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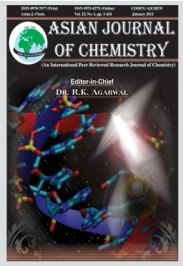

Seasonal Variation of Epipelic Algal Flora in Günyüzü Pond (Eskisehir/Turkey)

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In this study, the algal composition of epipelic algae in Günyüzü irrigation pond was investigated between August 2007 and July 2008 and totally 70 taxa were found belong to bacillariophyta (55), chlorophyta (9) and cyanophyta (6). As a result, *Achnanthes linearis* (W. Smith) Grunow, *Amphora ovalis* (Kützing) Kützing, *Caloneis silicula* (Ehrenberg) Cleve, *Cyclotella kützingiana* Thwaites, *Navicula cryptocehala* Kützing, *Nitzschia dissipata* (Kützing) Grunow, *N. palea* (Kützing) W. Smith and *Microcyctis aeruginosa* (Kützing) Kützing were most common and dominant in the pond. The physico-chemical features showed that this pond contains soft and clear water.

Key Words: Epipelic Algae, Günyüzü Pond, Seasonal wariation, Turkey.

INTRODUCTION

Algae are important component of aquatic systems by playing basic role in primer productivity[1,2]. These organisms, especially diatoms, have also been used as indicators of pollution in springs[3-6], rivers[7,8] and lakes[9]. They can be found numerous extreme conditions from caves[10,11] to polars[12,13] and thermal waters[14-18] or deep waters in low light and high pressure[19].

The first study on diatoms was already published in 1845[20] and further floristic investigations were carried out[14,21-24]. The first studies were done in Egirdir and Mogan lakes and the organisms were given genera level in these studies[25-27]. Then, numerous phycological investigations have been performed in the different Turkish river and lake basins[28-36]. The aim of this study is to determined the water quality stiuation by using epipelic algae compostion of Günyüzü irrigation pond and to contribute to Turkish freshwater algal flora.

EXPERIMENTAL

Because of lacking epilithic and epiphytic samples in the pond, only epipelic samples were collected in the study. Algae samples were simultaneously taken from three stations (St1, St2 and St3) between August 2007 and July 2008. St1 station is in North part; St2 station is in west and St3 station is in south of the pond (Fig. 1). Also water samles were simultaneously taken in August-2007, September-2007, January-2008 and March-2008 months, while the values of conductivity, temperature and pH were monthly measured.

Study area: Günyüzü Pond, 1.4 km^2 area and 864 m altitude and max. 1.2 km potential, is located Southernwest of Eskisehir in Eagean region. The pond is used for agricultural irrigation and fisheries[37].

Epielic algae samples: The samples were collcted by an 8 mm dia × 1 m glass pipe which was lowered by hand to the surface of sediment while one end was closed with thumb. It was then moved in a circular direction on the surface and the thumb was slightly loosened to scud the sediment into pipe. The collected sediment samples were transferred into laboratory for further examination. The sample were put into petri dishes and allowed to settle for 4-6 h. the supernatant was removed and cover glasses were washed into breakers. To remove carbonates from diatoms, they firstly treated with HCl and then it was used H_2O_2 for oxidation following by repeated washing of resultant. Diatom firustules with demineralized water[38] and two or three permanent slides were prepared for each samples. Permanent slides were examined using an Olympus Vanox research microscope under 1600 X magnification. Relevant books and references were used in the identification of diatoms[39-47].

RESULTS AND DISCUSSION

Physico-chemical parameters: The measured parameters were given in Table-1.

Taxonomical features: As a result, 70 taxa belonging to *Bacillariophyta* (55), *Chlorophyta* (9), *Cyanophyta* (6), were totally determined during the study (Table-2).

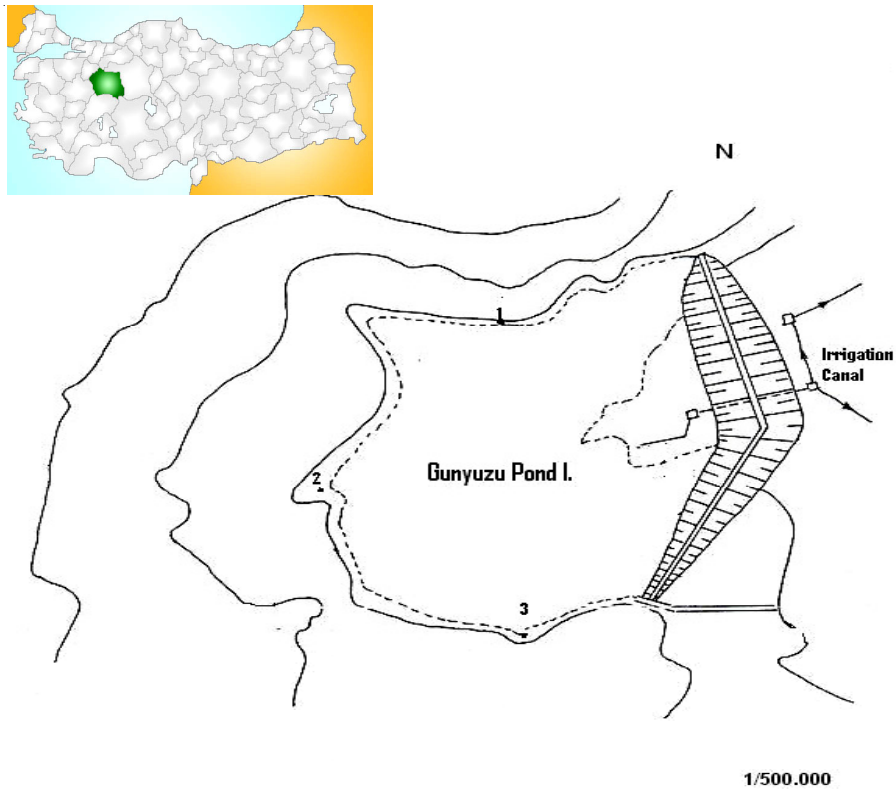


Fig. 1. Study area

TABLE-1
SOME MEASURED PARAMETERS

	August 2007	September 2007	October 2007	November 2007	December 2007	January 2008	February 2008	March 2008	April 2008	May 2008	June 2008	July 2008
COND (µS/cm^2)	334	331	329	320	316	313	319	324	336	339	328	322
pH	8.32	8.02	8.41	8.16	8.18	7.38	7.45	8.26	8.49	8.12	8.21	8.26
Temp. (ºC)	21	17	13	11	7.3	6.7	7	8	9.3	10.2	14.6	16.5
$CaCO_3$ (mg/L)	146	134				130		136				
Cl (mg/L)	4.3	6.1				6.8		5.2				
NH_3-N (mg/L)	0.04	0.23				0.48		0.34				
NO_2-N (mg/L)	0.0038	0				0.0025		0				
NO_3-N (mg/L)	0.43	0.6				0.53		0.31				
Na (mg/L)	3.27	6.43				3.18		9.25				
K (mg/L)	0.75	0.35				0.38		1.28				
Ca (mg/L)	36	38				33		41				
Mg (mg/L)	14.21	17.3				17.7		16.5				
SO_4 (mg/L)	10.45	23.52				15.5		33.4				

In this study, Bacillariophyta was the most abundant group in the pond (Fig. 2).

Seasonal variation: The most dominant taxa in the pond were also investigated and *A. linearis*, *C. küetzingiana*, *Amphora ovalis*, *N. cryptocephala* and *N. palea* were found as the most dominant taxa in the pond and their seasonal variation were given in Fig. 3. The percentage abundance of some dominant diatom taxa were listed in Table-3.

In this study, epilithic algal flora was investigated and Bacillariophyta (55 spp), Chlorophyta (9 spp) and Cyanophyta (6 spp) were determined. Also, the distribution of algal groups was determined (78.6, 12.8 and 8.6 %, respectively).

As a result, especially on diatoms, alteration was observed on abundance of the identified taxa, in the pond according to seasons. Generally, numbers of organisms decreased by coming of winter and this ratio incresed in spring and summer by beginning of spring (Table-2 and Fig. 3). The members of Bacillarophyta were more abundant than other groups and pennate diatoms were more abundant than centric diatoms in dominant group. Similar results were determined in many Turkish reservoirs (*e.g.*, Almus, Derbent, Hirfanli Dam Reservoirs) and and lakes (*e.g.*, Abant and Karagöl Lakes) by other authors[1,29,48-51]. In pennate diatoms, *Nitzschia* and *Cyclotella*, *Navicula* and *Pinnularia* genera were presented

TABLE-2
ALGAL COMPOSITION IN THE POND

	St1	St2	St3
Bacillariophyta			
Centrales			
Coscinodiscaceae			
C. comta (Ehrenberg) Kützing		+	+
C. kützingiana Thwaites	+	+	+
C. ocellata Pantocsek	+	+	+
C. operculata (C.Agardh) Brébisson	+	+	+
Discostella stelligera (Cleve & Grunow) Houk & Klee	+	+	+
Stephnodiscus astrea (Kützing) Grunow		+	+
Pennales			
Achnanthaceae			
Achanthes linearis (W. Smith) Grunow	+	+	+
A. peragalli Brun & Héribaud	+		+
Achnanthidium minutissimum (Kützing) Czarnecki		+	
Cocconeis pediculus Ehrenberg	+		+
C. placentula Ehrenberg		+	+
Cymbellaceae			
Amphora ovalis (Kützing) Kützing	+	+	+
Cymbella affinis Kützing	+	+	+
C. aspera (Ehrenberg) Cleve			+
C. cymbiformis Agardh			+
C. helvetica Kützing		+	+
C. lanceolata Kirchner	+		
C. tumida (Breb) V. Heurck		+	+
C. turgida (Gregory) Cleve		+	
Cymbopleura amphicephala (Nägeli) Krammer.		+	
C. naviculiformis (Auerswald ex. Heiberg) Kützing			+
Encyonema prostratum (Berkeley) Kützing	+	+	+
Epithemiaceae			
Denticula elegans Kützing	+		+
Fragilariaceae			
Fraglaria crotenensis Kitton.		+	
Didymosphenia geminata (Lyngbye) M. Schmidt			+
Naviculaceae			
Aneumastus laetus (A.Mayer) Lange-Bertalot	+		
Caloneis schumanniana (Grunow) Cleve	+		
C. silicula (Ehrenberg) Cleve	+	+	+
Eolimna minima (Grunow) Lange-Bertalot			+
Gyrosigma acuminatum (Kützing) Rabenhorst	+	+	
Navicula cincta (Ehrenberg) Ralfs	+	+	+
N. cryptocephala Kützing	+	+	+
N. dicephala Ehrenberg			+
N. menisculus Schumann			+
N. radiosa Kützing			+
N. salinarum Grunow	+		
Pinnularia mesolepta (Ehrenberg) W.Smith	+		+
P. microstauron (Ehrenberg) Cleve	+	+	+
P. rhombarea var. biundulata (O. Müller) Krammer	+		
P. supcapitata Gregory			+
P. supcapitata var. hilseana O.Müller		+	
Nitzschiaceae			
Nitzschia acicularis (Kützing) W.Smith			+
N. acuta Hantzsch	+	+	
N. amphibia Grunow	+		+
N.bremensis Hustedt			+
N. dissipata (Kützing) Grunow	+	+	+
N. frustulum (Kützing) Grunow		+	
N. frustulum var. subsalina Hustedt		+	
N. gracilis Hantzsch			+
N. palea (Kütz.) W. Smith	+	+	+
N. pusilla Grunow			+
N. thermalis Kützing		+	
Tryblionella apiculata Gregory	+		
Surirellaceae			
Cymatopleura solea (Brébisson) W. Smith		+	
Surirella ovata var. smithii Cleve	+	+	
Chlorophyta			
Chaetophorales			
Oocystaceae			
Chlorella ellipsoidea Gerneck	+		+
C. vulgaris Beijerinck		+	+
Chlorococcales			
Hydrodictyaceae			
Pediastrum boryanum (Turp.) Meneghini		+	+
P. duplex var.gracillimum W.G.S. West. G.M. Smith		+	
Pediastrum sp.		+	+
Cladophorales			
Scenedesmaceae			
Scenedesmus bijuga (Turp) Lagerheim.		+	
S. dimorghus (Turp) Kuetzing.		+	
S. quadricauda (Turp.)de Brebisson	+	+	
Senedesmus sp.		+	
Cyanophyta			
Chroococcales			
Chroococcaceae			
Chrococcus turgidus (Kuetz) Naeg		+	+
Merismopedia elegans A. Braun	+		+
Microcystis aeruginosa Kütz.	+	+	+
Hormogonales			
Nostocaceae			
Anabaena subcylindrica Borge.	+		+
Oscillatoriales			
Oscillatoria limosa C.A. Agardh	+		+
O. formosa Bory	+		+

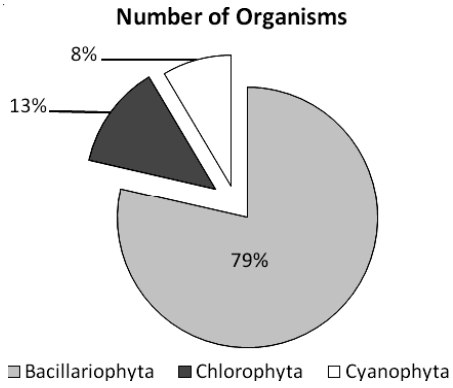
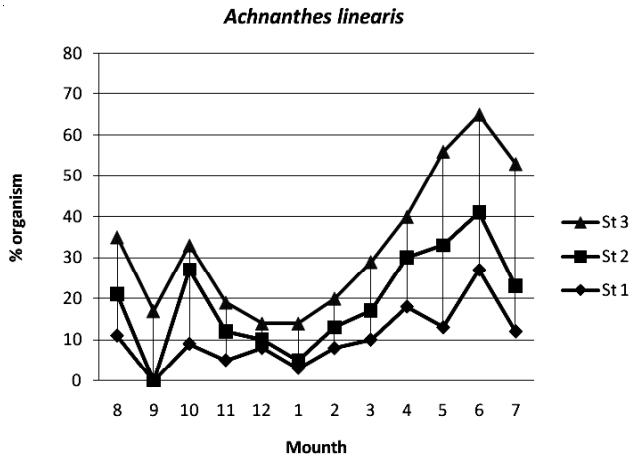
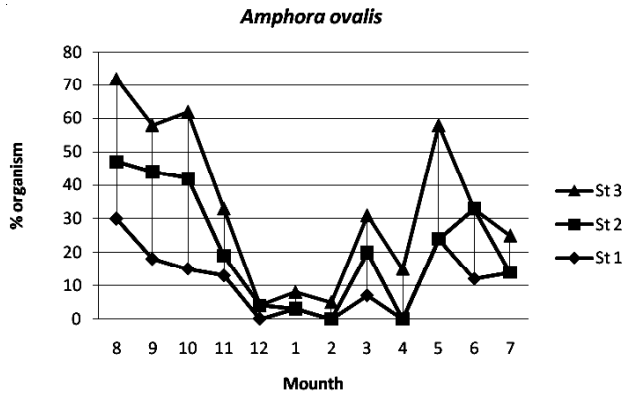


Fig. 2. Percentage distribution of algal groups

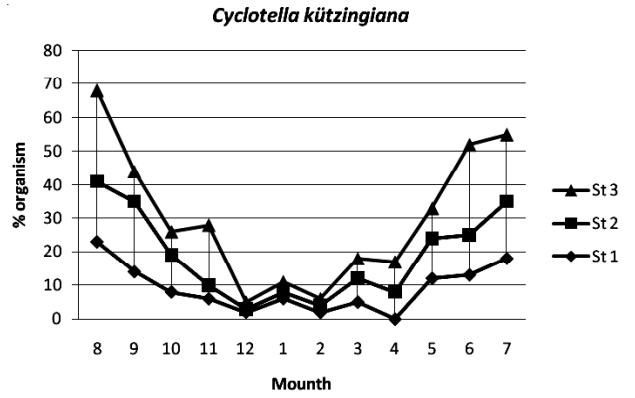
the most members in pennate diatoms. Among the members of *Navicula*, *N. cryptocephala* and *N. cincta* were dominant in all stations, while other members were permanently found especially in St3. Similarly, members of *Navicula* were dominant in other studies in Central Anatolia[52] and were common in Bedirkale Dam Reservoir[53] and members of *Nitzschia* were abundant in Hirfanli Dam Reservoir[49]. *N. cryptocephala* was also dominant in Almus Dam Reservoir[1],



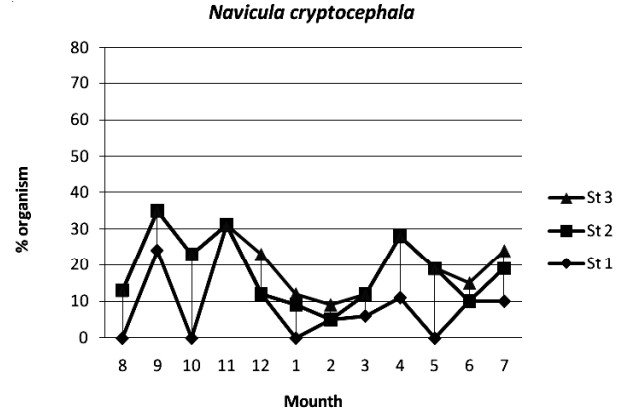
(a)



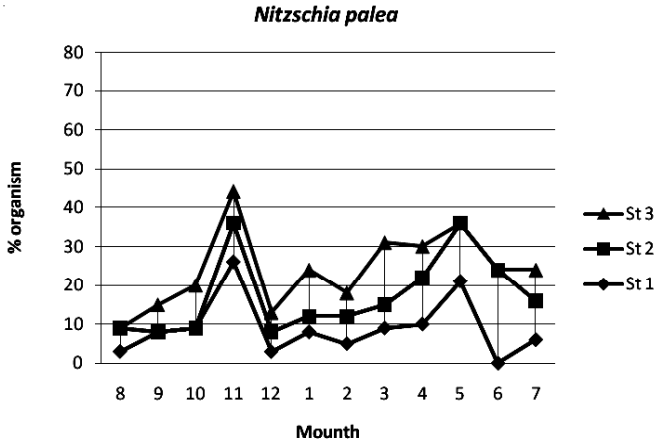
(b)



(c)



(d)



(e)

Fig. 3. Seasonal variation most dominant taxa in the pond (a) *A. linearis*, (b) *A. ovalis*, (c) *C. kützingiana*, (d) *N. cryptocephala*, (e) *N. palea*

Borabay Lake[54], Bedirkale Dam Reservoir[53] and Palandöken Pond[55]. *Nitzschia palea* was other common diatoms during the study. This taxon was also common and dominant in Porsuk Pond[56], Hirfanli Dam Reservoir[49], in epiphytic habitat in Bedirkale[53] and as the most abundant and continuosly in Tercan Dam Reservoirs[57], in phytoplankton in Almus Dam Reservoir[1]. This species was found in rich organic substance in Demirdöven Dam Reservoir[58]. The *Fragilaria* members, reported as planktonic and prefers rich nutrient conditions and found in mesotrohic water[59,60] was only found in St2. Fragilaria members were especially determined in pelajic zone of lakes and ponds (Porsuk Pond[56], Palandöken Pond[61] in Turkey but appearing in benthic can be explained by mixing of these habitats naturally. *F. intermedia*, among the dominant *Fragilaria* members in th pond was dominant as plankton in Almus Dam Reservoir[1] and also appeared in Yedigöller and Abant Lakes[62] almost all month. On the other hand, *F. ulna*, one of common and abundant diatoms in benthic flora of Turkish freshwaters wasn't determined in the epipelic habibtat of the pond (Table-3).

Chlorophyta group was represented as second most dominant group in the pond. This group can be generally found in all lakes in Turkey. Scenedesmus members (*Chlorococcales*) were more common than others. Also, these members were commonly examined in Mogan Lake[63] and Altinapa Dam Reservoir[64].

The amount of especially members of *Microcyctis*, member of the last group-*Cyanophyta*, went up in summer period in the pond. These taxa were rarely observed in Altinapa Dam Reservoir[64], Ankara and surrounding lakes[65] and Tortum Lake[66], while extremelly observed in Bafra Fish Lakes[67], Hasan Ugurlu[68] and Sarimsakli Dam Reservoir[29] and some other lakes. This taxon was observed in eutrofic lakes[69]. Causing toxicity and blooming[70-72], this taxon was commonly determined without blooming in this study. This stituation guided that phosphorate and nitrogen ratios were in tolerant and also, conductivity was stable during the study in the pond (Table-1).

TABLE-3
PERCENTAGE ABUNCANDE OF MOST DOMINANT DIATOMS IN THE POND

	August 2007			September 2007			October 2007			November 2007			December 2007			January 2008			February 2008			March 2008			April 2008			May 2008			June 2008			July 2008		
	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3	St1	St2	St3
Centrales																																				
Coscinodiscaceae																																				
Cyclotella. comta		1			9	3					3		4	5			8			10			8						1			1			8	
C. kützingiana	23	18	27	14	21	9	8	11	7	6	4	18	2	1	2	6	2	3	2	2	2	5	7	6		8	9	12	12	9	13	12	27	18	17	20
C. ocellata	2		2	11		1	4			3				2		3	3		7	3	1	3	2		9						4			2		
C. operculata			1			6			1			4	2	2	7		2	13		3	10		2	1			4			3			2			8
Discostella stelligera			4			4						2	5	6	3	11	2	9	10	1	8	11	1	2	7		4			6	6		2			4
Stephanodiscus astrea		2	2		6	2		10			5			3			14			9			11					3			4			2	
Pennales																																				
Achnanthaceae																																				
Achanthes linearis	11	10	14			17	9	18	6	5	7	7	8	2	4	3	2	9	8	5	7	10	7	12	18	12	10	13	20	23	27	14	24	12	11	30
A. peragalli	2			5			11			4			6		16	6		6	9		5	5			11		3	7			6		2	2		
Cocconeis pediculus			8			12			5			2	5					4			8			9			17			9			11			9
C. placentula		4							22		10			11	9								6	1				5						8		
Cymbellaceae																																				
Amphora ovalis	30	17	25	18	26	14	15	27	20	13	6	14		4		3		5			5	7	13	11			15	24		34	12	21		14		11
Cymbella affinis		4											18		7	15		8	14		10	9			5		2				3					
Encyonema prostratum	9	10	7		8	9	11				8	10		13	8			2		9	11	8		3	6	16	11	5	7	9	6		19	17	21	
Epithemiaceae																																				
Denticula elegans	2		3						3			8	13		5	14		3	6		4	6		8				10			11			8		3
Fragilariaceae																																				
Fraglaria crotenensis		9			4						9			9			9			12			7					8						6	
Naviculaceae																																				
Caloneis silicula	13		3	6			14		12		17	20	11	9	9	16	7	4	11	14	8			15			8			4		15			
Navicula cincta									13			7		10		5	10	17	6	7	2	9		7			2									
N. cryptocephala		13		24	11			23		31			12		11		9	3	5		4	6	6		11	17			19		10		5	10	9	5
Pinnularia microstauron	3		2			8				8			7		6		9		7		9			9			5	4		3			5		2
Nitzschiaceae																																				
N. acuta							13			4				2					2			3			5			4			2			6		
N. acuta							13			4				2					2			3			5			4			2			6		
N. disipata	2		2	14		8	6				19		4	8	8	10	5	2	8			9	14		18	20	2		10			8		8	
N. frustulum														4			12			10			5			7					9				
N. palea	3	6		8		7	9		11	26	10	8	3	5	5	8	4	12	5	7	6	9	6	16	10	12	8	21	15			24		6	10	8
Surirellaceae																																				
Cymatopleura solea		6			15			11			2			4			2			8			5			8									

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