Eutrophic Lakes

Trophic" means nutrition or growth. A **eutrophic** ("well-nourished") lake has high nutrients and high plant growth. An **oligotrophic** lake has low nutrient concentrations and low plant growth. Mesotrophic lakes fall somewhere in between **eutrophic** and **oligotrophic** lakes.

Eutrophication is the process in which **lakes** receive nutrients (phosphorus and nitrogen) and sediment from the surrounding watershed and become more fertile and shallow. ... The additional nutrients cause algal blooms, additional plant growth and overall poor **water** quality, making the **lake** less suitable for recreation.

These nutrients (Phosphorus and Nitrogen) support high densities of algae, **fish** and other aquatic organisms. Since **eutrophic lakes have** so much biomass, there is a lot of decomposition occurring at the bottom. This decomposition uses up oxygen, causing the bottom of the **lake** to become anoxic in the summer.

Eutrophication can have serious effects, like algal blooms that block light from getting into the water and harm the plants and animals that need it. If there's enough overgrowth of algae, it can prevent oxygen from getting into the water, making it hypoxic and creating a dead zone where no organisms can survive.

Eutrophication (lakescientist.com)

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Eutrophication has been the focus of scientific studies for more than 40 years. Although many definitions exist[1], it is generally defined as an increase in nutrients such as nitrogen and phosphorus that increase algal growth. Depending on the degree of eutrophication, severe environmental effects can develop, which degrade water quality. For example, increased phytoplankton biomass can decrease clarity, reduce levels of light, and decrease levels of oxygen, all of which ultimately have negative consequences for organisms that live in the lake. The magnitude of eutrophication reached a high point in the 1960s where Lake Erie, the smallest and shallowest of the Great Lakes, was considered a dead lake. Not only are the effects of eutrophication detrimental to lake biota, but they also pose a risk to human health in the form of harmful algal blooms.

The process of eutrophication is natural[2]. For many lakes, as they age over centuries, there is a buildup of nutrients, sediment, and plant material, which slowly fill the lake basin. Eventually, the process ends and the basin becomes colonized by terrestrial vegetation[3]. The timing of natural eutrophication is highly variable and depends on the characteristics of the basin, watershed, and climate[1]. However, humans, by altering nutrient inputs, have greatly increased the pace at which eutrophication can occur

The process of eutrophication can be both natural and human-induced. Natural eutrophication, where the basin gradually fills in from nutrient and sediment inputs, occurs over long time periods – on the order of centuries. Human-induced, or cultural eutrophication, occurs on a much shorter time scale (decades) as a result of human disturbance and nutrient inputs.

Human-induced eutrophication of freshwaters, also called cultural eutrophication, is largely a result of increased phosphorus inputs from sources such as agricultural fertilizers or partially treated sewage. First described by Vollenweider in 1968, phosphorus, and to a certain extent nitrogen, were linked to the growing problems of eutrophication. For the first time, the focus was not solely on the lake but the connection to the watershed[4]. Today, our knowledge of lakes — not as closed systems, but as integrators of environmental change[5] — highlights a stark contrast from earlier conceptions that lakes and their the biota were "closely related among themselves in all their interests, but so far independent of the land about them

Following Vollenweider's conclusions, evidence of human-induced eutrophication continued to amass and culminated with a large-scale experiment in a remote region of Canada, known as the Experimental Lakes Area (ELA). Established to investigate the growing problem of eutrophication, the ELA has been the site of many large-scale, ecological manipulations. The experiment at Lake 226, arguably one of the most important, used a large curtain to create a barrier between two sides of the lake. Nutrient additions of carbon and nitrogen were added to both sides, but one side was also fertilized with phosphorus. The influence of phosphorus on eutrophication was rapid, visually striking, and ushered in a new era of water quality protection laws and regulation. As a result, changes in management practices were implemented and, through nutrient reductions, the impacts of eutrophication were reduced and in some cases lakes fully recovered. Furthermore, a whole scientific movement began to further the understanding of the process and problems associated with rapid spikes in system productivity, something that continues to this day.

How does eutrophication cause fish kills?

One of the negative impacts of eutrophication and increased algal growth is a loss of available oxygen, known as anoxia. These anoxic conditions can kill fish and other aquatic organisms such as amphibians. However, how does eutrophication actually lower oxygen levels when it is common knowledge algae produce oxygen?

It is true algae produce oxygen, but only when there is enough light. Eutrophication reduces the clarity of water and underwater light. In eutrophic lakes, algae are starved for light. When algae don't have enough light they stop producing oxygen and in turn begin consuming oxygen. Moreover, when the large blooms of algae begin to die, bacterial decomposers further deplete the levels of oxygen. As a result, eutrophication can quickly remove much of the oxygen from a lake, leading to an anoxic — and lethal — underwater environment.

The Future of Eutrophication

Laws and regulations have been established that support high water quality standards. Often they specifically limit nitrogen and phosphorus inputs, simply because the effects of eutrophication, though reversible, can be quite devastating. Lakes with lower nutrients have lower algae concentrations, are generally clear, and are considered to be high-quality water resources and recreational sites. However, the management of these resources includes a complex set of interactions from within system processes to watershed interactions to even larger, global issues. Therefore, the continued effort to control eutrophication will require ongoing cooperation of citizens, scientists, managers, and policy makers.