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Use of Biological Diatom Index to Evaluate the Water Quality of Lotic Ecosystems: A Case Study of Murat Stream (Kütahya, Turkey)

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Abstract. Diatoms are one of the most commonly used organisms in water quality assessment studies and numbers of diatom indices have been developed in order to determine the water pollution and the trophic status of the aquatic habitats. Biological Diatom Index (BDI), which is one of the most commonly used diatom index, provides valuable data about the trophic status of the water environment. In the present study, the epilithic diatoms were monthly collected from 5 stations between the dates of September 2007 and April 2008 along the Murat Stream. As a result of this study, total of 75 diatom taxa were identified and 66 of them were used to calculate the Biological Diatom Index to make an assessment on the trophic status and water quality of Murat Stream. According to data observed, upstream of the investigated lotic ecosystem has a fine water quality and in an oligo – mesotrophic state; downstream of the investigated lotic ecosystem has moderate water quality and in a mesotrophic state.

Keywords: Murat Stream, Biyomonitoring, Biological Diaton Index

1. Introduction

Environmental pollution has become a major problem for mankind over the last few decades as a result of anthropogenic activities. Especially the aquatic life is being threatened by the contamination of freshwater ecosystems in an alarming rate [1], [2]. Physical and chemical parameters of water can be changed quickly by an instant contamination and they are often inadequate to present the long term effects on the water environment. New methods on monitoring of water quality especially by using biological organisms are one of the most popular topics for the scientific community in recent years. Diatoms, which are an important bioindicator organism groups because of they can be found in almost all the surface water ecosystems at any time, have been used as indicators of water pollution in a number of countries [3]-[9].

The aim of the present study was to assess the water quality and determine the trophic status of Murat Stream by using Biological Diatom Index based on epilithic diatom communities.

2. Material and Method

2.1. Study area

Murat Stream, which has an average flow of 2.5 m3/sec and has a length of 35 km, rises from the north of Murat Mountain and flows to the Kokar Stream approximately 11 km north of the Altıntaş District of Kütahya City [10].

The stations were selected on Murat Stream by taking into consideration of the source region, depth, flow rate and discharge zones. The selected stations are given in Fig. 1.

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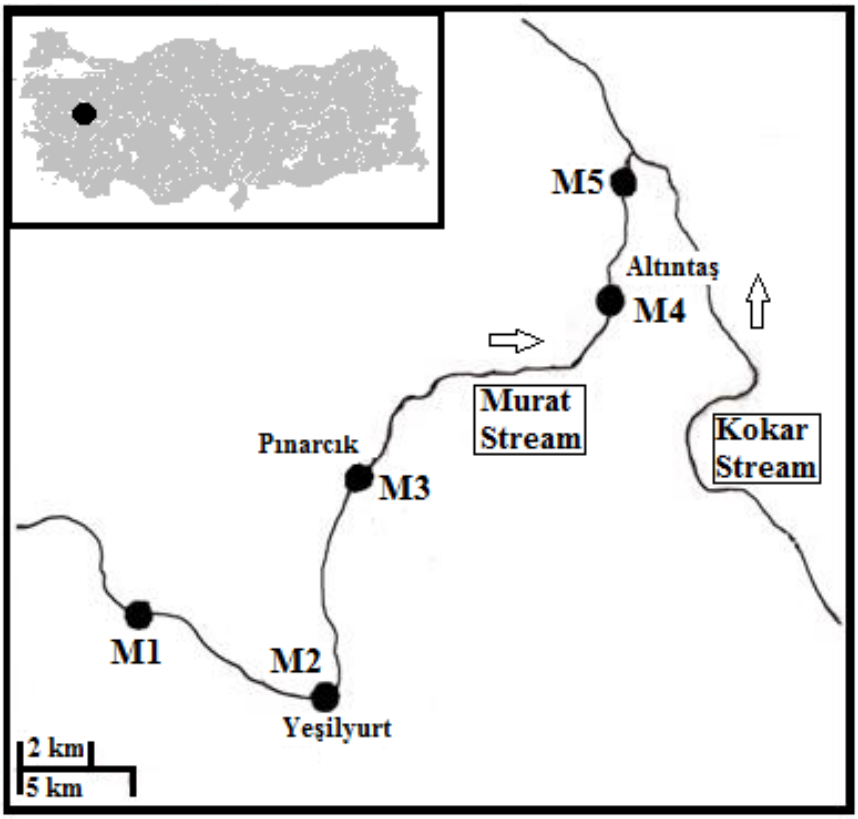

Fig. 1: Study area and selected stations

2.2. Sampling of diatoms and identification

The epilithic (EPL) diatom samples were collected monthly from 5 stations, between the dates of September 2007 and April 2008. Diatoms were collected by scraping 20 cm2 area stones. They were cleaned with acid (98% H2SO4 and 35% HNO3) and mounted on microscope for observation with a magnification of 1000X. Three slides were prepared for each site and minimum 100 valves enumerated in each slide [11, 12]. Diatoms were identified according to Krammer and Lange – Bertalot [13]-[16].

2.3. Calculating biological diatom index (BDI)

BDI values of stations were calculated automatically by using "Calculate BDI with Excel" program and the trophic status and water quality classes belonging to the BDI values are given in Table 1 [17], [18].

Table 1. Scale of BDI

Index Value	Quality Class	Trophic Status
> 17	High Quality	Oligotrophic
15 – 17	Fine Quality	Oligo – Mesotrophic
12 – 15	Moderate Quality	Mesotrophic
9 – 12	Low Quality	Meso – Eutrophic
< 9	Poor Quality	Eutrophic

3. Results and Discussion

Biological Diatom Index is a standardized method rarely used in Turkey. BDI, whichs formula was developed by Zelinka and Marvan [19], is based on 209 diatom taxa and provides information about trophic levels of the aquatic ecosystems [17].

In the present study, total of 75 diatom taxa were identified and 66 of them were used to calculate the Biological Diatom Index (BDI) scores of stations in order to determine the trophic status and water quality of Murat Stream. All the diatom taxa used in calculating BDI scores with index codes of species are given in Table 2. The index values of stations with the number of total identified diatoms used for calculating BDI scores are given in Fig. 2.

Table 2: Used diatom species to calculate BDI scores and codes of species

Index Codes	Used Diatoms
ADMI	*Achnanthidium minutissimum* (Kutz.) Czarnecki
AHUN	*Achnanthes hungarica* Grunow in Cleve et Grun.
AOVA	*Amphora ovalis* (Kutzing) Kutzing
APED	*Amphora pediculus* (Kutzing) Grunow
APEL	*Amphipleura pellucida* Kutzing
ASPH	*Anomoeoneis sphaerophora* (Ehr.) Pfitzer
AVEN	*Amphora veneta* Kutzing
CAFF	*Cymbella affinis* Kutzing var.affinis
CAMB	*Craticula ambigua* (Ehrenberg) Mann
CASP	*Cymbella aspera*(Ehrenberg) H.Peragallo
CELL	*Cymatopleura elliptica* (Brebisson)W.Smith var.elliptica
CHEL	*Cymbella helvetica* Kutzing
CHUS	*Cymbella hustedtii* Krasske var.hustedtii
CMEN	*Cyclotella meneghiniana* Kutzing
COCE	*Cyclotella ocellata* Pantocsek
CPED	*Cocconeis pediculus* Ehrenberg
CPLI	*Cocconeis placentula* Ehrenberg var.lineata (Ehr.)Van Heurck
CRCU	*Craticula cuspidata* (Kutzing) Mann
CSAP	*Cymatopleura solea* (Brebisson) W.Smith var.*apiculata* (W.Smith) Ralfs
CSIL	*Caloneis silicula* (Ehr.)Cleve
CSOL	*Cymatopleura solea* (Brebisson in Breb. & Godey) W.Smith var.*solea*
CSTR	*Cyclotella striata*(Kutzing)Grunow 1880 in Cleve & Grunow
CTMD	*Cymbella tumidula* Grunow in A.Schmidt & al.
DMON	*Diatoma moniliformis* Kutzing
FPAR	*Fragilaria parasitica* (W.Sm.) Grun. var. *parasitica*
FUAC	*Fragilaria ulna* (Nitzsch.)Lange-Bertalot var.*acus*(Kutz.)Lange-Bertalot
FULN	*Fragilaria ulna* (Nitzsch.) Lange-Bertalot var. *ulna*
GAFF	*Gomphonema affine* Kutzing
GAUG	*Gomphonema augur* Ehrenberg
GGRA	*Gomphonema gracile* Ehrenberg
GOLI	*Gomphonema olivaceum* (Hornemann) Brebisson var. *olivaceum*
GPAR	*Gomphonema parvulum* (K_zing) K_zing var. *parvulum* f. parvulum
GSPE	*Gyrosigma spencerii* (Quekett) Griffith et Henfrey
GTRU	*Gomphonema truncatum* Ehr.
GYAC	*Gyrosigma acuminatum* (Kutzing)Rabenhorst
HAMP	*Hantzschia amphioxys* (Ehr.) Grunow in Cleve et Grunow 1880
MCIR	*Meridion circulare* (Greville) C.A.Agardh var. circulare
MVAR	*Melosira varians* Agardh
NAAN	*Navicula angusta* Grunow
NAMP	*Nitzschia amphibia* Grunow f.amphibia
NCAR	*Navicula cari* Ehrenberg
NCIN	*Navicula cincta* (Ehr.) Ralfs in Pritchard
NCPL	*Nitzschia capitellata* Hustedt in A.Schmidt & al.
NDIS	*Nitzschia dissipata*(Kutzing)Grunow var.*dissipata*
NDME	*Nitzschia dissipata*(Kutzing)Grunow var.*media* (Hantzsch.) Grunow
NFON	*Nitzschia fonticola* Grunow in Cleve et Muller
NIAN	*Nitzschia angustata* Grunow
NIFR	*Nitzschia frustulum*(Kutzing)Grunow var.*frustulum*
NIGR	*Nitzschia gracilis* Hantzsch
NLAN	*Navicula lanceolata* (Agardh) Ehrenberg
NLIN	*Nitzschia linearis*(Agardh) W.M.Smith var.*linearis*
NMEN	*Navicula menisculus* Schumann var. *menisculus*
NMUP	*Navicula menisculus* Schumann var.*upsaliensis* Grunow
NPAL	*Nitzschia palea* (Kutzing) W.Smith
NRAD	*Navicula radiosa* K_zing
NTPT	*Navicula tripunctata* (O.F.M_ller) Bory
NVER	*Nitzschia vermicularis*(Kutzing)Hantzsch
PTLA	*Planothidium lanceolatum*(Brebisson ex K_zing) Lange-Bertalot
PVIR	*Pinnularia viridis* (Nitzsch) Ehrenberg var.*viridis* morphotype 1
SOVI	*Surirella ovalis* Brebisson
SPUP	*Sellaphora pupula* (Kutzing) Mereschkowksy
SSMI	*Stauroneis smithii* Grunow
SUTE	*Surirella tenera* Gregory
TAPI	*Tryblionella apiculata* Gregory
TGRL	*Tryblionella gracilis* w. Smith
THUN	*Tryblionella hungarica* (Grunow) D.G. Mann

BDI scores determined in the upside of Murat Stream (M1, M2 and M3) were significantly higher that detected in the downside of Murat Stream (M4 and M5). The highest BDI score was recorded in M1 station as 16.2, while the lowest BDI score was recorded in M5 station as 12.3. In a diatom indices application study

performed in Turkey, the water quality of Gürleyik Stream was presented by using Biological Diatom Index (BDI) and Trophic Diatom Index (TDI). According to data of mentioned study, Gürleyik Stream was in a mesotrophic state in terms of both BDI and TDI [9]. In another diatom index application study performed in Turkey, the water quality of Porsuk Dam Lake was presented by using Biological Diatom Index and Tokatlı [8] was stated that Porsuk dam Lake was in a mesotrophic state. According to data of the present study, M1, M2 and M3 stations of Murat Stream have "fine water quality" and in "oligo – mesotrophic state"; M4 and M5 stations of Murat Stream have "moderate water quality" and in "mesotrophic state".

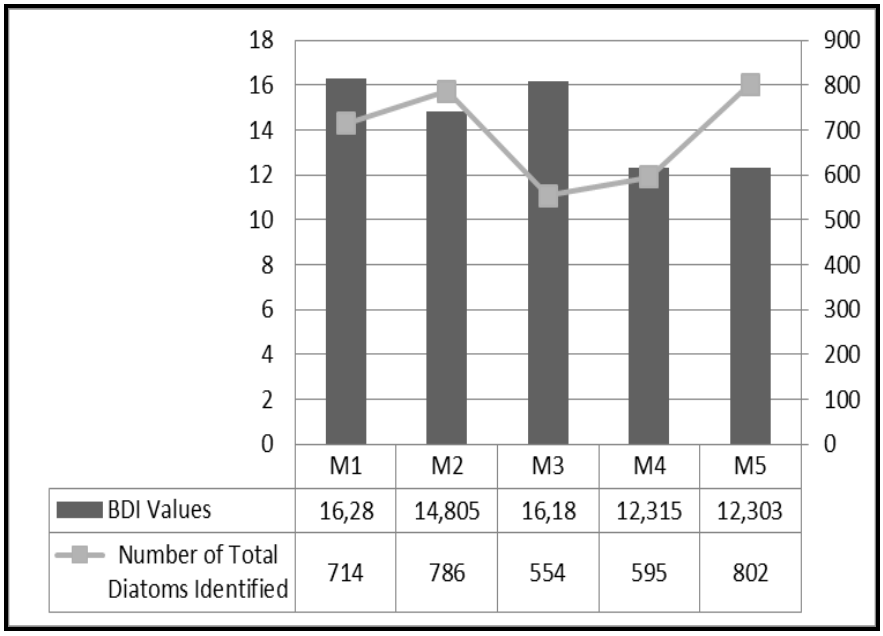

Fig. 2: BDI scores of stations

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