TAHOE: STATE OF THE LAKE REPORT 2011

BIOLOGY

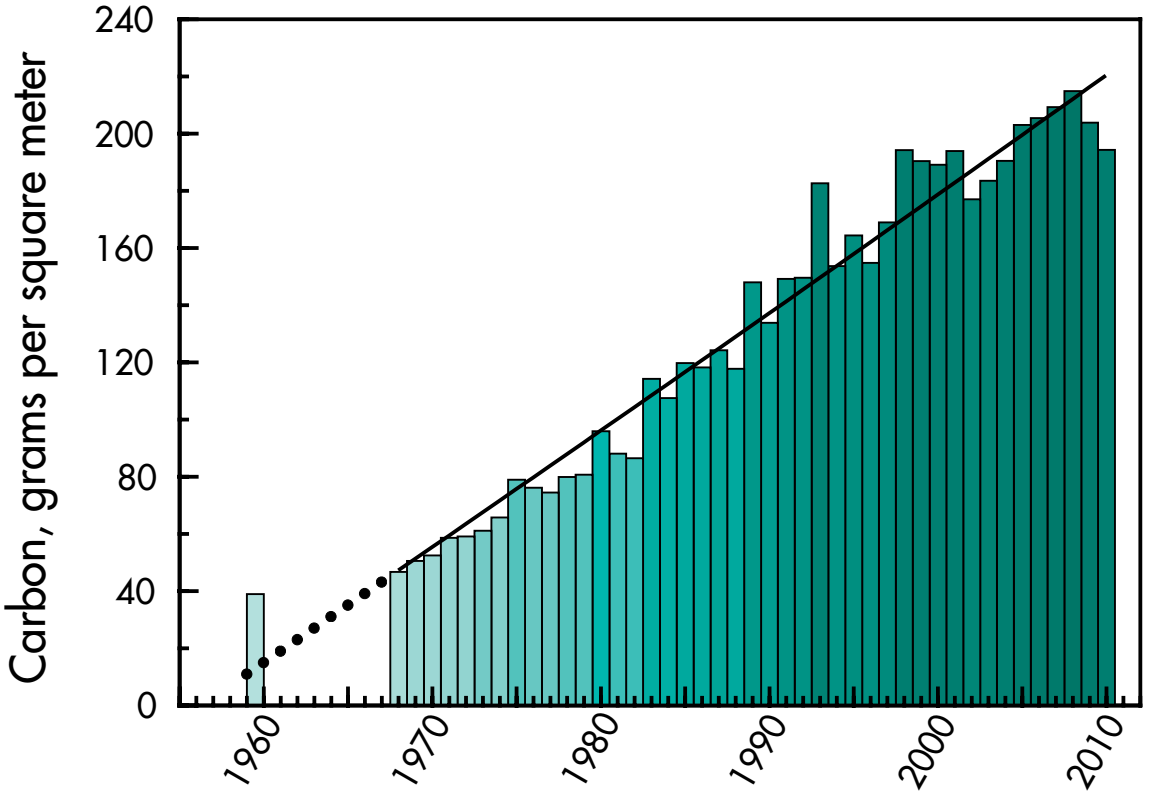
UCDAVIS
TAHOE ENVIRONMENTAL
RESEARCH CENTER

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 generally increased over that time, promoted by nutrient loading to the lake, changes in the underwater light environment and a succession of algae species. In 2010, primary productivity was 194.3 grams of carbon per square meter. This represented the third straight year of decrease in primary productivity, although the degree of decrease is small.



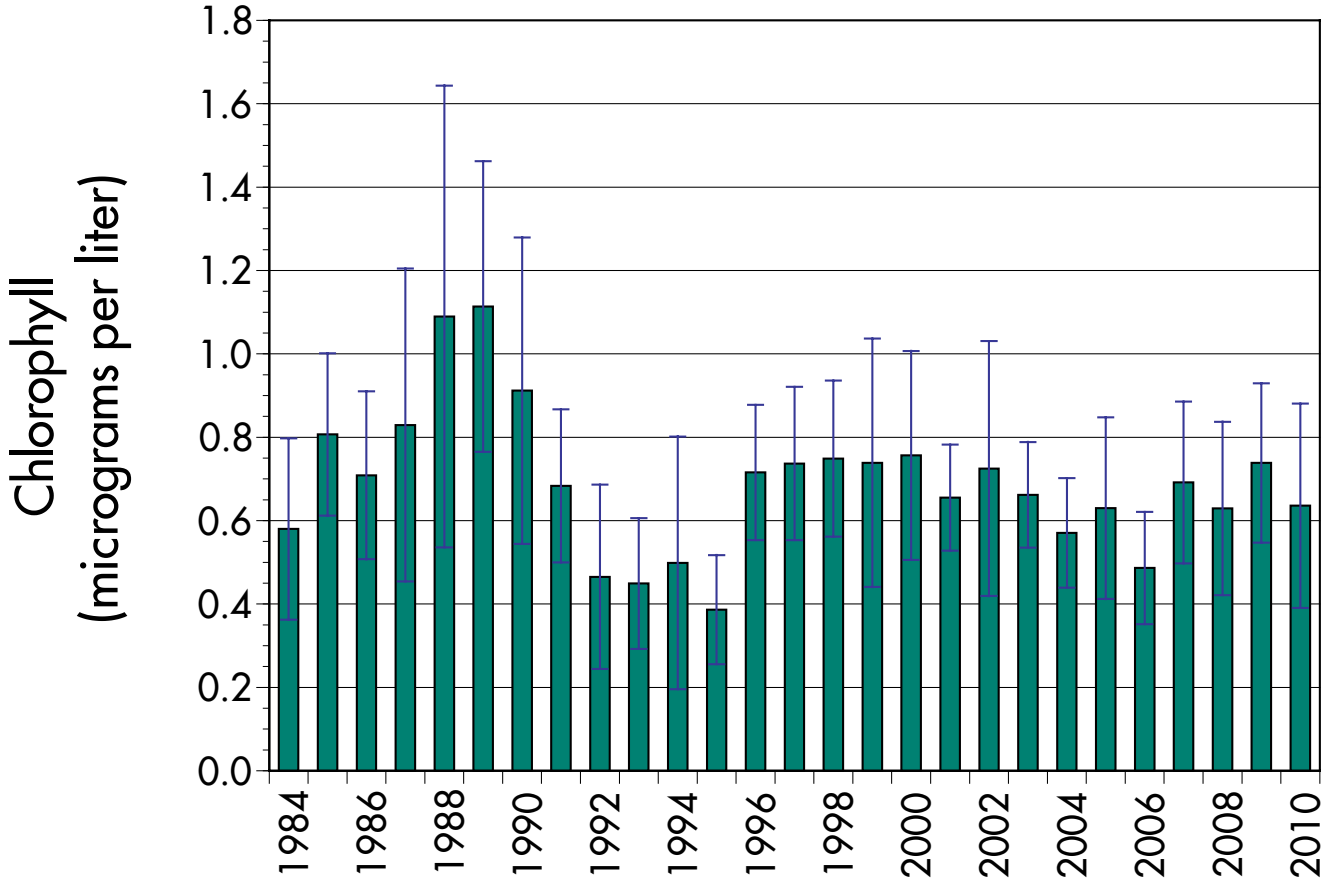
BIOLOGY

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 has not shown a long-term increase since measurements began in 1984.

The annual average value for 2010 was 0.64 micrograms per liter. The average annual chlorophyll *a* level in Lake Tahoe has remained relatively uniform since 1996.

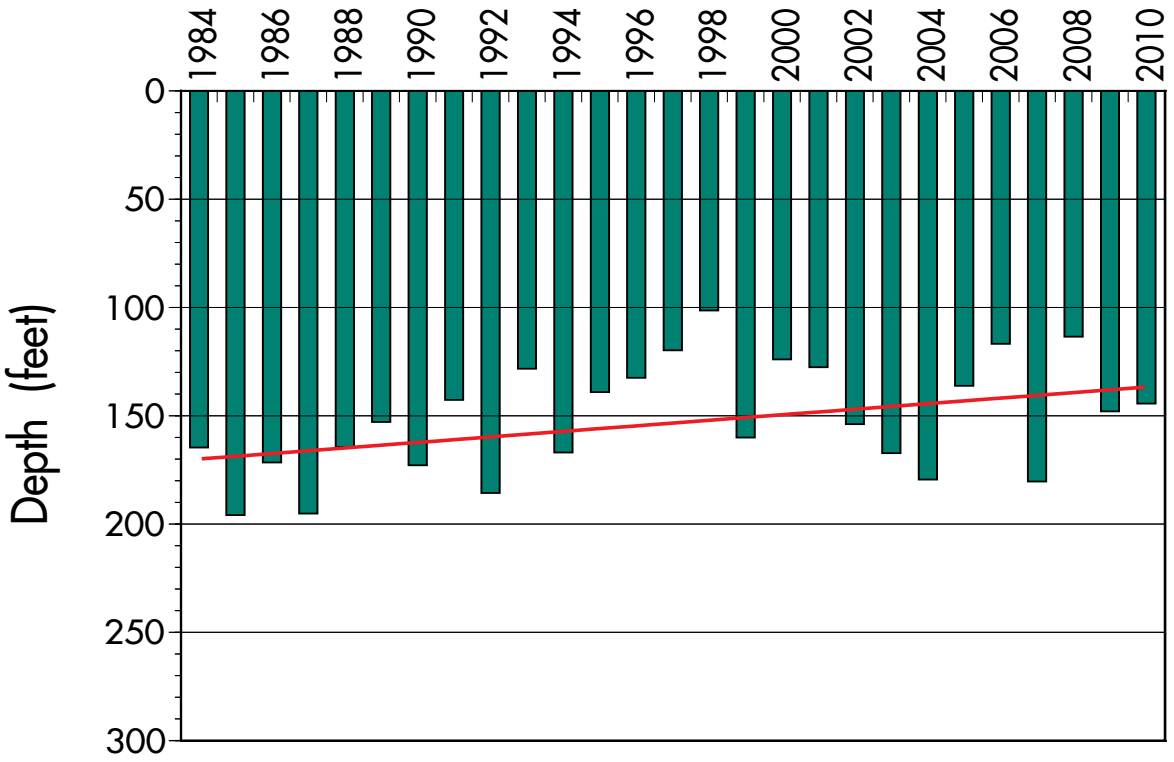


BIOLOGY

Depth of chlorophyll maximum

Yearly since 1984

The depth at which the deep chlorophyll maximum occurs varies from year to year. In 2010, the deep chlorophyll maximum was at about 144 feet, similar to the 2009 value of 146 feet and considerably deeper than the 2008 value of 115 feet. The deep chlorophyll maximum depth has generally been shoaling (getting shallower) over time, a trend believed to be linked to the decline in water clarity.

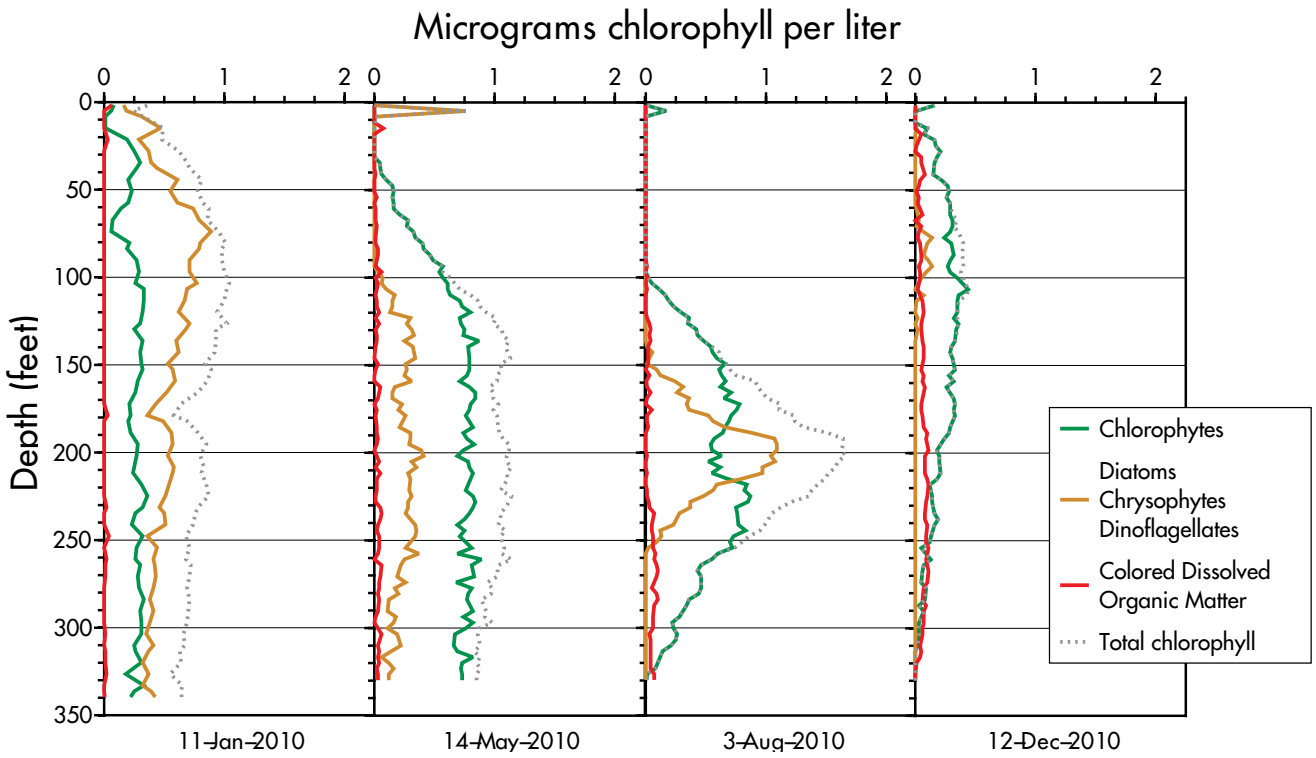


BIOLOGY

Algae group distribution by depth

In 2010

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 four profiles below show how the distributions develop throughout the year. Two algal groups, chlorophytes (green algae) and diatoms, were dominant. Notice the separation in depth between these two groups. In August for example, diatoms peaked at a depth of 200 feet, while chlorophytes had a bimodal distribution with peaks at 170 and 230 feet. The profile from May clearly shows the near-surface diatom population referenced in the Recent Research Clarity section (pages 6.6 - 6.8).

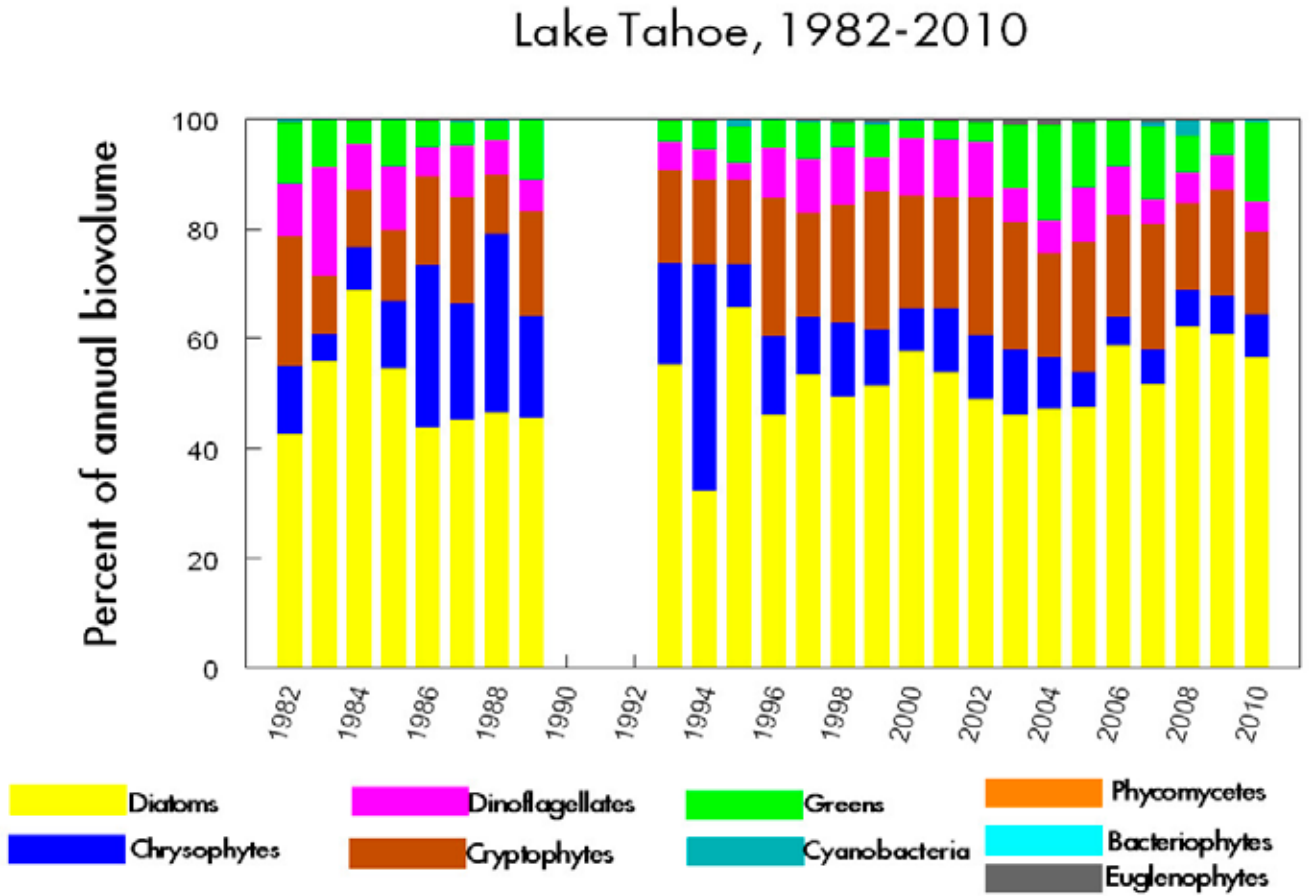


BIOLOGY

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. While the major algal groups show a degree of consistency from year-to-year, TERC research has shown that the composition of individual species within the major groups is changing in response to lake condition.

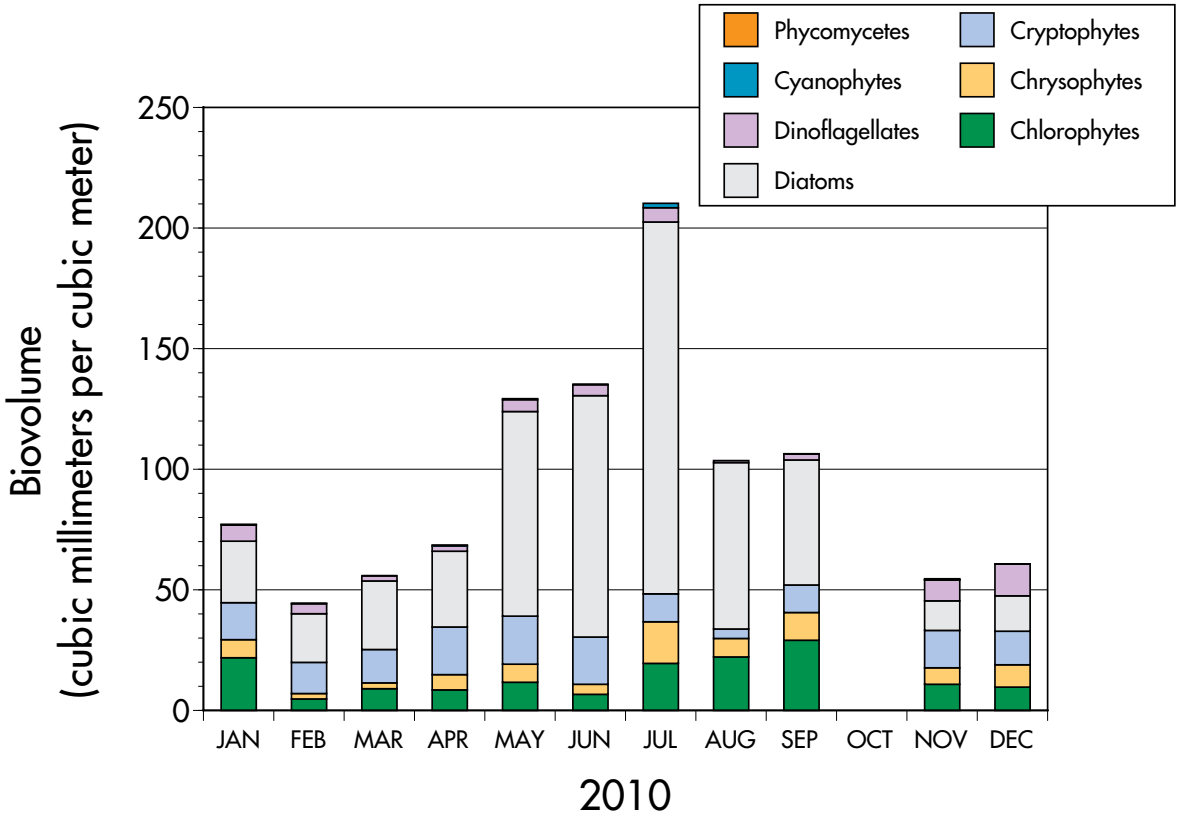


BIOLOGY

Algae groups as a fraction of total population

Monthly in 2010

Algae populations vary month to month, as well as year to year. In 2010, diatoms again dominated the phytoplankton community, especially in April-September when their biovolume was particularly high.

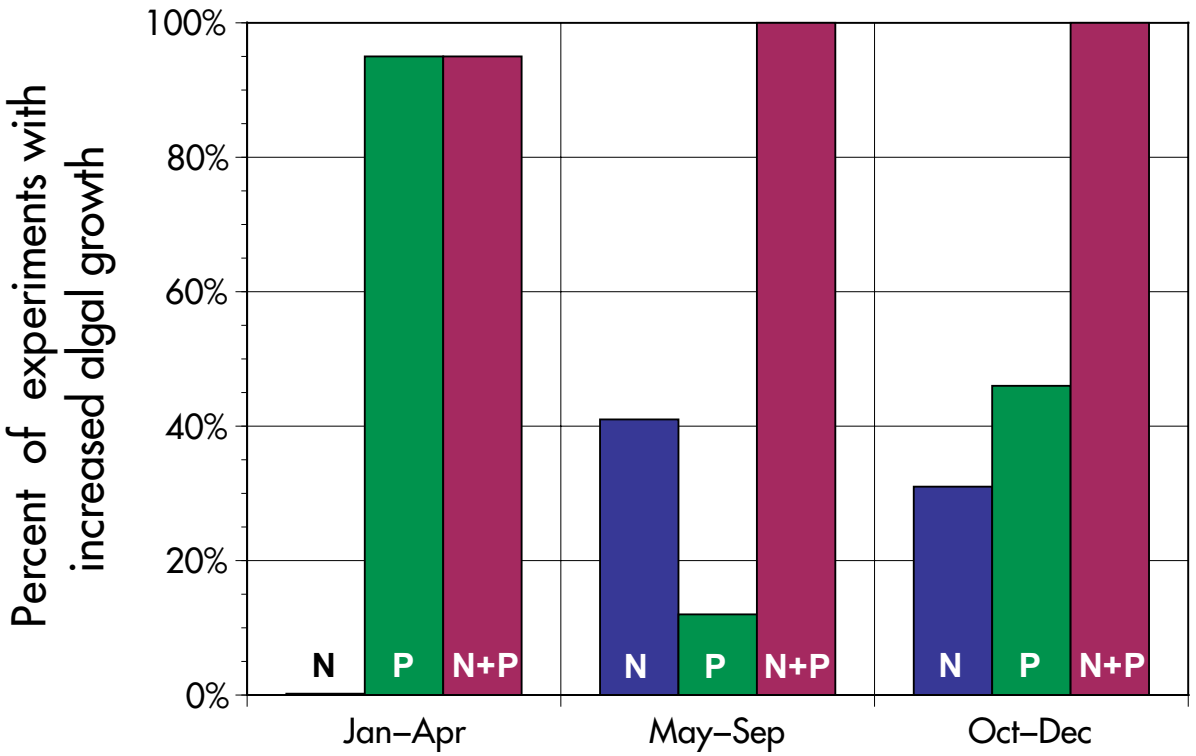


BIOLOGY

Nutrient limitation of algal growth

For 2002 - 2010

Bioassays determine the nutrient requirements of phytoplankton. In these experiments, 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 2002-2010 is summarized in the panels below. Between January and April, algal growth was limited purely by phosphorus (P). From May to September, Nitrogen (N) added by itself was more stimulatory, but the lake was co-limited, as shown by the greater response to adding both nutrients. Phosphorus 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.

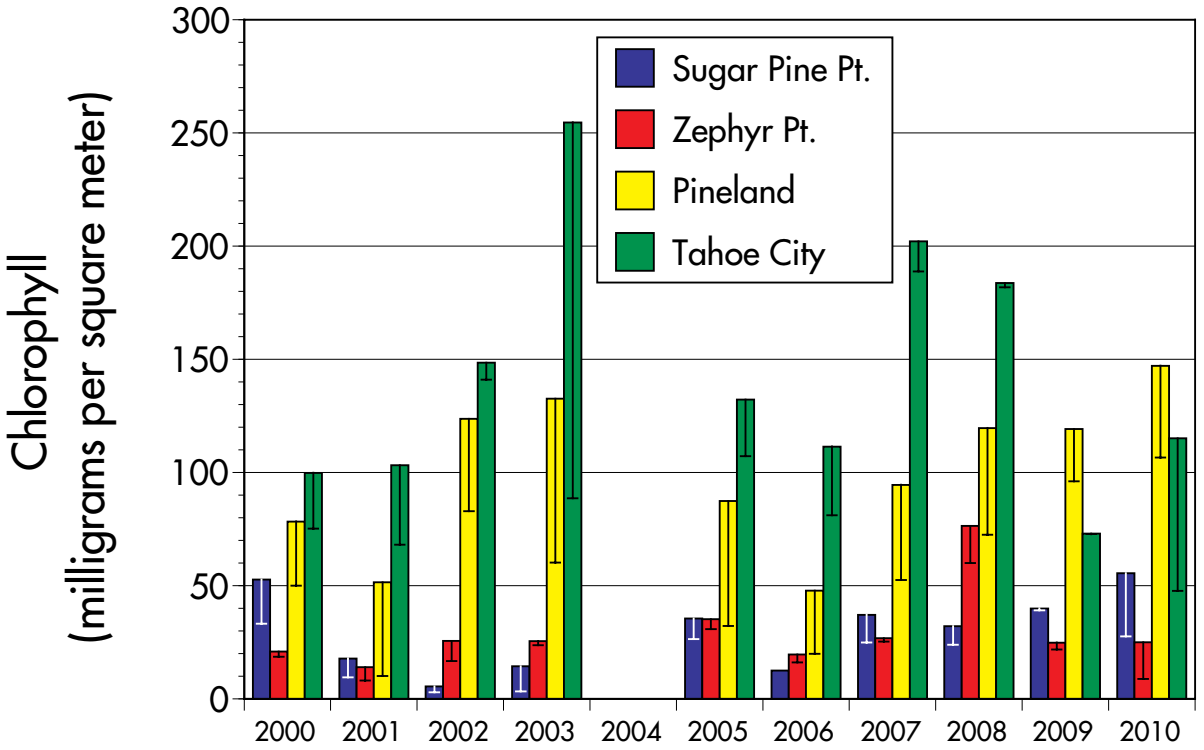


BIOLOGY

Shoreline algae populations

Yearly since 2000

Periphyton, or attached algae, makes rocks around the shoreline of Lake Tahoe green and slimy, or sometimes like a very plush white carpet. Periphyton is measured eight times each year, and this graph shows the maximum biomass measured at four sites. In 2010, concentrations were near or above average. The two sites with the most periphyton (Pineland and Tahoe City) are closest to urban areas. Tahoe City was higher than the previous year but down from high values in 2007 and 2008 and remained lower than Pineland. Peak annual biomass at the less urbanized Zephyr Point site remained down to the usual level, from the high value experienced in 2008. To date, no statistically significant long-term trend in maximum periphyton biomass has been detected at any of these individual locations. However, the higher biomass at the more urban sites has been dramatic year after year.



BIOLOGY

Shoreline algae distribution

In 2010

Periphyton biomass was surveyed around the lake during the spring of 2010, 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.) Compared with 2008, there were higher concentrations of periphyton particularly in the north-west.