Near-Real-Time Cyanobacterial Identification and Cell Counts Using Artificial Intelligence and Digital Microscopy

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Current methods of cyanobacteria monitoring rely heavily on laboratory analysis or sensor and/or fluoroprobe systems. These methods can prohibit frequent and efficient monitoring due to expense and logistical challenges (sample shipment to lab, analysis by expert, need for microscopy to ID cyanobacteria). Here, we present a cellphone-based microscopy method to rapidly identify and enumerate cyanobacterial concentrations. In this study, digital imaging microscopes were deployed to eight (8) volunteers across Wisconsin and New York. Volunteers collected cyanobacterial samples and images using the provided digital microscope. Images were emailed to a trained scientist, for cyanobacterial cell ID and processing of cyanobacterial counts. A model using colony volumes and average cell volumes was used to calculate cell densities (cells/ml). Generated reports showed great agreement with fluorometer analysis ($R^2 > 0.80$) and provided cell identification and counts in approximately 1-2 hours. We found the method to be easy-to-use across our volunteer network and that further development and replacement of scientist involvement with an artificial intelligence program will further reduce sample processing time, generating reports in 10 mins or less. Application of this method provides cost-effective, near-real-time monitoring of HABs to a wide range of users, requiring only an inexpensive field microscope and smart phone.