed” growth, and high dissolved oxygen concentrations near the lake bottom. **Eutrophic** lakes are considered “highly productive” enriched systems characterized by low water transparencies, high nutrient concentrations, high algae concentrations, large stands of aquatic plants and very low dissolved oxygen concentrations near the lake bottom. **Mesotrophic** lakes have qualities between those of oligotrophic and eutrophic lakes and are characterized by moderate water transparencies, moderate nutrient concentrations, moderate algae growth, moderate aquatic plant “weed” growth and decreasing dissolved oxygen concentrations near the lake bottom.

Is a pristine, oligotrophic, lake “better than” an enriched, eutrophic, lake? Not necessarily! As indicated above, lakes will naturally exhibit varying degrees of productivity. Some lakes will naturally be more susceptible to eutrophication than others due to their natural attributes and in turn have aged more rapidly. This is not necessarily a bad thing as our best bass fishing lakes tend to be more mesotrophic to eutrophic than oligotrophic; an ultra-oligotrophic lake (extremely pristine) will not support a very healthy cold water fishery. However, human related activities can augment the aging process (what is known as cultural eutrophication) and result in a transition from a pristine system to an enriched system in tens of years rather than the natural transitional period that should take thousands of years. Cultural eutrophication is particularly a concern for northern New England lakes where large tracts of once forested or agricultural lands are being developed, with the potential for increased sediment and nutrient loadings into our lakes, which augment the eutrophication process.

Additionally, other pollutants such as heavy metals, herbicides, insecticides and petroleum products might also affect your lake’s “health”. A “healthy” lake, as far as eutrophication is concerned, is one in which the various aquatic plants and animals are minimally impacted so that nutrients and other materials are processed efficiently. We can liken this process to a well-managed pasture: nutrients stimulate the growth of grasses and other plants that are eaten by grazers like cows and sheep. As long as producers and grazers are balanced, a good amount of nutrients can be processed through the system. Impact the grazers and the grass will overgrow and nuisance weeds will appear, even if nutrients remain the same. In a lake, the producers are the algae and aquatic weeds while the grazers are the microscopic animals (**zooplankton**) and aquatic insects. These organisms can be very susceptible to a wide range of pollutants at very low concentrations. If impacted, the lake can become much more productive and the fishery will be impacted as well since these same organisms are an important food source for most fish at some stage of their life.

Development upon the landscape can negatively affect water quality in a number of ways:

- Removal of shore side vegetation and loss of wetlands - Shore side vegetation (what is known as **riparian vegetation**) and wetlands provide a protective buffer that “traps” pollutants before reaching the lake. These buffers remove materials both chemically (through biological uptake) and physically (settling materials out). As riparian buffers are removed and wetlands lost, pollutant ma-

terials are more likely to enter the lake and in turn, favor declining water quality.

- Excessive fertilizer applications - Fertilizers entering the lake can stimulate aquatic plant and algal growth and in extreme cases result in noxious algal blooms. Increases in algal growth tend to diminish water transparency and under extreme cases culminate in surface “scums” that can wash up on the shoreline producing unpleasant smells as the material decomposes. Excessive nutrient concentrations also favor algal forms known to produce toxins, which irritate the skin and under extreme conditions, are dangerous when ingested.
- Increased organic matter loading - Organic matter (leaves, grass clippings, etc.) is a major source of nutrients in the aquatic environment. As the vegetative matter decomposes nutrients are “freed up” and can become available for aquatic plant and algal growth. In general, we are not concerned with this material entering the lake naturally (leaf senescence in the fall) but rather excessive loading of this material as occurs when residents dump or rake leaf litter and grass clippings into the lake. This material not only provides large nutrient reserves which can stimulate aquatic plant and algal growth but also makes great habitat for leaches and other potentially undesirable organisms in swimming areas.
- Septic problems - Faulty septic systems are a big concern as they can be a primary source of water pollution around our lakes. Septic systems are loaded with nutrients and can also be a health threat when not functioning properly.
- Loss of vegetative cover and the creation of impervious surfaces - A forested watershed offers the best protection against pollutant runoff. Trees and tall vegetation intercept heavy rains that can erode soils and surface materials. The roots of these plants keep the soils in place, process nutrients and absorb moisture so the soils do not wash out. Impervious surfaces (paved roads, parking lots, building roofs, etc.) reduce the water’s capacity to infiltrate into the ground, and in turn, go through nature’s water purification system. As water seeps into the soil, pollutants are removed from the runoff through absorption onto soil particles. Biological processes detoxify pollutants and/or immobilize substances. Surface water runoff over impervious surfaces also increases water velocities that favor the transport of a greater load of suspended and dissolved pollutants into your lake.

How can you minimize your water quality impacts?

- Minimize fertilizer applications whenever possible. Most people apply far more fertilizers than necessary, with the excess eventually draining into your lake. This not only applies to those immediately adjacent to the lake but to everybody within the watershed. Pollutants in all areas of the watershed will ultimately make their way into your lake. Have your soil tested for a nominal fee (contact your county UNH Cooperative Extension Office for further information) to find out how much fertilizer and soil amendments are really needed. Sometimes just an application of crushed lime will release enough nutrients to fit the bill. If you do use fertilizer try to use low phosphorus, slow release nitrogen varieties. And

remember that under the current NH Comprehensive Shoreline Protection Act (CSPA) you cannot apply any fertilizers or amendments within 25 feet of the shore.

- Don't dump leaf litter or leaves into the lake. Compost the material or take it to a proper waste disposal center. Do not fill in wetland areas. Do not create or enhance beach areas with sand (contains phosphorus, smothers aquatic habitat, fills in lake as it gets transported away by currents and wind).
- Septic systems will not function efficiently without the proper precautionary maintenance. Have your septic system inspected every two to four years and pumped out when necessary. Since the septic system is such an expensive investment often costing around \$10,000 for a complete overhaul, it is advantageous to assure proper care is taken to prolong the system's life. Additionally, following proper maintenance practices will reduce water quality degradation. Refer to:

Pipeline: Summer 2008 Vol. 19, No. 1. Septic Systems and Source Water Protection: Homeowners can help improved community water quality.

http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_SU08.pdf

- Try to landscape and re-develop with consideration of how water flows on and off your property. Divert runoff from driveways, roofs and gutters to a level vegetated area or a rain garden so the water can be slowed, filtered and hopefully absorbed as recharge. Refer to:

Landscaping at the Water's Edge: An ecological approach, 2nd edition. \$20.00/ea University of New Hampshire Cooperative Extension Publications Center, Nesmith Hall, 131 Main Street, Durham NH 03824.

Integrated Landscaping: Following Nature's Lead. \$20.00/ea University of New Hampshire Cooperative Extension Publications Center, Nesmith Hall, 131 Main Street, Durham NH 03824.

- Maintain shore side (riparian) vegetative cover when new construction is undertaken. For those who have pre-existing houses but lack vegetative buffers, consider shoreline plantings aimed at diminishing the pollution load into your lake. Refer to:

Landscaping at the Water's Edge: An ecological approach, 2nd edition. \$20.00/ea University of New Hampshire Cooperative Extension Publications Center, Nesmith Hall, 131 Main Street, Durham NH 03824.

Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities. Audubon Society of New Hampshire.

<http://www.nh.gov/oep/resourcelibrary/documents/buffershandbook.pdf>

- Review the New Hampshire Comprehensive Shoreland Protection Act (CSPA) if you have shoreland property. The CSPA sets legal regulations aimed at protecting water quality. If you have any questions regarding the act or need further information contact the *Shoreline Protection Act Coordinator* at (603) 271-3503.