NSF- DEB 1831061 (2018-2023): Dimensions: Collaborative Research: "The Cyanobacterial Bloom Microbial Interactome as a Model for Understanding Biogeographical and Seasonal Patterns in Functional Biodiversity"

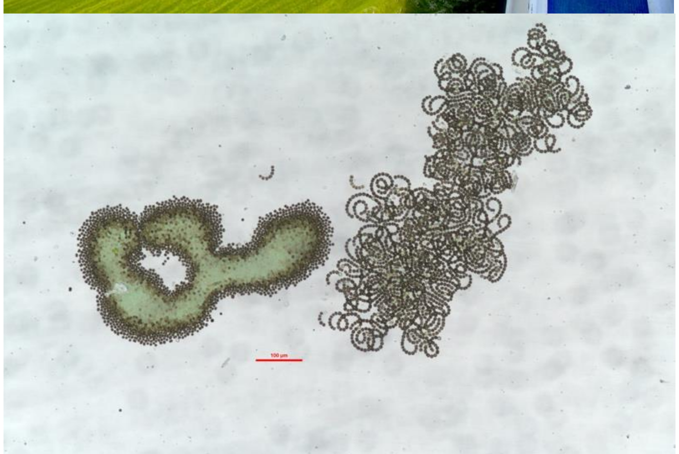
This NSF-supported project involves researchers at four U.S. institutions, including the University of Oklahoma (D. Hambright), as lead organization, **the University of North Carolina-Chapel Hill (H. Paerl)**, Auburn University (A. Wilson), and James Madison University (M. Steffen). Additionally, this project will involve researchers from Australia, Canada, China, France, Germany, Hungary, Israel, and New Zealand.

In recent years, harmful outbreaks of toxic cyanobacteria have reached new levels in water bodies all over the world. These cyanobacterial blooms are threatening freshwater lakes. The toxins pose substantial health risks to humans, pets, livestock, and wildlife. Rather than focusing strictly on nutrients and climate like previous research, this project explores the complex bacterial communities that cooccur with cyanobacteria. The project will test the hypothesis that cyanobacteria are supported through a mutually beneficial relationship with a mixture of other bacteria species. This project will make new discoveries about how to mitigate cyanobacterial blooms by comparing different ones across the world during important periods in their life cycles. This project will develop an enhanced understanding of the interactions between cyanobacteria and associated species. This project involves researchers at four U.S. institutions, one of which focuses on undergraduate education. There will be training of at least five Ph.D. and 20 undergraduate students. The project will specifically recruit underrepresented minorities into STEM fields to help prepare a diverse scientific workforce.

This project will study the fundamental interactions driving one of the most common environmental problems: freshwater toxic cyanobacterial blooms. The central hypothesis is that these blooms constitute complex interactions of cyanobacterial species and associated bacteria. These groups of bacteria coevolved to form a community of synergistic species, each with unique metabolic capabilities that are critical to the growth, maintenance, and demise of the bloom. Three approaches will be used: (1) a global survey of cyanobacterial blooms throughout the phases of the bloom, (2) a targeted series of metagenomic surveys, and (**3)-UNC-CH Institute of Marine Science component, Dr. Hans Paerl, P.I. experimental work in the lab and field at sites in China and North America. This component project will explore the roles of nutrient inputs, nutrient ratios, and various forms of nitrogen. New analyses will investigate the taxonomic identities and functional outcomes of these cyanobacterial communities.** The results of this project will lead to improved predictions about the toxicity of blooms threatening human activities. This research aims to mitigate harmful cyanobacterial blooms by using a realistic approach based on community ecology and evolutionary biology.

Microcystis spp.-dominated cyanobacterial bloom in Lake Taihu, photographed by P.I. Hans Paerl during July, 2018

Close-up photograph of *Microcystis* spp.-dominated cyanobacterial bloom in Lake Taihu, photographed by P.I. Hans Paerl during July, 2018



Photomicrograph of dominant cyanobacterial bloom genera found on Lake Taihu, China. Pn the left is a colony of the non N_2 fixer *Microcystis* and on the right is a colony of the N_2 fixer *Dolichospermum* (formerly *Anabaena*). Photographed by P.I. Hans Paerl during a July 2018 bloom

Shoreline *Microcystis* spp.-bloom in Lake Taihu, photographed by P.I. Hans Paerl during June, 2015

Experimental mescosms on the shoreline of Lake Taihu, used to examine nutrient-cyanobacterial bloom potentials. Shown are PhD Graduate Students (from left to right), Bryce Van Dam (PhD in Marine Science, UNC-CH, May 2018), Alexandria Hounshell (PhD in Marine Science UNC-CH, expected in May, 2019) and Kaijun Lu (PhD in Marine Science, Univ. of Texas, expected May, 2019).