Abstract

Agricultural runoff poses a threat to the Wilmington, Ohio municipal water supply and its source waters. A harmful alga bloom (HAB) was documented in June 2019 in Caesar Creek Lake, Waynesville, Ohio. This study seeks to establish baseline nutrient concentrations in Caesar Creek Lake (Warren County, Ohio) and its tributaries, and to identify potential non-point sources of excess nitrogen and phosphorous that contributed to the HAB event. In collaboration with the Wilmington Water Department, dissolved inorganic nitrogen DIN-\(N\) (sum of \(NH_3\)-\(N\), \(NH_4^+\)-\(N\), \(NO_2^-\)-\(N\), \(NO_3^-\)-\(N\) concentrations), dissolved phosphorous DP-\(P\), particulate phosphorous PP-\(P\), total phosphorous TP-\(P\) (total sum of DP-\(P\) and PP-\(P\) concentrations) and general water quality parameters were measured from May 30th, 2018 to the September 26th, 2019 in Caesar Creek Lake. Dissolved phosphorous DP-\(P\), particulate phosphorous PP-\(P\) and total phosphorous TP-\(P\) (total sum of DP-\(P\) and PP-\(P\) concentrations) concentrations were measured on January 23rd, 2019, and from April 9th, 2019 to September 26th, 2019. General water quality parameters, DP-\(P\) and DIN-\(N\) samples were taken at depths of 0, -2, -6, and -11 meters. Microcystin samples were obtained and analyzed concurrently by the Wilmington Water Department (WWD). Ion chromatography (IC) was used to determine nitrite, nitrate, and phosphate in water samples. Sediment samples were obtained from tributaries to Caesar Creek Lake and were analyzed for both TP-\(P\), DP-\(P\), and PP-\(P\) using inductively coupled plasma-optical emission spectrometry at 213.6 nm following acid digestion. A YSI Professional Plus electrochemical probe was used to measure general water quality parameters (dissolved oxygen, pH, temperature, specific conductance). The tributaries Turkey Run, Anderson Fork, and Buck Run had the highest measured inputs of DIN-\(N\) during the 2019 HAB event, with DIN-\(N\) concentrations of 6.58 mg/L, 3.74 mg/L, and 3.35 mg/L on June 5th, 2019. High precipitation and flow rates into each tributary prevents a definitive claim about a specific tributary potentially causing the 2019 HAB event. There is a clear trend between tributary increases in DIN-\(N\) and TP-\(P\) and the increase in microcystin concentrations [MC] in early June of 2019, showing a potential dual role of DIN-\(N\) and TP-\(P\) during a known HAB event that occurred from June 1st, 2019 to September 5th, 2019 with spikes of TP-\(P\) from Turkey Run and Buck Run on June 5th, 2019. Microcystin increased nearly logarithmically during the same time period, and TP-\(P\) values from Turkey Run and Buck Run found to be 0.318 mg/L, and 0.076 mg/L, respectively. DIN-\(N\) values from Turkey Run and Anderson Fork, also on June 5th, 2019, were 6.58 mg/L and 3.74 mg/L, respectively. [MC] values increased significantly during the same time period, with values of 0.170 µg/L, 0.365 µg/L, 0.809 µg/L, and 2.608 µg/L on May 30th, 2019, June 6th, 2019, June 13th, 2019, and June 19th, 2019, respectively.