WHERE DO WE GO FROM HERE? MITIGATING HARMFUL CYANOBACTERIAL BLOOMS IN A WORLD FACING HUMAN NUTRIENT OVER-ENRICHMENT AND CLIMATE CHANGE

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Harmful (toxic, hypoxia-generating, food web altering) cyanobacterial blooms (CyanoHABs) pose a serious environmental and human health problem that is expanding globally and threatening sustainability of our aquatic resources. Human nutrient enrichment and hydrologic modifications, including dam and reservoir construction and diversions, are a major driver of bloom expansion. However, climatic changes taking place, including warming, more extreme rainfall and drought events, act synergistically with man-made drivers to exacerbate the problem. Bloom mitigation steps must incorporate these dynamic interactive factors in order to be successful in the short- and long-term. To be most effective, these steps must be applicable along the freshwater to marine continuum spanning lakes, rivers, estuarine and coastal waters. Nutrient input reductions are an essential component of virtually all CyanoHAB mitigation strategies. Traditionally, phosphorus (P) reductions were prescribed for freshwater systems, while (N) reductions were stressed in brackish and coastal waters. However, these systems are hydrologically connected and on the watershed scale single nutrient (e.g., P) management steps taken upstream may not reduce CyanoHAB problems and sometimes exacerbate them downstream. To ensure long term, sustainable success, these strategies should include both nitrogen (N) and phosphorus (P) input reductions. Flexibility in nutrient reductions needed to mitigate along the continuum should be an integral component of nutrient management strategies because as climatic influences change, and internal nutrient loading decreases over time, new nutrient-bloom thresholds will likely emerge.