EPA United States Environmental Protection Agency

Issues

Mid Atlantic Integrated Assessment

Eutrophication

What is Eutrophication? Eutrophication is a condition in an aquatic ecosystem where high nutrient concentrations stimulate blooms of algae (e.g., phytoplankton).

Trophic States

Oligotrophic	Clear waters with little organic matter or sediment and minimum biological activity.
Mesotrophic	Waters with more nutrients, and therefore, more biological productivity.
Eutrophic	Waters extremely rich in nutrients, with high biological productivity. Some species may be choked out.
Hypereutrophic	Murky, highly productive waters, closest to the wetland status. Many clearwater species cannot survive.
Dystrophic	Low in nutrients, highly colored with dissolved humic organic material. (Not necessarily a part of the natural trophic progression.)

Why Should We Be Concerned?

Although eutrophication is a natural process in the aging of lakes and some estuaries, human activities can greatly accelerate eutrophication by increasing the rate at which nutrients and organic substances enter aquatic ecosystems from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded streambanks, and similar sources can increase the flow of nutrients and organic substances into aquatic systems. These substances can overstimulate the growth of algae, creating conditions that interfere with the recreational use of lakes and estuaries, and the health and diversity of indigenous fish, plant, and animal populations.

Algal blooms hurt the system in two ways. First, they cloud the water and block sunlight, causing underwater grasses to die. Because these grasses provide food and shelter for aquatic creatures (such as the blue crab and summer flounder), spawning and nursery habitat is destroyed and waterfowl have less to eat when grasses die off. Second, when the algae die and decompose, oxygen is used up. Dissolved oxygen in the water is essential to most organisms living in the water, such as fish and crabs. Increased eutrophication from nutrient enrichment due to human activities is one of the leading problems facing some estuaries in the mid-Atlantic.

What are we doing in MAIA?
Federal and state agencies have joined together to monitor the mid-Atlantic natural resources and report upon their condition. The data are being summarized into reports that tell the percent of ecological resources in good, fair, or poor condition for a wide variety of stressors. To date, we have completed the *Condition of the Mid-Atlantic Estuaries* report. Reports on Streams and Forests are currently being written.

ELECTRIC LIBRARY Presents ENCYCLOPEDIA.COM HOME

Search Encyclopedia.com Again

Find it!

Related Information

SEARCH IN ENCARTA

Premium Resources

Click here to see documents from Electric Library, a pay service.

Pictures & Maps

Listing from Electric Library, a pay service.

Where Do Fertilizers Go? ; Earth Explorer ; 02-01-1995; Size: 77K

eutrophication

eutrophication

Pronounced As: **yootrofikashn** , aging of a lake by biological enrichment of its water. In a young lake the water is cold and clear, supporting little life. With time, streams draining into the lake introduce nutrients such as nitrogen and phosphorus, which encourage the growth of aquatic organisms. As the lake's fertility increases, plant and animal life burgeons, and organic remains begin to be deposited on the lake bottom. Over the centuries, as silt and organic debris pile up, the lake grows shallower and warmer, with warm-water organisms supplanting those that thrive in a cold environment. Marsh plants take root in the shallows and begin to fill in the original lake basin. Eventually the lake gives way to bog, finally disappearing into land. Depending on climate, size of the lake, and other factors, the natural aging of a lake may span thousands of years. However, pollutants from man's activities can radically accelerate the aging process. During the past century, lakes in many parts of the earth have been severely eutrophied by sewage and agricultural and industrial wastes (see water pollution). The prime contaminants are nitrates and phosphates, which act as plant nutrients. They overstimulate the growth of algae, causing unsightly scum and unpleasant odors, and robbing the water of dissolved oxygen vital to other aquatic life. At the same time, other pollutants flowing into a lake may poison whole populations of fish, whose decomposing remains further deplete the water's dissolved oxygen content. In such fashion, a lake can literally choke to death.

Printable Copy

The Columbia Electronic Encyclopedia, Sixth Edition

Generate a Link

Aquatic Eutrophication - an Introduction

1. All plants and animals need a small amount of nutrients to grow and reproduce. However an excess of nutrients and its impacts in surface waters, termed aquatic eutrophication, is a major environmental issue at both national and international level. The Agency has identified it as a priority issue for fresh waters, and an issue requiring further investigation in saline waters around England and Wales. Eutrophication is defined by the Agency as: "The enrichment of water by nutrients, stimulating an array symptomatic changes including increased production of algae and/or higher plants, which can adversely affect the diversity of the biological system, the quality of the wat and the uses to which the water may be put."

2. Eutrophication can occur naturally, but there is increasing concern over the numbe lakes, rivers, estuaries and coastal waters in which it is being artificially accelerated b nutrient inputs from human activities. Although both phosphorus and nitrogen contribu to eutrophication, phosphorus is usually considered to be most important in fresh wat and nitrogen in estuarine and coastal waters. The main sources of nutrients are sewa effluents, leaching from agricultural land, contributions from rural populations and atmospheric nitrogen deposition. Figure 1 shows average nutrient levels of Orthophosphates and Nitrates from rivers in England and Wales, which can be used t assist in the identification of eutrophic areas.

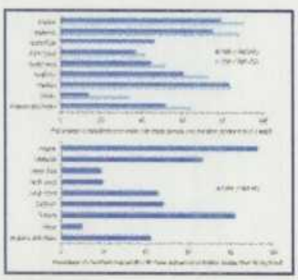


Figure 1 Average nutrient concentrations in rivers

Source

[1990 and 1995 Data 2k]

3. By the year 2000, 62 rivers and canals (around 2,500km), 13 lakes and reservoirs a 5 estuaries had been designated as Sensitive Areas (eutrophic) under the EC Urban Wastewater Treatment Directive (91/271/EEC), as shown in Figure 2. These designations are reviewed every four years. For each designated area, there is a

requirement for nutrient (usually phosphorus) reduction in discharges from sewage works which serve a population of 10,000 or more, unless it can be shown that this wi not result in improvements in water quality.

Figure 2 Eutrophic sensitive areas - 1994 and 1998 designations

4. Eutrophication can lead to excessive blooms of naturally occurring algae, the most well known being potentially toxic blue-green species. Communities of suspended or floating microscopic algae (phytoplankton) can reduce water clarity and block sunlight often resulting in the reduced aquatic plant growth. This can lead to a reduction in biodiversity as sensitive plants and animals of higher conservation value, are replacec more nutrient tolerant species. Algae can also cause large fluctuations in dissolved oxygen concentrations as they photosynthesise during daylight hours, adding oxygen the water, but respire at night, consuming oxygen. In bloom conditions, this can cause problems in the early morning when low oxygen levels can lead to invertebrate and fis mortalities. The decay of algal blooms and other plants can also deoxygenate the wat killing fish and other wildlife. High concentrations of algae can affect water treatment f public supply by blocking filters and affecting taste and odour.

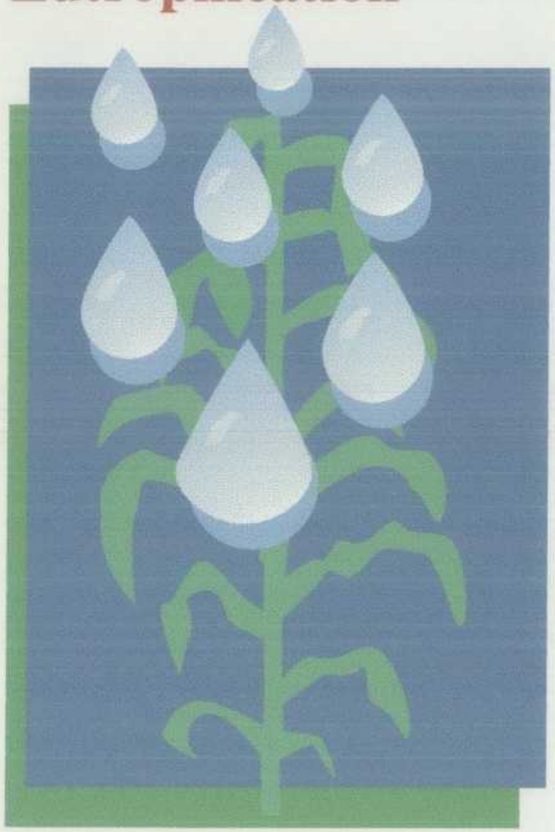
6. Algal blooms tend to be symptomatic of the later stages of eutrophication, but there also concern about the effects of eutrophication in waters which are currently of low nutrient (oligotrophic) status. Small increases in nutrient loads to these waters can ha relatively large impacts on the its plant and animal communities. Eutrophication has b implicated in the depreciating conservation value of some of the country's more pristir lakes and is adversely affecting many still water Sites of Special Scientific Interest (SSSIs).

7. Further information can be found in Freshwater algal blooms and toxic blue-green algae, Marine algal blooms and Assessment and control of eutrophication. The Agenc has also produced a series of leaflets entitled, 'Algae or Sewage', 'Blue-Green Algae', 'Aquatic Eutrophication', 'A key for the identification of blue green algae of the British Isles' and 'Marine Algae'. These are available on request from regional Environment Agency offices.

To jump to other sections of the report:

State of the Environment - Main Page | Jump

Agricultural Phosphorus and Eutrophication



Introduction

Eutrophication

Phosphorus (P) is an essential element for plant and animal growth and its input has long been recognized as necessary to maintain profitable crop and animal production. Phosphorus inputs can also increase the biological productivity of surface waters by accelerating eutrophication. Eutrophication is the natural aging of lakes or streams brought on by nutrient enrichment. This process can be greatly accelerated by human activities that increase nutrient loading rates to water.

Eutrophication has been identified as the main cause of impaired surface water quality (U.S. Environmental Protection Agency 1996). Eutrophication restricts water use for fisheries, recreation, industry, and drinking due to the increased growth of undesirable algae and aquatic weeds and to oxygen shortages caused by their death and decomposition. Associated periodic surface blooms of cyanobacteria (blue-green algae) occur in drinking water supplies and may pose a serious health hazard to animals and humans. Recent outbreaks of the dinoflagellate *Pfiesteria piscicida* in the eastern United States, and Chesapeake Bay tributaries in particular, have been linked to excess nutrients in affected waters. Neurological damage in people exposed to the highly toxic, volatile chemical produced by these algae has dramatically increased public awareness of eutrophication and the need for solutions (Burkholder et al. 1992).

Eutrophication of most fresh water around the world is accelerated by P inputs (Schindler 1977, Sharpley et al. 1994). Although nitrogen (N) and carbon (C) are also essential to the growth of aquatic biota, most attention has focused on P inputs because of the difficulty in controlling the exchange of N and C between the atmosphere and water and the fixation of atmospheric N by some blue-green algae. Therefore, P is often the limiting element, and its control is of prime importance in reducing the accelerated eutrophication of fresh waters. When salinity increases, as in estuaries, N generally becomes the element controlling aquatic productivity. However, in Delaware's inland bays (coastal estuaries), nitrate-N leaching has elevated N concentrations to the point where P is now the limiting factor in eutrophication.

Lake water concentrations of P above 0.02 ppm generally accelerate eutrophication. These values are an order of magnitude lower than P concentrations in soil solution critical for plant growth (0.2 to 0.3 ppm), emphasizing the disparity between critical lake and soil P concentrations and the importance of controlling P losses to limit eutrophication.

Agricultural Production

Confined animal operations are now a major source of agricultural income in several states. Animal manure can be a valuable resource for improving soil structure and increasing vegetative cover, thereby reducing surface runoff and erosion potential. However, the rapid growth and intensification of crop and animal farming in many areas has created regional and local imbalances in P inputs and outputs. On average, only 30 percent of the fertilizer and feed P input to farming systems is output in crop and animal produce. Therefore, when averaged over the total utilizable agricultural land area in the United States, an annual P surplus of 30 lb/acre exists (National Research Council 1993).

Before World War II, farming communities tended to be self-sufficient in that enough feed was produced locally and recycled to meet animal requirements. After World War II, increased fertilizer use in crop production fragmented farming systems, creating specialized crop and animal operations that efficiently coexist in different regions within and among countries. Since farmers did not need to rely on manures as nutrient sources (the primary source until fertilizer production and distribution became

Eutrophication

When sediments, sewage, or fertilizers are introduced into a waterway, the concentration of available nutrients in that system will increase, resulting in a condition known as "eutrophication".

Although wetlands are typically able to withstand substantial increases in the concentration of available nutrients, many deepwater habitats are not nearly so tolerant. Even relatively modest increases in the concentration of nitrogen or phosphorous may be sufficient to trigger an "algal bloom". Sometimes an algal bloom can kill all the fish in a lake or pond.

Algal Bloom

Algal blooms are one of the more insidious consequences of eutrophication. In addition to being unsightly and smelly, masses of blue-green algae can literally choke the life out of a lake or pond by depriving it of much needed oxygen.

At first glance this may seem like something of a paradox - since blue-green algae undergoes photosynthesis, it should produce more oxygen than it consumes. However, after large concentrations of algae have built up, aerobic processes such as respiration and the decomposition of dead algal cells becomes increasingly significant. Under extreme conditions a eutrophic lake or pond may be left entirely devoid of fish.