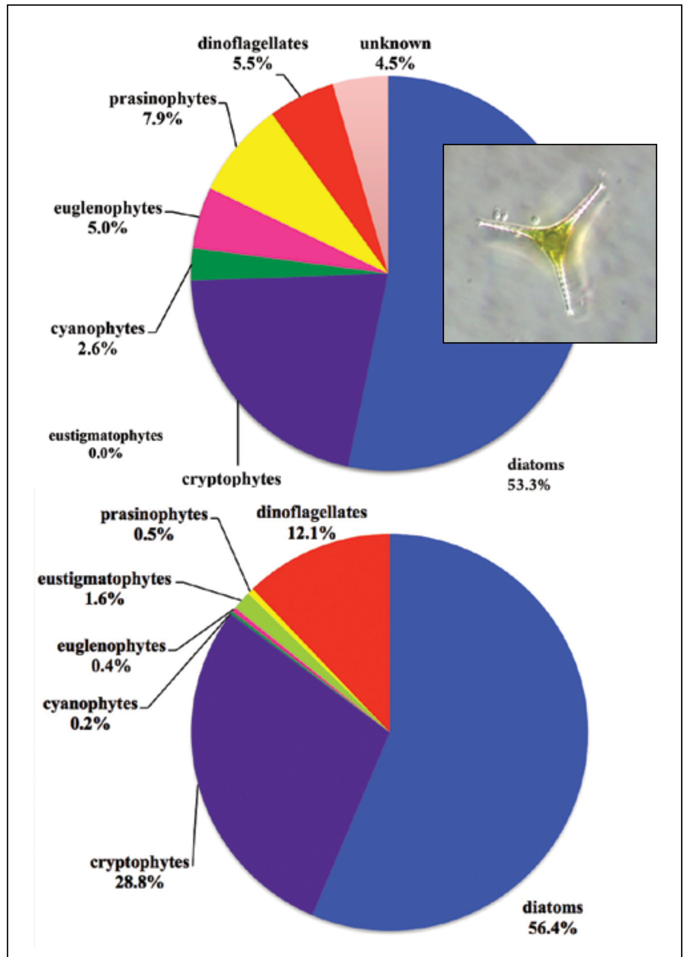
S C I E N C E

Revealing Plankton Pigments



Pigment analysis (top) and microscope analysis (bottom) produce similar results, but pigment analysis is better at identifying small or rare component species of phytoplankton. Source: Kudela Lab (inset), Peacock et al., UCSC, USGS, SFEI.

Keeping tabs on San Francisco Bay's wildlife involves counting plants. That means tracking the relative numbers and types of the microscopic floating plants that feed the Bay. Known as phytoplankton, their number includes diatoms, dinoflagellates, cyanobacteria, and chromophytes, to name a few.

"Some are like the kale of the sea, others are like french fries," says Jim Cloern, a scientist who monitors Bay food webs for the U.S. Geological Survey. Some can also produce toxins, while others cannot. For these reasons, understanding which phytoplankton are in the Bay can help scientists predict booms and busts in fish populations, forecast toxic algal blooms, and warn seafood eaters of potential danger.

"What phytoplankton species are in the Bay has a big economic impact on fisheries, travel, and tourism. For example, you can't allow people to collect mussels during a toxic bloom," says Misty Peacock, a postdoctoral fellow at UC Santa Cruz.

Since 1988, the U.S. Geological Survey has tracked the types of phytoplankton in the Bay by taking water samples at 36 locations from Rio Vista to Alviso. They send two plankton samples from each cruise to a laboratory for microscopic analysis.

Though a tried and true technique, microscopic analysis is also expensive and time-consuming. Technicians must be trained to identify phytoplankton types by sight, and must painstakingly count hundreds of the tiny cells in samples.

Over the past year, Peacock has helped the USGS identify a faster and cheaper plankton-counting method. Known as pigment analysis, this technique deduces which groups are present by identifying their unique photosynthetic pigments. Each pigment reflects different light wavelengths, making them different colors.

While all phytoplankton produce chlorophyll a, each class also produces at least one unique accessory pigment. For example, diatoms are the only phytoplankton that produce fucoxanthin (brown), while dinoflagellates have a lock on peridinin (brown-gold), and cyanobacteria alone make zeaxanthin (orange).

To obtain samples for pigment analysis, technicians capture phytoplankton in a given volume of Bay water on filter paper — the same process used for microscope analysis. Back at the lab, the plankton are broken up to release their pigments, and suspended in solvent. The solution is then forced through a high performance liquid chromatography, or HPLC column. The column separates the pigments so that each emerges at a different time. As each pigment emerges, a device that analyzes its color detects its presence and records this information as a graph. Each pigment forms a distinctively-shaped peak, and the larger the area under the peak, the more of the pigment is present.

Finding an accessory pigment is like locating a fingerprint at a crime scene. "Even if we didn't see that organism via microscopy but we see their diagnostic pigment in our samples, we know they're still in the water," Peacock says. For this reason, pigment analysis is the method of choice for finding relatively rare and extremely tiny organisms.

The total amount of cells in the sample is determined by analyzing the amount of chlorophyll a present. The proportion of each class of phytoplankton can be determined by the relative amount of its accessory pigment.

Pigment analysis promises to revolutionize our ability to track what's in the Bay at any given time. Because the technique is so economical, the agency can sample up to 15 samples per cruise and obtain a much higher-resolution phytoplankton snapshot. Although the technique has been around since the 1990s, Peacock and the USGS are the first to apply it to long-term monitoring in San Francisco Bay.

However, Peacock says, pigment analysis shouldn't replace microscopy but rather should be used alongside it. Pigments alone can't identify a phytoplankton species. That means the technique cannot pinpoint the source of harmful algal blooms, which can suffocate fish and poison everything from pelicans to people.

Yet the technique can guide Bay sampling efforts. "If I saw an increase of cyanobacteria using pigment analysis, I would know it was important to go out and sample more in the Bay. The results can help us decide where the best places to monitor some of these harmful species might be," Peacock says. This would allow scientists to stay on top of an evolving bloom, and alert health authorities accordingly. **KW**

CONTACT Misty Peacock
mdbpeacock@gmail.com