JOURNAL OF NEW RESULTS IN SCIENCE (JNRS)
ISSN: 1304-7981
http://dergipark.gov.tr/jnrs
Research Article

Volume : 6
Issue: 2
Year: 2017
Pages: 17-23

***Received*:** 14.03.2017
***Accepted*:** 18.08.2017

Editors-in-Chief: ***Ebubekir ALTUNTAS***
Area Editor: ***Yasar GULMEZ***

An Investigation on the Benthic Diatoms of Murat River (Muş) and Comparison with Ehrenberg's Study

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ABSTRACT: In this study, benthic diatoms of Murat River between June 2015 and September 2015 were examined. *Cymbella, Navicula, Nitzschia* and *Cocconeis* species were intensively recorded in benthic flora. The results of this study were compared to the result of benthic algal research in Murat River by a German scientist, Ehrenberg, 170 years ago.

Keywords- *river, benthic algae, diatom*

1. Introduction

In this study, it was aimed to determine the benthic diatoms of Murat River. In addition, findings from this research have been compared with results of the research on Murat River's benthic diatomites made by German scientist Ehrenberg, 170 years ago. The benthic algae of the Murat River have been examined in accordance with the procedures, taking samples from specific regions; epipelic, epilithic and epiphytic habitats.

2. Definition of Research Area

The Murat River is one of the two important branches of the Euphrates River and is poured into the Keban Dam Reservoir near the Palu Town, (Google Earth, 2017), (Figure 1). The waters of the Murat River, which is fed with snow and rain water, float in April and go down to the lowest level in September. Average flow of the river is 126 m^3/s. The length is 600 km long and debt is 200-300 m^3. The flow rate reaches 2500 m^3 at the time of the storm. When the water decreases, it falls to 50-70 m^3 (Muş, 2015).

2.1. Example Stations

Three stations were selected to investigate the benthic diatom flora of the study area. Plant, stone and mud samples were collected from June 2015 to September 2015 at the following stations:

1. Station: It is located near the village of Toklu, approximately 5 km ahead of I. Alparslan Dam.
2. Station: It was taken near Rüstemgedik Village and Kotanlı Village.
3. Station: It is located near the Muratgören Village.

Figure 1. Murat River Pour into the Keban Dam in the vicinity of Palu District (This map was modified from Google Earth, 2017).

3. Material and Methods

Sediment, stone and plant specimens were taken from three stations in order to examine the bentich algae of Murat River. In these samples benthic algae (Round, 1953; Hasle, 1978) method was investigated. Many sources have been utilized in the identification of diatoms (Husted, 1930, Creve Euler, 1951; Patrick and Reimer, 1966; Vanlandingham, 1967-1978).

4. Results and Disscussion

Chemical and physical properties of Murat River were taken from Ankara General Directorate of State Hydraulic Works (Ankara DSİ, 2015). The highest temperature in the working period was in July (22.4 C^o). The high pH values were observed in May and July (pH: 8.0). The water was observed to be slightly mildly alkaline in the working section of the Murat River (Table 1. and Table 2).

Table 1. Chemical properties of the Murat River

Parameter	**Symbol**	**Unit**	**May**	**July**	**September**	**October**
Calcium	Ca	mg/L	9,0	26,4	24,8	21,8
Chlorine	Cl	mg/L	26,3	20,9	11,0	24,5
Potassium	K	mg/L	6,24	5,46	4,68	3,51
Magnesium	Mg	mg/L	8,6	10,9	8,8	7,7
Sodium	Na	mg/L	28,98	26,68	24,84	23,23
Ammonium Nitrogen	NH_4-N	mg/L	0,740	0,235	0,575	0,190
Nitrite Nitrogen	NO_2-N	mg/L	0,011	0,021	0,020	0,100
Nitrate Nitrogen	NH_3-N	mg/L	0,060	2,10	2,90	2,80
Orthophosphate	oPO_4	mg/L	0,13	0,22	0,26	0,29
Fenolfitalin Alkalinity	P-Al	mg/L $CaCO_3$	0,0	0,0	0,0	0,0
Parmanganate Value	pV	mg/L	1,30	0,80	5,80	4,40
pH		mg/L	8,0	8,0	7,7	7,6
Total amount of dissolved substance	TDS	mg/L	189	342	201	302
Sulfate	SO_4	mg/L	23,0	19,5	31,5	49,5
Methyl Orange Alkalinity		mg/L $CaCO_3$	120,0	127,0	108,5	

Table 2. Physical properties of the Murat River

Parameter	**Symbol**	**Unit**	**May**	**July**	**September**	**October**
Conductivity	EC	ppm	296	441	314	286
Temperature	T	C^o	20,5	22,4	15,0	10,0
Total hardness	TH	ppm	108,0	111,0	98,0	86,0
Turbidity	Turb	TTU	20,0	20,0	15,0	20,0

In this study, benthic diatoms were examined with examples taken between June 2015 and September 2015. At selected stations, diatoms in epilithic, epiphytic and epipelic algae habitats in the Murat River were analyzed. A total of 39 benthic diatom taxa were identified in the analysis of samples taken from Murat River (Table 3.).These algae have been identified from three different habitats,28 taxa epipelic, 28 taxa epilithic and 33 epiphytic habitats. 18 of these were very common which have been recorded from all three habitats.

In benthic habitats, species belonging to *Cymbella, Navicula, Nitzschia* and *Cocconeis* genera were intensively recorded. The densities of *Cymbella* and *Cocconeis* genus are generally noticed in the benthic diatomis floristic studies near work zone in Turkey (Altuner, 1988; Altuner and Gürbüz, 1989; Altuner and Gürbüz, 1991, Ersin et al., 2006).

Ehrenberg, a German scientist, studied Murat River algae flora by taking samples through a scientist named Prof. Koc in Turkey 170 years ago. Ehrenberg compared algae found in two rivers by studying the algae of Murat and Aras Rivers in Turkey on November 16, 1843 (Ehrenberg, 1885). Ehrenberg stations from the Murat river were; Çolbuhur Water, Kaşbel Water, Badişan Stream, Göksu, Hınıs water, Muş Stream and Karasu.

In this study, samples were taken from near the stations of Ehrenberg (1845) and they are compared with that of his taxa, which have been collected 170 years ago. However, some taxa that were recorded by Ehrenberg were not found in our study. Conversely, some of our taxa have not been recorded in his study, but overall 8 taxa were common in both studies; *Amphora, Cocconeis, Gomphonema, Navicula, Surirella, Synedra, Eunotia, Fragilaria* (Table 4- 5).

Table 3. The distributions of diatoms taxa according to habitats are shown in the table below.

Divisio : Bacıllarıophyta **Classis : Centrobacillariophyceae** **Ordo : Centrales**	**Epp.***	**Epl.**	**Epf.**
Stephanodiscus astraea (Kützing) Grunow	+		+
Cyclotella meneghiniana Kütz.	+	+	+
Melosira varians C.A.Ag		+	+
Melosira sp.			+
Stephanodiscus aegypticus Ehr.	+	+	
Classıs: Pennatıbacıllarıophyceae Ordo: Pennales			
Amphora ovalis Kütz.	+	+	+
Achnanthidium minutissimum (Kützing) Czarnecki	+	+	+
Cocconeis pediculus Ehr.	+	+	+
Cocconeis placentula Ehr.			+
Cymbella affinis Kütz.	+	+	+
Cymbopleura angustata (W.Smith) Krammer		+	+
Cymbella cistula Grun.	+		
Encyonema triangulum (Ehrenberg) Kützing	+	+	+
Eunotia amphioxys Ehr.	+	+	
Fragilaria rhabdosoma Ehr.	+		+
Fragilaria sp.	+	+	+
Gomphonema augur Ehr.			+
Gomphonema parvulum Grun.	+	+	+
Gomphonema olivaceum Kütz.	+	+	+
Gomphonema truncatum Ehr.		+	+
Navicula cincta Ehr.	+		
Navicula cluthensis Greg.	+	+	
Navicula cryptocephala Kütz.	+	+	+
Navicula dicephala W.Smith	+	+	+
Navicula dissipata Kütz.		+	+
Fallacia pygmaea (Kützing) D.G.Mann	+	+	+
Navicula rhyncocephala Kütz.	+	+	+
Navicula venata Kütz.			+
Neidium dubium Ehr.	+		+
Nitzschia amphibia Grun.	+	+	+
Nitzschia angustata (W.Smith) Grun.		+	+
Nitzschia cursoria Donkin			+
Nitzschia palea (Kütz). W. Smith	+	+	+
Nitschia vivax W. Smith	+		+
Rhoicosphenia abbreviata (C.Agardh) Lange-Bertalot	+	+	+
Surirella linearis var. eliptica		+	+
Surirella ovalis Breb.	+	+	+
Synedra acicularis Lemm.	+	+	
Ulnaria ulna (Nitzsch) Compère	+	+	+

*Epp: Epipelic, Epl: Epilithic, Epf: Epiphytic

Table 4. The types of diatoms that found by Ehrenberg

- *Amphora crystallina*
- *Amphora gracilis*
- *Amphora hyalina*
- *Amphora libyca*
- *Amphora ovalis*
- *Biblarium gibbum*
- *Cocconeis crux*
- *Cocconeis finnica*
- *Cocconeis pediculus*
- *Cocconeis placentula*
- *Cocconema lanceolatum*
- *Discoplea sp.*
- *Eunotia amphioxys*
- *Eunotia textricula*
- *Fragilaria sp.*
- *Fragilaria hyemalis*
- *Fragilaria mesodon*
- *Fragilaria nodulosa*
- *Fragilaria rhabdosoma*
- *Gallionella laevis*
- *Gomphonema gracile*
- *Meridion pupula*
- *Meridion vernale*
- *Mononeis dicephala*
- *Mononeis viridis*
- *Navicula aequalis*
- *Navicula biceps*
- *Navicula dilatata*
- *Navicula fulva*
- *Navicula leptocephala*
- *Navicula mesotyla*
- *Navicula silicula*
- *Navicula undosa*
- *Pinnularia amphioxys*
- *Stauroptera cardinalis*
- *Surirella brevis*
- *Surirella lepida*
- *Surirella librile*
- *Synedra ulna*

Table 5. Taxa detected from the Murat river comparison

Names of taxa recorded from Murat River benthic diyatom research	**Ehrenberg's record in his work**	**In our own work we record**
Achnanthes minustissima Kütz.		+
Amphora crystallina	+	
Amphora gracilis	+	
Amphora hyalina	+	
Amphora libyca	+	
Amphora ovalis Kütz.	+	+
Biblarium gibbum	+	
Cocconeis crux	+	
Cocconeis finnica	+	
Cocconeis pediculus Ehr.	+	+
Cocconeis placentula Ehr.	+	+
Cocconema lanceolatum	+	
Cyclotella astrea Kütz.		+
Cyclotella meneghiniana Kütz.		+
Cymbella affinis Kütz.		+
Cymbella angustata		+
Cymbella cistula Grun.		+
Cymbella triangulum		+
Discoplea sp.	+	
Eunotia amphioxys	+	+
Eunotia textricula	+	
Fragilaria hyemalis	+	
Fragilaria mesodon	+	
Fragilaria nodulosa	+	
Fragilaria rhabdosoma	+	+
Fragilaria sp.	+	+
Gallionella laevis	+	
Gomphonema augur		+
Gomphonema gracile		
Gomphonema olivaceum		+

Gomphonema parvulum		+
Gomphonema truncatum		+
Melosira orichalcea		+
Melosira varians C.A.Ag		+
Meridion pupula	+	
Meridion vernale	+	
Mononeis dicephala	+	
Mononeis viridis	+	
Navicula dicephala	+	
Navicula aequalis	+	
Navicula biceps	+	
Navicula cincta		+
Navicula cluthensis		+
Navicula cryptocephala Kütz.		+
Navicula dicephala W.Smith		+
Navicula dilatata	+	
Navicula dissipata		+
Navicula fulva	+	
Navicula leptocephala	+	
Navicula mesotyla	+	
Navicula pygmea		+
Navicula rhyncocephala		+
Navicula silicula	+	
Navicula undosa	+	
Navicula venata		+
Neidium dubium Ehr.		+
Nitzschia amphibia		+
Nitzschia angustata		+
Nitzschia cursoria		+
Nitzschia palea (Kütz). W. Smith		+
Nitzschia vivax		+
Pinnularia amphioxys	+	
Rhicosphenia cruvata		+
Stauroptera cardinalis	+	
Stephanodiscus aegypticus Ehr.		+
Surirella brevis	+	
Surirella lepida	+	
Surirella librile	+	
Surirella linearis var. eliptica		+
Surirella ovalis		+
Synedra acucularis		+
Synedra ulna	+	+

5. Conclusion

A total of 39 benthic diatoms taxa were identified in the analysis of samples taken from Murat River.We think that this study, which was made 170 years after Ehrenberg's work contributes significantly to the determination of the benthic diatom flora of the Murat River. In addition, it was possible to check the names of some taxa recorded 170 years ago. Looking at the physical and chemical analyses (Table 1 and Table 2), it was observed that the Murat River was contaminated more frequently during the summer months due to the

temperature and discharged domestic wastes and cleaning materials were left in the water. If necessary precautions are not taken and conscious action, the flora and fauna elements will be seriously diminished as the pollutant elements are emptied into the Murat River.

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