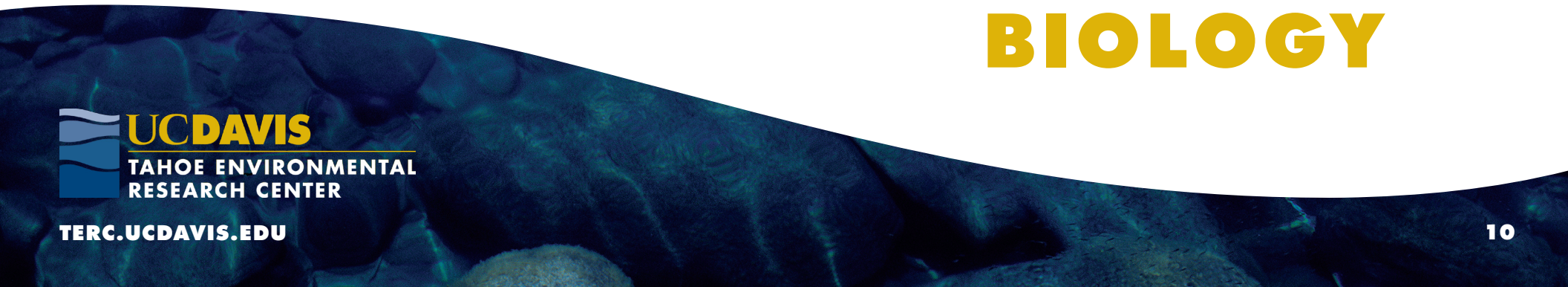
TAHOE: STATE OF THE LAKE REPORT 2015

BIOLOGY



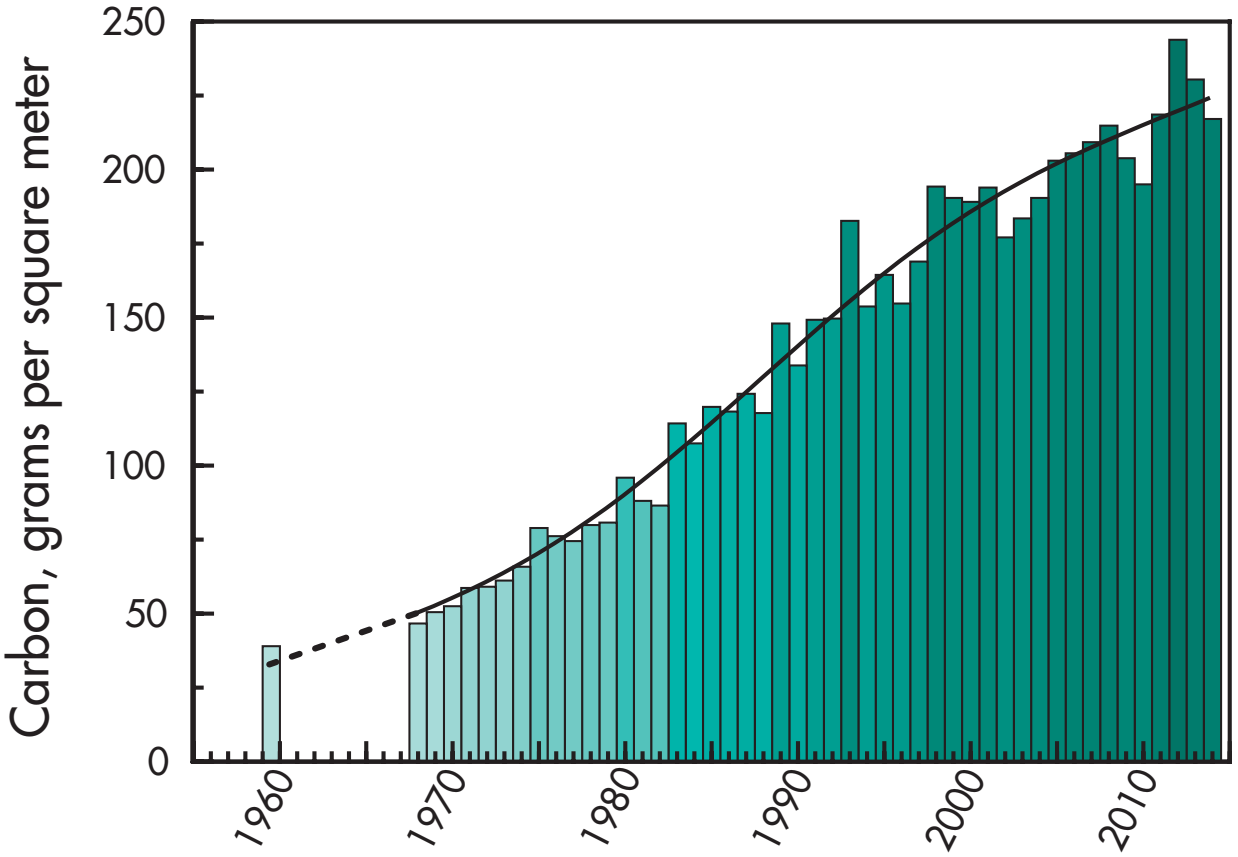
UCDAVIS
TAHOE ENVIRONMENTAL RESEARCH CENTER

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. 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 increased substantially over time. In 2014, there was a slight decrease in primary productivity to 217.1 grams of carbon per square meter.

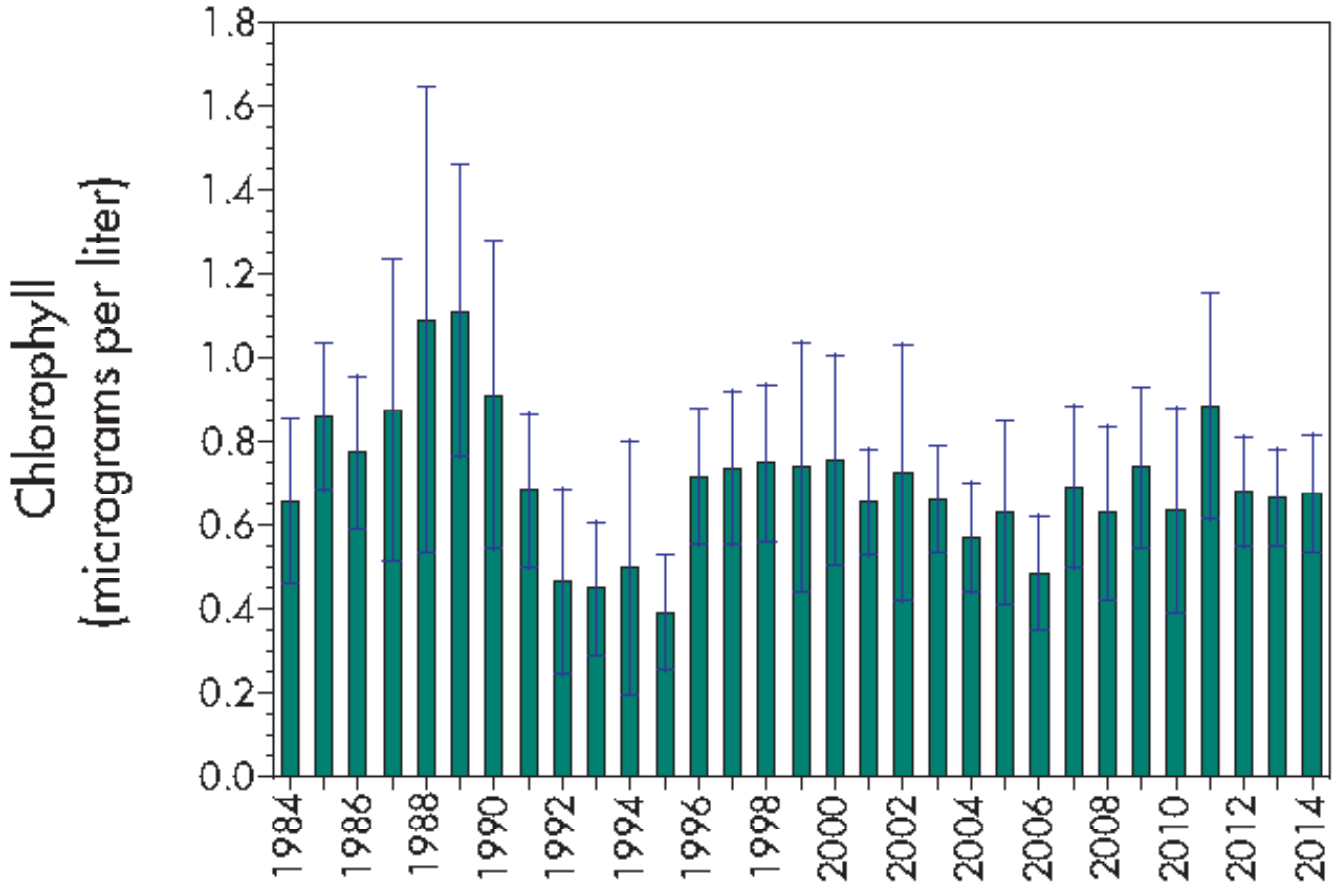


BIOLOGY

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 concentration for 2013 was 0.67 micrograms per liter. The average annual concentration for 2014 was 0.68 micrograms per liter, virtually identical to the previous two years. For the period of 1984-2014 the average annual chlorophyll-*a* concentration in Lake Tahoe was 0.70 micrograms per liter.



BIOLOGY

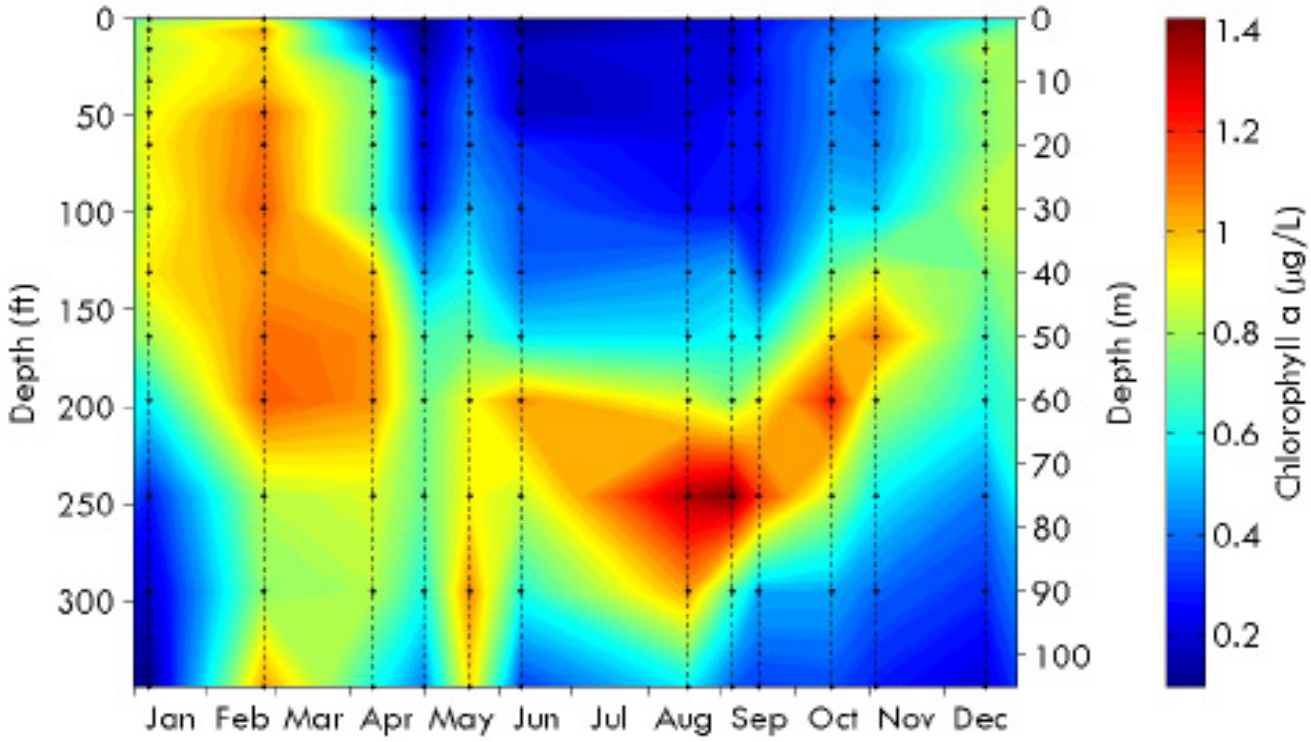
Chlorophyll-*a* distribution

In 2014

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" in the summer that is in the range of 150-300 ft. At that depth the light and nutrient conditions are most favorable for algal growth. The depth of the deep chlorophyll maximum increased in 2014 because of improved lake clarity.

In the early part of the year, the algae were distributed over a greater depth range because of the mixing processes that were occurring. With the onset of thermal stratification in spring, the algae were confined to a discrete band. Throughout the year concentrations decreased as nutrients were depleted. In November and December, the commencement of mixing again redistributed the algae over a broader depth range.

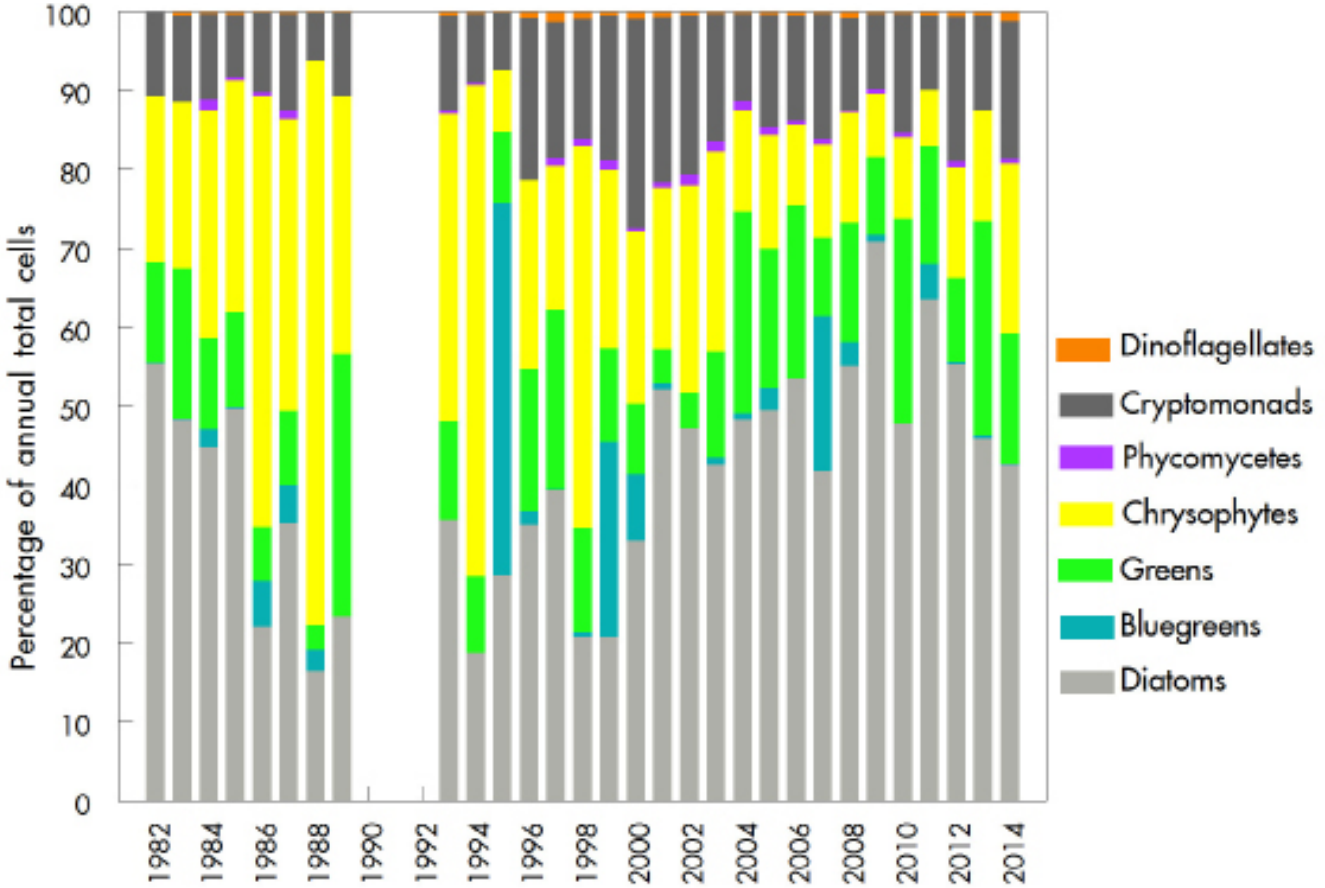


BIOLOGY

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 over 40 percent of the total abundance of algal cells in 2014. Chrysophytes, cryptomonads and green algae are next, each comprising less than 20 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.

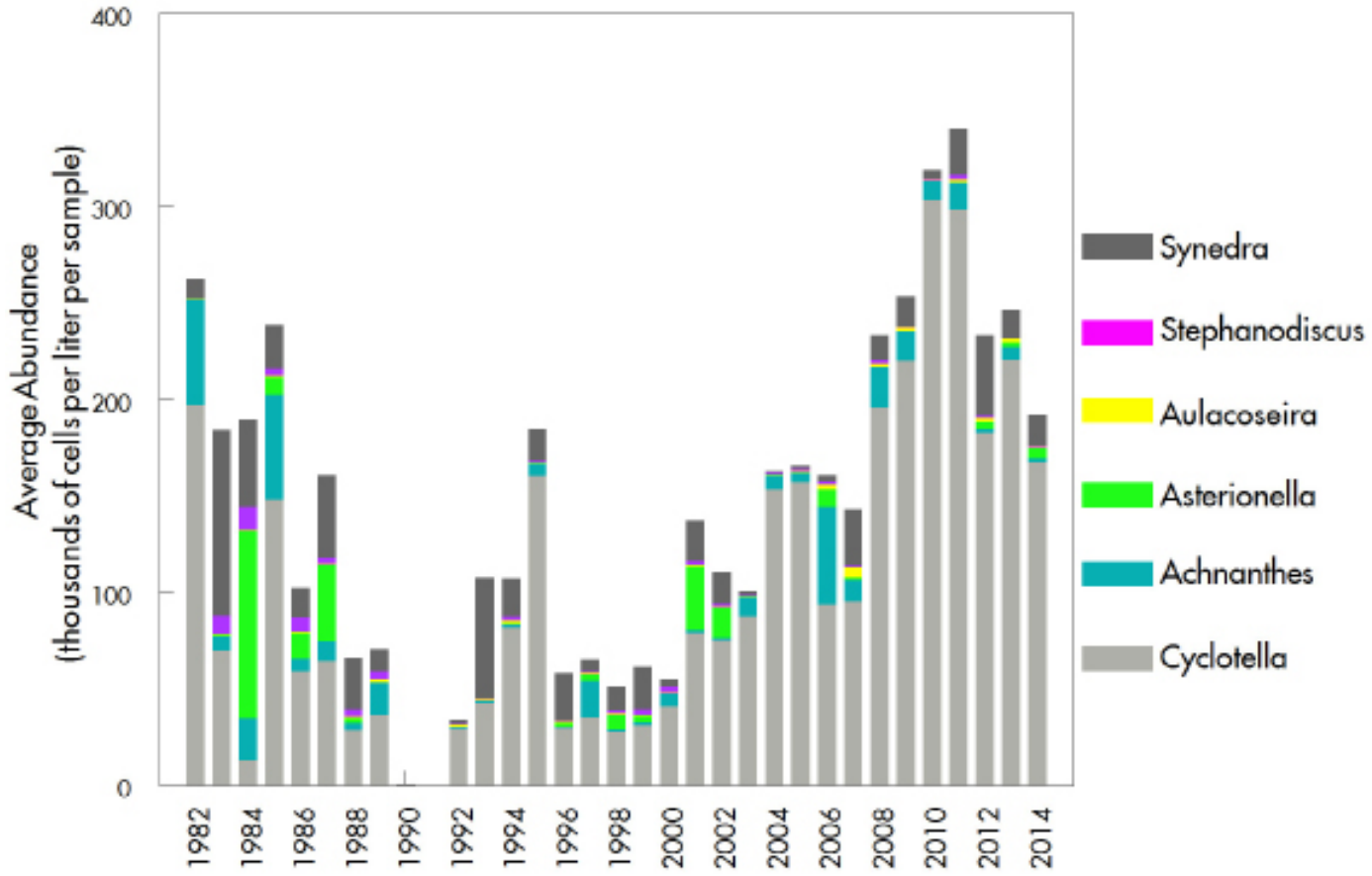


BIOLOGY

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 2014 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. The recent increase in *Cyclotella gordonensis* that peaked in 2010 and 2011 markedly reduced clarity in those years.

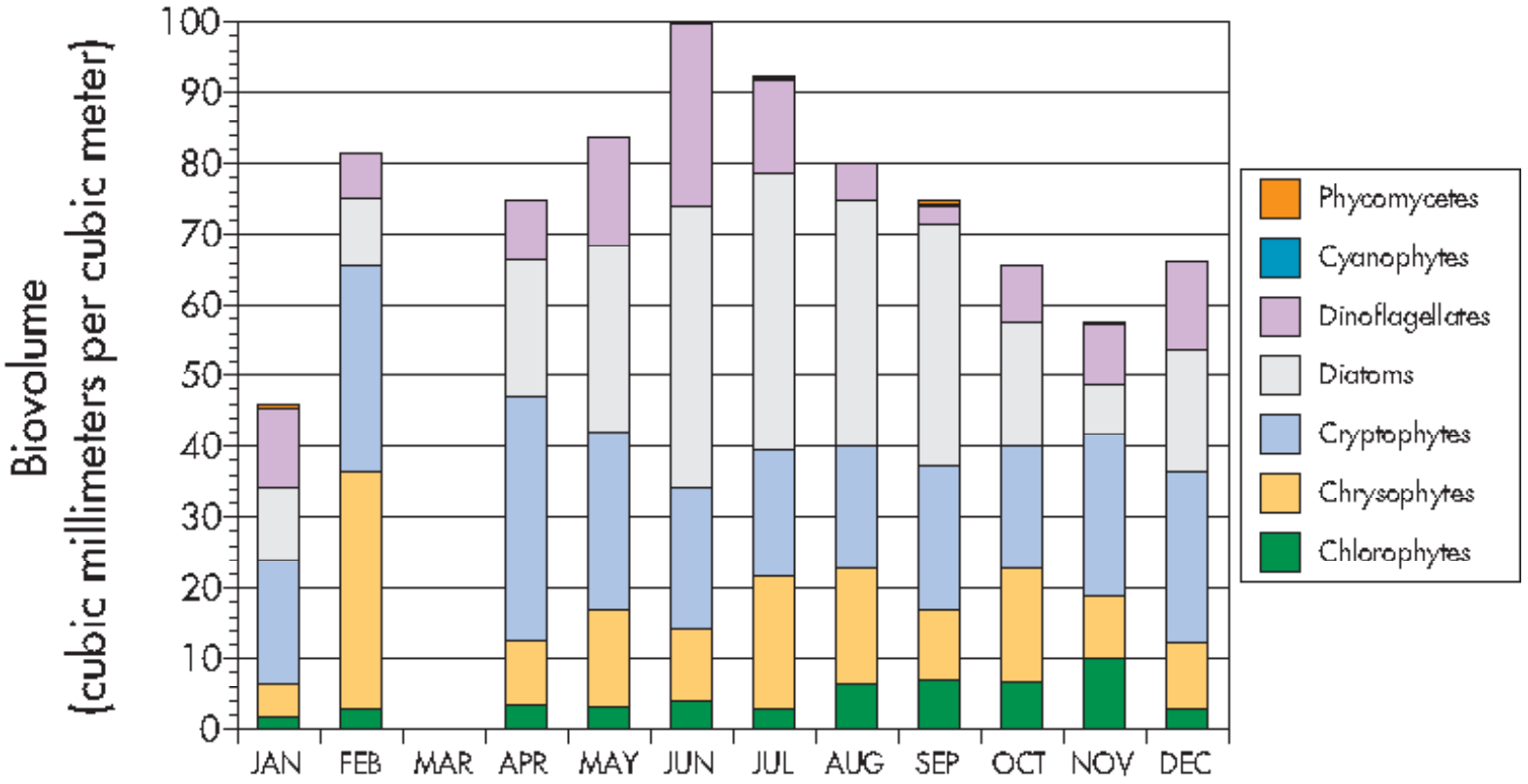


BIOLOGY

Algal groups as a fraction of total biovolume

Monthly in 2014

The biovolume of algal populations vary month to month, as well as year to year. In 2014, diatoms again dominated the biovolume of the phytoplankton community, especially in the summer. 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 2014 (100 cubic millimeters per cubic meter) was five percent lower than the peak in 2012.

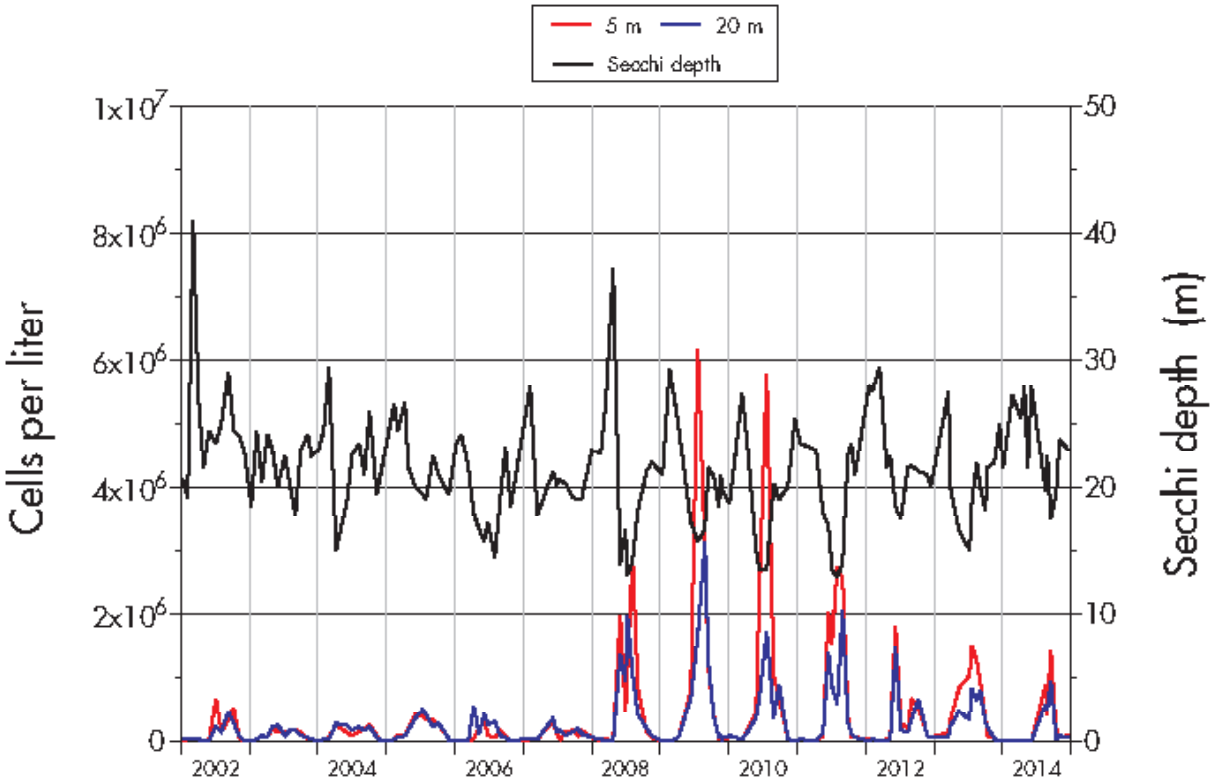


BIOLOGY

Predominance of *Cyclotella spp.*

From 2002 through 2014

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, which is the same as the inorganic particles, is ideal for light scattering. The growing numbers of *Cyclotella* between 2008-2011 were believed to be in large part responsible for the major decline in summer clarity in those years. In 2014 the concentration of *Cyclotella* cells continued to decrease, and in particular the duration of bloom conditions was lower than in the past. The blue and red lines below indicate the concentrations of *Cyclotella* at depths of 66 feet (20 m) and 16.5 feet (5 m) respectively. The black lines indicate the individual Secchi depths taken since 2002. The summer decrease of Secchi depth coincides perfectly with the increase in *Cyclotella* concentration.

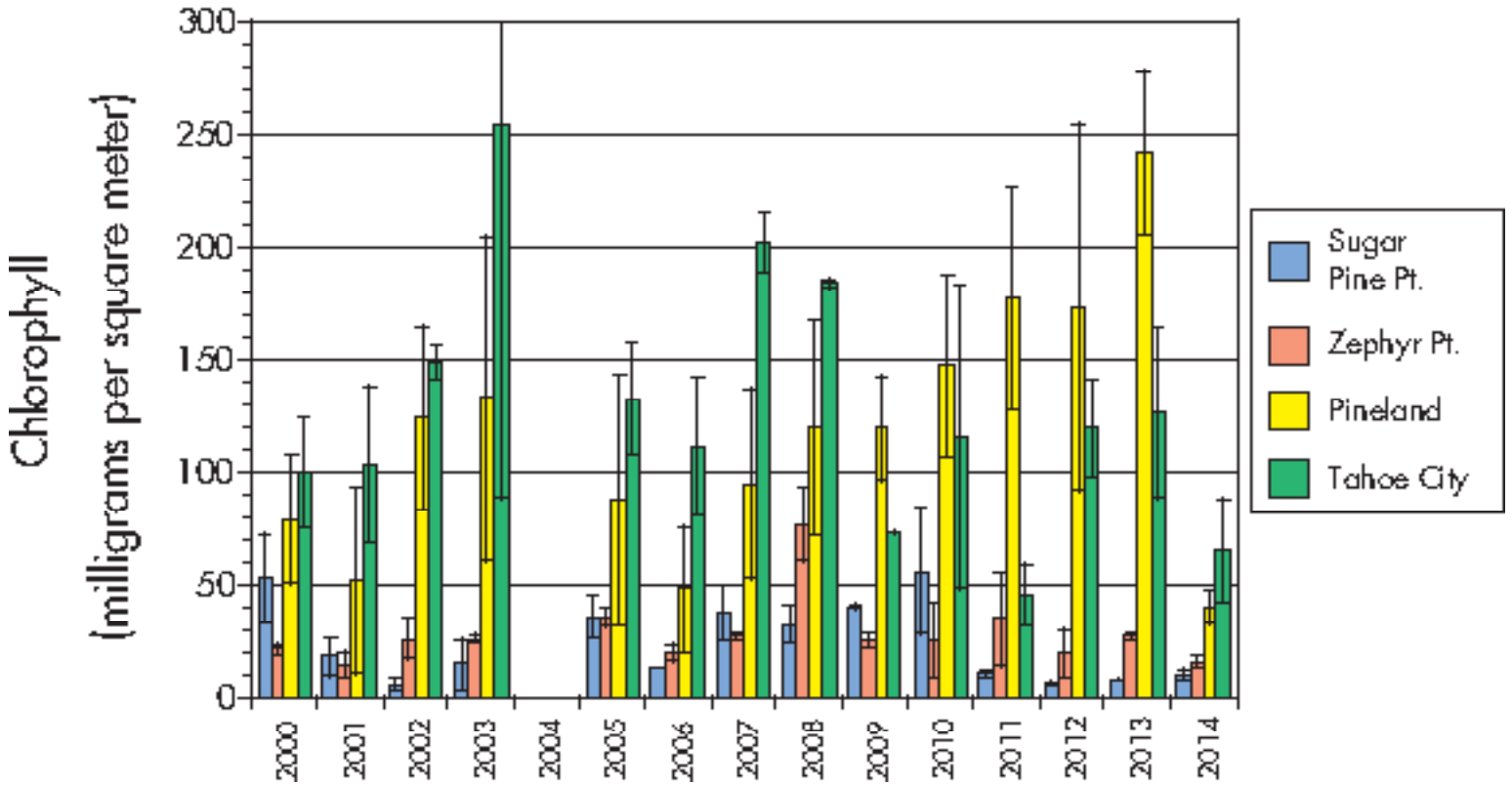


BIOLOGY

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 for the period from January to June. In 2014, concentrations at the four sites shown were at or below their historic lows. The two most urbanized sites. Tahoe City and Pineland, were one half to one sixth of their values in comparison with 2013. While monitoring periphyton is an important indicator of near-shore health, these data do not shed information on what is controlling year-to-year changes. The Nearshore Network (see Recent Research, Section 6) is intended to provide deeper insight on the factors controlling periphyton growth.



BIOLOGY

Shoreline algae distribution

In 2014

Periphyton biomass was surveyed around the lake during the spring of 2014, 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 (cm) of the algal filaments. Zones of elevated PBI are evident, particularly near South Lake Tahoe, and to a lesser extent this year in the north-west. Overall conditions in 2014 were greatly improved compared to 2013 and most results from the last 14 years. Low lake level largely accounts for this.

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.

Distribution of Periphyton Biomass
at 0.5m Depth, Spring 2014