TAHOE: STATE OF THE LAKE REPORT 2019

BIOLOGY

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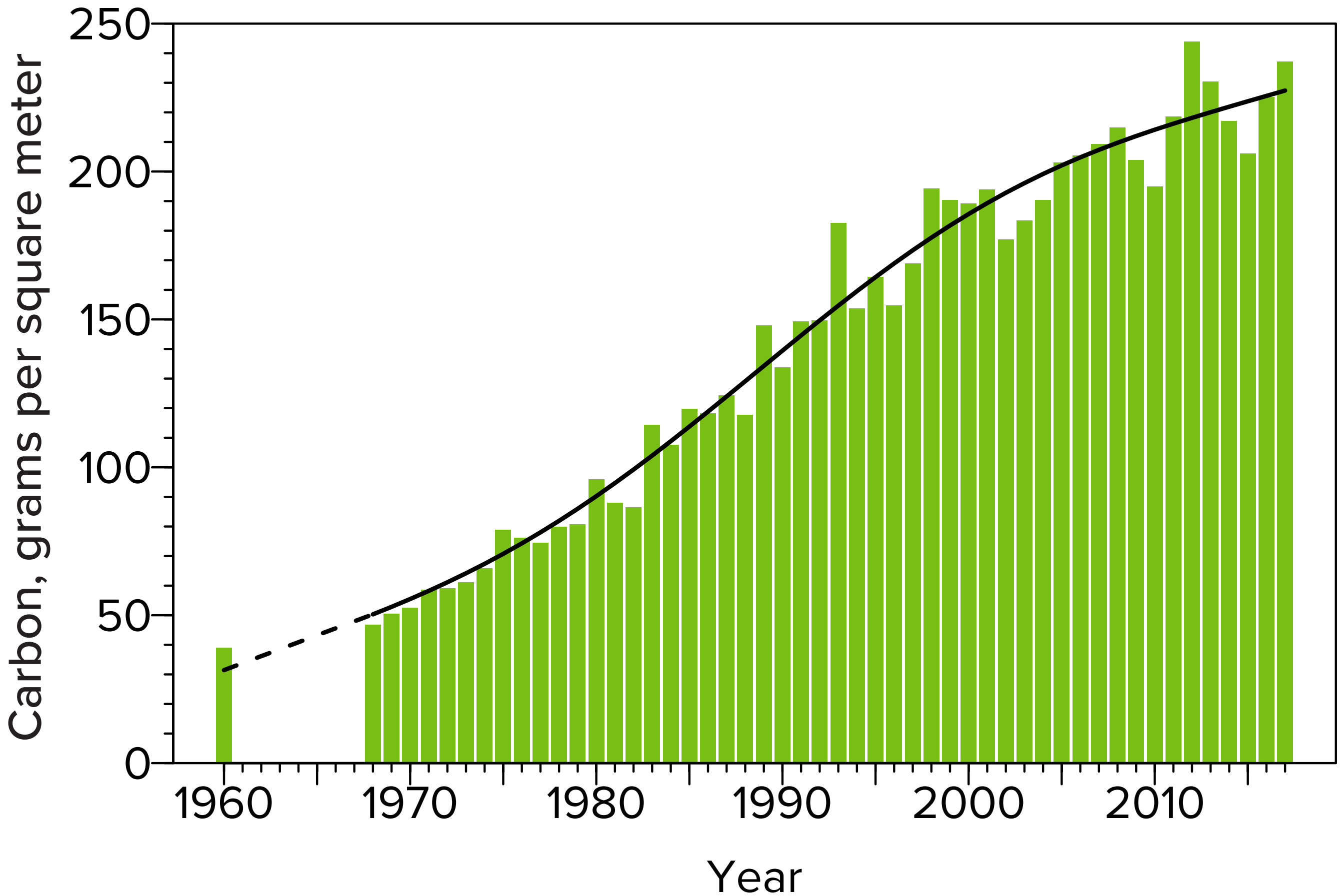
Algae growth (primary productivity)

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 2017, there was an increase in primary productivity to 237.2 grams of carbon per square meter.*

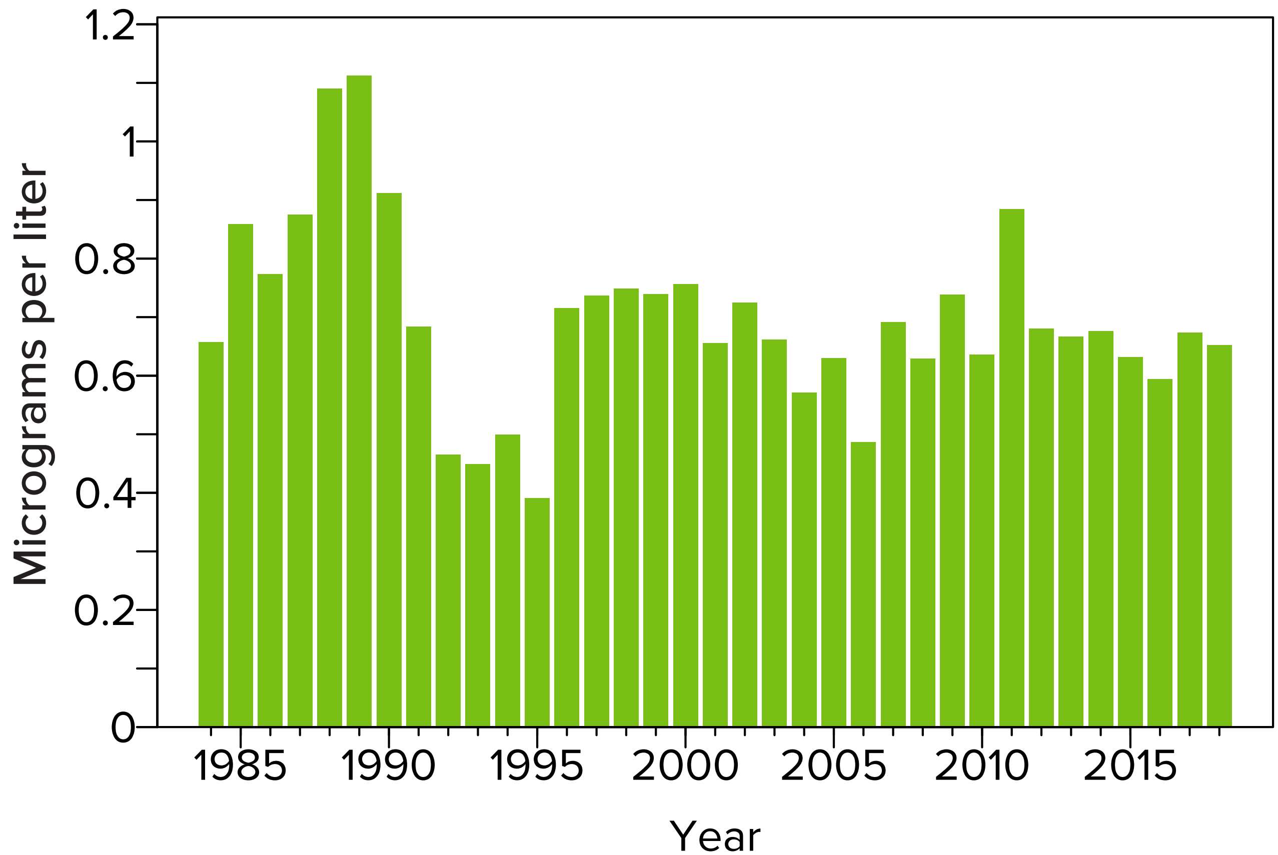


Please note: 2017 data show, data for 2018 currently not available

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 convert energy from the sun. Though the value varies annually, it has shown remarkable consistency over the last 30 years. The average annual concentration for 2018 was 0.65 micrograms per liter. For the period of 1984-2018 the average annual chlorophyll-*a* concentration in Lake Tahoe was 0.70 micrograms per liter.

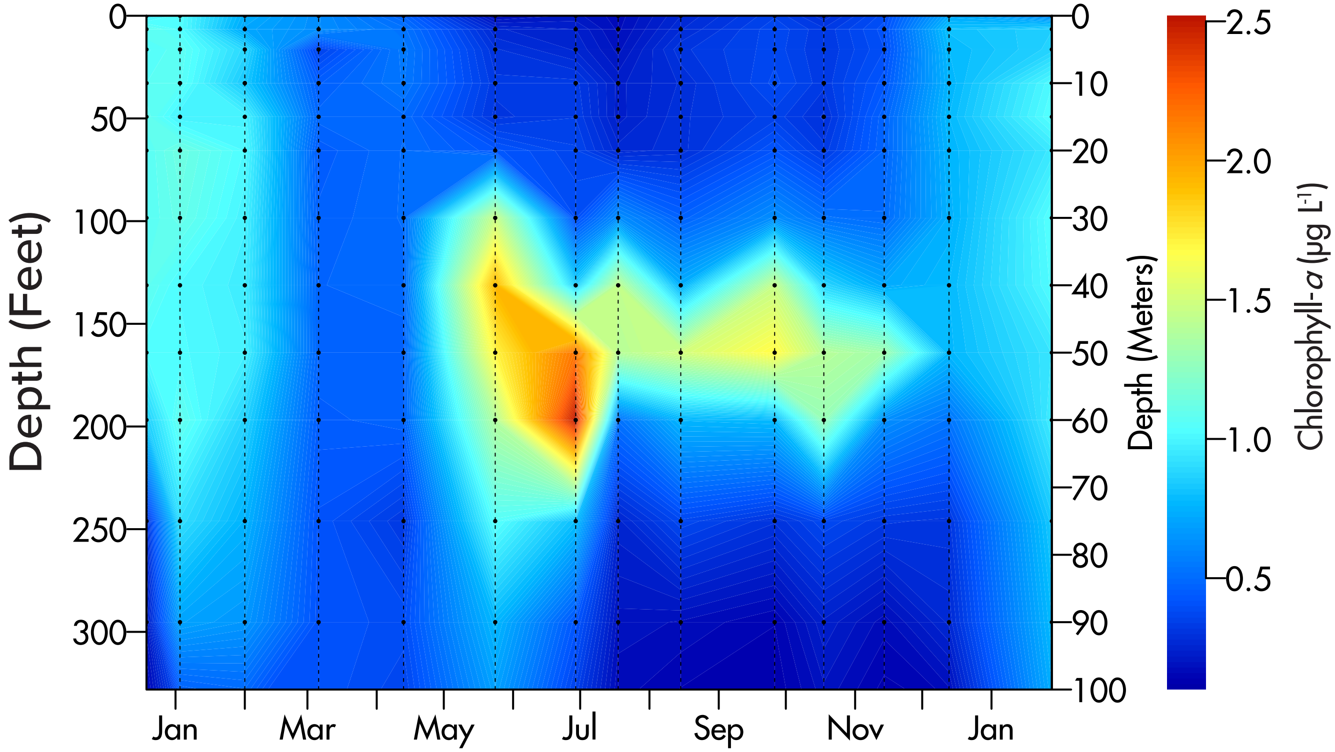


Chlorophyll-*a* distribution

In 2018

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 chlorophyll-*a* concentrations are near zero due to the absence of light. Lake Tahoe has a "deep chlorophyll maximum" in the summer that occupies the range of 150-300 feet in the water column. In that depth range, the light and nutrient conditions are most favorable for algal growth.

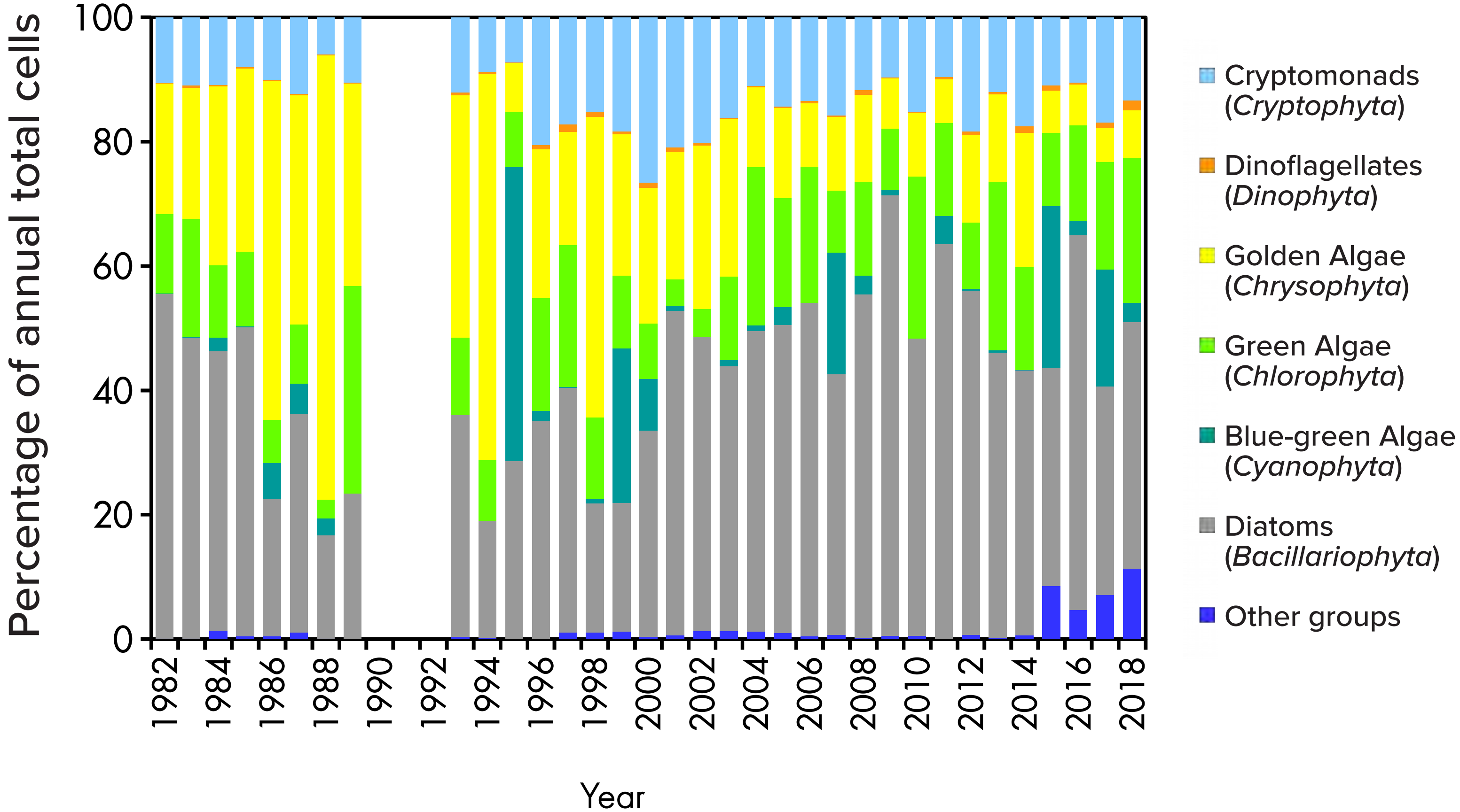
With the onset of thermal stratification in spring, the majority of the algae were confined to a discrete band. The time of maximum chlorophyll-*a* concentration was during late June, and centered at a depth of 150-200 feet. Later in the year concentrations decreased as nutrients were depleted. In November and December, the commencement of mixing again redistributed the algae over a broader depth range. Note that the *Cyclotella gordonesis* at the surface have a very small chlorophyll expression. However, the large number of these tiny cells are what matters.



Annual distribution of algal groups

Yearly since 1982

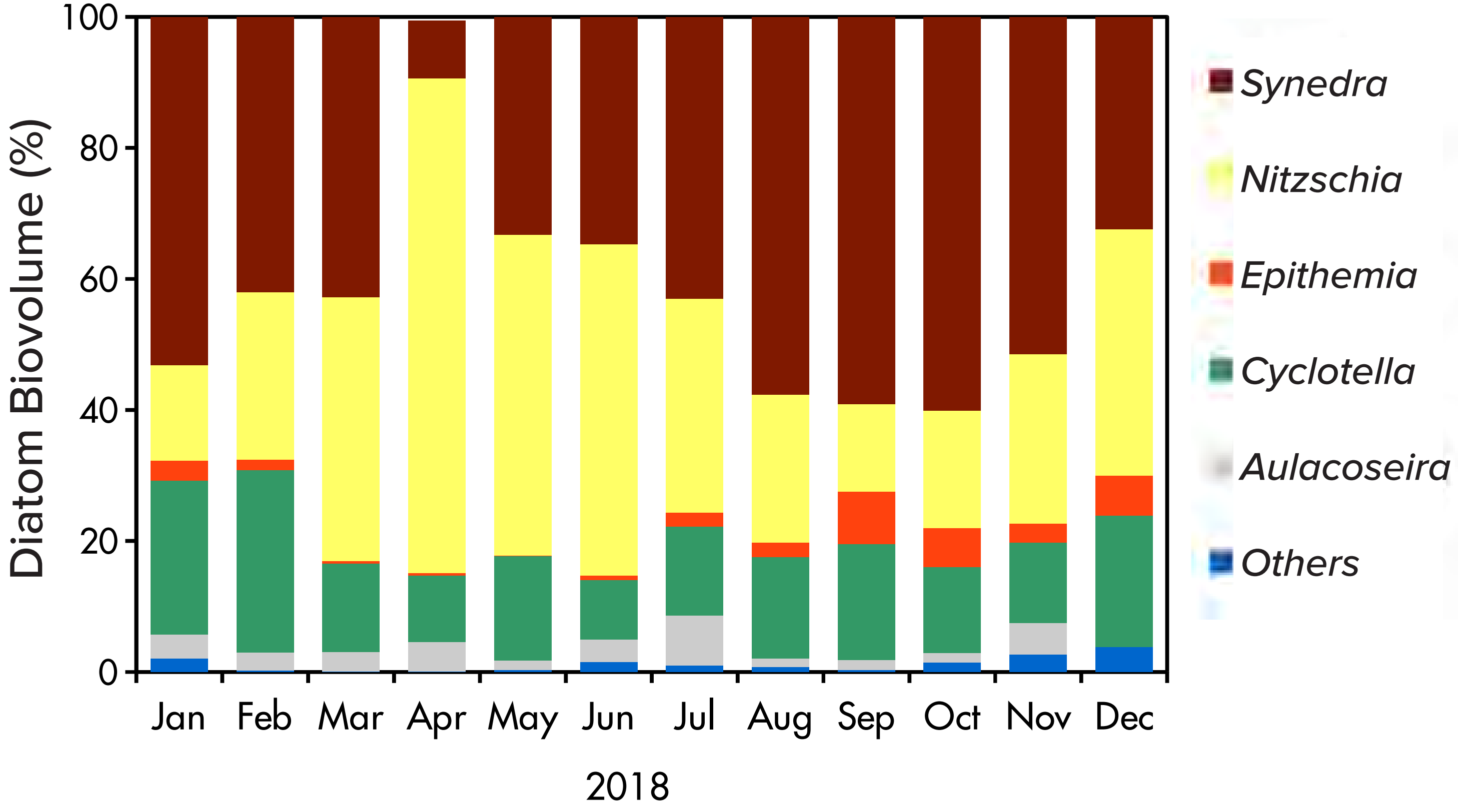
The amount of algal cells from different groups varies from year to year. Diatoms are the most common type of alga, comprising approximately 50 percent of the total abundance of algal cells in 2018. Green algae, Cryptomonads, and Chrysophytes are next, each comprising less than 15 percent of the total. Interestingly, over the last 4 years, there has been an increase in the total fraction of "minor" algal groups. 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.



Abundance of dominant diatom species

Monthly in 2018

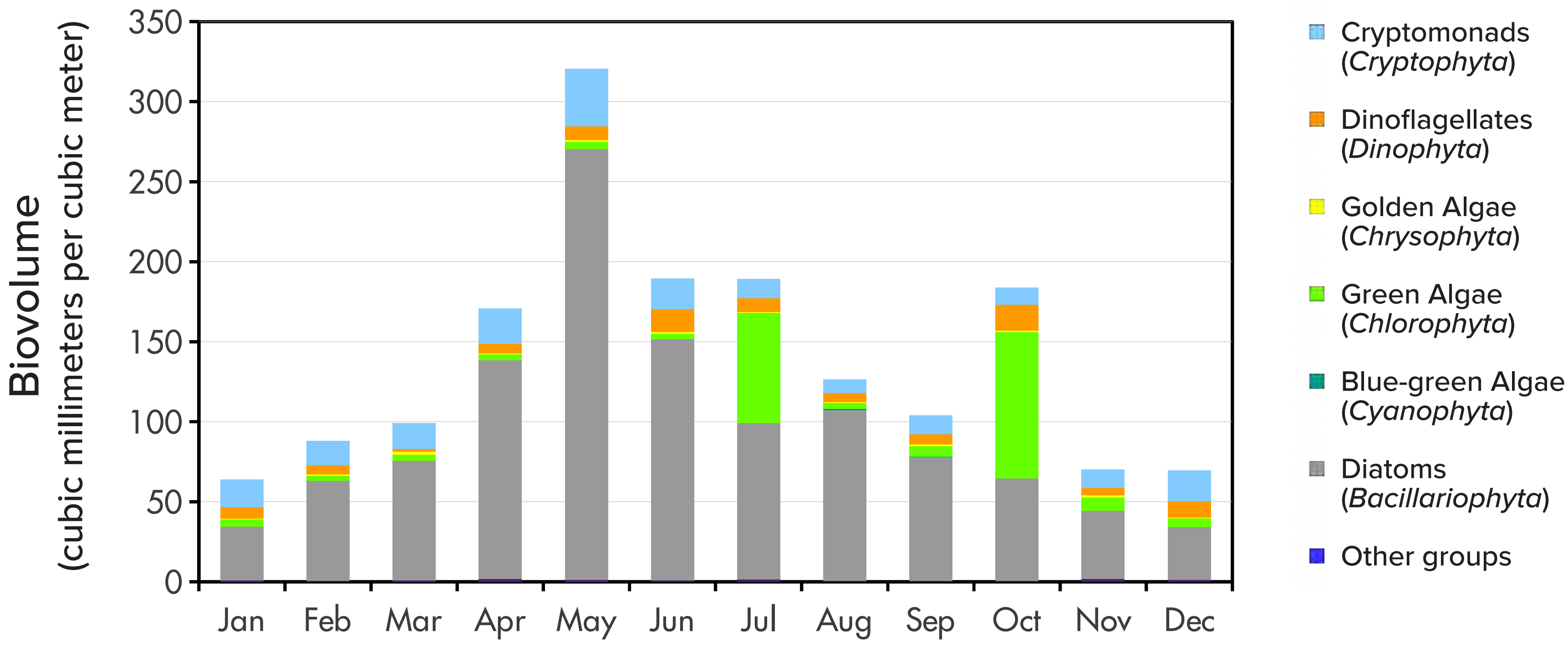
Since 1982, diatoms have been the dominant algal group at Lake Tahoe for all but a few years. Diatoms are unique in that they are enclosed within a cell wall made of silica, called a frustule. The dominant diatom species at Lake Tahoe in 2018 are shown below. Large variations in the relative composition are evident by month. *Synedra* and *Nitzschia* were the dominant diatom species during every month of the year, forming over 80% of the diatoms during spring. Although *Cyclotella* was a lower fraction of the diatoms in 2018, it still had a large impact on clarity.



Algal groups as a fraction of total biovolume

Monthly in 2018

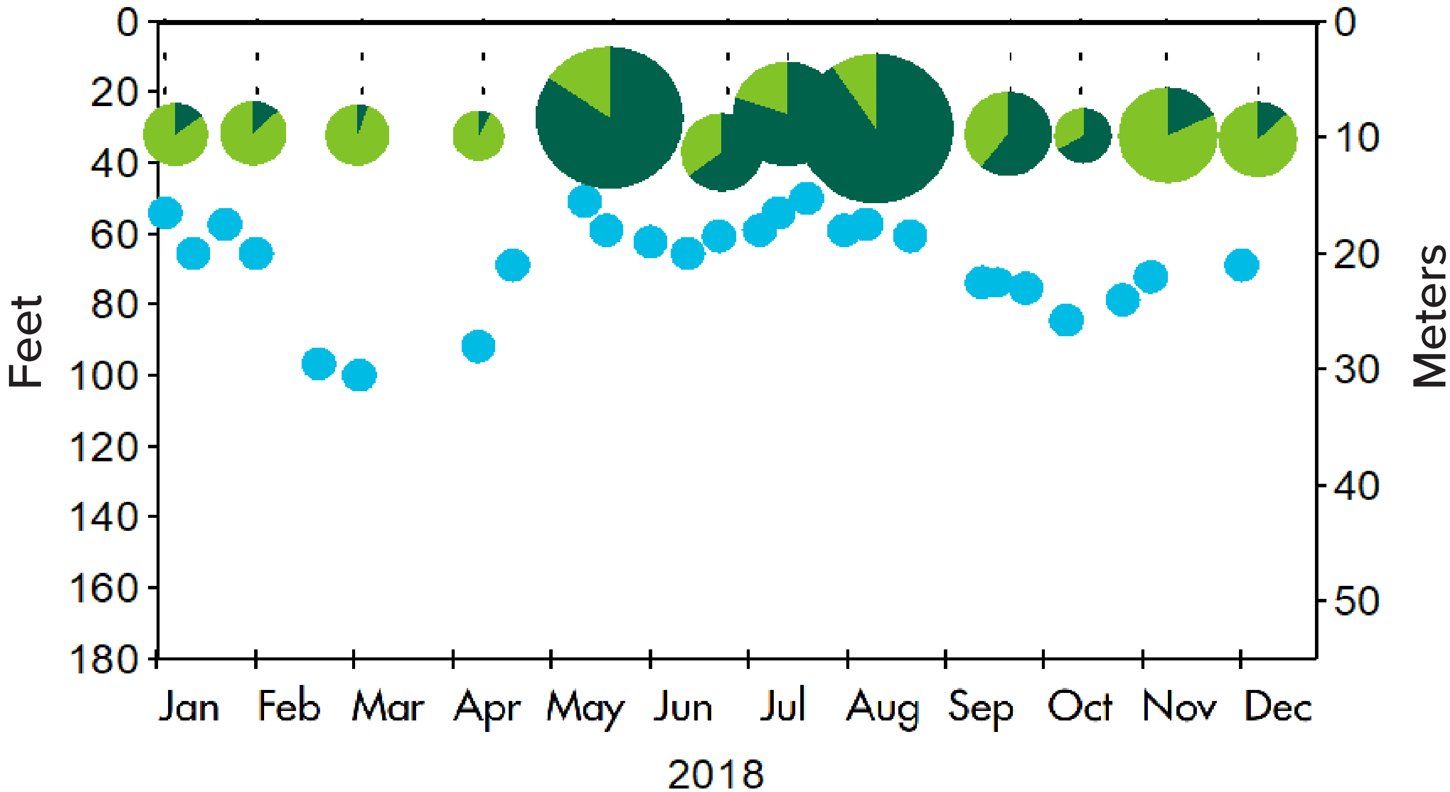
The biovolume of algal populations vary month to month, as well as year to year. In 2018, diatoms again dominated the biovolume of the phytoplankton community in every month, with the exception of October. The peak in the biovolume occurred in May 2018, the same as in 2017 (the "spring bloom"). The peak biovolume in 2018 was 320 cubic millimeters per cubic meter, almost double the biovolume in the last three years, a reflection of the increase of *Synedra* and *Nitzschia*.



Distribution of *Cyclotella gordonensis* in the upper water column

In 2018

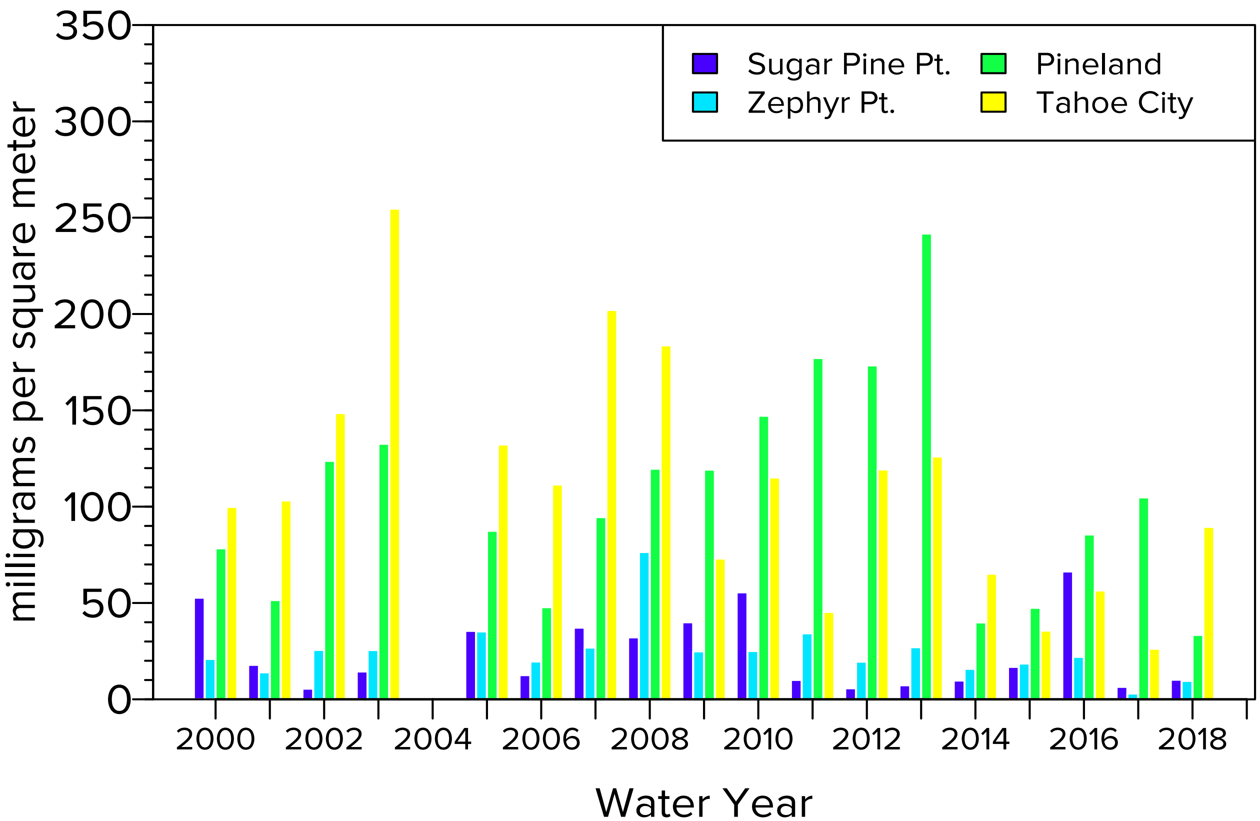
This year the diatom *Cyclotella* gordonensis was again present in Lake Tahoe in high numbers, although it was not the dominant diatom on the basis of biovolume. Its extremely small size (2-4 microns) means that even with small biovolume, there can be a large number of individual cells. The pie charts indicate the contribution of *Cyclotella* (dark green) to total phytoplankton assemblage (light green) smaller than 20 µm. Each pie chart is the average of values from 5 m and 20 m, which corresponds to the data available to the layer above or close to the Secchi depth. Secchi depths recorded at the LTP station are also shown (small blue circles).



Peak shoreline algae concentrations

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 after they have been sun-bleached. Periphyton is measured five to eight times each year, and this graph shows the maximum biomass measured 1.5 feet (0.5 m) below the surface at four sites from January to June. In 2018, concentrations at the four sites shown were well below their historic lows. One of the most urbanized sites, Pineland, historically one of the heaviest periphyton locations, was at the lowest value recorded. Monitoring periphyton is an important indicator of near-shore health, but it is very challenging to characterize it on account of the variability inherent in the system, as Figure 10.9 makes evident.



Shoreline algae distribution

In 2018

Periphyton biomass was surveyed around the lake over a three-week period during the spring of 2018, when it was estimated to be at its annual maximum. 54 locations (shown as stars) 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 rapidly assess levels of periphyton. 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. A large number of sites had high PBI in 2018 (i.e. about a third of the sites had PBI > 1.5 indicated by red-shaded sections of shoreline in the map). Various factors may have contributed to this high PBI including contributions of nutrients associated with the occurance of multiple storms, sustained high lake levels, and possible effects associated with following an extremely wet year in 2017. Compared to previous years, this is considered to be a relatively heavy periphyton year, although specific measurements of chlorophyll concentration at four sites (Fig. 10.8) would suggest otherwise. The north-east shore has relatively low growth. This is in part a reflection of the high wave activity causing the periphyton to slough (see “Current Directions”), as well as generally lower amounts of precipitation and runoff along the east shore.

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 2018