TAHOE: STATE OF THE LAKE REPORT 2023

CURRENT RESEARCH

UC DAVIS
Tahoe Environmental
Research Center

Current research

This section of the State of the Lake Report describes some ongoing research that is above and beyond the monitoring described in the subsequent sections, although in many cases it is predicated on that monitoring.

The changes to Lake Tahoe that were observed in late 2021 and in 2022 are among the largest and most significant that have been observed in the 55-year data record. These changes are documented in this section, and relate to major shifts in the lake's zooplankton and phytoplankton. The extent to which these shifts are inter-related is a focus of our current research. Being able to understand what is driving these changes and what these circumstances may mean for issues like restoring lake clarity, makes them all high-priority research questions.

Left to right: Long periods of freezing cold temperatures had quite an impact on the Lake's clarity. Extreme snow levels mean extreme stream conditions.
(Photos: A. Toy and A. Vanderpool)

The changes in Lake Tahoe's deepwater biology and implications for clarity

The last two years have seen some major changes in the lake's deepwater, or pelagic, biology related to the base of the food web. There are also major changes happening in the shallow water regions, but that is a different topic.

What is driving these pelagic changes and what their consequences will be are part of our ongoing research. But with researchers out on the lake most days of the week year-round, and with over 55 years of a long record to draw upon, TERC is uniquely positioned to detect these changes. The first inklings of the changes were from our lake sampling team noticing changes in the color of the filters that were used to separate algae from the water, changes in algae on the zooplankton nets, and observing species that had never previously been recorded in the sampling history.

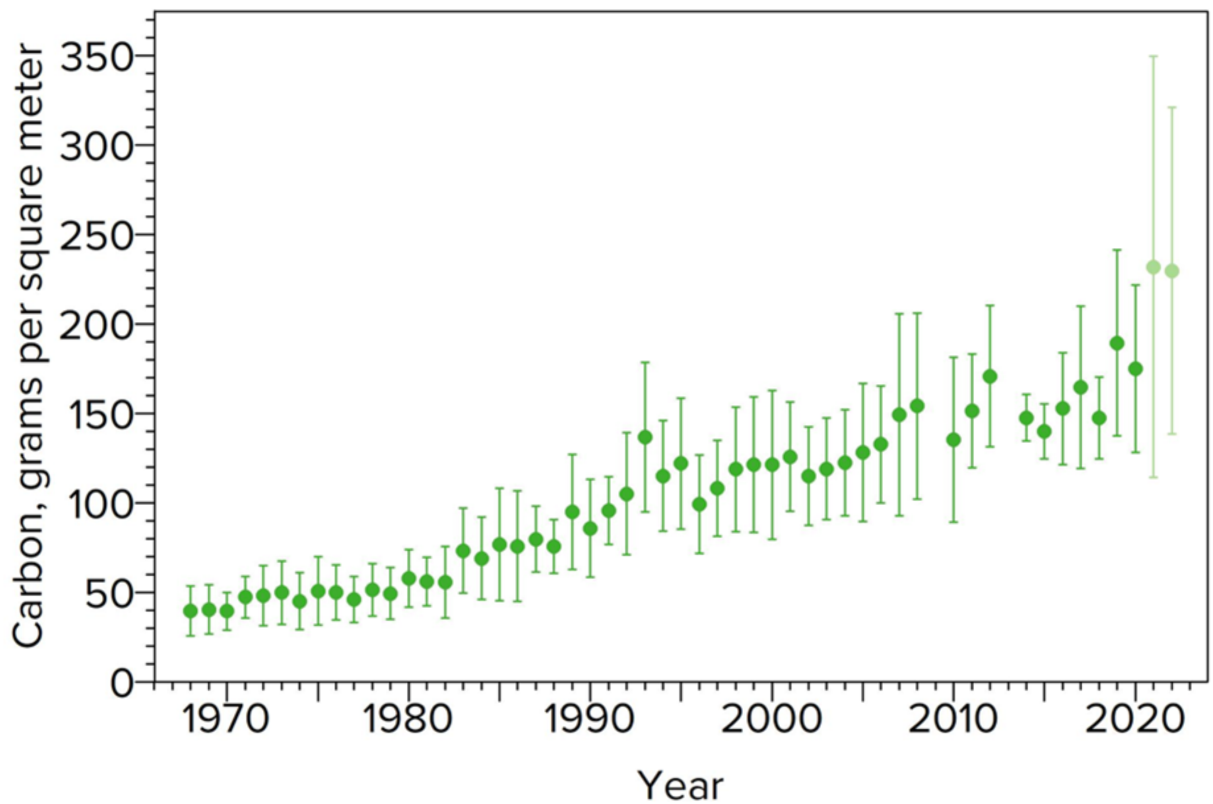
In the last two year, cold temperatures at Lake Tahoe have had major implications on lake clarity. Photo: B. Allen

Changes in the zooplankton regime has also contributed to the changes in lake clarity. Photo: A. Toy

The changes in Lake Tahoe's deepwater biology and implications for clarity

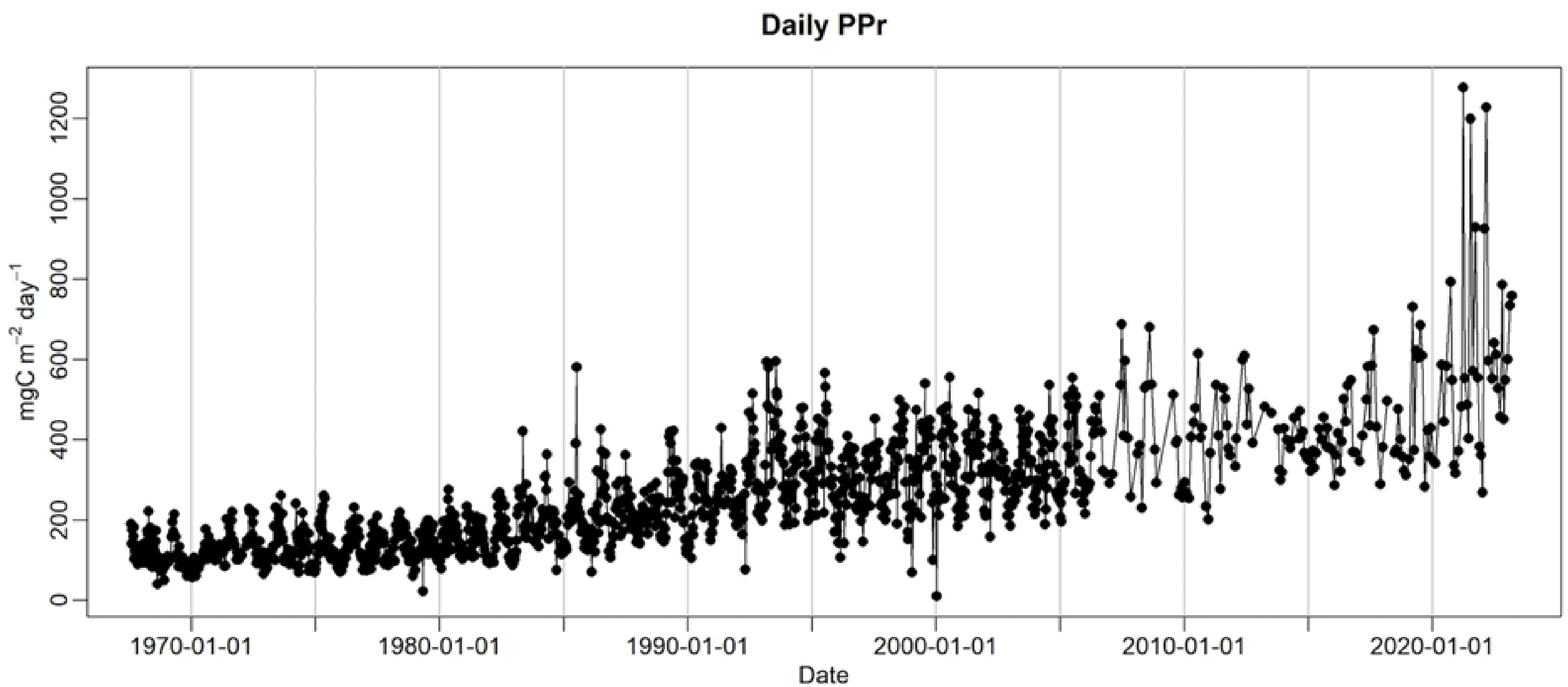
Phytoplankton

The algae, or phytoplankton, are the base of the aquatic food web. In 2021 and 2022, the primary productivity (PPr), the annual rate at which phytoplankton take in carbon carbon, rose to rates higher than experienced for the last 55 years.



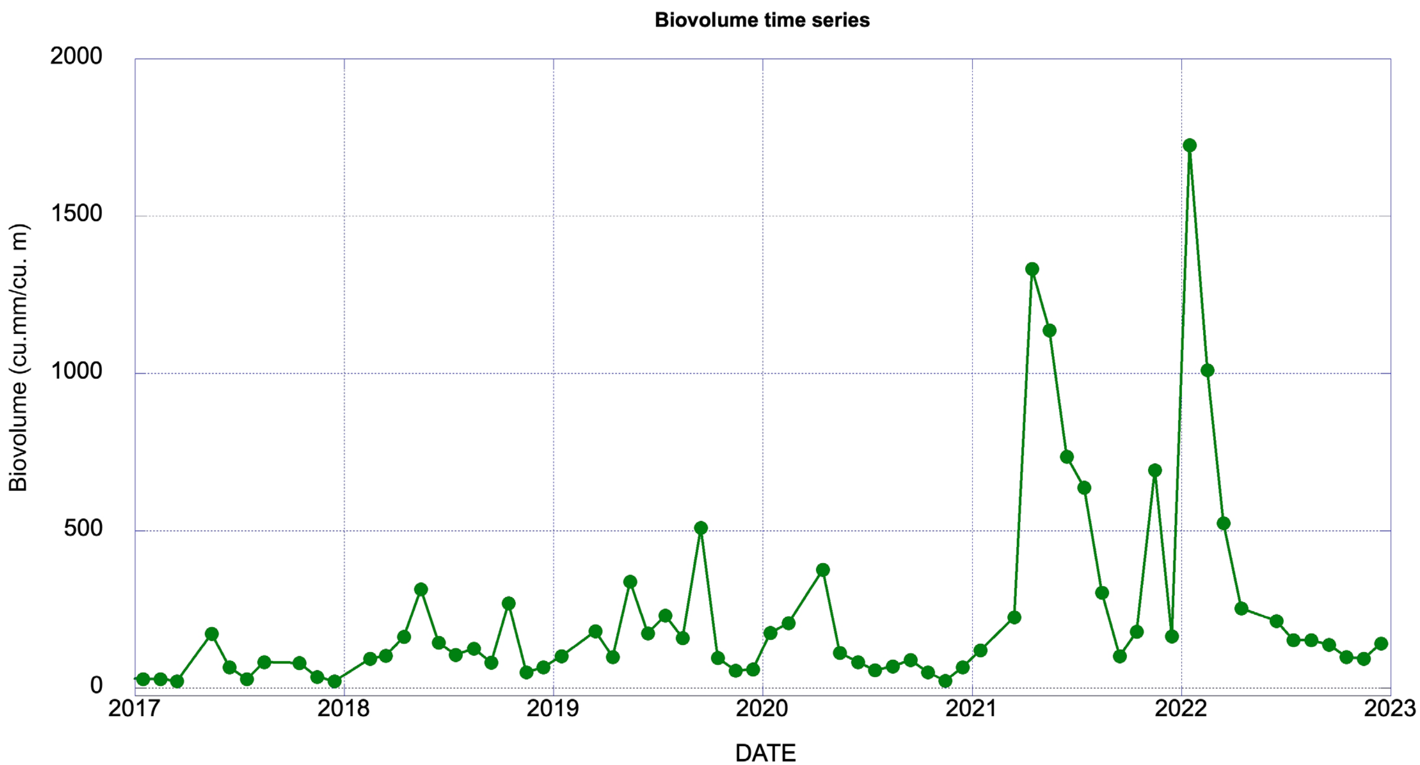
The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

The individual PPr readings that are averaged over 12 depths in the upper 350 ft of the lake, showed an extremely high level of variability, as shown in the monthly values for the entire 55 year record. In the context of the entire record, the last two years stood out as different. Could this change be real? Or are the measurements erroneous?



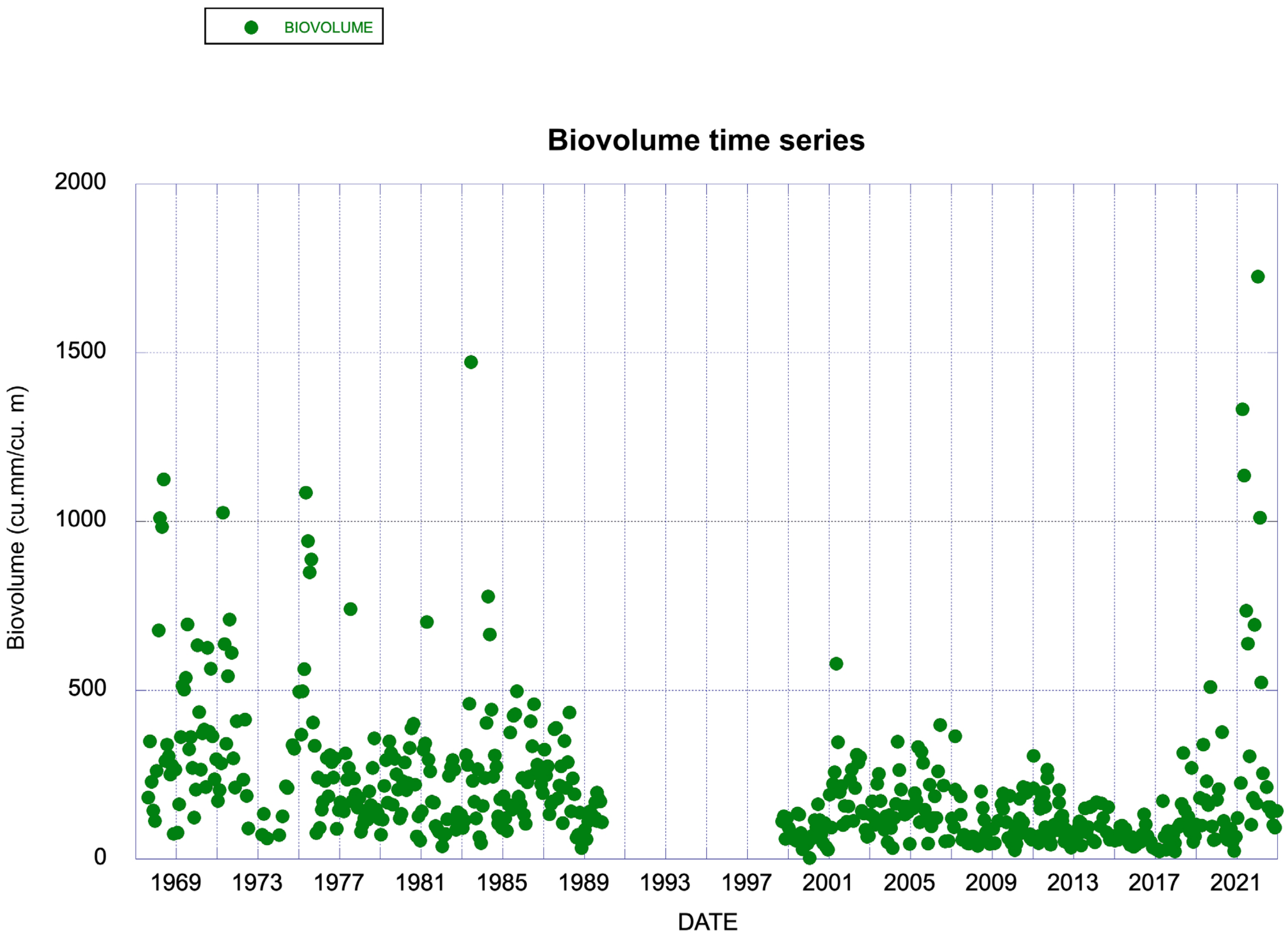
The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

To answer that question we reviewed other, independent measures related to algal growth. The first of these is the biovolume. The biovolume (or cell volume) of phytoplankton is an estimate of the concentration of algal biomass in the upper part of the lake. It is based on a time-intensive process in which biovolume is estimated for individual taxa from formulae for solid geometric shapes that closely match the cell shape. Samples for biomass estimates are taken from depths of 5, 20, 40, 60, 75 and 90 meters, and an integrated estimate is produced. The biovolume data since 2017 show that it too has "anomalous" peaks in 2021 and 2022. The biovolume peaks and the PPr peaks do not align as they represent different things. The PPr is a growth rate and tends to be low when the biovolume is high.



The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

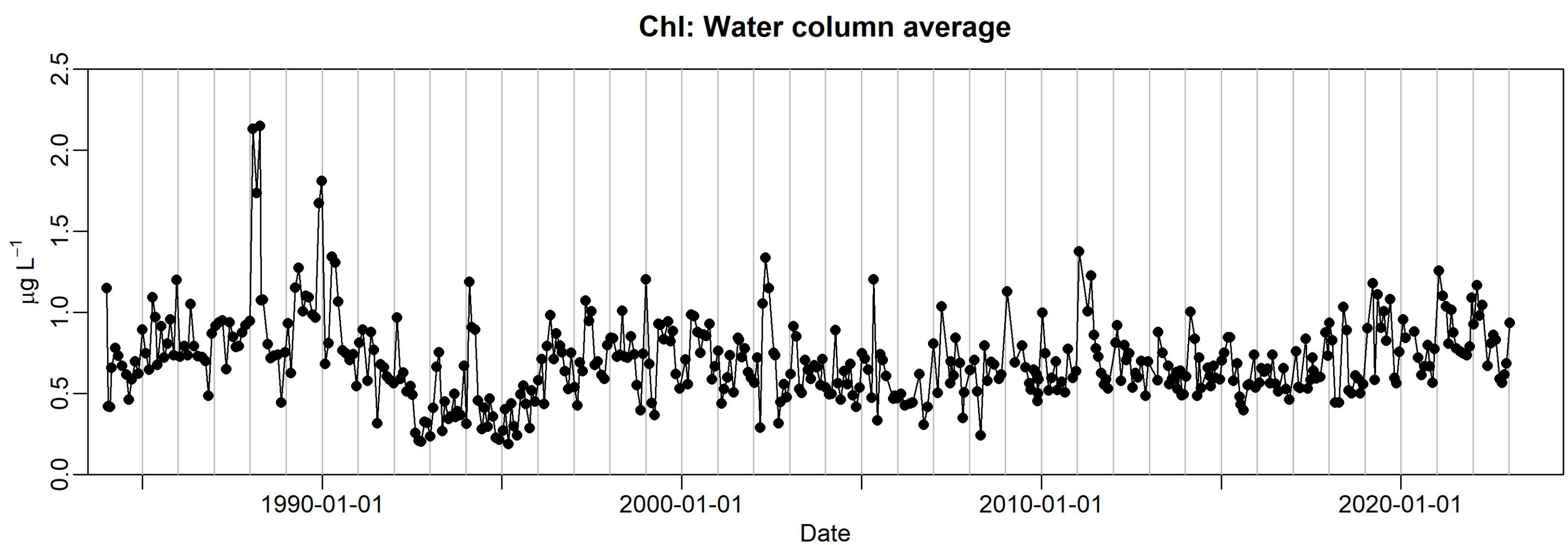
The picture gets interesting when we look at the entire record of biovolume estimates from 1968 to the present. Although there were little data from the 1990s, what is apparent is that high values of biovolumes are not new. Through the 1980s, there were numerous occasions when biovolume was at similar levels to what was observed in 2021 and 2022, suggesting that the high peaks of the last few years are not anomalous, but rather a return to conditions similar to earlier conditions.



The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

A third measure related to phytoplankton is their chlorophyll-*a* concentration, the photosynthetic pigment that they contain. The long-term data (back to 1984) show that chlorophyll-*a* concentration has remained relatively more stable, at least since the mid-1990s, although peaks in the last two years are higher than many years.

Both the PPr and the biovolume data, and possibly the chlorophyll-*a* data suggest that there was a significant change in 2021 and 2022. Did the taxa of the phytoplankton change?

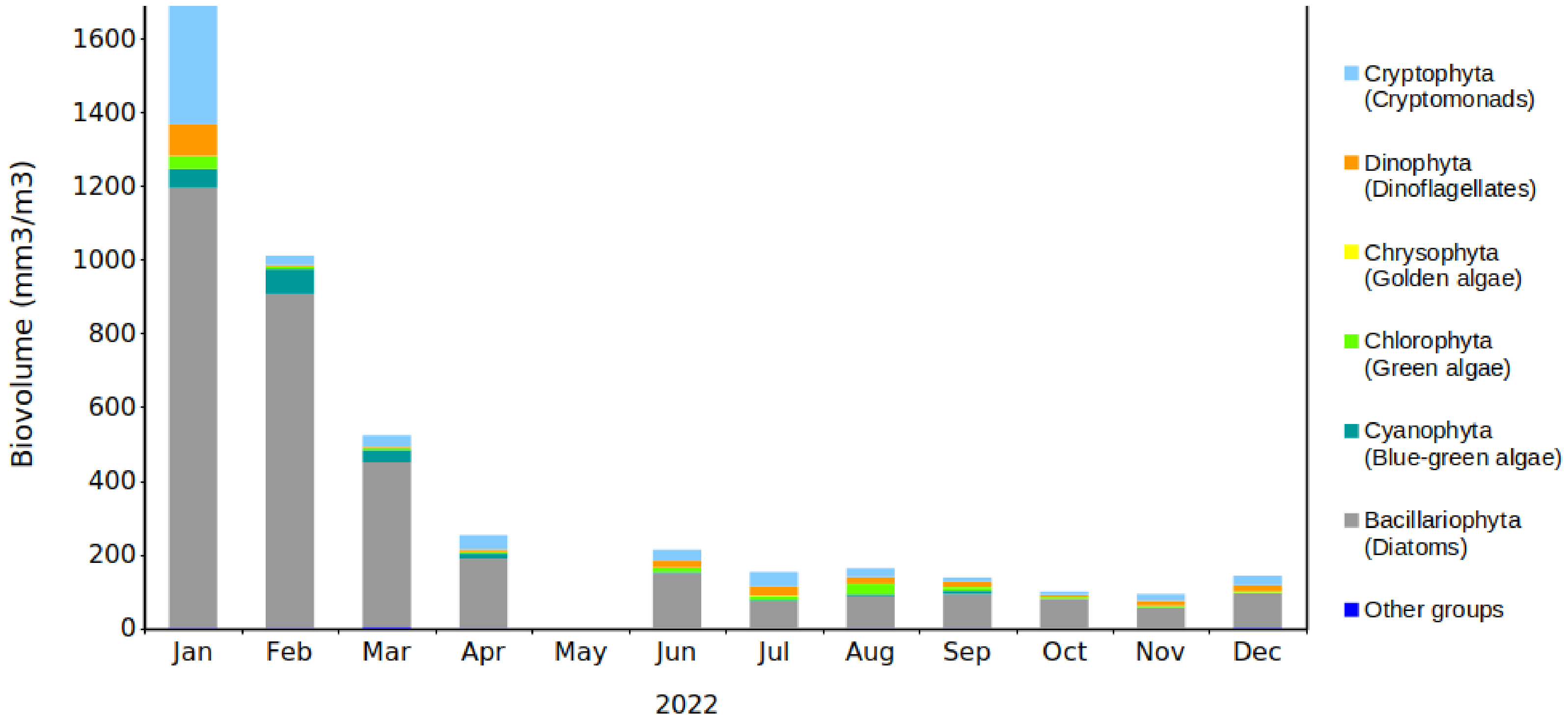


The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

Looking in detail at which algal taxa comprised the biovolume by month in 2022, we can start to understand what may be happening. The high values of biomass in the first three months of 2022 were dominated by the diatom *Synedra*. While *Synedra* often dominates in Lake Tahoe, it rarely reaches the biovolumes levels it reached 2021 and 2022, and is typically below 100 mm^3/m^3 for most of the year.

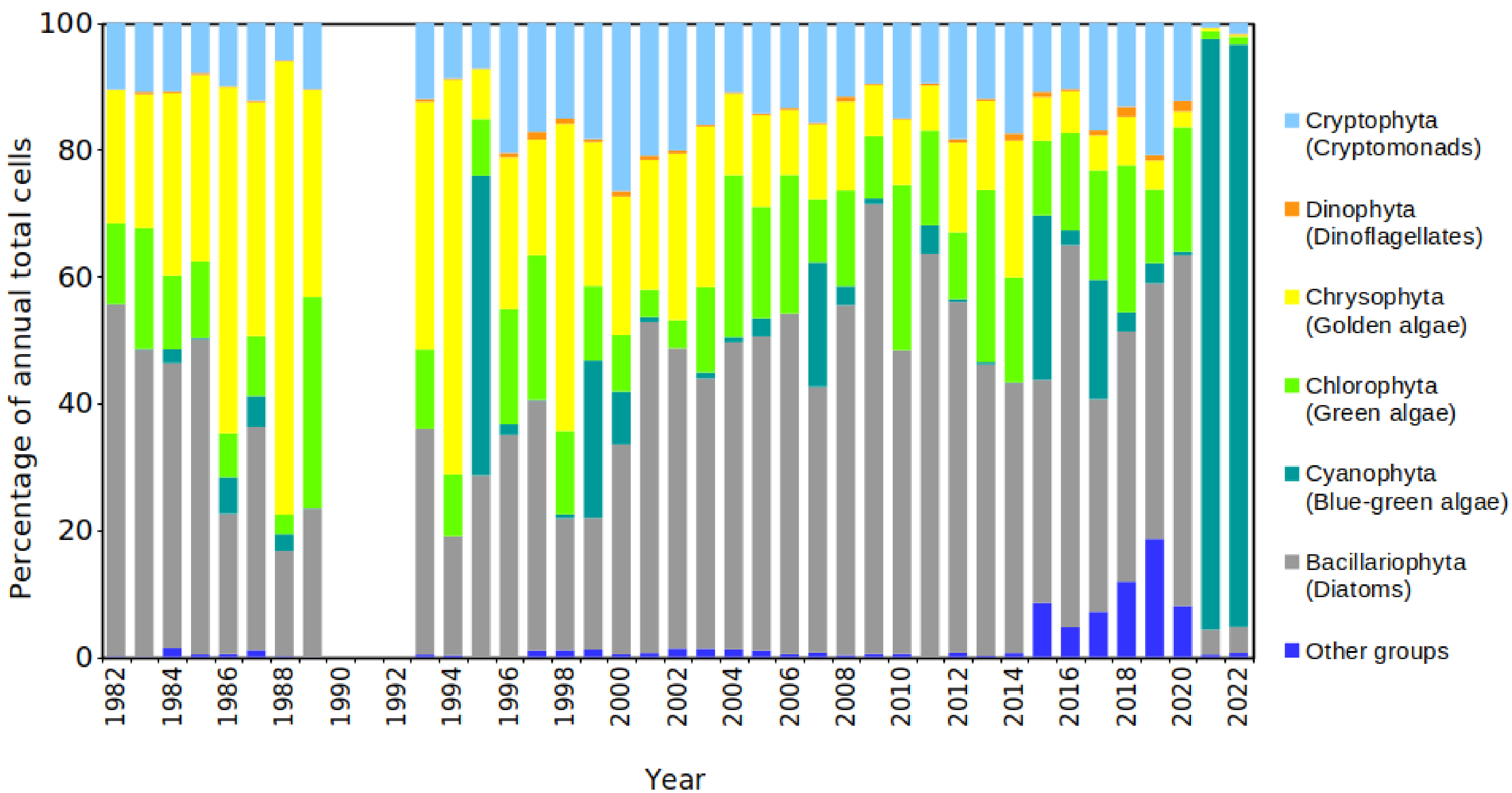
It is noteworthy that larger algae have higher biovolumes, while smaller algae, though far more numerous, have smaller biovolumes. Comparing a 2 micron and a 200 micron spherical algal cell, it would require one million of the smaller algae to have the same biovolume of a single large alga.

So we now have in the first part of 2022, exceptionally high PPr, exceptionally high biovolumes, elevated chlorophyll and the occurrence of large diatoms. The idea that the PPr measurements are not an "error", but an indicator of real change now seems far more plausible.



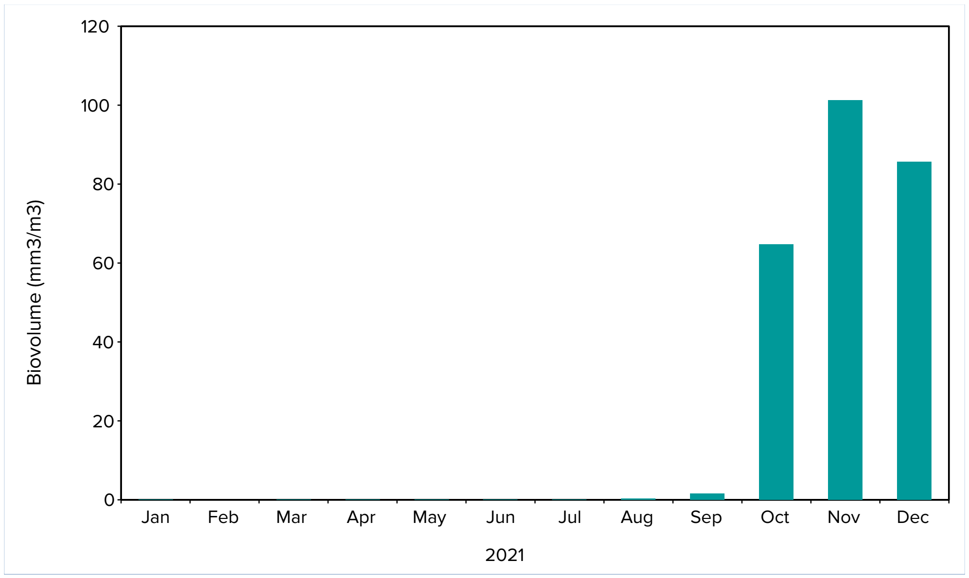
The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

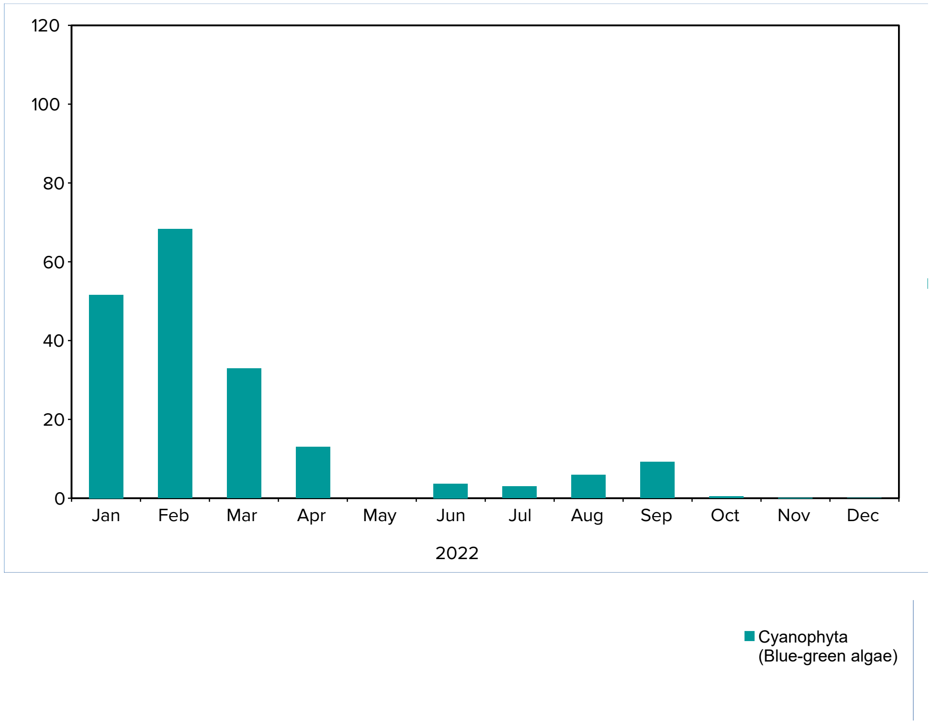
But the story is actually more complex. At the same time that the *Synedra* was dominating the biovolume, the actual number of individual algal cells was dominated by a very small algal cell, the cyanobacteria, *Leptolyngbya*. Looking at the annual percentage of total algal cells in the lake, it is dominated in 2021 and 2022 by *Leptolyngbya*, even though they comprise a small part of the biovolume.



The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

Leptolyngbya was first reported in late 2021, as being suddenly present as a likely consequence of nutrient inputs from wildfire smoke. This is actually reinforced by looking at the *Leptolyngbya* data from 2021 and 2022 side-by-side.



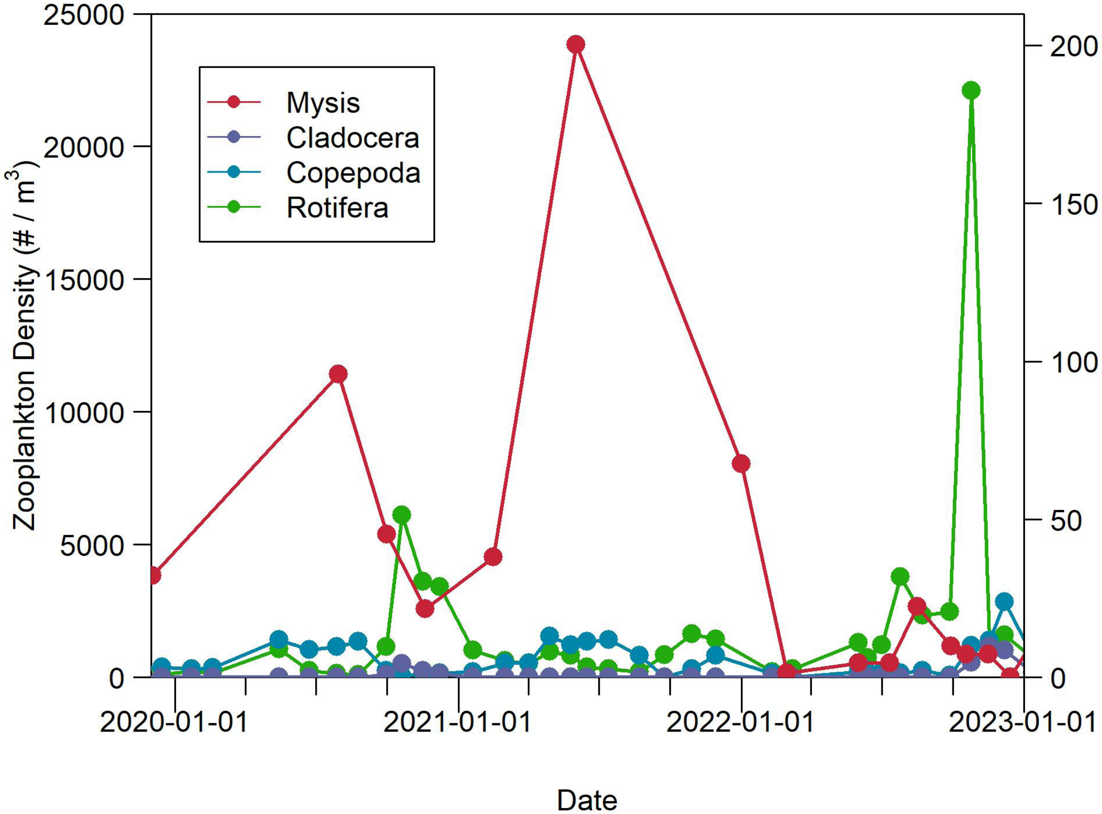


The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

Mysis and zooplankton

In early 2022 the population density of *Mysis* shrimp suddenly collapsed. Since their introduction in the 1960s their numbers have varied and generally been in excess of 100 individuals/sq. m, but now they were present in single digits.

Immediately prior to their collapse the populations of copepods also collapsed. The reason for this collapse is believed to be a fungal infection, and as they are a primary source of *Mysis* sustenance this may well have contributed the *Mysis* collapse by starvation.



Two dead copepods covered by fungus.
Photo: K. Senft

The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

With *Mysis* and copepods reduced, there was the opportunity for other species to become established. One such group was cladocerans, that prior to the introduction of *Mysis* were the dominant zooplankton group and known to be able to clear water of fine particles at a high rate. However, cladocerans did not immediately re-establish and instead rotifers increased by April 2022 and it took a further four months for cladocerans to start increasing.

The two cladocerans species at Lake Tahoe, Bosmina (left), Daphnia (middle), and the rotifer (right) which quickly reestablished itself following the mysterious die-off of the Mysis shrimp.

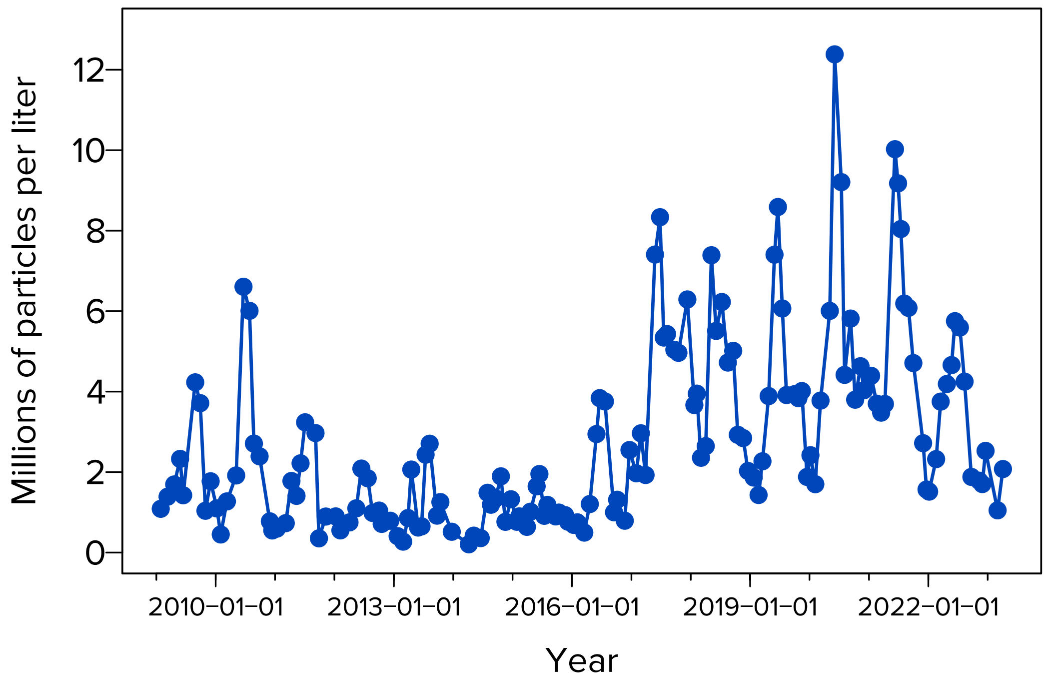
The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

Clarity

Do these biological changes have any bearing on lake clarity? We believe they do. It is known that the very smallest phytoplankton and inorganic particles have a very large impact on reducing clarity. The number of fine particles in Lake Tahoe had been elevated since the very wet winter of 2017. The figure below shows the concentration of fine particles (1–6 microns) in the upper 165 feet of the water column. The annual peaks from 2017 through 2021 are evident, and account for the poor clarity in those years.

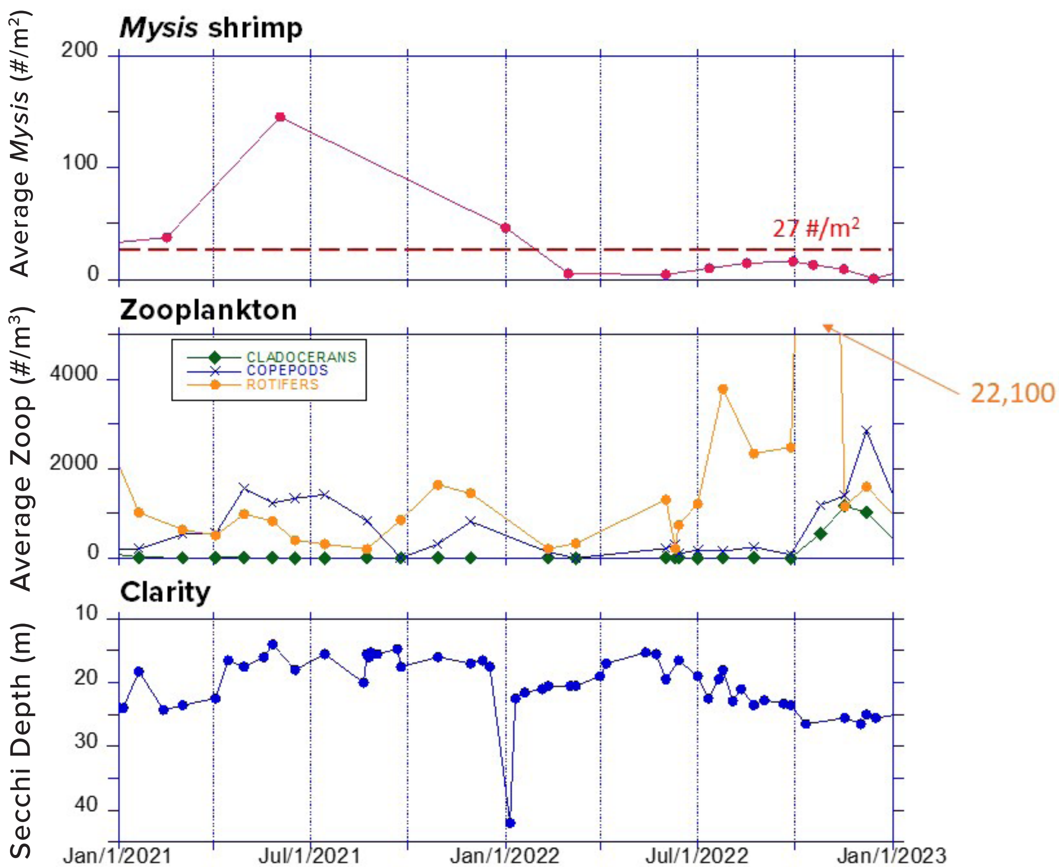
At the beginning of 2022, the concentration of particles is low, but that is possibly due to the impact of the extreme upwelling event described elsewhere in this report. But it is only after June, that the concentration of particles commences to decrease to low values.

That is the period, August–December 2022, when clarity at Lake Tahoe attained values that had not been observed consistently since the 1980s.



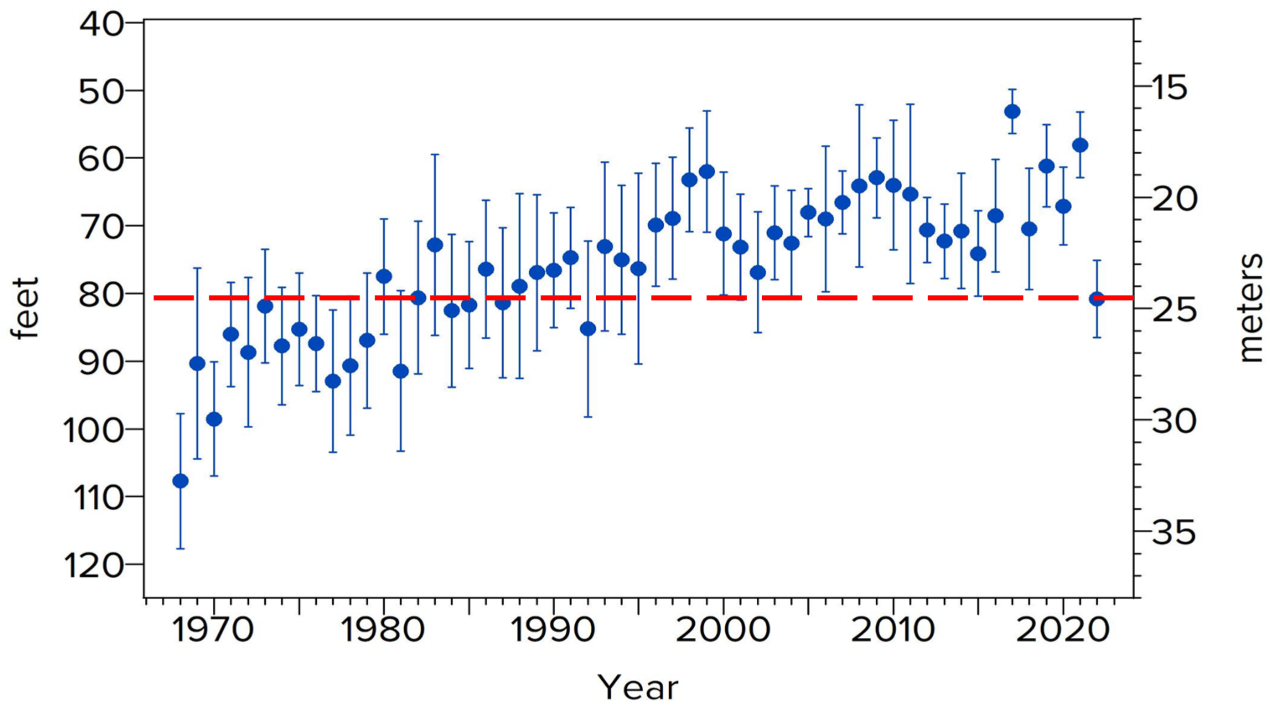
The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

This figure provides a chronology of events that unfolded in 2021 and 2022. The decline of *Mysis* below a level of 27 individuals/m^2 has been shown in research in the 1980s to be a level at which *Mysis* and cladocerans can co-exist. Within less than 6 months of *Mysis* populations falling below this value, changes started manifesting themselves in the zooplankton community. Initially this was observed in a large increase in the rotifer population, followed by increases in copepods and finally cladocerans. Throughout this succession of events the lake clarity improved to levels not experienced in over 40 years.



The changes in Lake Tahoe's deepwater biology and implications for clarity, continued

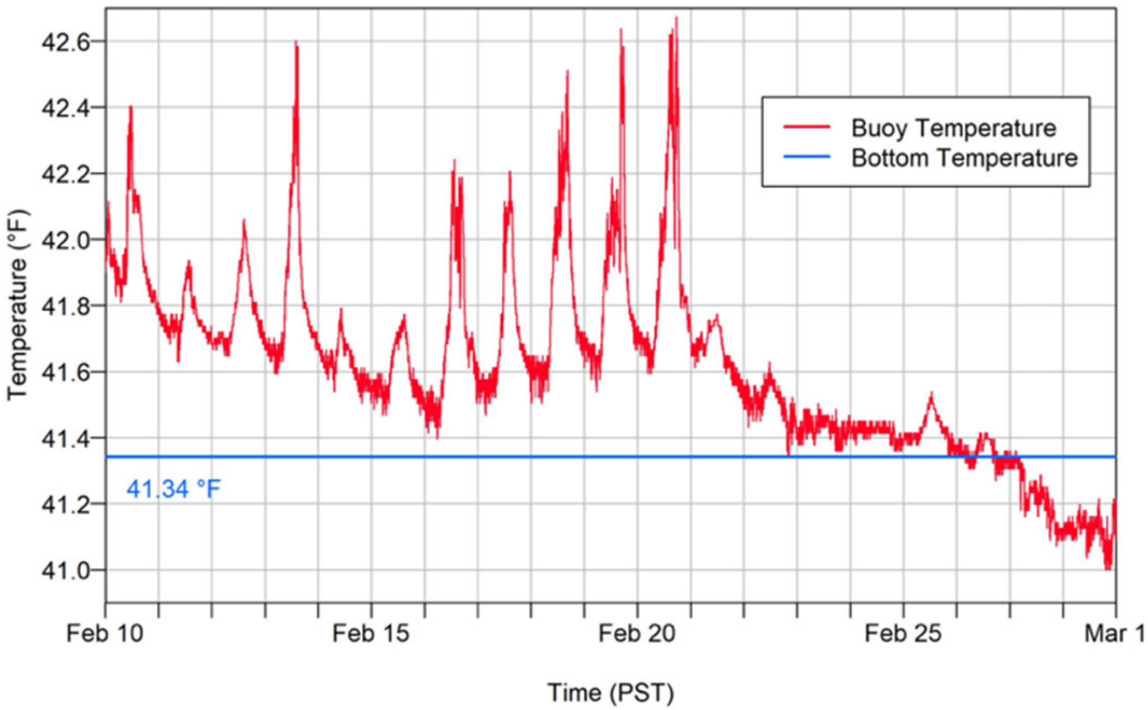
2023 promises to be an interesting year. The record winter has brought large concentrations of fine particles into the lake. At the same time, the conditions still exist where *Mysis* are largely absent and cladocerans are increasing. With the continued monitoring of the lake, we are likely to learn a lot about the controllers of lake clarity.



Extreme ice and extreme mixing

One of the most extreme periods on record at Lake Tahoe was the year 2022 and the first part of 2023. The basin and surround areas experienced the intensity of the 2022-2023 winter, and in particular, very low air temperatures. For example, in November and December 2022, averaged temperatures were well-below the 112-year average temperature (see Fig. 7.4).

The first direct consequence of these extremely cold air temperatures was the complete mixing or "flipping" of Lake Tahoe from top to bottom. Every winter, the surface waters of Lake Tahoe cool and become denser and start to descend. The falling of the water leads to vertical mixing. Most years the mixing might only reach a depth of 600–700 feet. Possibly in every 4-5 years the mixing will extend all the way to the bottom, and that is what happened commencing on February 27, 2023. By continuously measuring the water temperature from a buoy, we can determine when the water temperature fell below the bottom water temperature, an indicator of complete mixing.

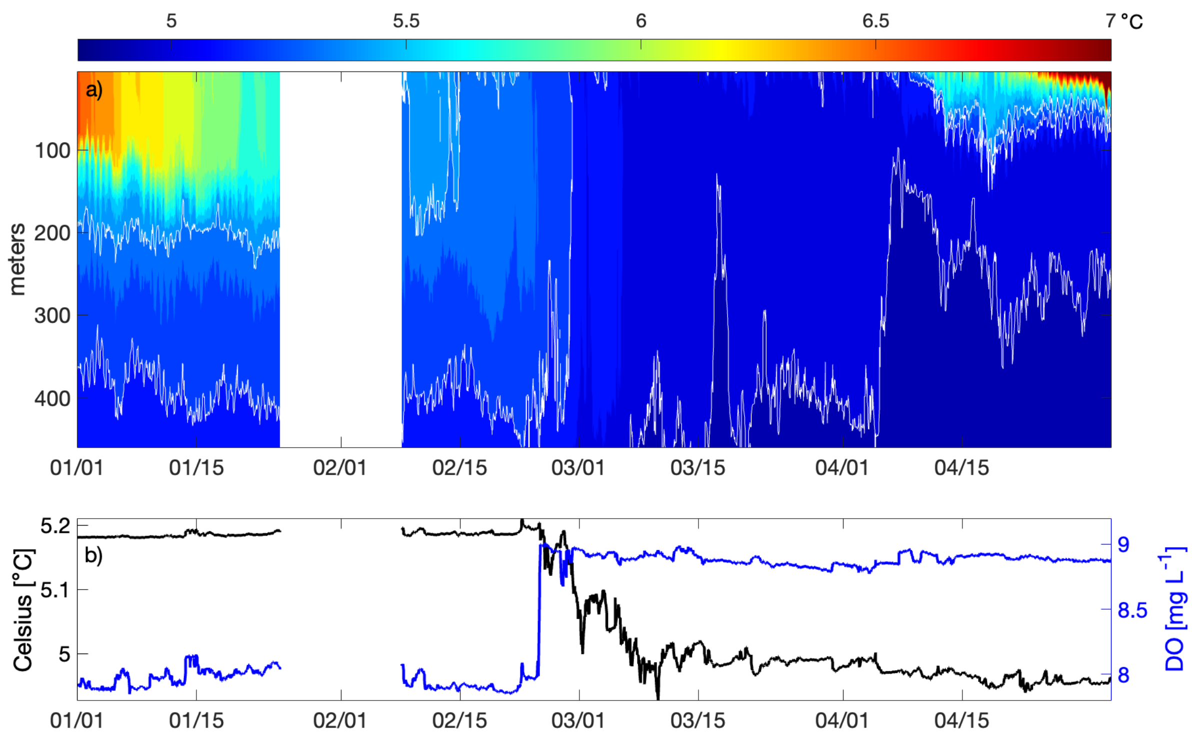


Freezing temperature

Extreme ice and extreme mixing, continued

What are the consequences of "flipping"? First, it is a major controller of the water temperature at the bottom of the lake. Second, and more importantly, it is one of the ways that oxygen reaches the bottom of the lake. The upper panel shows the vertical temperature structure measured at our permanent station near Glenbrook, Nevada, from January to April 2023. The white lines indicate 0.2 °C isotherms. The plot illustrates the loss of thermal stratification on around February 27, and the ensuing cooling of the lake bottom.

The lower panel shows the temperature (black) and dissolved oxygen (blue) as measured at a depth of 460 meters. As deep mixing proceeds, the temperature rapidly declines over a two-week period, then continues to slowly cool over the next seven weeks. The change in dissolved oxygen is far more rapid, with an almost instantaneous jump in dissolved oxygen just as the deep mixing process commences. Figures courtesy of Micah Swann.



Extreme ice and extreme mixing, continued

The second direct consequence of this winter's low air temperatures was the freezing of the entire surface of Emerald Bay. As early as February 1, large parts of the lake started developing a thin crust of ice, but it was not until March that the entire surface froze and snow started accumulating on top of the ice. This is believed to be the first time this has happened in at least 40 years.

Lake Tahoe did not completely freeze over, although many marinas and parts of the shoreline experienced ice during this last winter. There are no data to show that Lake Tahoe has ever been ice-covered since the time of John Fremont's first sighting of the lake in 1844. Why? Quite simply it is too deep given its latitude and altitude. For the lake to freeze, the surface water would have to fall to 39.2 oF across its entirety, which would require losing a lot of stored heat. Winter is not long enough for that to occur.

Emerald Bay Feb 1, 2023, before freezing over. Photo: Brant Allen, TERC

Emerald Bay March 15, 2023, after freezing over. Photo: Cal. State Parks

The passing of the disk

The management of Lake Tahoe has to a large degree been predicated on the clarity of the lake, as defined by how far down a highly trained observer could see a 10" white disk, known as a Secchi disk. From 1968 to 2004, responsibility for reading the depth of the Secchi disk rested on one person, TERC boat captain Bob Richards. After he retired, that responsibility fell on the new boat captain Brant Allen, who for many years had been trained under the watchful "eyes" of Bob Richards. Alas, after 35 years of studying Lake Tahoe (19 years of which included responsibility for the Secchi disk readings), Brant Allen has also decided to retire.

For many years, TERC received a great many questions about the health of the lake, the complex motions of the water, the algae accumulating in the nearshore, and other important topics. However, the most frequently asked question is, "how do you know that the clarity of the lake is declining, rather than the eyesight of the reader?" The question was usually answered by providing evidence of the 20/20 vision of our two long time readers, describing the highly prescribed methodology that is followed for an "official" Secchi disk reading, and citing the scientific literature that confirms the robustness of this measure.

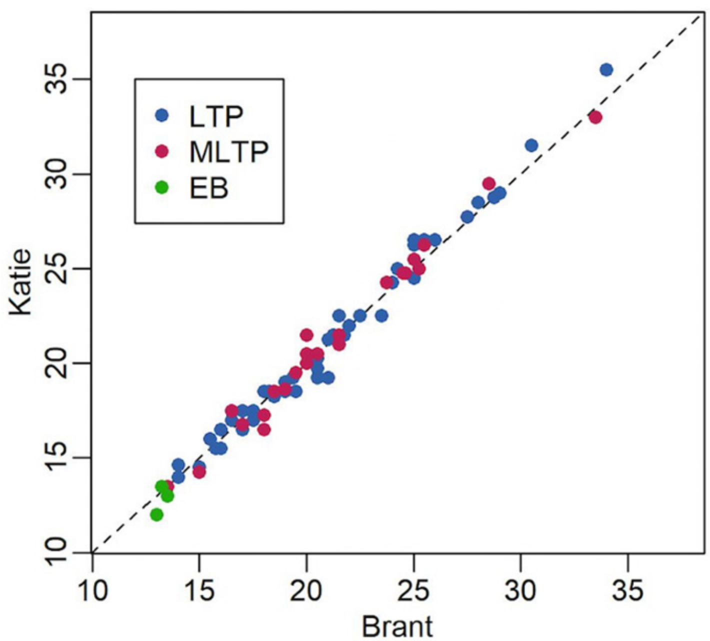
After over 30 years as TERC's boat captain dedicated to research and conservation efforts at Lake Tahoe, Brant Allen sets his eyes on new things. Photo: M. Okimoto

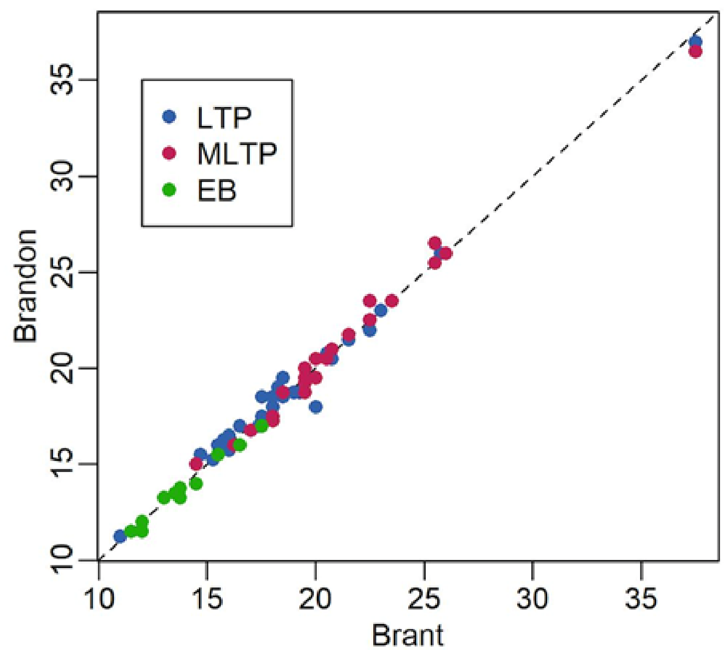
The passing of the disk, continued

As we prepared to enter this post-Brant era, let us settle the question once and for all. Since 2016, our two "back up" Secchi disk readers, Katie Senft and Brandon Berry, have independently read the Secchi depth within a few minutes of Brant completing his "official" reading. None of the readers were aware of the others reading and the results were passed off under the highest security to our data manager, Dr. Shohei Watanabe. For the first time, the results from this first-of-its-kind Secchi disk comparison is being revealed publicly.

The figures indicate the comparisons between observations from Katie and Brant (left) and observations from Brandon and Brant (right). The tests were conducted at the mid-lake MLTP site, the western LTP site, and in the center of Emerald Bay. As the results show, the correlation is remarkable. Statistically, both Katie and Brandon are within 0.2% of Brant's reading. In other words, if Brant reads 23 m (75.5 ft), then the other readings coincide to within 5 cm (2 inches).

Hopefully, understanding this rigorous comparison of Secchi depth readings will allay fears of accuracy. In the same way that we test the veracity of clarity measurements, we also go to great lengths to double check the tens of thousands of measurements we take annually at Lake Tahoe.



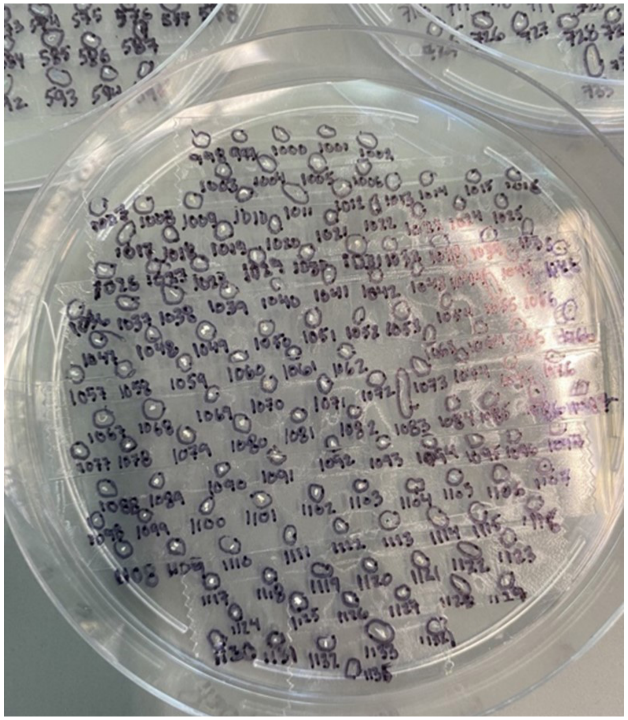


The microplastics of Lake Tahoe

A research team comprised of TERC researchers and the UC Davis One Health Institute completed the most comprehensive evaluation of microplastics in Lake Tahoe to date. The study was funded by the Nevada Division of Environmental Protection and the Tahoe Water Suppliers Association.

Using a Manta Trawl, water samples were collected from the lake surface and from 6 depths within the lake, down to 1,500 ft. Additionally, lake sediments and biota (Asian clams and kokanee salmon) were sampled. Following collection, processing, and isolation of particles suspected to be plastic, the particle composition was determined using Raman spectroscopy. Based on chemical identity determined by Raman spectroscopy, particles were classified into different types of plastics.

Manta trawl skims the water, collecting microplastics from Lake Tahoe's surface. Photo: K. Senft



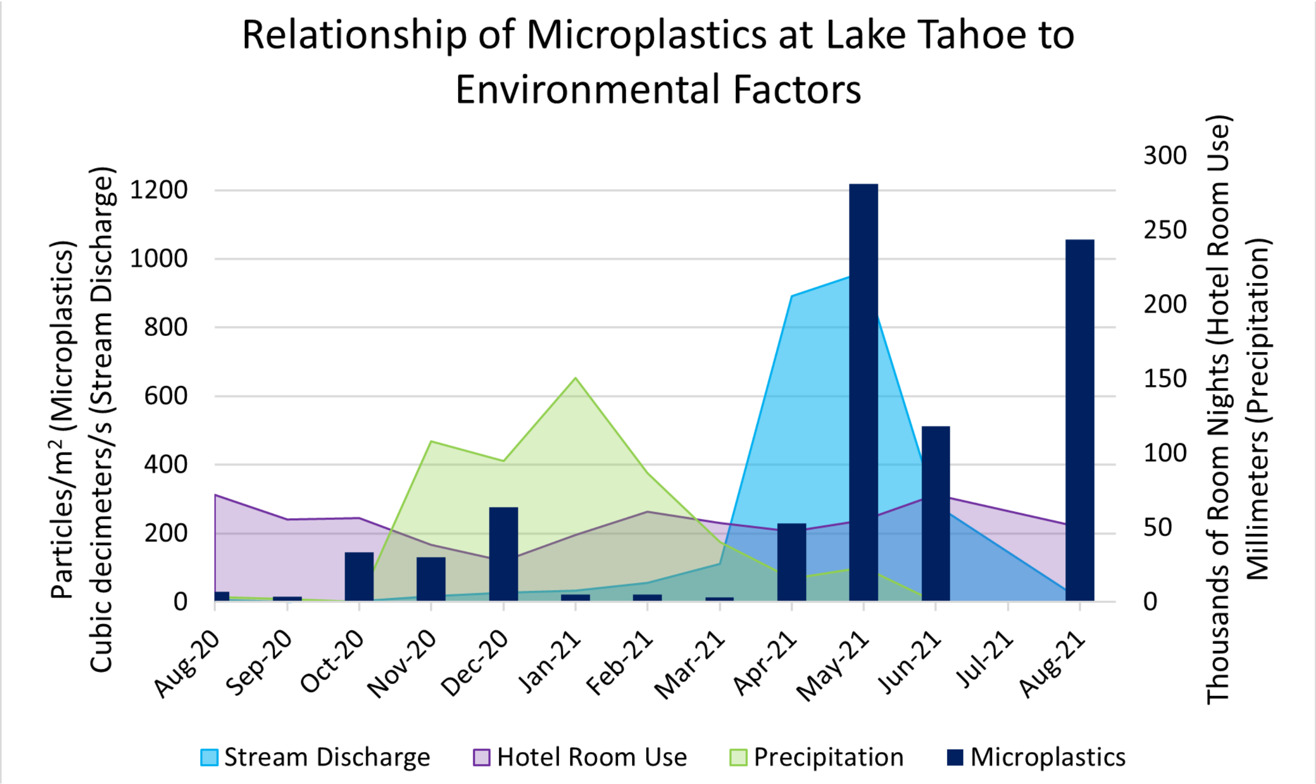
A meticulous count microplastics pulled from lake samples. Photo: S. Sesma

The microplastics of Lake Tahoe, continued

The microplastic abundance on the surface waters of Lake Tahoe are some of the highest reported amongst North American lakes (range: 13,000 – 1,220,000 particles/km2). However, higher values have been reported in other systems such as Lake Taihu, China (range: 10,000 – 6,800,000 particles/km2) and the San Francisco Bay (range: 34,000 – 1,800,000 particles/km2).

This study was limited by the mesh size of the traditional methodology of a Manta trawl, which allowed the escape of microplastics less than 335 microns or 1/64 of an inch. It is believed that smaller microplastics are far more abundant and are more likely to have human health and wildlife health impacts. A current pilot study, titled "The Ones that Got Away", is examining particles down to 1 micron (4 hundred thousandths of an inch) in size.

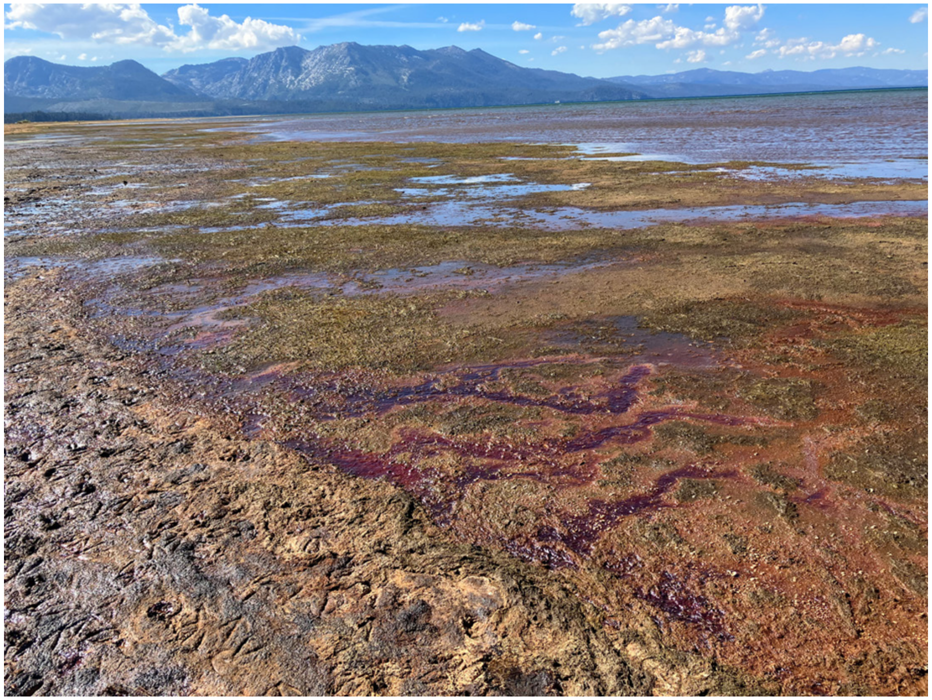
Our full report is available at https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/LakeTahoe%20Microplastics%20Report_Final_20230302.pdf



The state of Lake Tahoe beaches

The nearshore of Lake Tahoe is where the public most often interacts with the lake and where public opinion regarding the lake's aesthetic character is primarily formed. Beyond aesthetics, the condition of the shore is a symptom of the overall health of the entire lake ecosystem and the presence of periphyton (attached algae) and metaphyton (unattached algae) are strong indicators.

In 2022, Lake Tahoe's nearshore regions and beaches experienced some of the most extreme conditions ever observed. Whether it was the broad expanses of attached algae (periphyton) around Tahoe City or the acres of washed-up filamentous algae (metaphyton) on the southern shoreline, these were not conditions that anybody wanted to continue.



Metaphyton and iron-rich pools at Conservancy Beach, September 29, 2022. Photo: S. Hackley

Metaphyton washing up on Kiva Beach, August 2022. Photo K Senft

The state of Lake Tahoe beaches, continued

The apparent increase in both the intensity and spatial extent of nearshore nuisance algae has a range of contributing factors, including climate warming of the nearshore waters and low lake levels during droughts. For the case of metaphyton, which have become a particular nuisance for the beaches, it is clear that the presence of Asian clams is a major driver. Laboratory experiments have shown that the Asian clam excretion contains 10–100x the level of nutrient concentrations of ambient lake water, sufficient to meet the nutrient needs of metaphyton species. Warming temperatures also allow Asian clams to be active for longer each summer.

What is being done? First, with Agency support, TERC has improved the ability to quantify the actual location of both periphyton and metaphyton. TERC researchers are currently implementing and evaluating a new monitoring program for nearshore algae that combines remotely sensed (drone and helicopter) imagery data with in-situ data collected by divers. Estimates of algal coverage and biomass will be generated from aerial images using machine learning and compared with coverage and biomass measurements at fixed stations around the lake. The new monitoring plan is designed to track both spatial differences in algal coverage as well as seasonal and interannual change in nearshore periphyton and metaphyton biomass.

A helicopter raw image showing the banded nature of the periphyton north of Ward Creek on April 28, near the peak of periphyton growth. Photo: M. Bruno

Periphyton near the mouth of the Truckee River, June, 2022. Photo: S. Hackley

The state of Lake Tahoe beaches, continued

Second, we are working on solutions for metaphyton control. One of the solutions entails the suction removal of metaphyton while it is still located above the Asian clam beds and before it is washed up on the beaches. The second, approach deals with the root cause of the problem, the Asian clams themselves. A laboratory experiment in summer 2023 will explore the efficacy of using hydrogen peroxide to oxidize Asian clams. Although hydrogen peroxide is a chemical, something that many at Tahoe are concerned about, it has the advantage that as it works it breaks down to form pure water.

Collected metaphyton, Regan Beach, August 2022. Photo K. Senft

Asian clams in a solution of hydrogen peroxide and water. Photo: O. Nole

Where does the flow go?

Lake Tahoe has 63 inflowing streams. Depending on the temperature and flow rate of each stream, as well as the temperature stratification of the lake, inflows can either flow in horizontally at the surface or they can plunge down vertically below the surface. In spring, when the stream flows are highest, they typically plunge below the surface, but most of the water stays in the upper 100 feet of the lake.

Where does the stream water flow to? That is a more complex question to answer, as it depends on the lake's currents, which are constantly changing in response to wind and other factors. But it is an important question as the stream water is loaded with nutrients, fine particles, microplastics, and a range of other pollutants of concern. To answer the question, it is necessary to use a complex, three-dimensional hydrodynamic model that can represent the flows that will carry the inflows.

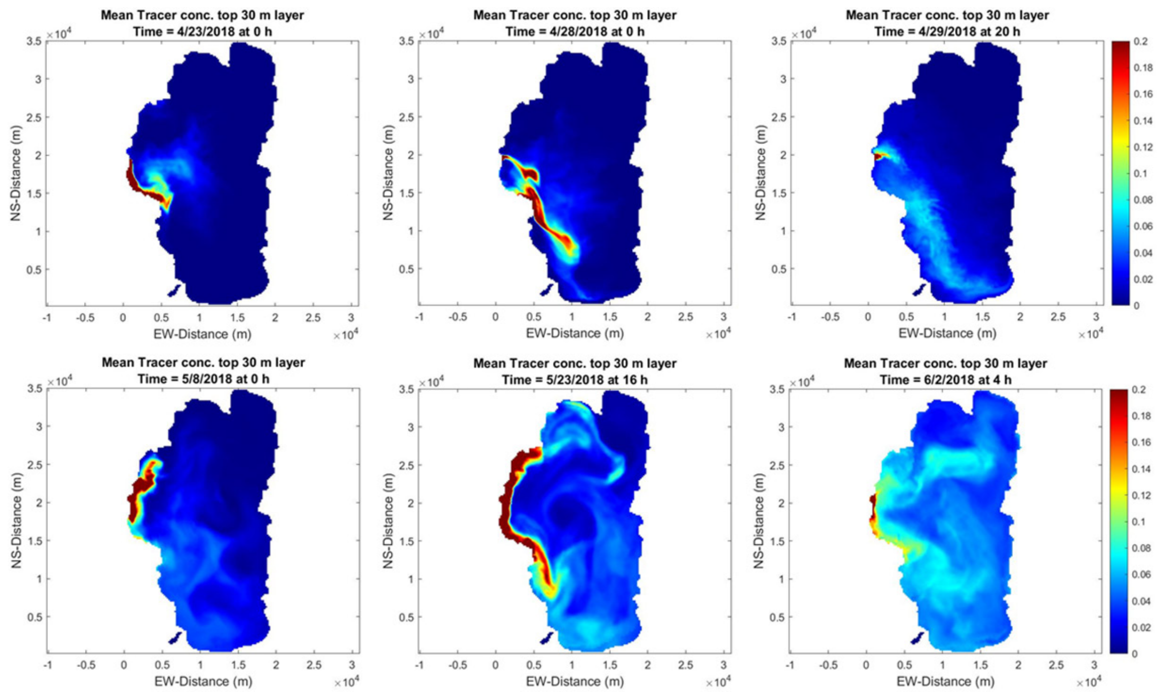
To illustrate the complexity of the fate of the stream water, the model depicts where a "tracer" would be carried in the upper 100 feet of Lake Tahoe. For illustration purposes, a continuous injection of a tracer added to Blackwood Creek was modeled commencing in April 2018. The tracer was just added to the model, not to the actual creek.

Streamflow can vary from year to year and based on flow rates and temperature stratification can have various effects on Lake Tahoe. Photo: A. Toy

Where does the flow go?, continued

The results are displayed as a series of the tracer distribution images in the upper 100 feet of the lake. They show multiple changes in the inflow fate during spring 2018. The tracer injection commenced on April 20, 2018 and continued through June 2, 2018. During late April, the inflow tended to flow south hugging the shoreline, but at the same time part of the inflow can be seen in the center of the lake. By early May, the flow pattern changed, and while the water inflow was observed moving north, the entire southern part of the lake showed some tracer concentration. By May 23, there are high concentrations along most of the west shore, but nearly the entire lake was impacted. By June 2, inflows are low, so relatively little tracer is being added, but the existing tracer was being spread and diluted throughout the lake.

Running scenarios with hydrodynamic models provide great insight into the workings of the lake, both physically and ecologically. It allows us to better understand the fate of contaminants that enter Lake Tahoe and in so doing allows for the more strategic planning of future monitoring. This is an important tool for helping to protect the long-term health of Lake Tahoe. Model results provided courtesy of Alicia Cortés.



The scientific underpinnings of no-wake zones

No-wake zones are common in most lakes, including Lake Tahoe. Near the shore, where the water is shallow and boating activity is high, the flows and waves generated by boats have the potential to resuspend sediment and nutrients from the lakebed.

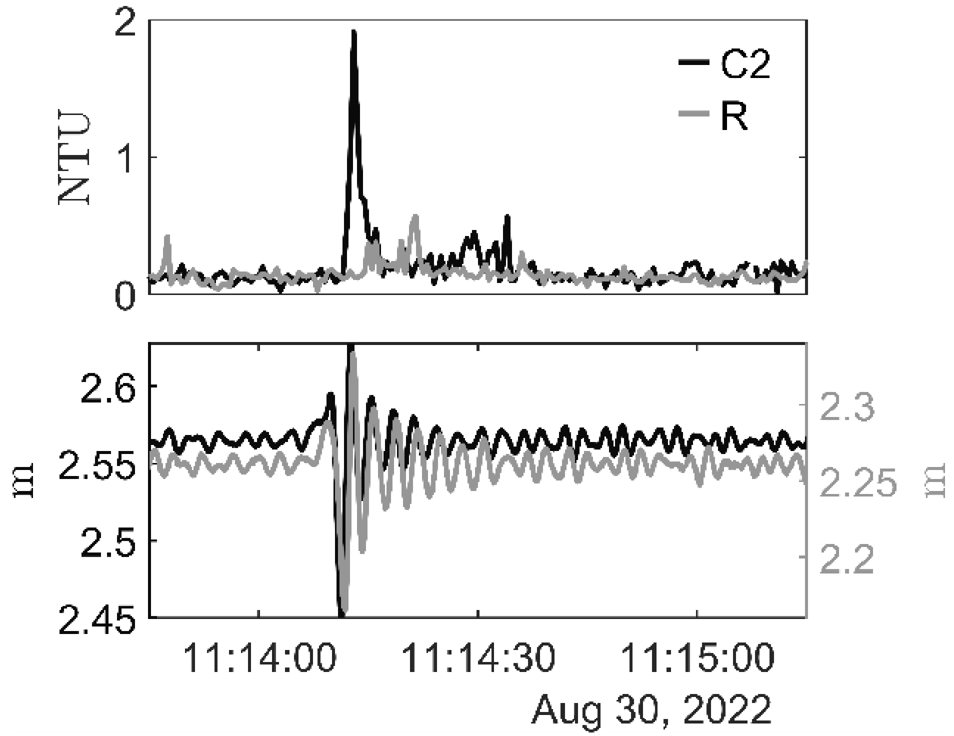
Field campaigns in 2019 and 2022, funded by the Tahoe Regional Planning Agency, revealed that boat-induced waves accounted for up to 45% of the total wave activity registered on the south shore of Lake Tahoe during the summer. The boat-induced waves generally at a maximum between 10:00 am and 12:00 pm, gradually declining in the afternoon to about 10% of the total wave activity. As the summer transitioned into fall, the contribution of boat wake to overall wave activity decreased.

The instruments at Site C2 measuring water clarity (turbidity), pressure (depth), and water velocity induced by a boat travelling at 10mph over the site. Site R is out of the frame as it is 20 ft to the left of Site C. An in situ video camera was used for this image.

The scientific underpinnings of no-wake zones, continued

In 2022, turbidity and wave measurement instruments were installed at a water depth of 8 feet, and boats driven over the site at a range of speeds. When boat speeds exceeded 5 mph, sediment resuspension occurred, and resulted in turbidity increases of up to 6 NTU. This value is well above the desired turbidity level. The highest impacts were for speeds of 10 mph. The boat-induced sediment resuspension was characterized by an instantaneous increase in turbidity (decrease in water clarity).

The study found that the existing no-wake zones were protective of most, but not all, of Lake Tahoe's nearshore. Where they were found to be lacking were on the south shore and on the northwest shore, where shallow shelfs are present. We are working with Agencies to determine if modifications to the policy are needed to provide more complete protection. Plots courtesy of Sergio Valbuena.



Turbidity (upper) and wave amplitude induced by boat passage of recreational watercraft at speed of 10 mph. The instruments at C2 are located immediately below the boat passage, whereas the instruments at R are 20 feet off the boat's trajectory.

What is yellow and floating in the middle of Lake Tahoe?

In late June 2023, Tahoe visitors bore witness to the very large release of pine pollen at Lake Tahoe. The pollen coated cars with a yellow hue, infiltrated homes, and caused allergies to flare up, but much of it seemed to end up on the lake itself. Being lighter than water, pollen floats for a long time, before either being washed up on the shore or becoming coated with other particles and sinking to the lake bottom.

A pine pollen grain from 20 m depth at Lake Tahoe. Photo: L. Tanaka

Pollen forming intricate patterns at Crystal Bay, NV. Photo: M. Bruno

What is yellow and floating in the middle of Lake Tahoe?, continued

Does the pollen impact lake water quality? In a 1970 study performed by Dr. Pete Richerson of UC Davis, five plastic tubs were placed around the lake to collect the pollen. Based on the results, an estimated 12.5 kg of nitrogen and 16.6 kg of phosphorus were added across the entire lake via pollen. By comparison, in 2022, the Upper Truckee River alone contributed 11,100 kg and 1,680 kg of nitrogen and phosphorus respectively. Therefore the nutrient contribution from pollen is negligible.

Does the pollen impact clarity? Probably not. Most pollen grains are about 20–100 microns in diameter, about 10 times larger than the particle sizes that reduce clarity.

In conclusion, it seems that the largest negative impact of the pollen is the annual cleaning of decks, garden furniture,

Pollen in the nearshore at Tahoe Vista, CA. Photo: K. Larrieu

Dense collection of pollen at Moon Dunes beach. Photo: A. Toy

A new opportunity for tomorrow's scientists and educators

This year TERC has launched a new summer internship program to help train and inspire the future generations of scientists. While we have always had summer interns, they were focused on a single area of TERC research and generally were unpaid positions. As a consequence, only students who did not need a paying position or already had housing in the Tahoe area would apply.

This year is different. Each intern is paid a "living stipend" and works under the guidance of a research mentor. The group convenes weekly to share their progress and updates. They participate in a weekly lecture from outside experts from Tahoe's agencies, non-profits, or other community experts. On the first day of the 2023 program, the group had a unique opportunity to hear from Herman Fillmore, the Washoe Tribe's Culture and Language Resources Director, speaking on the history and significance of his tribe at Lake Tahoe. Through this new innovative program, interns are gaining exposure to all of TERC research and learn about science guided policy and advocacy from local experts.

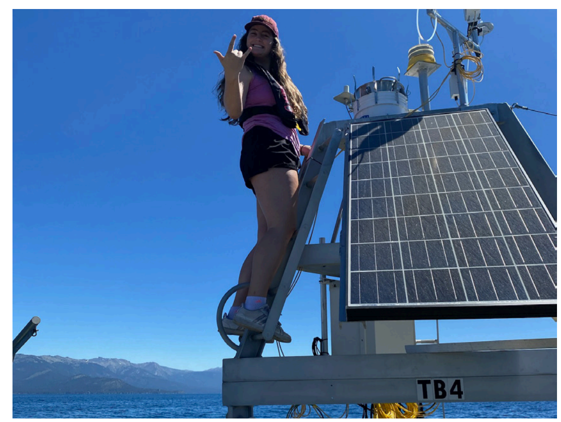
Following the launch of the TERC Internships for Scholars program, we had over 30 applicants and were able to offer positions to seven scholars whose interests and level of scholarship best matched our research needs. The group represents students from UC Davis, Cal Poly San Luis Obispo, University of Nevada Reno, Drake University, University of Washington, and University of Denver.

The culmination of the summer internships will take place on August 10, 2023, at Granlibakken in Tahoe City, and the whole community is invited to meet them and learn the results of their research.

The funding for the TERC Internships for Scholars program has come exclusively from philanthropic support and we thank the donors who gave so generously. If you are interested in supporting this annual program, please visit https://give.ucdavis.edu/TERC/TERCG56

Olivia Nole sets up bins of hydrogen peroxide for an Asian clam experiment. Photo: O. Nole

Sydney Mendelson and Sidney Barbier teach visitors and residents all about TERC. Photo: K. Wilson



Katie Fielder checking out the TERC research equipment aboard buoy TB4. Photo: K. Senft