



Original Research

Predicting the effects of sediment based internal nutrient loads on eutrophication in Küçükçekmece Lagoon for rehabilitation planning

Cenk Gürevin*, Ali Erturk, Meric Albay

Istanbul University, Faculty of Aquatic Sciences, Division of Freshwater Biology, Laleli 34130, Istanbul, Turkey

ARTICLE INFO

Article history:

Received 15 January 2016

Received in revised form

13 July 2016

Accepted 12 August 2016

Keywords:

Ecological modelling

Eutrophication

Küçükçekmece Lagoon

Limited sea water exchange

Recovery

ABSTRACT

In deep stratified coastal lagoons, hypoxic waters that result from phytoplankton decomposition in the stratified bottom waters are often associated with eutrophication. Decomposing biomass reaches the bottom sediments and enriches them with nutrients and organic matter. Nutrients trapped in sediments are released with time and promote excessive phytoplankton growth in the surface water. Because eutrophication in lentic ecosystems progresses in a self-fuelling cycle, outflow is the only available process for exporting excess nutrients to recover from eutrophication. Thus, rehabilitation of eutrophic coastal lagoons that have limited seawater interactions is a long term process. The importance of nutrient release from sediments on eutrophication and the delay effect of internal nutrient loading on the rehabilitation of a eutrophic coastal lagoon with limited seawater exchange were analysed in this study. An ecological model that couples the water column and the sediment diagenesis processes, was developed for water quality management purposes. Our findings indicate that the recovery of the Lagoon from eutrophication will be taken decades even in the absence of external nutrient loading. Therefore, we suggest applying rehabilitation strategies that control the nutrient fluxes from sediments for a faster recovery from heavily eutrophic conditions. Land-based nutrient sources must also be controlled because they feed water column and the bottom sediments with nutrients.

© 2017 International Research and Training Centre on Erosion and Sedimentation/the World Association for Sedimentation and Erosion Research. Published by Elsevier B.V. All rights reserved.

1. Introduction

Coastal lagoons are considered to be vulnerable to eutrophication (Almeida et al., 2012; Gonzalez et al., 2008; Meyers et al., 2010; Newton et al., 2003). Eutrophication is a global problem that is characterised by high nitrogen and phosphorus loads in water bodies and results in excessive growth of phytoplankton and other aquatic plants (Schindler et al., 2008).

Eutrophication is affected by various anthropogenic and natural factors (Hall et al., 1999; Müller et al., 1998). Relationships between anthropogenic factors such as land use, point-source pollution, water management, and eutrophication had been frequently studied (Doody et al., 2012; Ekholm & Lehtoranta, 2012; Fenn et al., 2010; Fraterrigo & Downing, 2008; Galbraith & Burns, 2007; Kagalou et al., 2008; Kuo et al., 2008; Lowery, 1998; Räsänen et al., 2006; Touzet, 2011).

Eutrophication and phytoplankton blooms (for example, cyanobacteria) have occurred in recent decades. Thus, bottom areas with increased hypoxia (Albay et al., 2004, 2005) are a major environmental problem in the Küçükçekmece Lagoon. The increased nutrient concentrations in the epilimnion of the water column lead to higher biomass production and organic matter sedimentation (Gürevin, 2010).

Among several tools and methods (such as chambers, microcosms, mesocosms, ecological modelling) that are available to quantify the effect of water column-sediment nutrient interactions on eutrophication, ecological modelling is utilized in this study. The advantages of ecological models over other eutrophication assessment tools and methods are listed below (Umgiesser, 2009).

- Models can spatially and temporally interpolate between measurement data points.
- Modelling allows for the testing of several hypotheses and investigating the outcomes of different scenarios. Models can be used for “what if predictions” and to answer arising questions. This advantage is extremely important for the presented case study in which the outcomes of nutrient load reduction are investigated to rehabilitate a coastal lagoon. Since this study is

* Correspondence to: Istanbul University, Fisheries Faculty, Ordu Str. No: 200 Laleli – Fatih, Istanbul, Turkey. Fax: +90 212 514 03 79.

E-mail addresses: cenk.gurevin@yahoo.com, cgurevin@istanbul.edu.tr (C. Gürevin).

<http://dx.doi.org/10.1016/j.ijsrc.2016.08.002>

1001-6279/© 2017 International Research and Training Centre on Erosion and Sedimentation/the World Association for Sedimentation and Erosion Research. Published by Elsevier B.V. All rights reserved.

based on predicting the future, numerical modelling is used in this study.

In addition to the advantages of ecological models, there are several disadvantages listed below.

- A good database is required to apply ecological models to specific ecosystems. The collection of these datasets may increase the study efforts and costs considerably.
- Complex ecological models that contain many parameters may be difficult to validate, requiring expertise to identify the key processes and extensive computational resources during the simulations repeated many times.
- There are generally accepted ecological/biogeochemical models for eutrophication analysis; however, these models are not always applicable to specific problems or ecosystems. Thus,

scientists may need to develop their own models, which may require extensive man-hours and increase the study costs.

This study aims to determine the importance of nutrient release from sediments (as internal loads) on the eutrophication process. The study also aims to determine the delayed effect of internal nutrient loading on the rehabilitation of the Küçükçekmece Lagoon (based on the modelling efforts and the field investigations conducted between 2006 and 2008). In environmental science, ecological models are used to evaluate the potential impacts of external forcings and to understand the system function (Arhonditsis & Brett, 2004; Chapra, 1997; Thomann & Mueller, 1987). These models are useful tools that create a holistic picture of an ecosystem, fill in field data gaps, or forecast the system responses to external forcings.

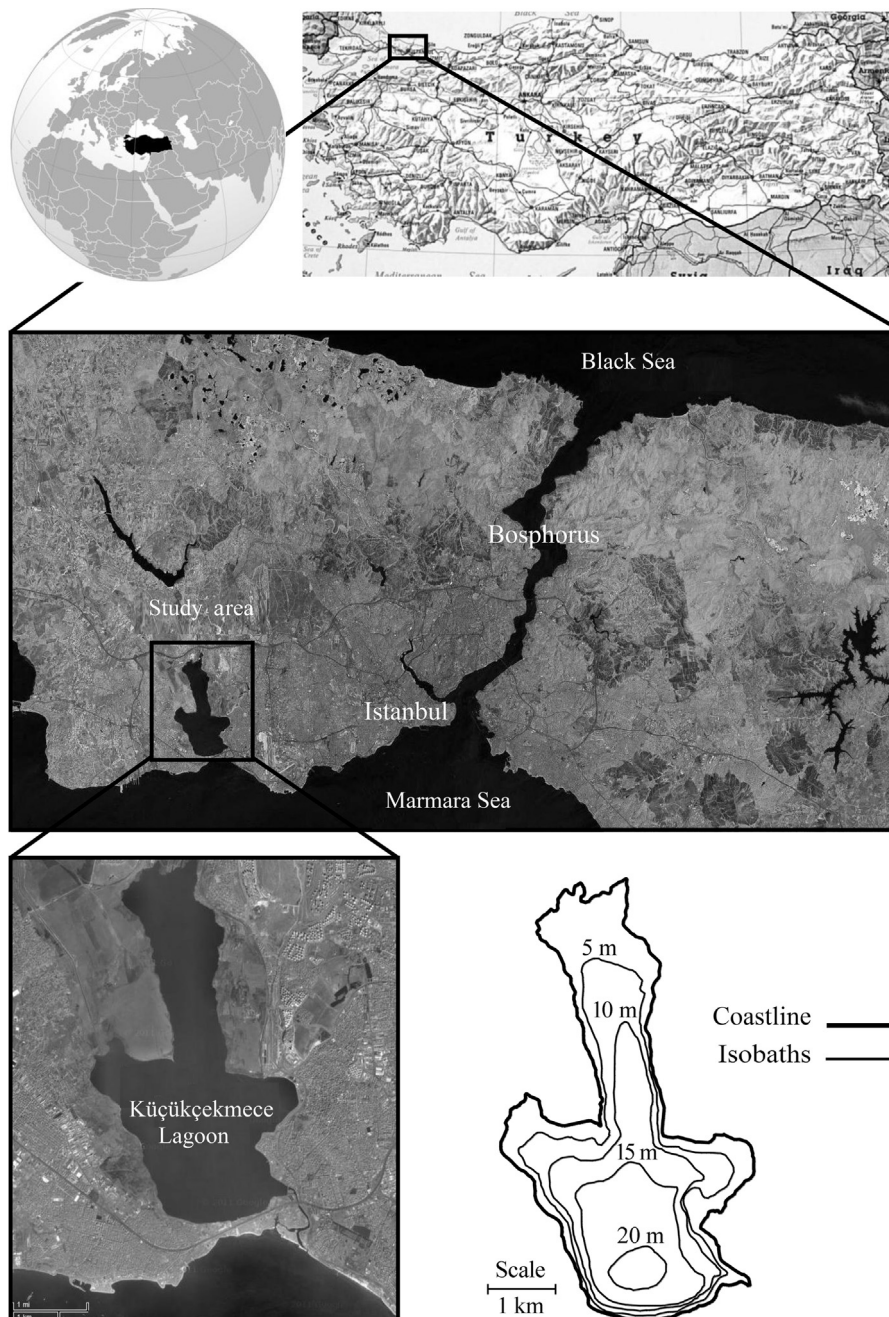


Fig. 1. The study area location map.

source: <https://en.wikipedia.org/wiki/Turkey>; <http://www.lib.utexas.edu/maps/turkey.html>; <http://geology.com/world-cities/>.

Please cite this article as: Gürevin, C., et al. Predicting the effects of sediment based internal nutrient loads on eutrophication in Küçükçekmece Lagoon for.... *International Journal of Sediment Research* (2017), <http://dx.doi.org/10.1016/j.ijsrc.2016.08.002>

Download English Version:

<https://daneshyari.com/en/article/8911135>

Download Persian Version:

<https://daneshyari.com/article/8911135>

[Daneshyari.com](https://daneshyari.com)