TAHOE: STATE OF THE LAKE REPORT 2014

BIOLOGY

UC DAVIS
TAHOE ENVIRONMENTAL RESEARCH CENTER

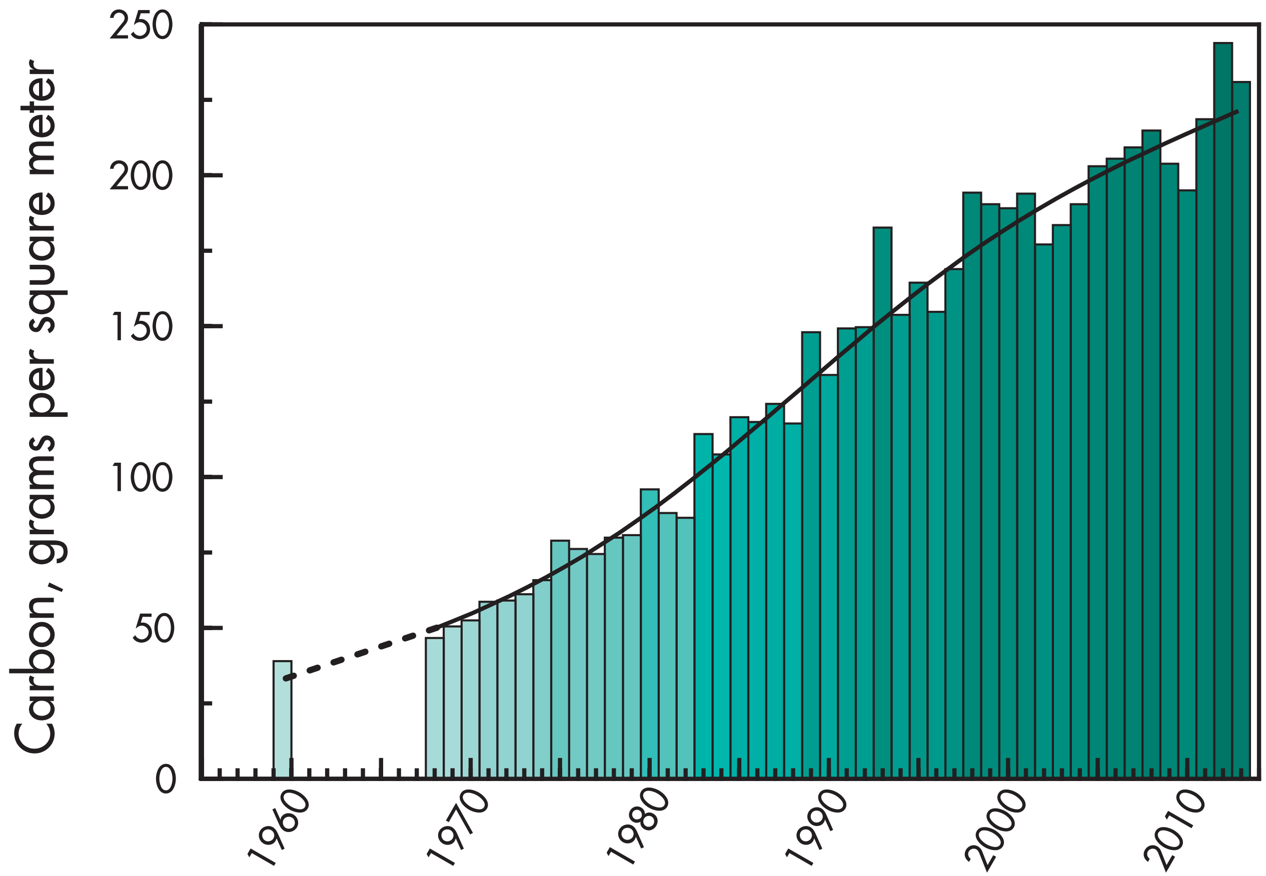
TERC.UCDAVIS.EDU

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. Supported by nutrient loading into the lake, changes in the underwater light environment and a succession of algal species, the trend shows primary productivity has generally increased over time. In 2013 we saw a slight decrease in primary productivity to 230.9 grams of carbon per square meter, but this was still the second highest volume on record.

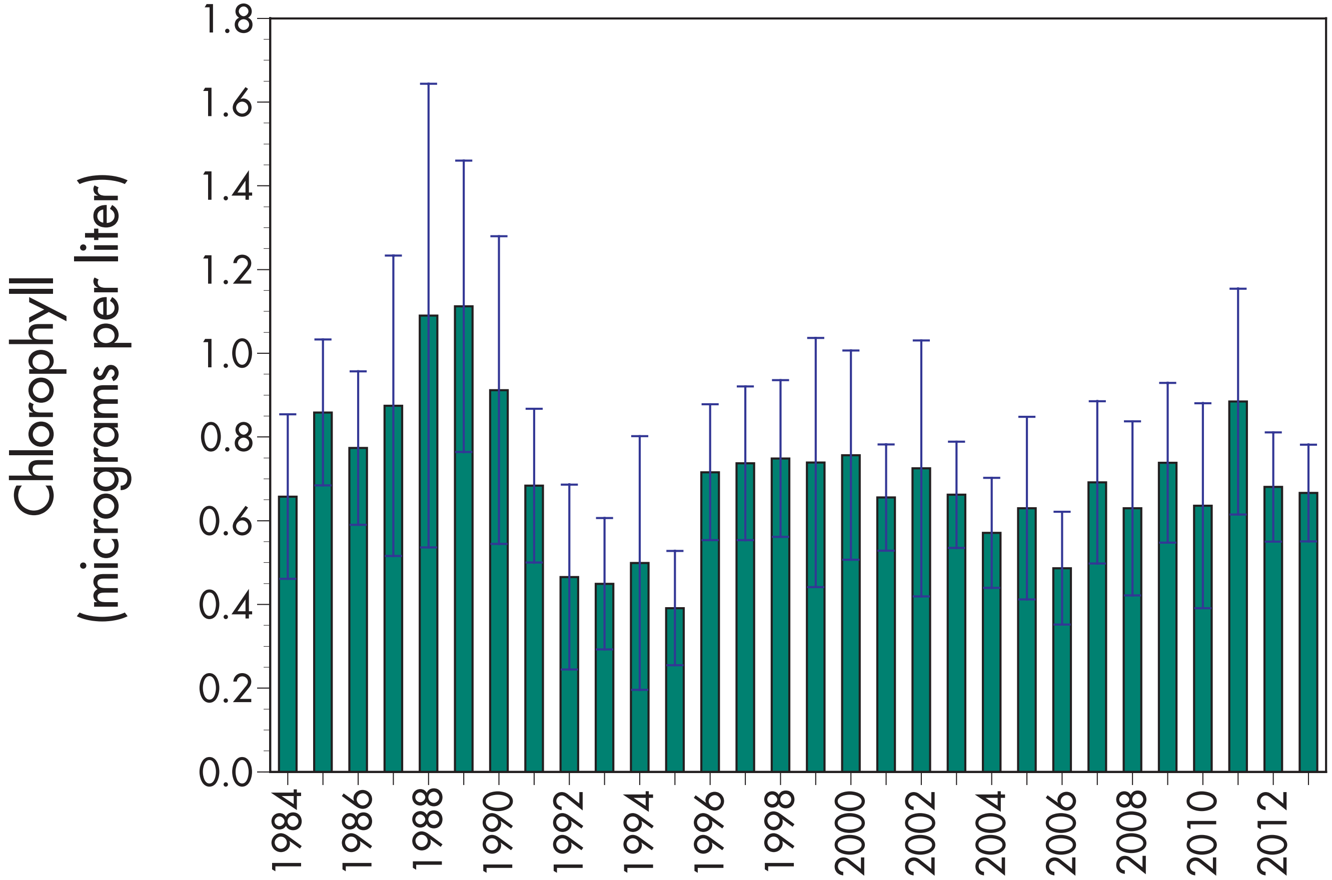


BIOLOGY

Algae abundance

Yearly since 1984

Algae (phytoplankton) are the base of the Lake Tahoe food web, and essential for lake health and the well-being of the entire ecosystem. The amount or biomass of free-floating algae in the water is determined by extracting and measuring the concentration of chlorophyll-*a*, a photosynthetic pigment that allows plants to absorb energy from the sun. Though the value varies annually, it has not shown a significant increase since measurements began in 1984. The annual average value for 2013 was 0.67 micrograms per liter. The average annual chlorophyll-*a* level in Lake Tahoe has remained relatively uniform since 1996. For the period of 1984-2013 the average value was 0.70 micrograms per liter.



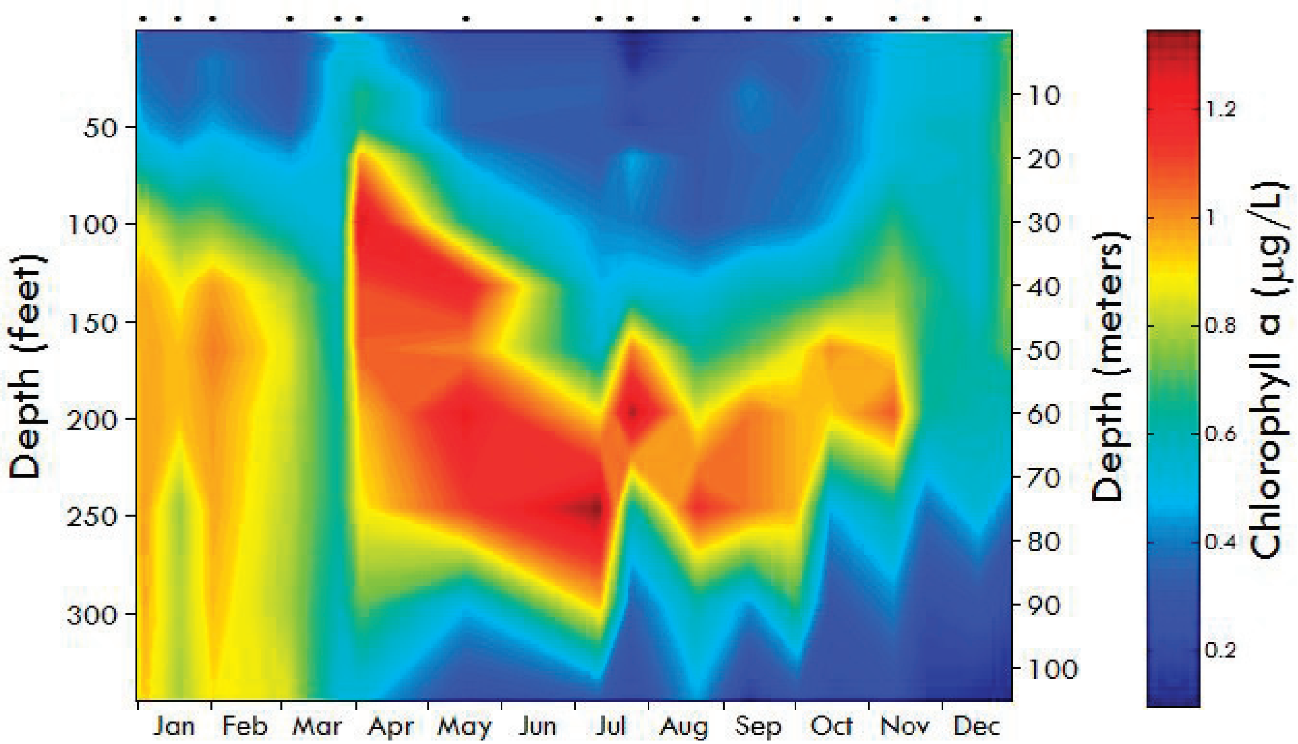
BIOLOGY

Chlorophyll-*a* distribution

In 2013

The distribution of algae (measured as chlorophyll–*a*) is the result of a combination of light availability, nutrient availability, mixing processes and to a lesser extent water temperature. This figure shows color contours of chlorophyll-*a* concentration down to a depth of 350 feet. Below this depth concentrations are near zero due to the absence of light.

Lake Tahoe has a "deep chlorophyll maximum", that is in the range of 100-200 ft. At that depth the light and nutrient conditions are most favorable for algal growth. In the early part of the year, the algae were distributed over a greater depth range because of the deep mixing processes that were occurring. With the onset of thermal stratification, the algae were confined to a discrete band. Throughout the year concentrations decreased as nutrients were depleted. In December, the commencement of deep mixing again redistributed the algae over a broader depth range. This period when algae are lifted into the surface water usually coincides with a decrease in water clarity.

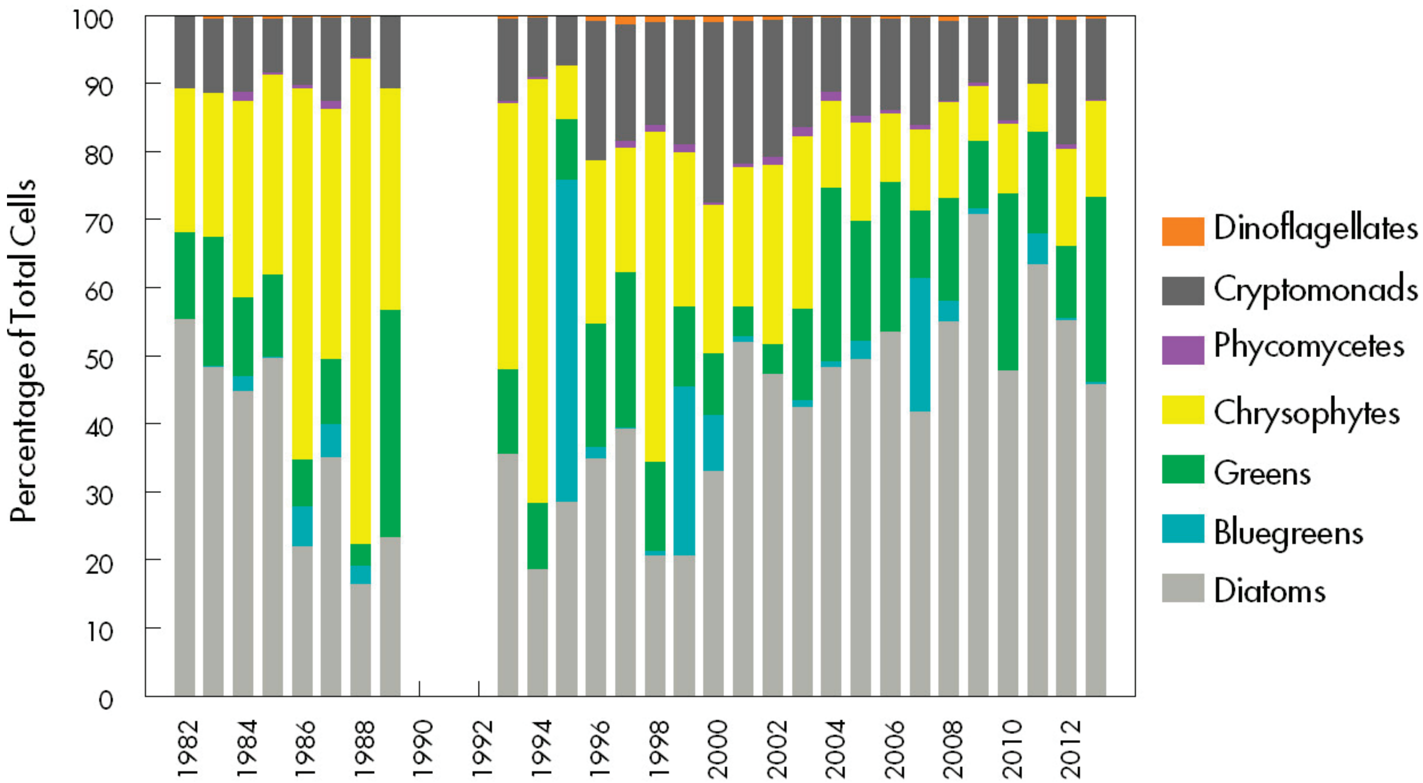


BIOLOGY

Annual distribution of algal groups

Yearly since 1982

The amount 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 abundance of algal cells each year. Chrysophytes, cryptophytes and green algae are next, comprising 10 to 30 percent of the total. While the proportion of 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, both seasonally and annually, in response to lake conditions.

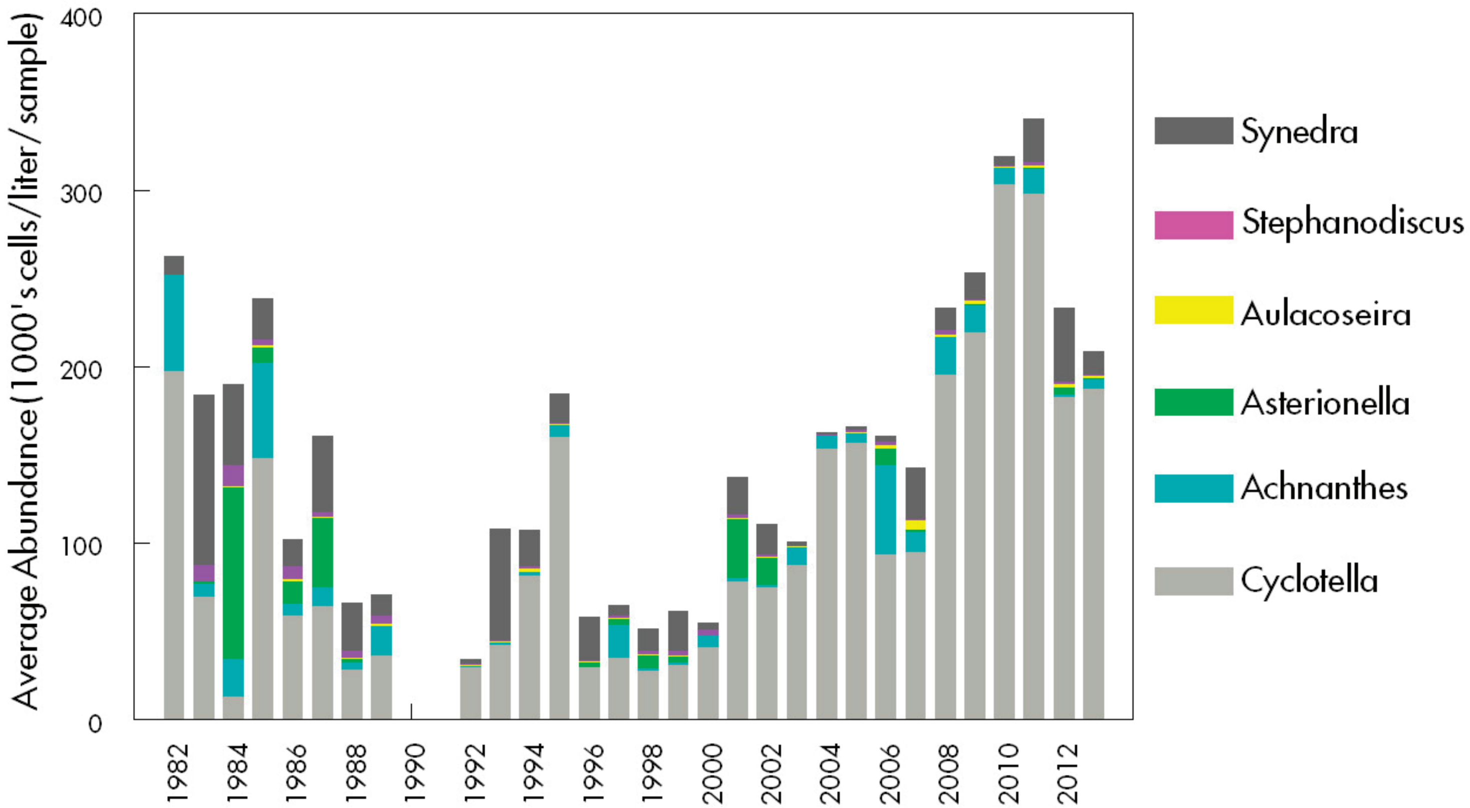


BIOLOGY

Abundance of dominant diatom species

Yearly since 1982

Diatoms have been the dominant algal group at Lake Tahoe for all but a few years since 1982. Diatoms are unique in that they are enclosed within a cell wall made of silica called a frustule. Here the dominant diatom species at Lake Tahoe between 1982 and 2013 are shown. Huge inter-annual variations are evident, both in the overall abundance and in the relative composition. Generally *Cyclotella gordonensis* is the dominant diatom species in Lake Tahoe.

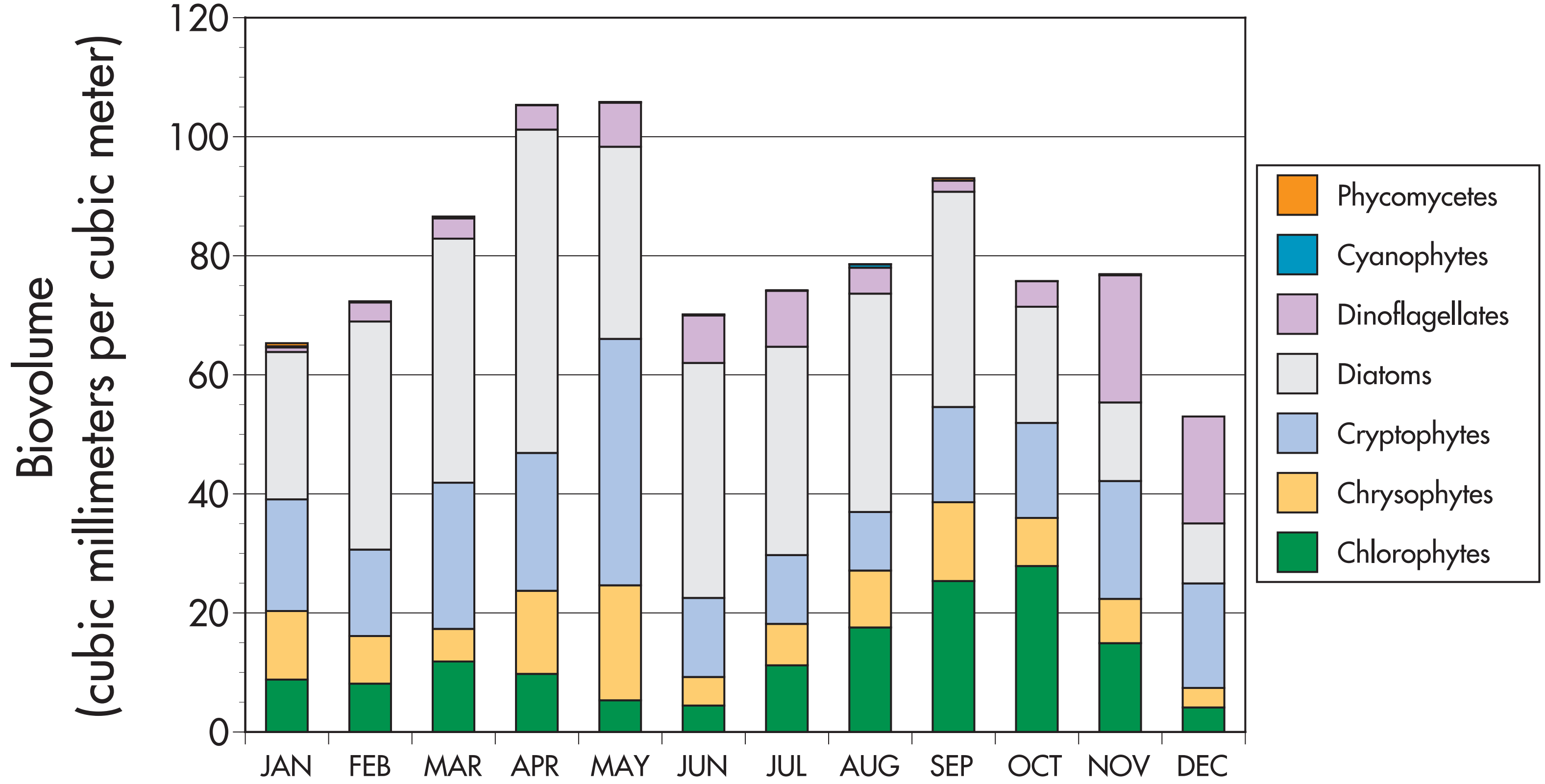


BIOLOGY

Algal groups as a fraction of total population

Monthly in 2013

Algae populations vary month to month, as well as year to year. In 2013, diatoms again dominated the phytoplankton community, especially in the first six months of the year. Diatom concentrations peaked in April and May (the "spring bloom"). Even at the peak of the bloom, algal cells occupied only one ten-millionth of the water in the lake. The peak biovolume in 2013 (105 cubic millimeters per cubic meter) was 35% lower than the peak in 2012. If all the algae in Lake Tahoe were spread out on a football field, they would fill it to a height of 9.2 feet (2.8 m).

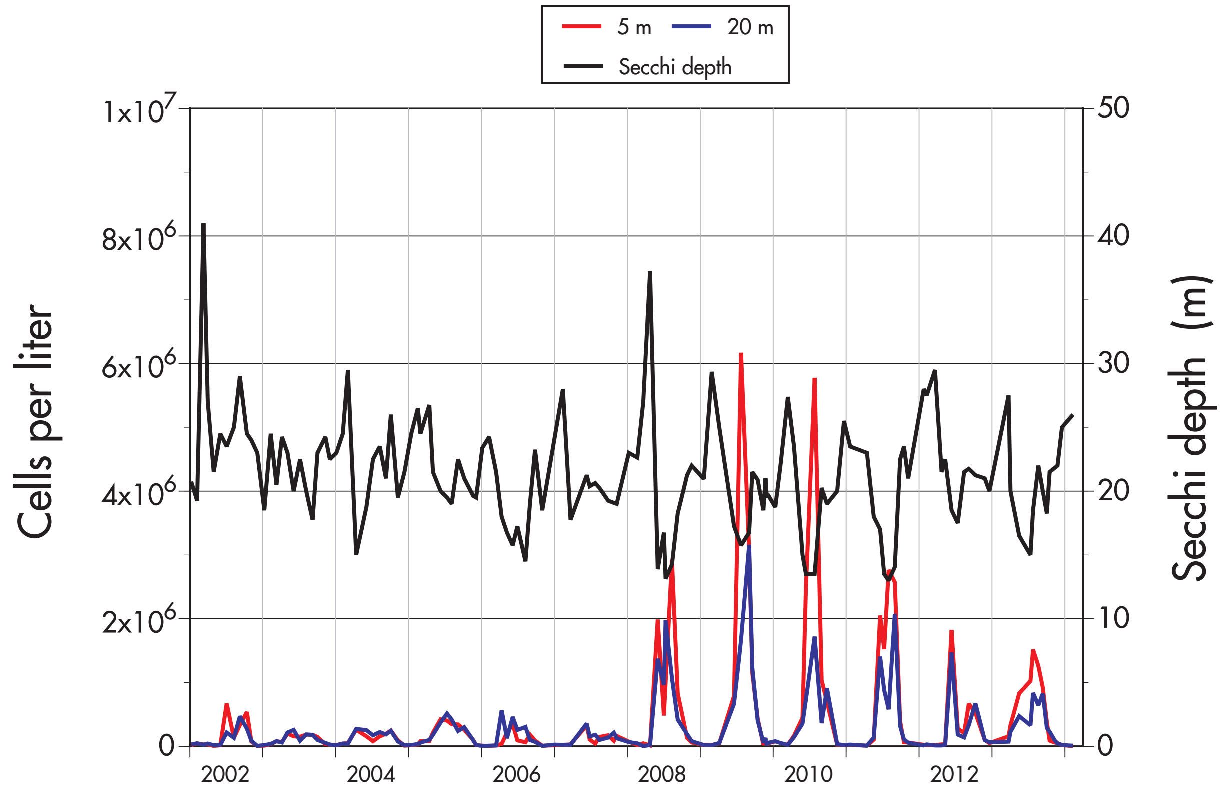


BIOLOGY

Predominance of *Cyclotella sp.*

From 2002 through 2013

In 2008, one species of algae, *Cyclotella gordonensis*, started to dominate the make-up of algae at Lake Tahoe. The cells range in size from 4 - 30 microns in diameter. During the summer, the smallest cells, 4 - 5 microns, control the community in the upper euphotic zone. This size range is ideal for light scattering, and the growing numbers of *Cyclotella* in 2008-2011 were believed to be in large part responsible for the major decline in summer clarity in those years. In 2013 the concentration of *Cyclotella* cells continued to decrease, and summer clarity was relatively high for the second year running. The blue and red lines below indicate the concentrations of *Cyclotella* at depths of 20 m (66 ft) and 5 m (16.5 ft) respectively. The black lines indicate the individual Secchi depths taken since 2002. The summer values of Secchi depth coincide perfectly with the changes in *Cyclotella* concentration.

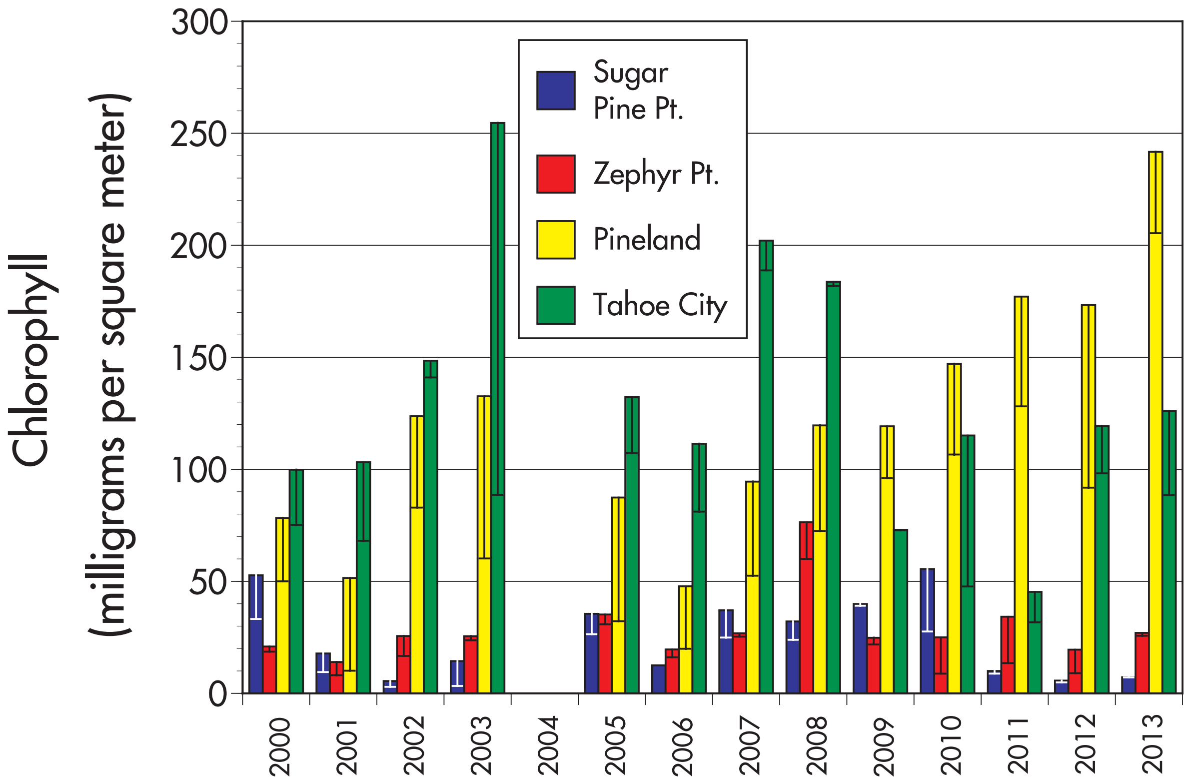


BIOLOGY

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 2013, concentrations at Sugar Pine Pt. (no urban influence) were below the long-term average. Tahoe City (heavily urbanized) and Zephyr Pt. were close to the long-term average. The site with the most periphyton (Pineland) is close to an urban area, and was at the highest level ever recorded. While monitoring periphyton is an important indicator of near-shore health, it is clear that greater attention to the mechanisms of periphyton growth is required if a decrease in attached algae is the desired end goal.



BIOLOGY

Shoreline algae distribution

In 2013

Periphyton biomass was surveyed around the lake during the spring of 2013, when it was at its annual maximum. Nearly 45 locations were inspected by snorkel survey in 1.5 feet (0.5 m) of water. A Periphyton Biomass Index (PBI) is used 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 fraction of the local bottom area covered by periphyton multiplied by the average length of the algal filaments (cm). Zones of elevated PBI are evident, particularly along the north and west shores of Lake Tahoe, although elevated levels of periphyton are also observed in South Lake Tahoe. Overall conditions in 2013 were slightly improved compared to 2012.

Note: The width of the colored band does not represent the actual dimension of the onshore-offshore distribution. Similarly its length does not represent the precise longitudinal extent.