TAHOE: STATE OF THE LAKE REPORT 2009

BIOLOGY

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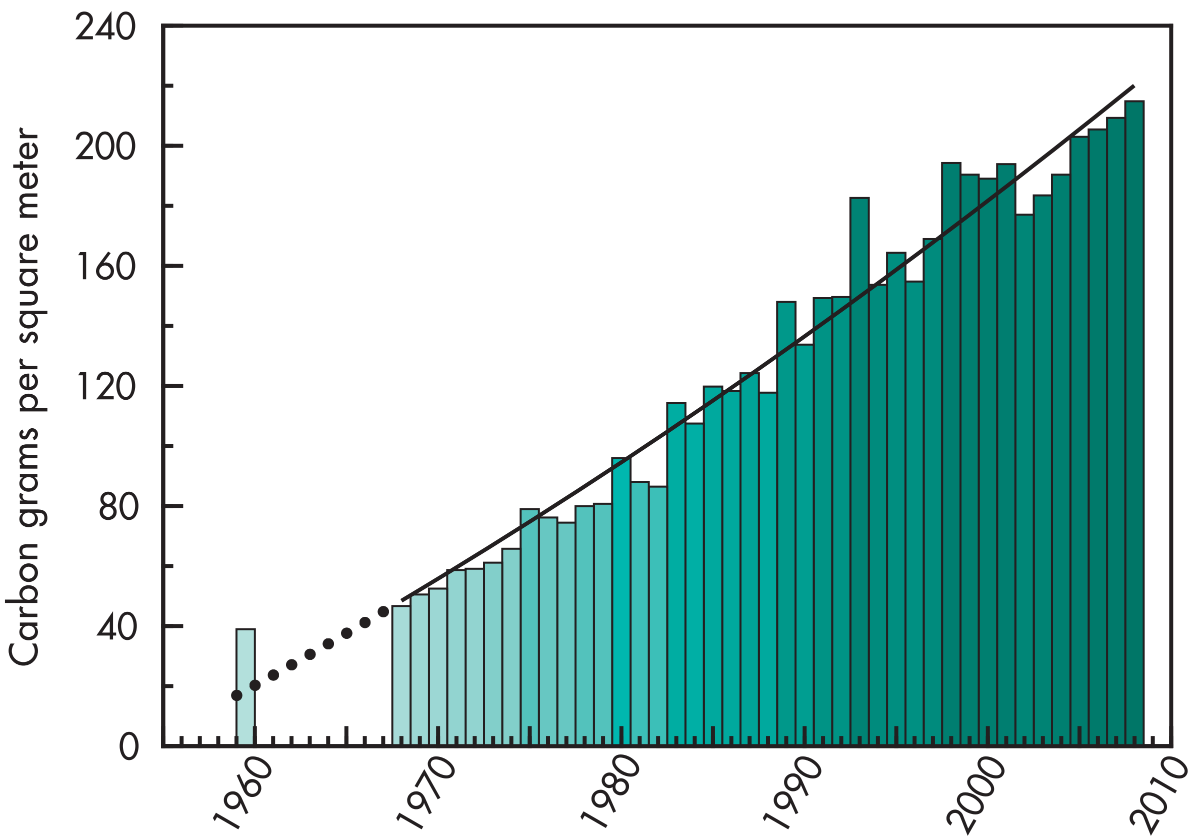
BIOLOGY

Algae growth (primary productivity)

Yearly since 1959

Primary productivity is a measure of the rate at which algae produce biomass through photosynthesis. It was first measured at Lake Tahoe in 1959 and has been continuously measured since 1968. Primary productivity has steadily increased over that time, promoted by nutrient loading to the lake, changes in the underwater light environment and a succession of algae species. In 2008, primary productivity was 214.8 grams of carbon per square meter.



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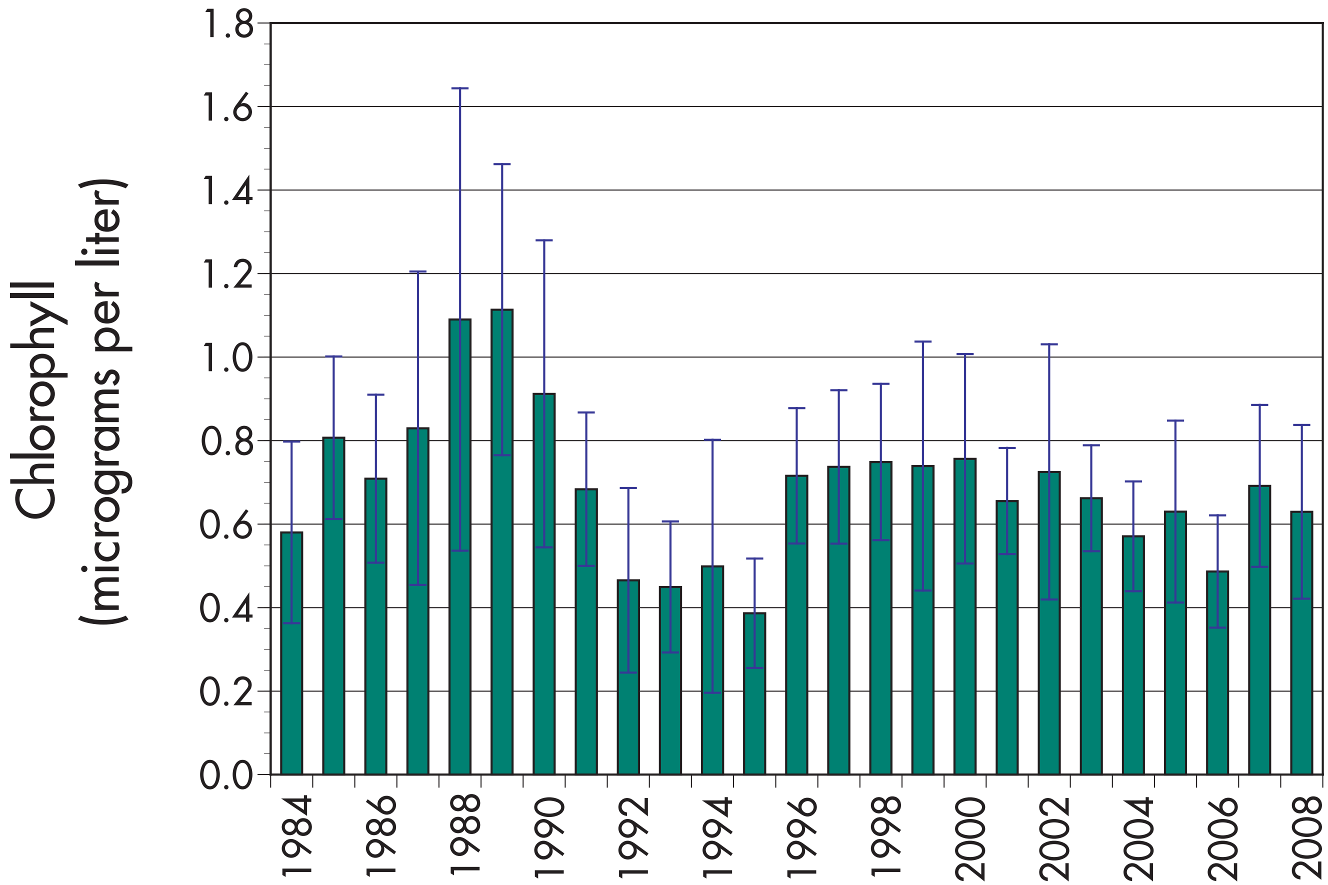
Algae abundance

Yearly since 1984

The amount of free-floating algae (phytoplankton) in the water is determined by measuring the concentration of chlorophyll a. Chlorophyll a is a common measure of phytoplankton biomass. Though algae abundance varies annually, it does not show a long-term increase. The annual average value for 2008 was 0.63 micrograms per liter. The average annual chlorophyll a level in Lake Tahoe has remained relatively uniform since 1996.



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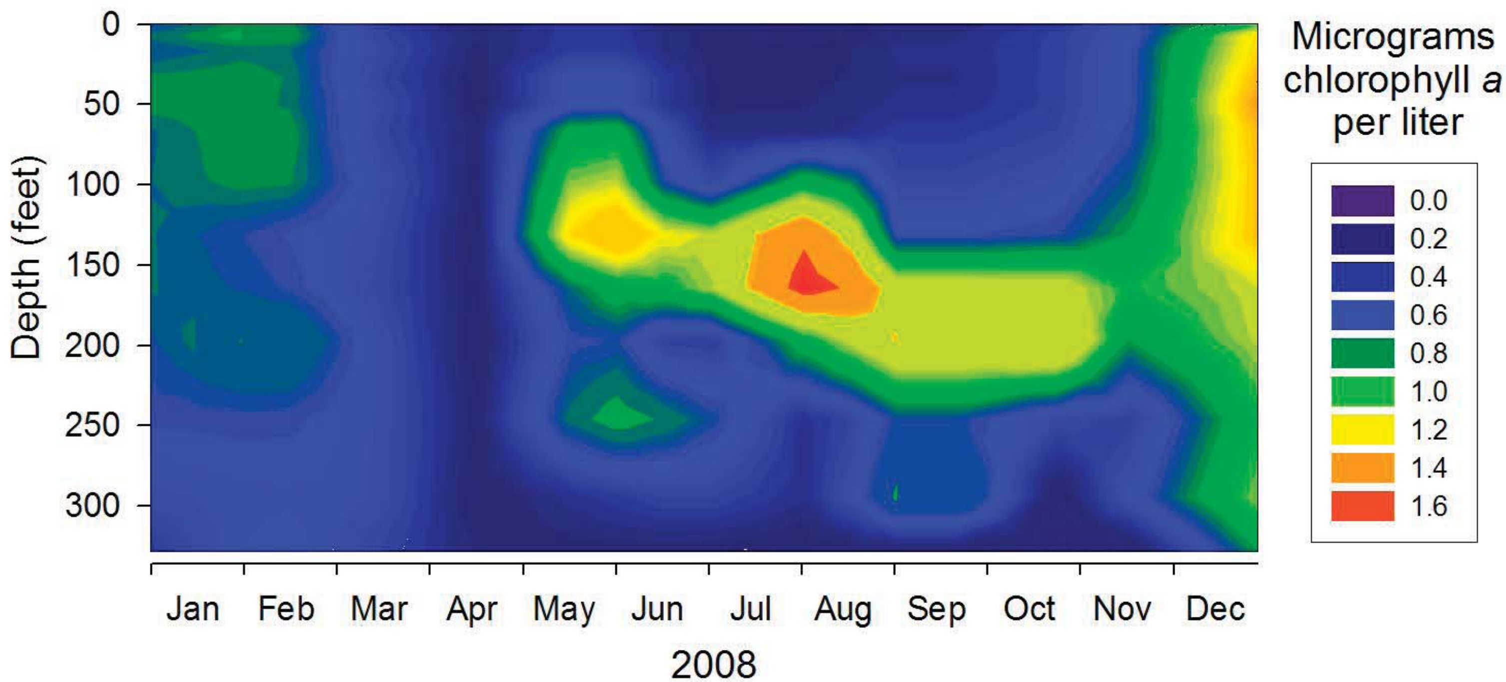
Algae concentration by depth

In 2008

The highest concentrations of algae (as measured by chlorophyll a concentration) occur in summer between the 100 and 200-foot depths. This discrete layer, known as the deep chlorophyll maximum, forms in spring and persists until winter mixing redistributes algae. In 2008, winter mixing began in late-November and early-December. The deep chlorophyll layer is below the Secchi depth (Figs. 11.1 and 11.2), and does not influence lake clarity until winter mixing relocates chlorophyll into the range of the Secchi disk (50 to 80 feet).



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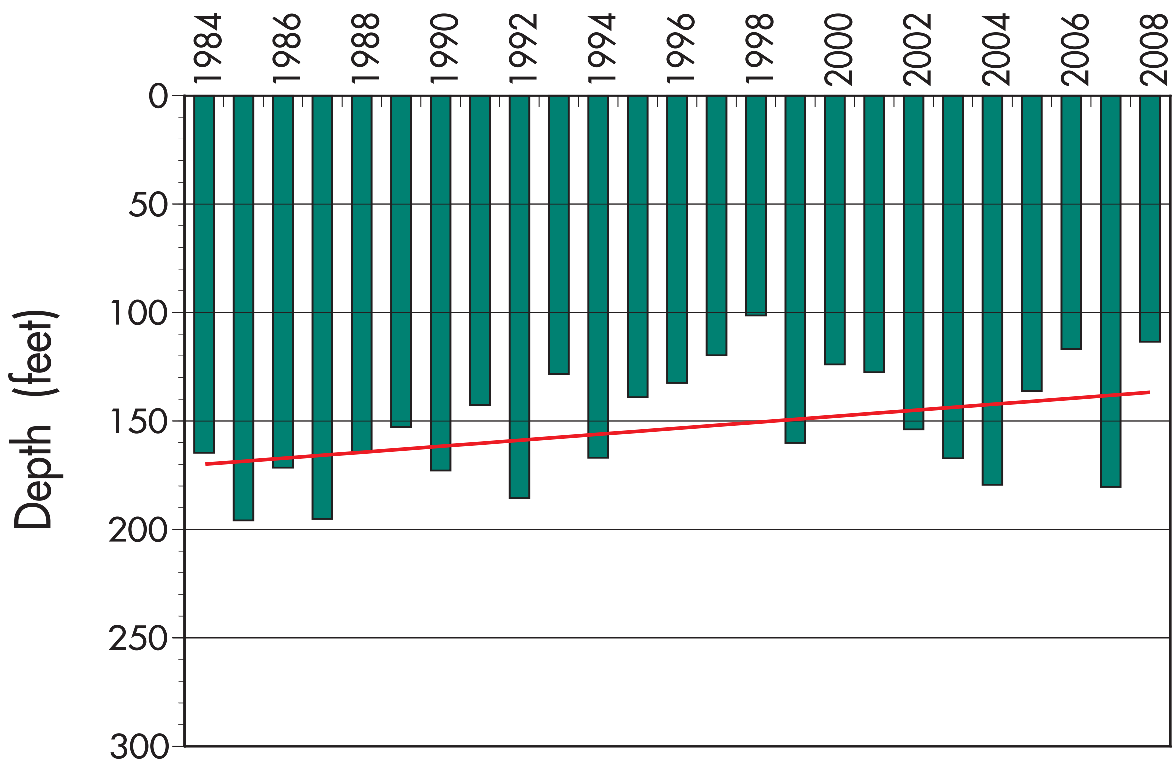
Depth of chlorophyll maximum

Yearly since 1984

The depth at which the deep chlorophyll maximum occurs varies from year to year. In 2008, the deep chlorophyll maximum was relatively shallow at about 115 feet. The deep chlorophyll maximum depth has generally been getting shallower over time, a trend believed to be linked to the decline in water clarity.



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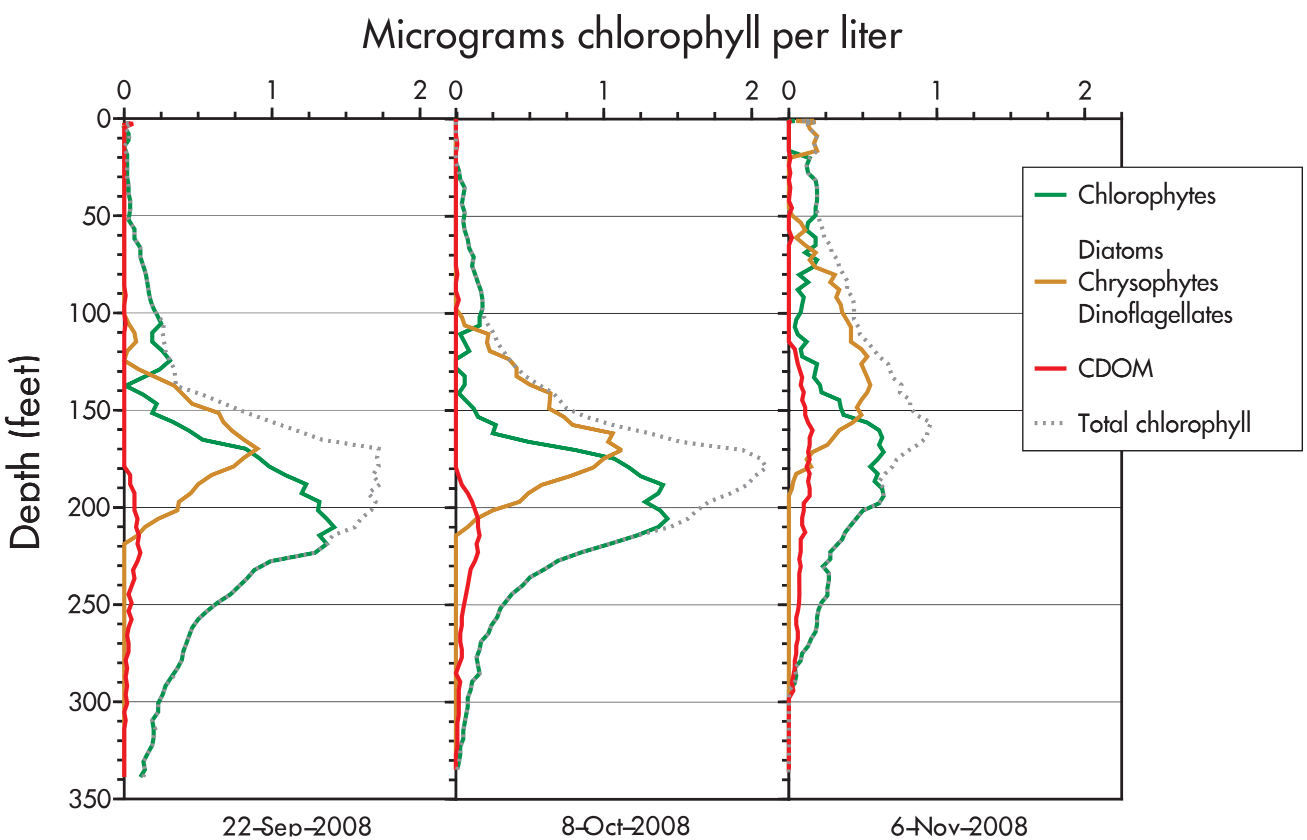
Algae group distribution by depth

Fall 2008

Lake Tahoe supports many types of algae. Different groups grow at various depths below the lake surface, depending on their specific requirements for light and nutrient resources. The three profiles shown below focus on the September-November period when the deep chlorophyll layer is beginning to break down as mixing in the upper water column commences (refer to Fig. 10.3 and compare similar dates). Two algal groups, chlorophytes, or green algae, and diatoms were dominant at this time of year. Notice the separation in depth between these two groups with the chlorophyte peaks occurring about 50 feet lower. This type of vertical separation is common in lakes as different algae coexist by occupying a unique depth range and thereby avoiding direct competition for resources.



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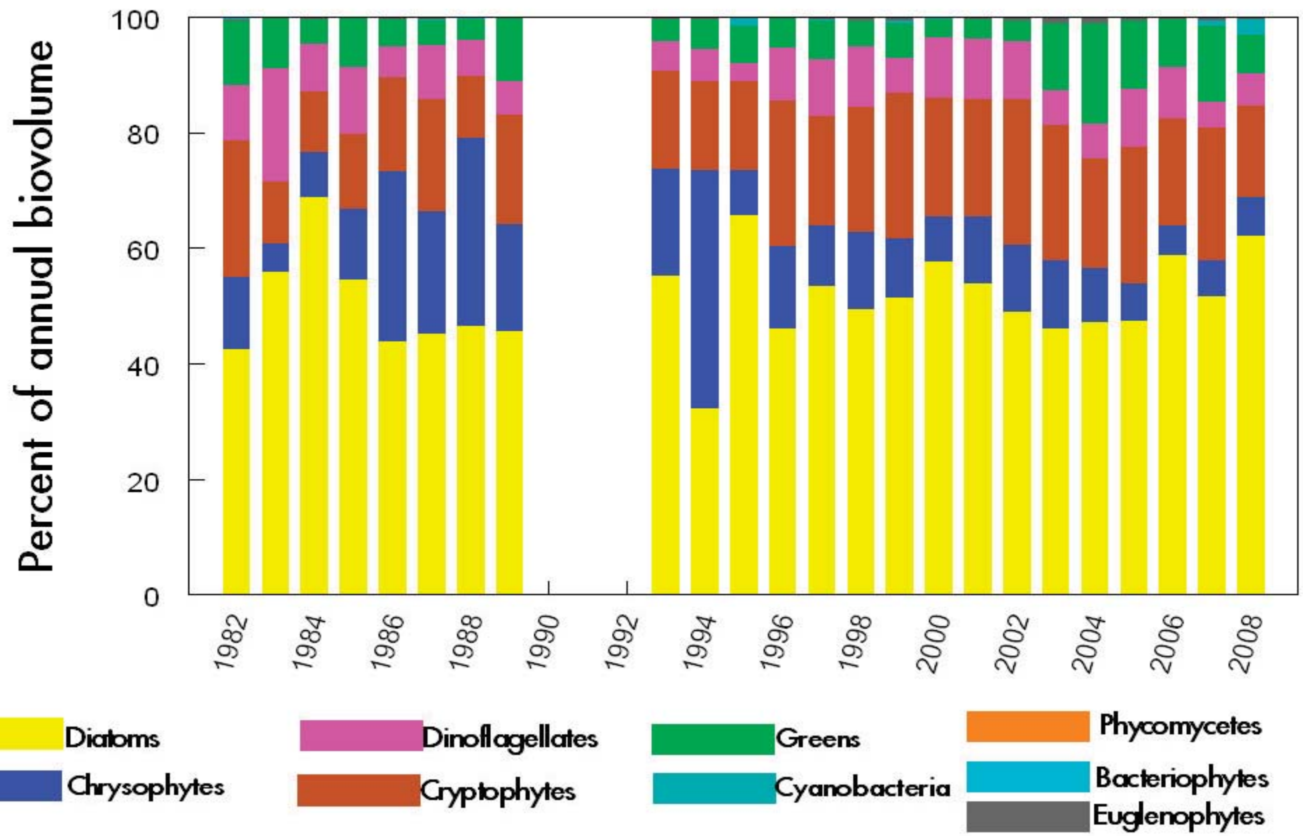
Algae groups as a fraction of total population

Yearly since 1982

The population, or biovolume, of algal cells from different groups varies from year to year. Diatoms are the most common type of alga, comprising 40 to 60 percent of the total biovolume each year. Chrysophytes and cryptophytes are next, comprising 10 to 30 percent of the total. Since 2003 and including 2008, the chlorophytes, or green algae, have increased in abundance, and the relative contribution of each of the major algal groups has remained relatively uniform.



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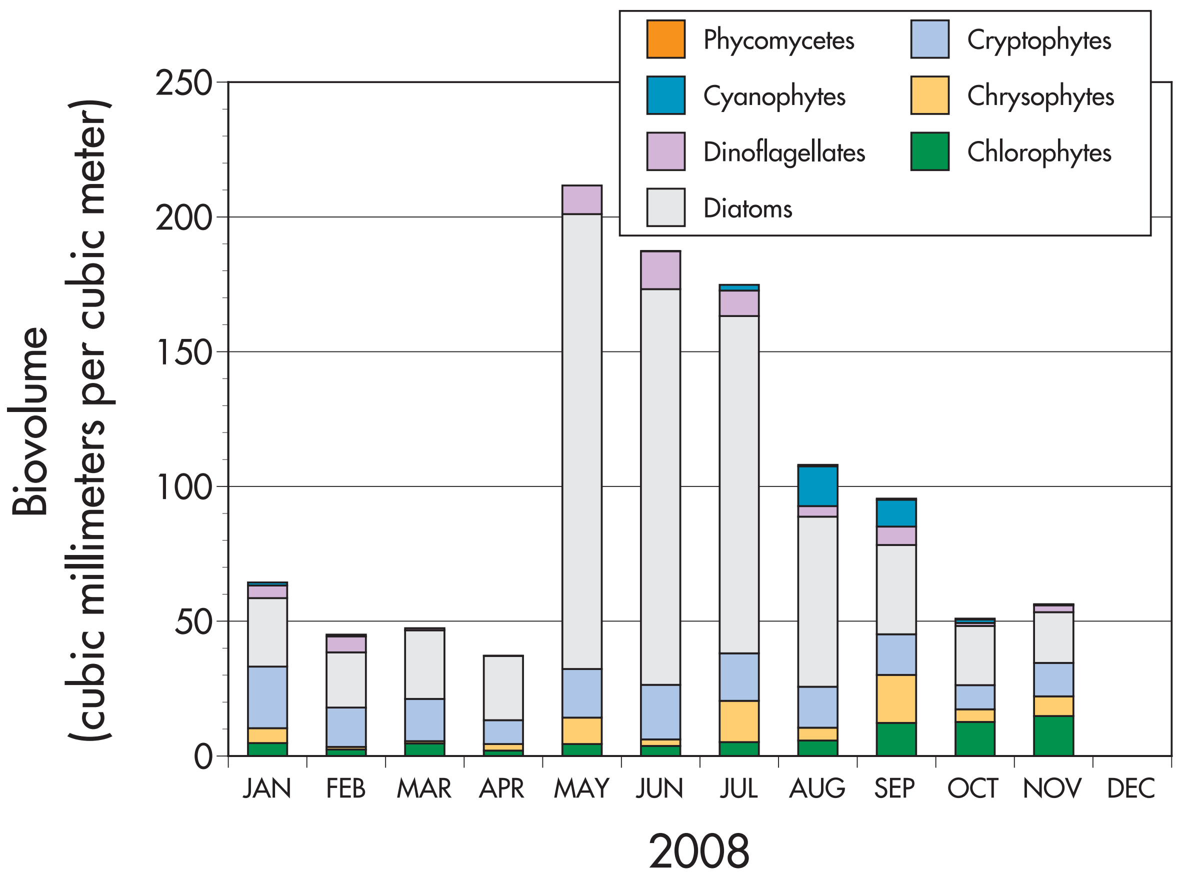
Algae groups as a fraction of total population

Monthly in 2008

Algae populations vary month to month, as well as year to year. In 2008, diatoms again dominated the phytoplankton community, especially in May-July when their biovolume was high. While the relative importance of the chlorophytes (green algae) increased in the fall, their biovolume did not peak as dramatically in 2008 as it did in 2007.



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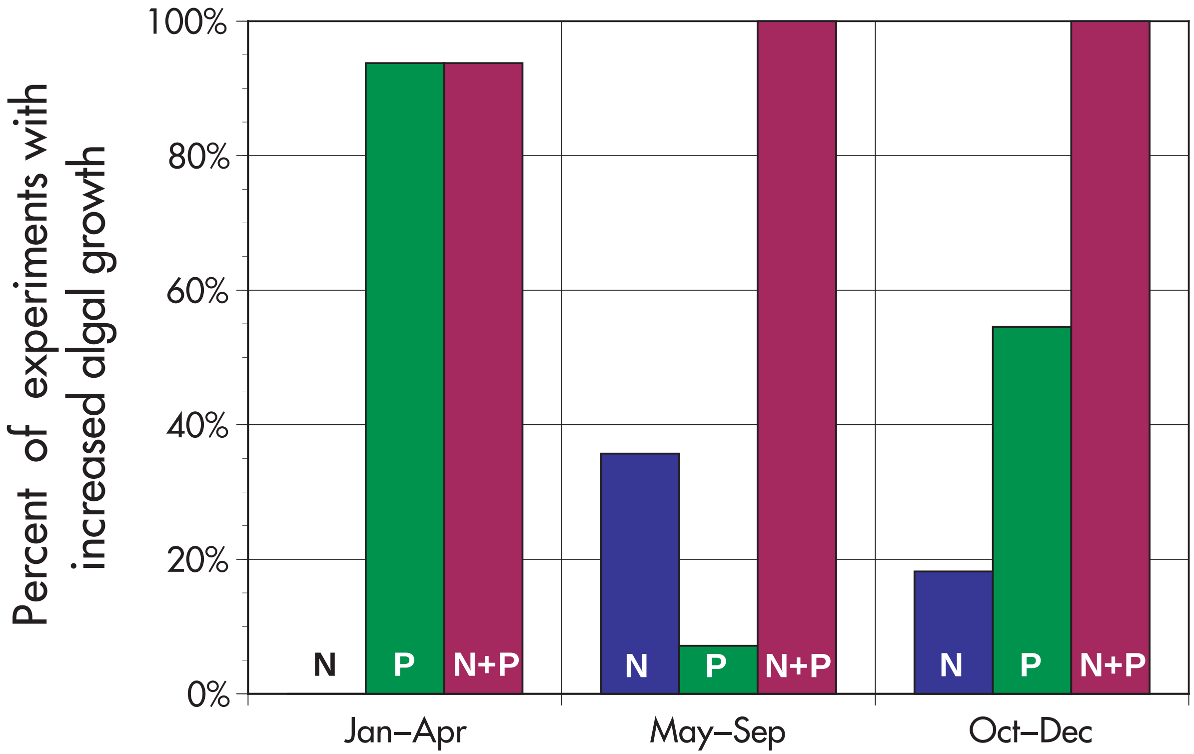
Nutrient limitation of algal growth

In 2008

Bioassays determine the nutrient requirements of phytoplankton. Nutrients are added to lake water samples and algal biomass is measured. These tests document both seasonal and long-term changes in nutrient limitation. Phytoplankton response to nutrient addition for the period 2002-2008 is shown in the panels below. Between January and April, algae were limited by phosphorus (P), not nitrogen (N), when added alone. When added together, stimulation nearly always occurred. From May to September, N added by itself was more stimulatory, but the lake was co-limited, as shown by the greater response to adding both nutrients. P was more stimulatory from October to December, but co-limitation was again the dominant condition. These results highlight the role of nutrients in controlling algal growth. They also underscore the synergistic effect when both are available.



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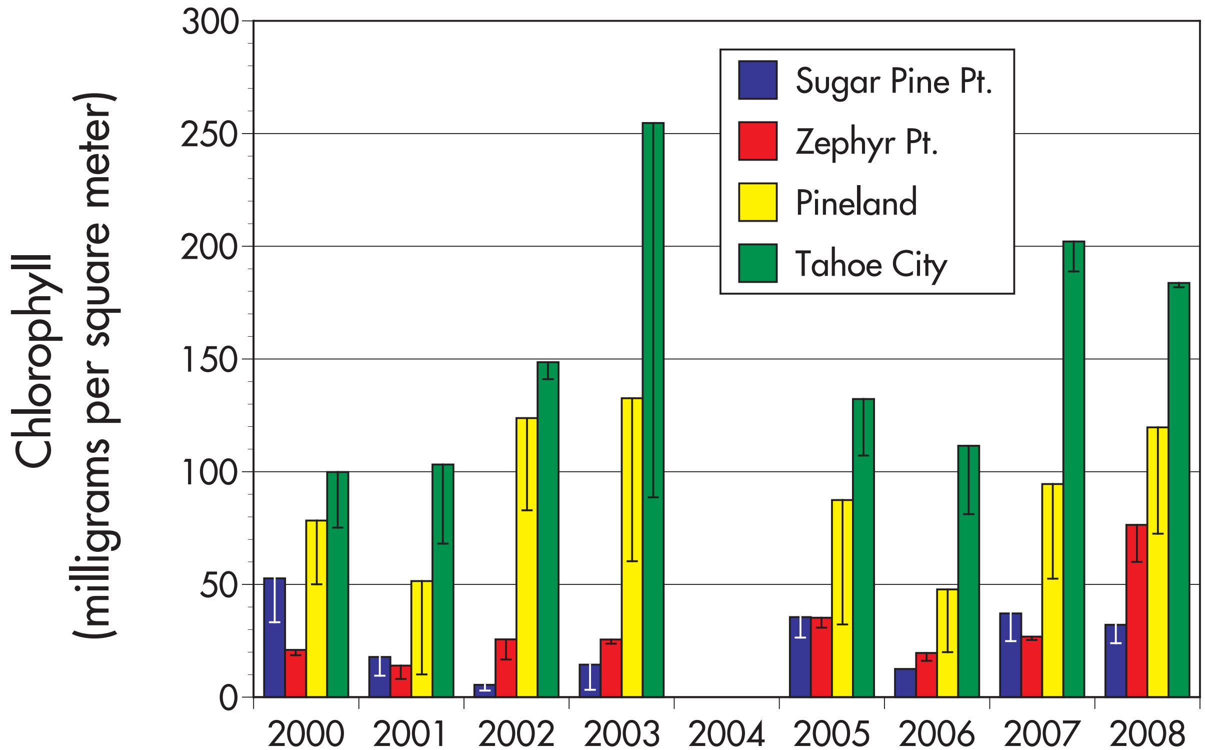
Shoreline algae populations

Yearly since 2000

Periphyton, or attached algae, makes rocks around the shoreline of Lake Tahoe green and slimy. Periphyton is measured eight times each year, and this graph shows the maximum biomass measured at four sites. In 2008, concentrations were near or above average. The two sites with the most periphyton (Tahoe City and Pineland) are closest to urban areas. Peak annual biomass at the less urbanized Zephyr Point site was about 2-3 times higher than found previously. To date, no statistically significant long-term tend in maximum periphyton biomass has been detected at these locations. However, the higher biomass at the more urban sites has been dramatic year after year.



Shoreline algae distribution

In 2008

Periphyton biomass was surveyed around the lake during the spring of 2008, when it was at its annual maximum. Nearly 45 locations were surveyed by snorkel in 1.5 feet of water. A Periphyton Biomass Index (PBI) was developed as an indicator to reflect what the casual observer would visually detect looking into the lake from the shoreline. The PBI is defined as the percent of the local bottom area covered by periphyton multiplied by the average length of the algal filaments (cm). Zones of elevated PBI are clearly seen. (The width of the colored band does not represent the actual dimension of the onshore-offshore distribution.)