Fact Sheet: Why is Phytoplankton Measurement Important?

Aquatic scientists and water resource managers measure phytoplankton to gain a more in depth understanding on ecological dynamics, ecological health, nutrient status, and harmful algal bloom potential in aquatic systems. Submersible fluorescence sensors help to make this measurement easy, efficient, and economical by enabling real-time field estimates of phytoplankton biomass that can be directly correlated to quantitative laboratory measurements using standard methods.

Figure 1. Phytoplankton come in many different shapes, sizes, and colors

Measuring phytoplankton can provide valuable insights regarding the biological status of any given aquatic system. Some common applications include: Eutrophication / Nutrient Status Monitoring, Harmful Algal Bloom (HAB) Monitoring, Drinking Water Management

Common Applications

Primary Productivity Quantification

As phytoplankton form the foundation of aquatic food webs, concentrations of phytoplankton can have a direct effect on all organisms higher up on the food chain. Quantifying primary production through phytoplankton biomass measurements is a common way to gather direct insights on the baseline energy available within any given aquatic food web.

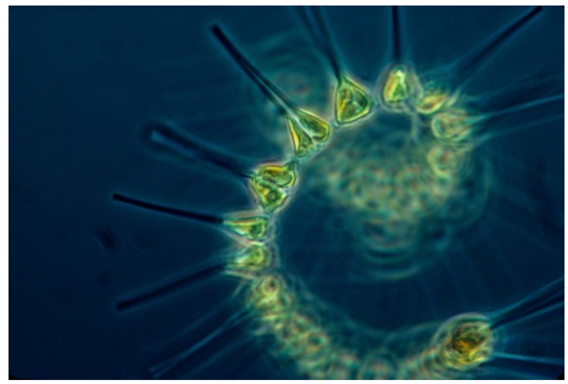

Figure 2. Phytoplankton

Eutrophication / Nutrient Status Monitoring

Eutrophication is the process where nutrients such as nitrogen and phosphorous are loaded into an aquatic system, typically caused by watershed run-off inputs. Eutrophic systems are highly prone to phytoplankton blooms which can lead to dissolved oxygen depletion when phytoplankton cells die off. Phytoplankton monitoring can help water resource managers to control watershed inputs that can affect nutrient loading within aquatic systems.

Harmful Algal Bloom (HAB) Monitoring

Certain species of phytoplankton, mainly cyanobacteria, can release toxins that can cause adverse health effects to humans and animals. Continuous monitoring of phytoplankton levels as part of a broad management plan can help water quality managers to decrease the prevalence of health incidents due to harmful algae.

Drinking Water Management

Certain species of phytoplankton can produce compounds that create taste and odor issues in water, including the compounds 2-MIB and geosmin. Proactive phytoplankton monitoring can provide data that helps managers determine when and where to apply algaecide, as well as which source water intakes to pull from to minimize the biological load entering a treatment system.

How to Measure In Vivo Fluorescence

Multiparameter water quality instruments, such as HYDROLAB sondes, utilize integrated submersible fluorescence sensors from Turner Designs for in vivo phytoplankton biomass measurements. Depending on the objectives of the user, these sensors can be deployed for use in spot sampling, vertical profiling, horizontal profiling, and continuous long-term installation applications.

Figure 3. Real-time in vivo phytoplankton measurement using fluorescence sensors on a HYDROLAB sonde

Which Fluorescence Should I Use?

Available options include sensors designed to measure in vivo chlorophyll a, phycocyanin, and phycoerythrin pigments. *In vivo* chlorophyll *a* is the most commonly deployed sensor among the three *in vivo* phytoplankton fluorescence sensors offered on HYDROLAB sondes, followed by phycocyanin and phycoerythrin. The optics on the *in vivo* chlorophyll *a* sensor are specifically aligned with the *in vivo* fluorescence signature of the chlorophyll *a* pigment. This optical configuration provides *in vivo* data that is directly relevant to extracted chlorophyll *a* measurements, which is important considering that EPA Method 445.0 are specifically based on chlorophyll *a* pigment concentrations.

Figure 4. HYDROLAB Chlorophyll a Sensor

In applications where cyanobacteria are dominant or are the main type of phytoplankton that are of interest, the phycocyanin or phycoerythrin sensors are the most appropriate for the application. The phycocyanin sensor is used in fresh water environments, while the phycoerythrin sensor is used for marine environments.

How Can the Data Be Used?

Used on their own, these submersible fluorescence sensors give instantaneous results regarding relative changes in phytoplankton biomass. This relative data may be sufficient for the needs of some aquatic scientists or water resource managers. For others, determining the actual quantitative value using laboratory methods is still required, typically in the units of micrograms per liter or cells per milliliter. By combining *in vivo* fluorescence field data with the taking of occasional grab samples used for quantitative laboratory analysis, a relationship between both data sets can be determined. Once this relationship is known, a correlation coefficient can be generated, enabling the ability to convert unit-less relative field data into estimations of phytoplankton biomass that have units.

As a very simplified hypothetical example, imagine two samples of water taken at the same time from a pond with green algae and placed into two separate buckets. Using a submersible *in vivo* chlorophyll *a* fluorescence sensor, a reading of "50" from bucket #1 and a reading of "100" from bucket #2 are generated. What this indicates is that there is twice as much signal in bucket #2 relative to bucket #1, assuming that both samples are operating within the linear range of the sensor. To convert these relative readings into quantitative readings, the water samples are then taken to a laboratory for quantitative analysis. Chlorophyll *a* extractions are performed with the bucket samples and it is then determined that bucket #1 (that read "50" in the field) has 10 micrograms per liter of chlorophyll *a*, while bucket #2 (that read "100" in the field) has 20 micrograms per liter of chlorophyll a. With a correlation now determined between field data and laboratory data, one can now make estimations regarding actual concentrations of other simultaneously collected field data (in this simplified example, in vivo field data x 0.2 = estimated microgram per liter concentration.

For more information on why Phytoplankton measurement is important, contact OTT Hydromet.

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