TAHOE: STATE OF THE LAKE REPORT 2012

BIOLOGY

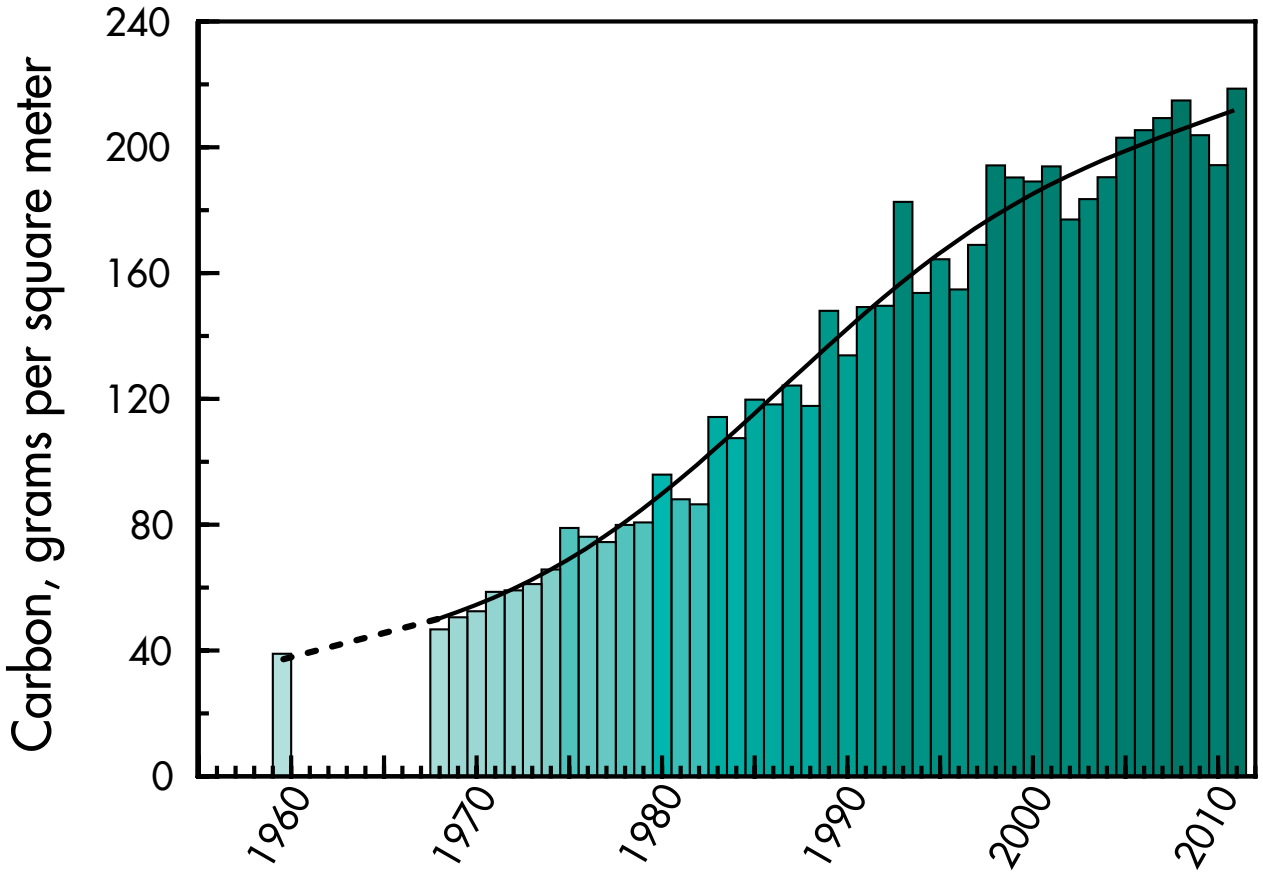
UCDAVIS
TAHOE ENVIRONMENTAL
RESEARCH CENTER

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 2011, primary productivity was 218.6 grams of carbon per square meter.



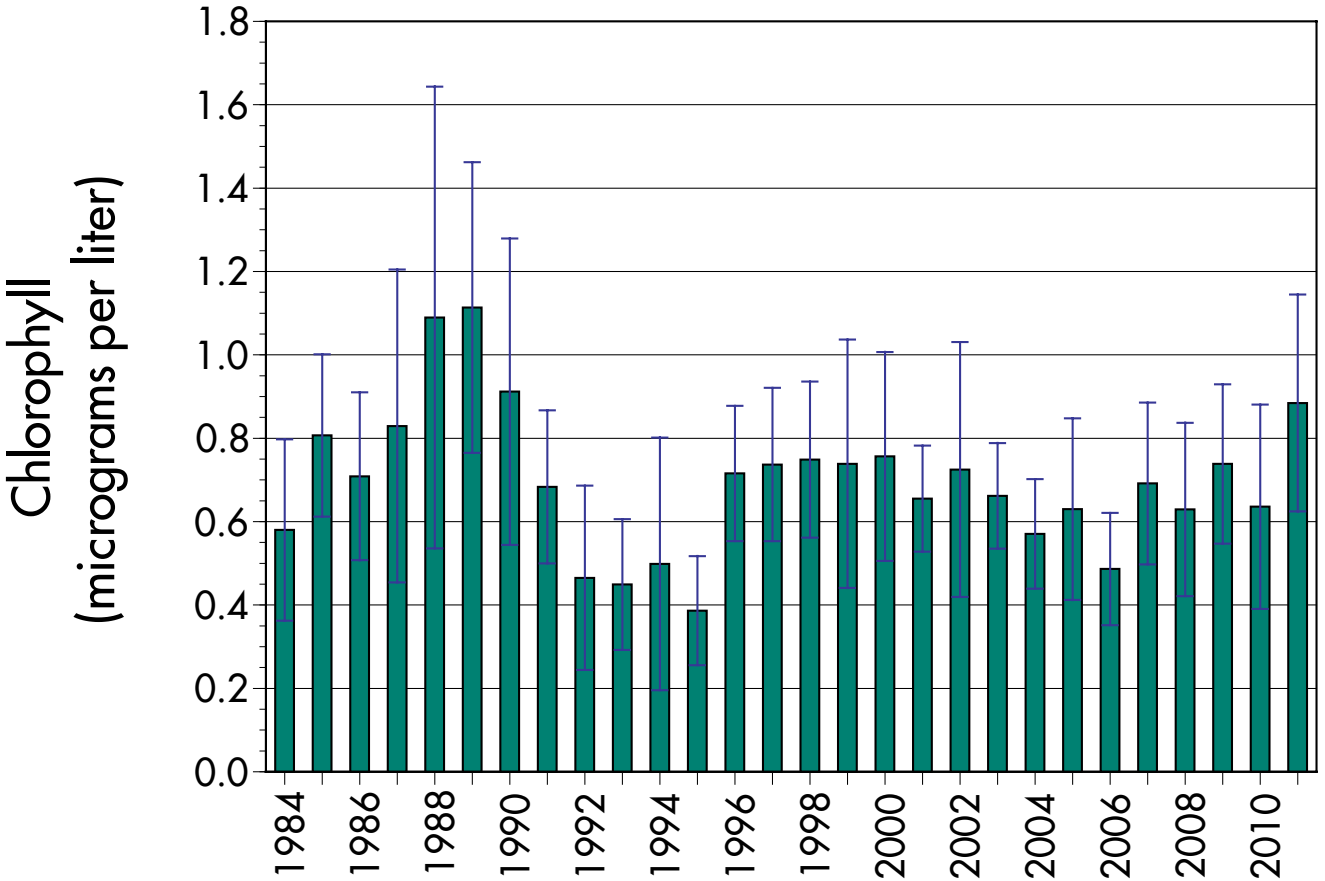
BIOLOGY

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 2011 was 0.88 micrograms per liter. The average annual chlorophyll *a* level in Lake Tahoe has remained relatively uniform since 1996.

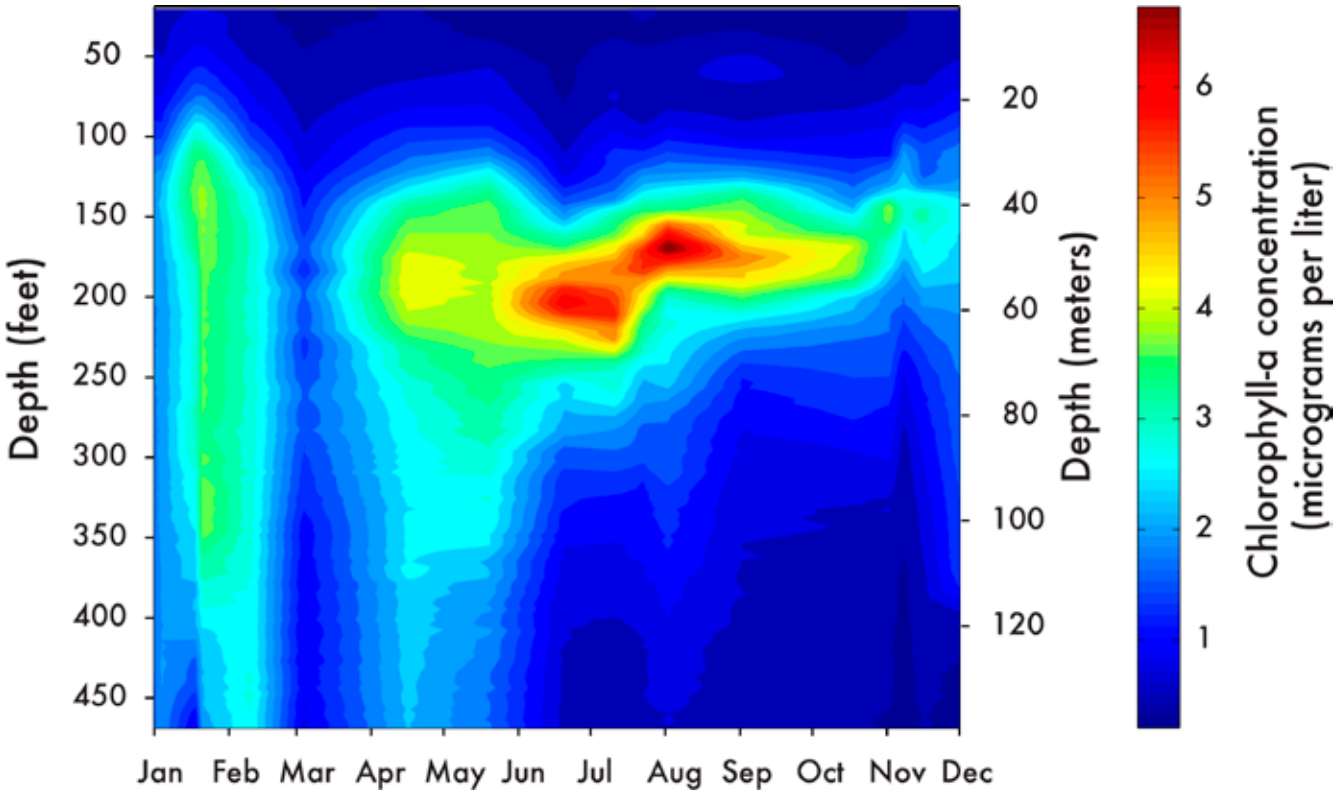


BIOLOGY

Algae concentration by depth

In 2011

Chlorophyll concentration can be measured in situ and is used for a surrogate for the concentration of algae. In summer in Lake Tahoe much of the algae is located within a deep chlorophyll layer, between 150 - 250 feet below the surface. In fall, when the lake commences to mix, the chlorophyll gets spread over a much broader depth range.

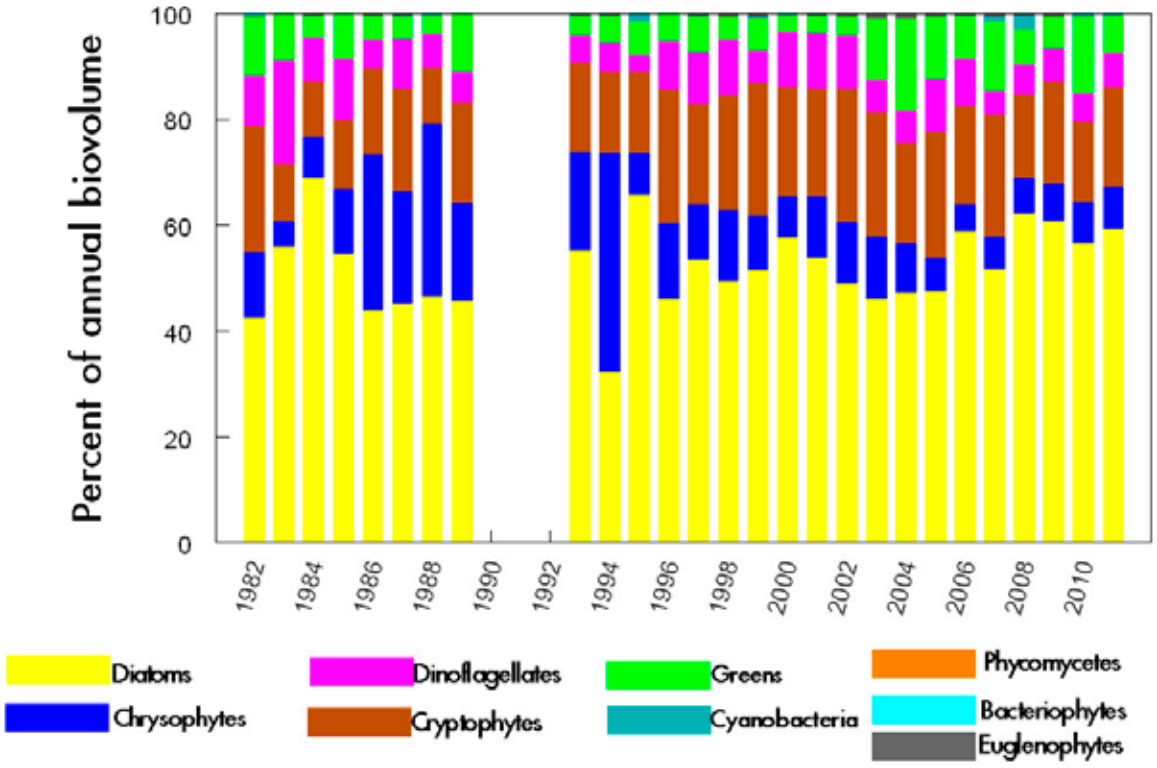


BIOLOGY

Annual distribution of algal groups

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.

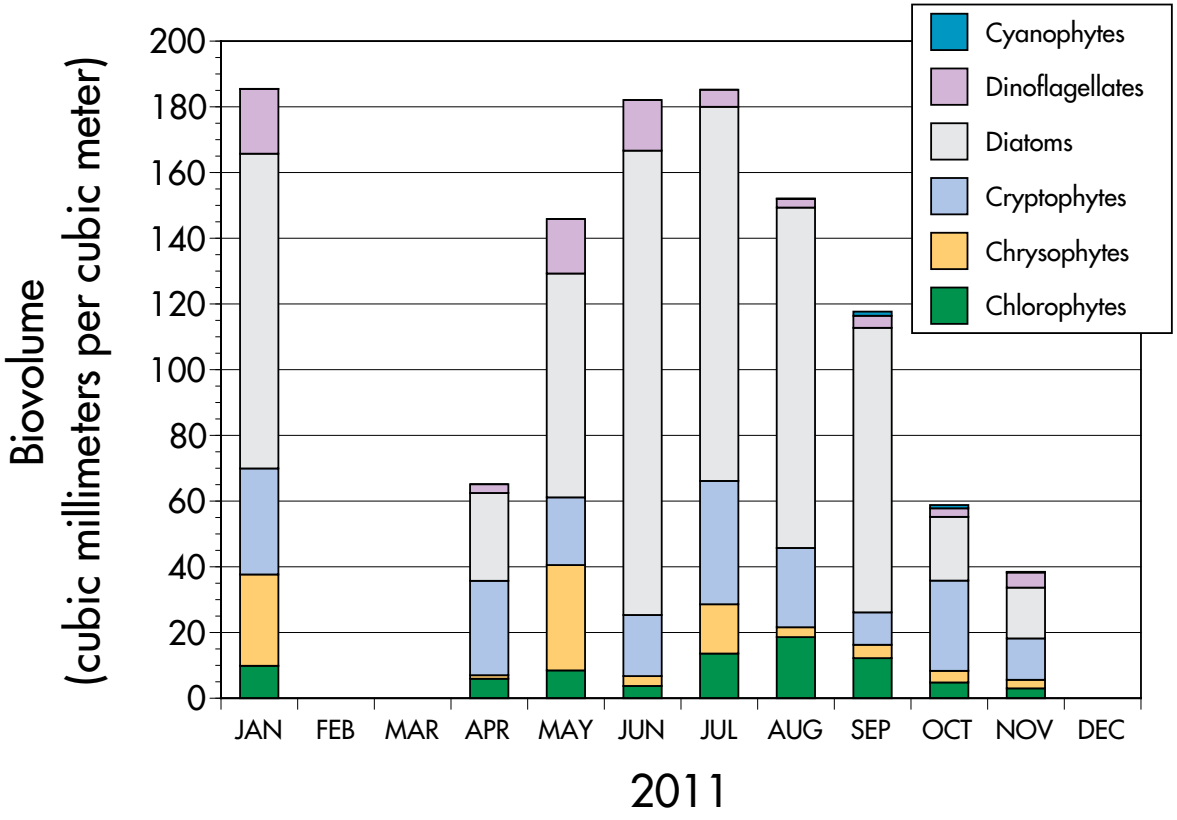


BIOLOGY

Algal groups as a fraction of total population

Monthly in 2011

Algae populations vary month to month, as well as year to year. In 2011, diatoms again dominated the phytoplankton community, especially in May-September when their biovolume was particularly high. In 2011, January had an unusually high biovolume compared to previous years.

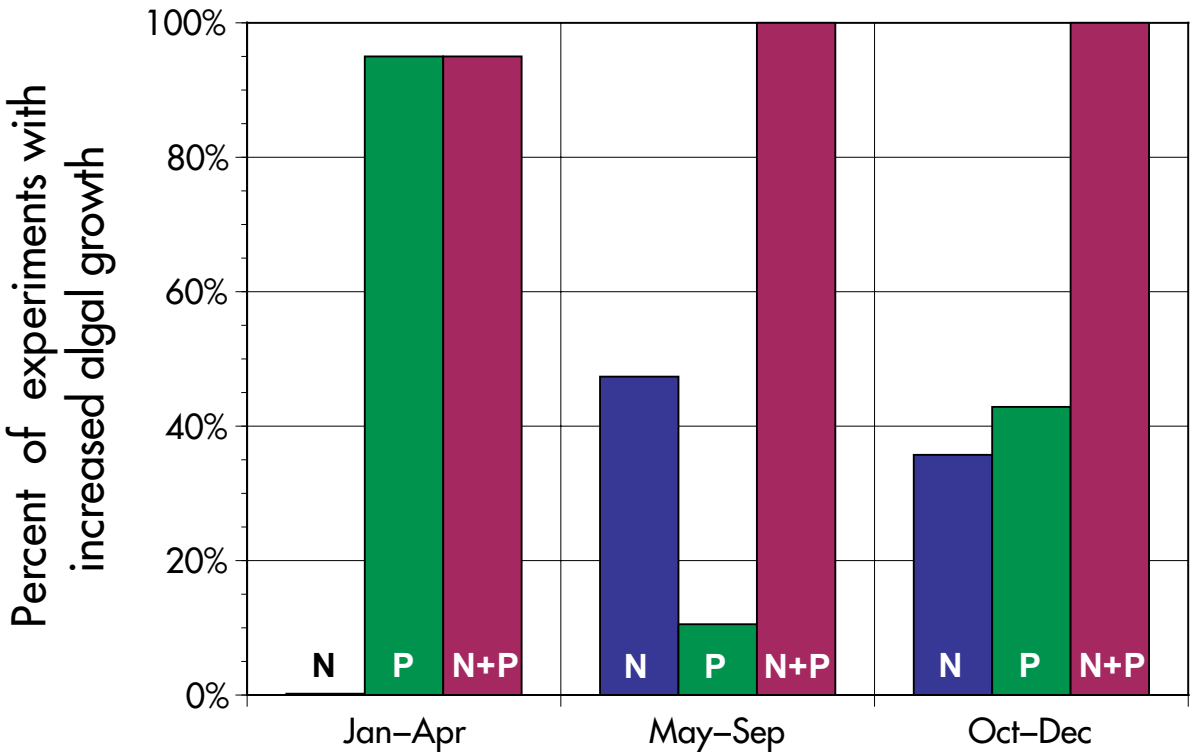


BIOLOGY

Nutrient limitation of algal growth

For 2002 - 2011

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 2002-2011 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.

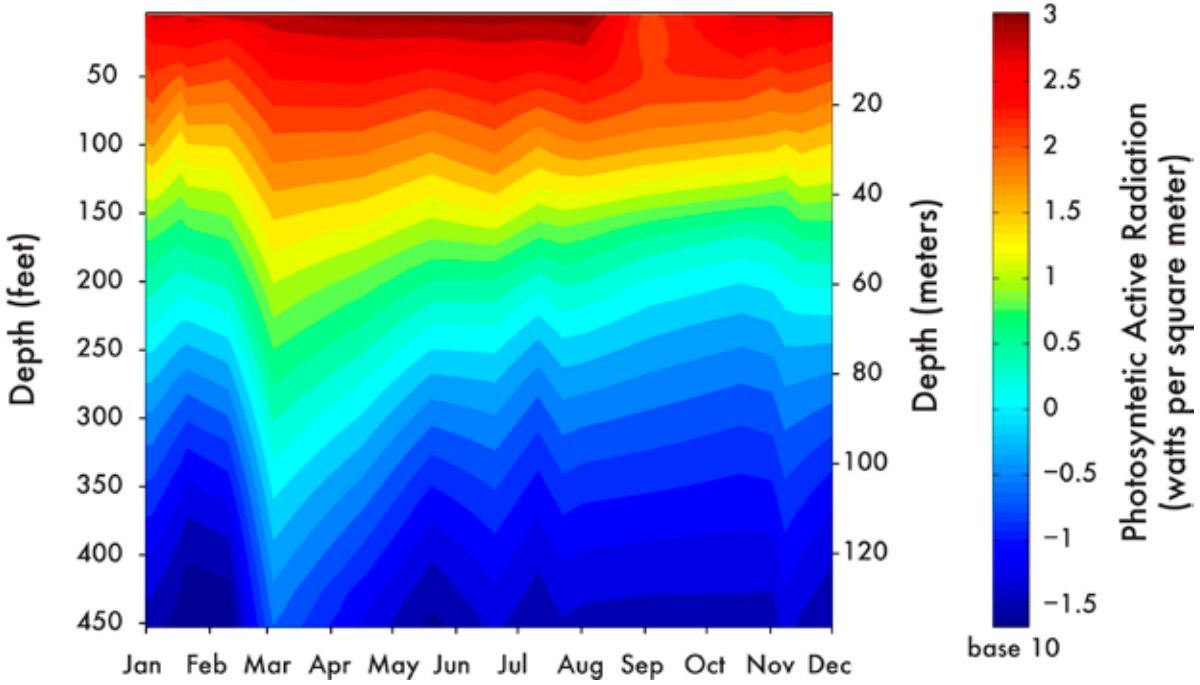


BIOLOGY

Photosynthetically active radiation

In 2011

Photosynthetically active radiation, often abbreviated PAR, designates the spectral range (waveband) of solar radiation from 400 to 700 nanometers that algae are able to use in the process of photosynthesis. Beyond a depth of about 300 feet there is insufficient light to promote photosynthesis. Higher intensity sunlight in summer produces an increase in the depth to which photosynthesis can occur.

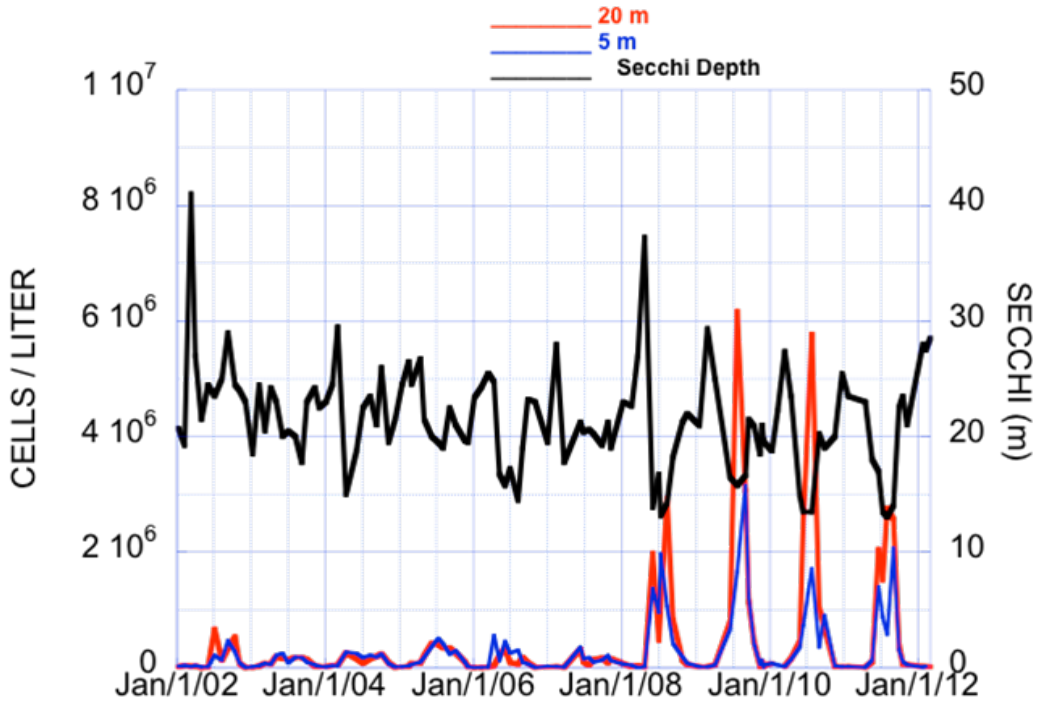


BIOLOGY

Predominance of Cyclotella sp.

From 2002 through 2011

In the last four years, one species of algae, *Cyclotella*, has started to dominate the make up of algae at Lake Tahoe. The individual cells are in the size range of 2 – 4 microns, the ideal size for light scattering. It is believed that the growing numbers of *Cyclotella* are in large part responsible for the decline in summer clarity. The red and blue lines below indicate the concentrations of *Cyclotella* at depths of 20 m (66 ft) and 5 m (16.5 ft) respectively. The black lines indicates the individual Secchi depths taken since 2002. The summer decline in Secchi depth coincides perfectly with the increase in *Cyclotella* concentration.

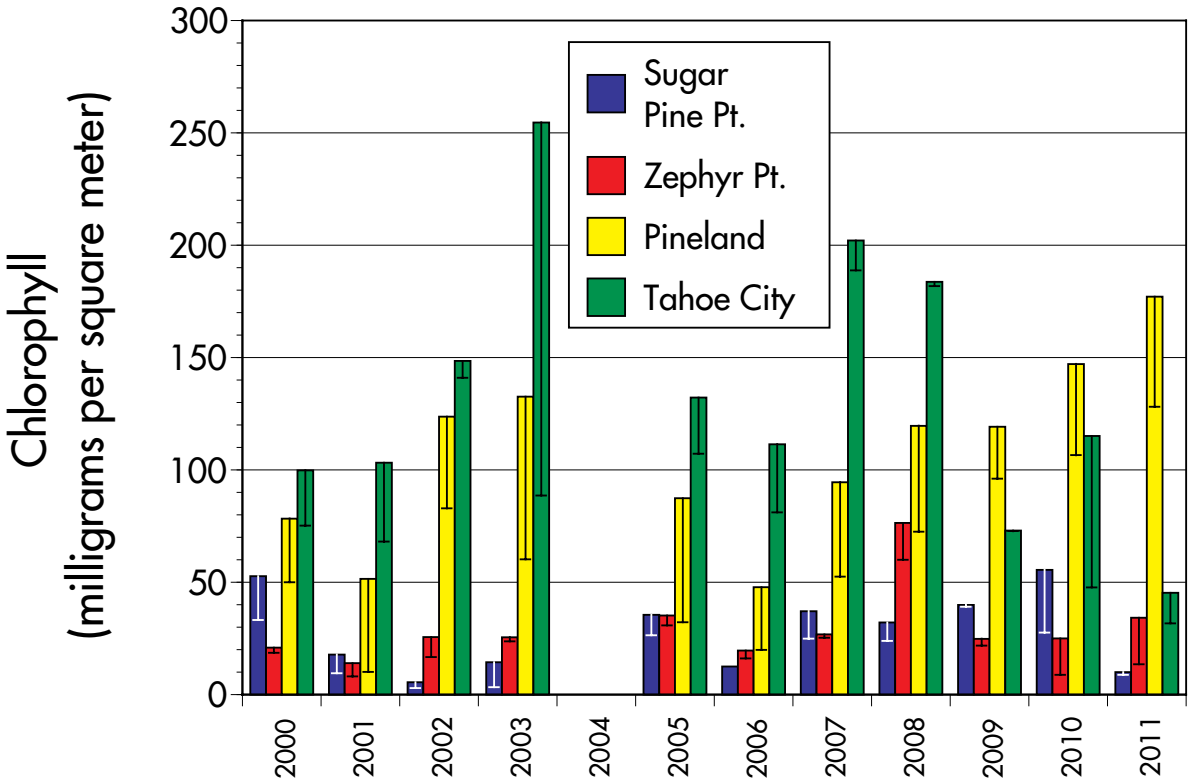


BIOLOGY

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 2011, concentrations were near or above average. The site with the most periphyton (Pineland) is close to urban areas. Tahoe City recorded the lowest values for that site since monitoring began in 2000. Peak annual biomass at the less urbanized Zephyr Point site remained down at 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. Monitoring periphyton is an important indicator of near-shore health.



BIOLOGY

Shoreline algae distribution

In 2011

Periphyton biomass was surveyed around the lake during the spring of 2011, 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.