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Research article/Araştırma makalesi

A lake restoration project carried out in Tuzla Kamil Abdus Lake, Istanbul/Turkey

Arzu MORKOYUNLU YUCE [*1], Ayfer OZMEN [1], Mehmet Zeki YILDIRIM [2]

[1] Kocaeli University, Hereke O.I. Uzunyol Vocational Schools, 41000, Kocaeli, Turkey
[2] Mehmet Akif Ersoy University, Faculty of Education, 15000 , Burdur, Turkey

Abstract

The water resources of Istanbul, the largest metropolis of Turkey, face the problems brought along with the ever increasing population, urbanization and industrialization. In the present study, the restoration applications carried out on the Kamil Abdus Lake (Tuzla/Istanbul), which is vital in ecological and biological terms among the sensitive wetlands of Istanbul - Turkey, which had lost its characteristics of being a lagoon due to the improper planning carried out in Turkey. In the present study, the lake restoration applications carried out on the Tuzla Kamil Abdus Lake, which had completely dried up in 2001 as a result of wrong planning, yet later which has been reintroduced to aquatic ecosystem in consequence of the said rehabilitation works (2001-2005; 2013-2014), the pytoplankton composition of the lake, the species available in it and environmental effects were evaluated.

Key words: phytoplankton, lagoon lake, environmental effects, environment restoration

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Türkiye'de uygulanmış göl iyileştirme çalışması ve hidrobiyolojik yapısı (İstanbul)

Özet

Türkiye'nin en büyük şehri olan İstanbul'un su kaynakları her geçen gün artan nüfus, kentleşme ve sanayileşmenin beraberinde getirdiği sorunlarla baş başadır. Bu çalışmada, İstanbul - Türkiye hassas sulak alanları için ekolojik, biyolojik yaşamsal öneme sahip, korunması gereken ve Türkiye'de düzensiz planlama sonucu lagün gölü özelliğini kaybederek 2001 yılında kuruyan ancak, rehabilitasyon çalışmasıyla sucul ekosisteme kazandırılan Tuzla Kamil Abduş Gölü'nde (Tuzla/İstanbul) yapılan göl iyileştirme uygulamaları(2001-2005; 2013-2014), microplankton kompozisyonu, yayılış gösteren sucul canlılar ve çevresel etkiler değerlendirilmiştir.

Anahtar kelimeler: phytoplankton, lagün gölü, çevre etkileri, çevre restorasyon

1. Introduction

Sustainability of lake ecosystems requires the protection and development of these ecosystems and the natural and cultural environment they are in relation with. Lake management is to protect and develop a lake, other ecosystems in relation with the lake and their resources in order to water need both today and tomorrow. Within this frame, World Lake Vision reports the harmony between human and the nature, the suitable geographical management unit, prevention strategy, decision making based on scientific information, rational use, participation and a good administration as the primary principles in lake management plans (Didinen et al.,2008; Demir and Bulut, 2014).

The path to success in a lake restoration project requires one to know these systems thoroughly and to interpret them in light of scientific knowledge the. Success has been attained in many lake restoration projects through the joint and coherent works of scientists and managers. The support received from the public further consolidates success (Carpenter and Lathrop, 1999).

Lake restoration methods have been tried and developed in many countries, particularly in Denmark and Sweden. The main objective in these works is to fight against eutrophication, which is caused by high concentrations of

* *Corresponding author* / Haberleşmeden sorumlu yazar: Tel.: +902625115675; Fax.: +902625115676; E-mail: arzu.yuce @kocaeli.edu.tr
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phytoplankton and results in the deterioration of the water quality and biologic diversity of lakes, and to enable the recovery of the lake's ecosystem in the past.

In the present study, the lake restoration applications carried out on the Tuzla Kamil Abdus Lake, which had completely dried up in 2001 as a result of wrong planning, yet later which has been reintroduced to aquatic ecosystem in consequence of the said rehabilitation works (2001-2005; 2013-2014), the pytoplankton composition of the lake, the species available in it and environmental effects were evaluated.

2. Materials and methods

Tuzla Kamil Abdus Lake (40°49'50"N 29°17'11"E), is a lagoon lake with an area of 300 hectares, formed by getting separated from the sea via natural and partially artificial sandbars in the inner part of the old Aydinlar Port north of the Tuzla Peninsula, which in former years had a maximum depth of 80 - 90 cm (20 - 40 cm in summer seasons) and which had lost all its water due to several ecological and biological factors within years (Anonymus, 2012;Yalcın et al., 2007). Research stations were given in Figure 1.

For the purpose of reintroducing this lake, which had completely dried by the 2001, back to the aquatic ecosystem a project was initiated with the meeting of Istanbul Provincial Department of Environment, Istanbul Metropolitan Municipality, General Directorate of Istanbul Water and Sewage Administration, Department of Environment Protection and Development, Istanbul Provincial Directorate of Agriculture, 14th Regional Directorate of State Hydraulic Works, Tuzla Mayoralty, Istanbul Financial Office Directorate of National Estate, Istanbul 5th Regional Directorate of Cultural and Natural Heritage Preservation Board and Tuzla District Governorship. The necessity of enabling fresh water input in order to preserve lake area and its surroundings, to reestablish its connection with the sea and to bring back its lagoon characteristics was set forth. Following the exchange of opinions among the public organizations and institutions, and after obtaining the necessary permits, the works were initiated. In the works carried out from 2003 to 2005 within the scope of revitalizing Tuzla Fish Lake, the soils collected from lake bed were compressed and laid around the lake. For the purpose of enabling water entry to the lake, two ducts with approximately 500 m distance between them were opened on the side of the lake that is connected to the sea. In order to ensure that the water received from these two main channels is circulated within the lake, intermediary channels that are interconnected were opened. By means of these channels, it was ensured that sea water and the fresh water in the bottom of the lake are mixed.

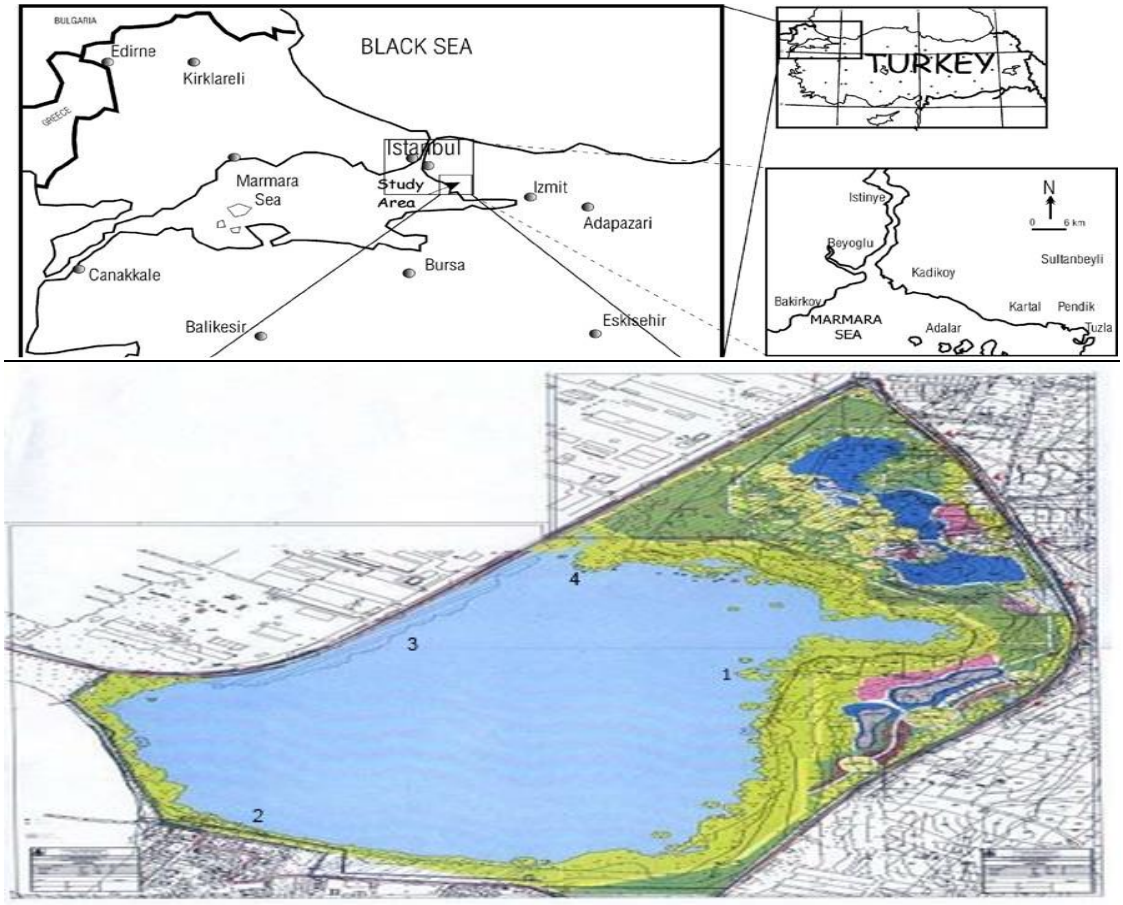

Figure.1. Map showing the study area in Lake Kamil Abdus (1-4)

In order to determine the hydrobiological properties of the lake that is reintroduced to the aquatic ecosystem, its microplankton composition, aquatic species available in it and environmental effects were examined on seasonal basis from four research stations (Figure 1). Phytoplankton analyses were collected with plankton net (55μ). Samples were put into 500 mL polyethylene bottles, fixed with 4 % formaldehyde solution and immediately transferred to the laboratory. Before counting process, samples were homogenized by shaking gently. 10 mL samples were put into 15mL falcon tubes. At least 3 parallels were centrifuged 10 min. at 800rpm and supernatant was removed. Counting chamber and light microscope were used to quantitative evaluation of microplankton. Identification was carried out according to Cupp (1943), Kramer and Lange-Bertalot (1986) and Tomas (1995), and Hartley et al. (1996), Hustedt (1985), Patrick and Reimer (1966,1975), Cleve-Euler (1966). The microalgae species qualitative identified in the coastal area of the lake are presented in Table 1.

3. Results

In order to monitor the formation of the aquatic ecosystem, the area close to the channel with which the lake and sea are connected, was selected as the first station. In addition to large and small stones, bivalvia species, *Gammarus sp*., freshwater diatome species such as *Amphora ovalis* Kützing, *Cymbella affinis* Kütz., *Gomphonema olivacea*(Horn.)P. Daws.exRoss et Sims var. *olivacea, Cocconeis pediculus* Ehr., *Navicula lanceolata* (Agardh) Kützing, *Nitzschia sigma* (Kützing) W. Smith, also *Ceratium furca var. furca (*Ehrenberg) Schiller, which is a marine species, were identified in the soil. While the second station is similar to the first station eco-biologically, also cocoons belonging to gastropods were identified. In addition to *Cymbella affinis* Kütz., *Cocconeis pediculus* Ehr., *Navicula lanceolata* (Agardh) Kützing, *Pseudo-nitzschia delicatissima* (P. T. Cleve) Heiden in Heiden & Kolbe and *Ceratium furca var. furca (*Ehrenberg) Schiller, *Ceratium fusus var. fusus* (Ehrenberg) Schiller, *Navicula pennata* A. Smith were determined. In the soils of the area selected as the third station, a yellowish layer on the surface was noted as well as the stones of varying sizes and epilithic algae (*Cymbella affinis* Kütz., *Cocconeis pediculus* Ehr.) and in consequence of microscopy examination plenty of bivalvia larvae were found. In the ground of the area selected as the fourth station stones of varying sizes, bivalvia shells, living crabs, and balanus distribution on stone surfaces have been noted. While marine species (*Ceratium furca var. furca (*Ehrenberg) Schiller, *Ceratium fusus var. fusus* (Ehrenberg) Schiller) were dominant in the parts of the lake ecosystem connected with the sea, due to the freshwater entrance from the bottom of the inner parts of the lake, it was determined also species that can live in both salty and freshwaters were present. Phytoplancton taxa detected in Lake Kamil Abduş were also encountered in the studies carried out on the lentic and lotic aquatic ecosystems of our country (Gönülol, 1996 ;Aysel, 2005;Kucuk and Ergul 2011). The list of planktonic and epilithic algal flora determined in Lake Kamil Abdus were given in Table 1.

Table 1. Phytoplankton and epilithic taxa in Lake Kamil Abduş

Classis: DINOPHYCEAE Pascher 1914
Subordo: Ceratiineae Fensome et al. 1993b
Familia: Ceratiaceae Willey and Hickson 1909
Genus: Ceratium F. von P. Schrank 1793
*Ceratium furca var. furca (*Ehrenberg) Schiller
Ceratium fusus var. fusus (Ehrenberg) Schiller
Classis: BACILLARIOPHYCEAE Haeckel1878 emend Mann in Round et al. 1990
Subclassis: BACILLARIOPHYCIDAE Mann in Round et al. 1990.
Ordo: NAVICULINEAE Hendey 1937.
Familia: Cymbellaceae Greville 1833.
Genus: Cymbella C. A. Agardh 1830
Cymbella affinis Kütz.
Familia: Gomphonemataceae Kützing 1844.
Genus: Gomphonema Ehrenberg 1831
Gomphonema olivacea(Horn.)P. Daws.exRoss et Sims var. *olivacea*
Familia: Cocconeidaceae Kützing 1844
Genus: Cocconeis Ehrenberg 1838
Cocconeis pediculus Ehr.
Ordo: NAVICULALES Bessey 1907 sensu emend
Subordo: Neidiineae Mann in Round et al. 1990.
Familia: Naviculaceae Kützing 1844.
Genus: Navicula Bory de St. Vincent 1822 emend. Cox 1979
Navicula lanceolata (Agardh) Kützing
Navicula pennata A. Smith

Table 1. Continued

Familia: Catenulaceae Mereschkowsky 1902.
Genus: Amphora Ehrenberg 1840
Amphora ovalis Kützing
Ordo: BACILLARIALES Hendey 1937 sensu emend
Familia: Bacillariaceae Ehrenberg 1831.
Genus: Pseudo-nitzschia H. Peragallo in H. Peragallo & M. Peragallo 1900
Pseudo-nitzschia delicatissima (P. T. Cleve) Heiden in Heiden & Kolbe
Genus: Nitzschia Hassall 1845
Nitzschia sigma (Kützing) W. Smith

It was determined that the amount of water increased in time at places where the channels are close to the sea due to precipitation, groundwaters and tides, and that various bird species such as curlew, shelduck and glossy ibis inhabit the lake. The lake that had completely dried out in 2001 today exhibits a lively nature by means of the 2 channels that connect it to the sea. Green areas and bird observation houses arranged by the Tuzla Municipality are available around the lake. However, the shipyards and greenhouses near the lake and the recreational usage of its surroundings affect the lake negatively. As a result of picnic activities carried out in this area particularly in weekends, domestic wastes are introduced to the environment. As a consequence, the physico-chemical and microbiological structure of the water is being affected, light transmittance is inhibited and the aquatic ecosystem is affected negatively. In order to prevent these negative effects caused by human activities on the Kamil Abdus Lake, which is a significant value among Turkish fragile ecosystems, placing information boards intended to raise the awareness of the public, increasing the number of suitable trashcans, carrying out environmental inspections and cleaning activities regularly and popularizing social responsibility project intended to raise environmental awareness are the measures that should be prioritized within the scope of sustainable water resources management.

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