World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:11, No:12, 2017

The Effects of Above-Average Precipitation after Extended Drought on Phytoplankton in Southern California Surface Water Reservoirs

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Abstract : The Metropolitan Water District of Southern California (MWDSC) manages surface water reservoirs that are a source of drinking water for more than 19 million people in Southern California. These reservoirs experience periodic planktonic cyanobacteria blooms that can impact water quality. MWDSC imports water from two sources – the Colorado River (CR) and the State Water Project (SWP). The SWP brings supplies from the Sacramento-San Joaquin Delta that are characterized as having higher nutrients than CR water. Above average precipitation in 2017 after five years of drought allowed the majority of the reservoirs to fill. Phytoplankton was analyzed during the drought and after the drought at three reservoirs: Diamond Valley Lake (DVL), which receives SWP water exclusively, Lake Skinner, which can receive a blend of SWP and CR water, and Lake Mathews, which generally receives only CR water. DVL experienced a significant increase in water elevation in 2017 due to large SWP inflows, and there were no significant changes to total phytoplankton biomass, Shannon-Wiener diversity of the phytoplankton, or cyanobacteria biomass in 2017 compared to previous drought years despite the higher nutrient loads. The biomass of cyanobacteria that could potentially impact DVL water quality (Microcystis spp., Aphanizomenon flos-aquae, Dolichospermum spp., and Limnoraphis birgei) did not differ significantly between the heavy precipitation year and drought years. Compared to the other reservoirs, DVL generally has the highest concentration of cyanobacteria due to the water supply having greater nutrients. Lake Mathews' water levels were similar in drought and wet years due to a reliable supply of CR water and there were no significant changes in the total phytoplankton biomass, phytoplankton diversity, or cyanobacteria biomass in 2017 compared to previous drought years. The biomass of cyanobacteria that could potentially impact water quality at Lake Mathews (L. birgei and Microcystis spp.) did not differ significantly between 2017 and previous drought years. Lake Mathews generally had the lowest cyanobacteria biomass due to the water supply having lower nutrients. The CR supplied most of the water to Lake Skinner during drought years, while the SWP was the primary source during 2017. This change in water source resulted in a significant increase in phytoplankton biomass in 2017, no significant change in diversity, and a significant increase in cyanobacteria biomass. Cyanobacteria that could potentially impact water quality at Skinner included: Microcystis spp., Dolichospermum spp., and A.flos-aquae. There was no significant difference in Microcystis spp. biomass in 2017 compared to previous drought years, but biomass of Dolichospermum spp. and A.flos-aquae were significantly greater in 2017 compared to previous drought years. Dolichospermum sp. and A. flos-aquae are two cyanobacteria that are more sensitive to nutrients than Microcystis spp., which are more sensitive to temperature. Patterns in problem cyanobacteria abundance among Southern California reservoirs as a result of above-average precipitation after more than five years of drought were most closely related to nutrient loading.

Keywords : drought, reservoirs, cyanobacteria, and phytoplankton ecology
Conference Title : ICHA 2017 : International Conference on Harmful Algae
Conference Location : San Diego, United States
Conference Dates : December 18-19, 2017