ABSTRACT

Lake Munson is located in North Florida, on the south side of Tallahassee. It was selected as the study area due to its long history of water quality degradation, attributed to multiple factors, including historical discharges of effluent from the Tallahassee Wastewater Treatment Plant (WWTP), decades of untreated urban stormwater runoff, agricultural fertilizer inputs, and the availability of extensive—albeit inconsistently documented—data from long-term restoration efforts.

The objectives of this study include: (1) To identify the sources of nutrient pollution in Lake Munson and determine the primary contributor, (2) To assess the amount of phosphorus released from the lake's muck into the overlying water column, (3) To evaluate the effectiveness of previous restoration interventions, such as lake drawdown and phytoremediation (i.e., vegetation-based remediation efforts). Accordingly, this research aims to investigate the nutrient dynamics between the muck and water column and propose evidence-based solutions to support Leon County's ongoing efforts to restore Lake Munson.

The spatial and temporal variations of nutrients—specifically nitrogen (N) and phosphorus (P) were analyzed. The total phosphorus (TP), total nitrogen (TN), and Chlorophyll-a (Chl-a) levels mostly exceed the total maximum daily load (TMDL) limit set by FDEP to restore the lake.

Results indicate that the significant source of nutrient input is internal—specifically, the release of legacy phosphorus from the muck into the water column. This internal loading significantly fuels the year-round proliferation of algal blooms. On average, the flux is approximately 10.16 $mg/m^2/day$ across the lake. Specifically, 8.57 $mg/m^2/day$ at the western station—LMU7—and 11.75 $mg/m^2/day$ at the eastern station—LMU8, both located in the mid-section of the lake. After applying area-weighting, the estimate of the total exchange capacity is approximately 4.32 t/y (tons per year).

The nutrients and Chl-a concentration levels increased following the lake drawdown. However, the nutrients and Chl-a levels significantly decreased when vegetation-based phytoremediation was implemented and managed adequately between 2015 and 2023. Therefore, the nutrient level has been on a decline in recent years.

Meanwhile, the assessment of vegetative health in the lake ecosystem shows a decline in the Lake Vegetation Index (LVI). The LVI score of the lake was 43 in 2021, a substantial decline from 57 in 2018 and the year 2020's score of 53. The 2022 LVI score is 30, placing the lake's vegetative population further in the impaired category. If the LVI score continues to decline, the aquatic vegetation may not function adequately to support ecosystem health. Therefore, continuous monitoring is essential to ensure that vegetation conditions remain stable or significantly improve over time.

Keywords: Lake Munson; Eutrophication; Algal blooms; Nutrients recovery; Circular economy; Water quality; Environmental sustainability