Journal of Ecosystem & Ecography
ISSN: 2157-7625

Zhang, J Ecosys Ecograph 2022, 12:6

Review Article

Open Access

Environmental Effects on the Release of Nutrients at the Sediment-Water Interface

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Abstract

To investigate the biogeochemical properties of nitrogen and phosphorus, to calculate the loads of these nutrients, and to evaluate their e ects on water quality, surface sediment and water samples were taken from Daihai Lake. Total Phosphorus (TP), Total Nitrogen (TN), and various nitrogen forms in sediments were examined, as well as their regional distributions. TN and TP concentrations in surface sediments were found to range from 0.27 to 1.78 g/kg and from 558.31 to 891.29 mg/kg, respectively, according to the results. The C: N ratios ranged from 8.2 to 12.1, which showed that the majority of the nitrogen collected, came from terrestrial sources. All sampling sites had N: P ratios that were less than 10, indicating that N was the limiting nutrient for algae development in this lake. An impact of it was also determined what e ects the environment has on the release of nitrogen and phosphorus in lake sediments; high pH levels may facilitate the release of nitrogen and phosphorus. To determine the trophic classiýcation of the studied lake, modiýed Carlsonís Trophic State Index (TSIM) and Comprehensive Trophic State Index (TSIC) were used. The values of TSIM and TSIC ranged from 53.72 to 70.61 and from 47.73 to 53.67, respectively, indicating that the Daihai Lake was in the stage of hypereutropher.

Keywords: Biogeochemical; Lake; Environment of Change; Nitrogen

Introduction

Eutrophication, which is brought on by excessive phosphorus and nitrogen inputs, has become one of the most prevalent impairments of surface waters in China and is one of the main threats to the health of freshwater ecosystems. It frequently takes the form of harmful algal blooms, which make it difficult for sunlight to reach underwater plants and lower oxygen levels. In general, sewage discharges, agricultural wastewater, and diffuse runoff from agricultural land are external sources that contribute nutrients into lakes and reservoirs. These nutrients may accumulate over time in the sediment and could provide an internal load that, depending on the environmental circumstances, could be recycled back into the water column. In addition, there is internal source of nutrients that may be crucial because, in the summer, when dissolved oxygen levels are at their lowest, nutrients from sediment can be released into the water column to support the growth of algae. However, it is unclear what the internal sources are. Understanding the effects of the chemical composition and trophic level of aquatic systems, especially in shallow lakes and coastal marine habitats, depends greatly on the complicated exchange mechanisms of nutrients across the sediment-water interface. P, one of the essential nutrients for aquatic ecology, is the nutrient that photosynthetic organisms need in the greatest amounts and is therefore the main factor limiting their growth. In estuary and lake conditions that support algal development, P can also inhibit or colimit that growth. Large N inputs Sediment is recognised as one of the main constituents of the internal source because it contributes significantly to the phosphorus concentration in the water that lies above estuarine and coastal areas. The water quality could be significantly impacted by such a release from bottom sediment, which could lead to continuous eutrophication. For freshwater ecosystems, sediments are an essential source of nutrients. Phosphorus is released to the water column from underlying sediments by a variety of processes, such as the microbial mineralization of organic matter, the desorption and dissolution of P bound in precipitates and inorganic materials, and the diffusion of dissolved P from sediment pore fluids. Temperature, dissolved oxygen concentration, pH level, and redox potential are the environmental factors that seem to control the rate at which dissolved P is released from sediments. Most experimental research conducted during the past few decades have focused on the static releases of phosphorus from lake sediments. Contaminated sediment discharged under hydrodynamic conditions is becoming more and more of a research priority because studies on dynamic release are still insufficient. Experiments in the lab using an oscillating grid, an annular tank, and open water channel have been used to evaluate how frequently contaminated material is released when there is running water. A variety of papers have classified lakes using different methods and indexes [1].

Mathematical models are vital tools to depict the level of eutrophication of natural water bodies because of the significance, complexity, and variability of eutrophicated systems. However, the assessment techniques for the various forms of lakes eutrophication varies due to varied geographic locations, environments, and human activities. The scoring method, nutritional index method, integrated nutrition state index method, modified Carlson trophic status index, and other methodologies are currently presented. The biomass related trophic status index created by Carlson is one of them, and it is the traditional and most widely applied measure that is based on the productivity of the water body. TSI, or Carlson's Trophic State Index, is a widely used a technique for describing the trophic status or general health of a lake. To determine the degree of eutrophication of the lake environment, the estimation of TSI requires knowledge of six physical, chemical, and biological parameters, including Total Phosphorus (TP), Total Nitrogen (TN), Chemical Oxygen Demand (COD),

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Received: 11-Apr-2022, Manuscript No: jee-22-68074, **Editor assigned:** 12-Apr-2022, PreQC No: jee-22-68074(PQ), **Reviewed:** 25-Apr-2022, QC No: jee-22-68074, **Revised:** 1-Jun-2022, Manuscript No: jee-22-68074(R), **Published:** 8-Jun-2022, DOI: 10.4172/2157-7625.1000335

Citation: Zhang F (2022) Environmental E ects on the Release of Nutrients at the Sediment-Water Interface. J Ecosys Ecograph 12: 335.

Secchi Disc Depth (SD), Chlorophyll-a (Chl-a), and Phytoplankton Biomass (CA). Carlson's trophic status index will be calculated using the average TSI values of these six factors. The TSI provides a 0-100 scale with continuous numerical classifications of lake trophic states and a solid theoretical framework for quantitative investigations of the eutrophication mechanism [2].

Analysis Methods

According to the book Lake Ecosystem Observation Method, the locations of the sampling sites in Lake Daihai were chosen. In September 2007, the samplings in this area were conducted. In plastic bottles prepared overnight with a 1 M HCl solution and then twice rinsed with redistilled water, water samples were taken at a depth of 0.5 m below the water surface for nutrient analysis. Two parallel water samples were taken at each location, one of which. Filters that had been purified via a 0.45 m nitrocellulose membrane were kept at 20˚C until they were ready for analysis. Grab samplers were used to swiftly pack samples of surface sediments that were collected at a depth of 0 to 10 cm in airtight containers. The laboratory for storage at 20˚C prior to the analytical determinations in polythene bags. The sites were located using a Global Positioning System (GPS) during the sample collection. Additionally, the investigated lake's water quality was monitored in situ for pH, salinity, temperature, dissolved oxygen, and Secchi depth. A 2 mm screen was used to filter out the gravel and coarse debris after drying sediment samples in an oven at 60˚C to constant mass for roughly 48 hours. Prior to laboratory testing, the sieved samples were homogenised, then ground to a fine powder using a mortar and pestle. The Kjeldahl nitrogen method was used to calculate the Total Nitrogen (TN) of the sediment. After being digested with HNO_3-HCl at 200˚C, Total Phosphorus (TP) was measured using a spectrophotometer increase in dissolved inorganic phosphorus in the surrounding water. In the presence of light, benthic algae and phytoplankton as well as bacteria had an impact on this process [7].

Discussion

Increased water abstraction from AW for soda ash production, as well as from its primary feeder river, the Bulbula, for irrigation and domestic use, has resulted in a rapid reduction in the wetland's water level. Irrigation around Ziway Lake and its two tributaries, the Katar and Meki Rivers, has been extensive. As a result, the amount of water flowing into Lake Ziway, which is the river Bulbula's principal source, has decreased significantly. Apart from small-scale irrigation, the expansion of large-scale farming projects for horticulture, floriculture, and vegetation production along the banks of Lake Ziway and the Bulbula river consumes a lot of water and discharges chemical pollutants into the water. Various farming operations also drain water