Evaluation of cyanobacterial populations in White Pond, Concord, MA
Addendum- October 29. 2021

The comprehensive monitoring program has been developed to provide information related to the seasonal ecology of cyanobacterial populations in White Pond, the amounts of cyanobacterial biomass, the concentrations of cyanotoxins and the potential influence of external factors (e.g. fish stocking) on plankton dynamics that can facilitate management decisions. The program uses a tiered approach successively including additional parameters to enrich the interpretations, while respecting limitations such as availability of trained field personnel, funding for laboratory analysis, municipal capabilities and responsiveness. Additionally, a complementary program has been developed for the Town Beach tailored to meet the MA DPH recreational guidelines

Tier 1 Monitoring: Microcystin estimation and bloom prediction at Deep and Cove SItes

The first tier of the program includes the use of a traditional whole lake water sample as well as size fractionated samples (i.e. <50 micron and bloom-forming cyanobacteria) to describe distinct cyanobacterial populations that typically inhabit freshwater systems and/or have been previously documented in White Pond. The <50 micron sample represents cyanobacteria that are readily bioavailable (i.e. enter the food web), can be aerosolized and tend to be planctonic. The bloom-forming cyanobacteria (BFC) are those that are buoyant, becoming responsible for surface scums and accumulation (a.k.a. blooms). Using microscopic techniques the samples are analyzed to determine the cyanobacteria by genus (composition) and to what level they contribute to the entire cyanobacterial population in the lake (relative dominance). Using fluorometric techniques to measure the cyanobacterial pigment phycocyanin, the amount of biomass is quantified. This information can now be used in two different ways: 1) to estimate microcystin concentrations using a simple deterministic model and 2) to predict the occurrence of surface blooms using a simple growth rates model. The deterministic model provides a first order screening that can be used by local officials to determine if additional testing consistent with the MA DPH guidelines needs to be conducted. The growth rate model provides an early warning system of the pending increase in cyanobacterial biomass that has the potential to create bloom conditions. Combined, both models can be used by local officials as part of a proactive approach to managing cyanobacterial populations and the hopefully minimizing exposure.

Tier 2 Monitoring: Trophic interactions and food web transport of cyanotoxins at Deep Site #1

The second tier of the program includes the analysis of the zooplankton assemblage in the water body. The zooplankton are a sensitive biological indicator of the changes in water quality and the influence of predation pressure on the structure of the cyanobacterial population. Genus level identification can identify zooplankters associated with trophic state (oligotrophic, mesotrophic and eutrophic) and using known assemblage ratios (i.e the predator/panfish ratio) the structure of the fish population in White Pond. The biomass of the zooplankton can be compared to the biomass of the cyanobacterial populations to quantify their interactions. This information can be used by the natural resource managers to assist in their decision-making processes.

Town Beach Sampling

The sampling at the Town Beach will rely upon the collection and analysis of the BFC sample to compare with the results from the Deep and Cove sites. The results from BFC sample are critical to understanding the spatial dynamics of these cyanobacteria in White Pond, as bloom conditions have been noted at the beach (a regulated site) and other coves (non-regulated sites) used for bathing. The growth rates of the BFC population typically signal bloom conditions 7-10 days in advance of the appearance of surface accumulations and are a critical component of the early warning system. The fluorometric data from the BFC and scum samples (if present) can be used to estimate the microcystin concentrations. If these estimates (growth and toxin concentration) are high enough, the town can make the decision as to additional sampling and analysis (MC ELISA EPA Method 546 and cell counts) are warranted. As part of a long term monitoring program within the Board of Health, the fluorometry and MC ELISA data can be used to confirm the correlation between cyanobacterial biomass and microcystin concentrations. This relationship has been confirmed during the Summer 2021 sampling associated with the A-pod Pilot Study.