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Taxonomic Survey of Benthic Diatoms on Natural Substrata From Coastal Lagoon (Aegean Sea, Turkey)

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Abstract

The taxonomical composition of epilithic diatoms was investigated at intertidal zone of Homa lagoon, Aegean sea, Turkey. The stations are located in different littoral zones of the study area and they are different from each other in terms of hydrological respect. The samples contained a mixture of forms growing on the stones themselves, on silt accumulated on the stones and forms epiphytic on other algae, I will refer to this collective community as epilithon. Epilithic diatom species, which constitute the majority of the community were examined from obtained material. A total of 67 diatom taxa belonging to 34 genera were identified to the genus or species level. The species more frequently found in the samples were *Cocconeis placentula*, *Cocconeis scutellum*, *Mastogloia pumila*, *Navicula cincta* and *Navicula crypyocephala var. veneta*. Nine of the species identified during the research period seem to be previously unreported for Turkish coastal waters. Morphological characteristics of these species were given in detail information and original photographs.

Keywords: Epilithic diatom, species identification, Homa lagoon, Aegean Sea, Eastern Mediterranean Sea.

Kıyısal Lagündeki (Ege Denizi, Türkiye) Doğal Substratumda Bulunan Bentik Diyatomelerin Taksonomik Olarak İncelenmesi

Özet

Epilitik diyatomelerin tür kompozisyonu, Homa lagününün (Ege Denizi, Türkiye) kıyısal zonunda incelenmiştir. İstasyonlar, çalışma bölgesinin farklı kıyısal zonlarında yer almaktadır ve hidrolojik açıdan birbirlerinden farklıdır. Alınan örnekler, taş üzerinde bulunan diyatomeleri, taş üzerine biriken kum taneciklerine yapışarak yaşayan diyatomeleri ve diğer algler üzerinde bulunan epifitik diyatomeleri kapsamaktadır ve bu kommunite epiliton olarak ifade edilmektedir. Kommunitenin büyük çoğunluğunu oluşturan epilitik diyatome türleri toplanan materyalde incelenmiş, 34 genusa ait toplam 67 taxa, tür ve genus seviyesinde tanımlanmıştır. *Cocconeis placentula*, *Cocconeis scutellum*, *Mastogloia pumila*, *Navicula cincta* and *Navicula crypyocephala* var. *veneta* türleri örnekleme boyunca sık bulunan türlerdir. Araştırma döneminde saptanan türlerin 9 tanesi Türkiye kıyısal suları için daha önceden rapor edilmemiştir. Bu türlere ait detaylı morfolojik özellikler ve orijinal fotoğraflar çalışmaya eklenmiştir.

Anahtar Kelimeler: Epilitik diyatome, tür teşhisi, Homa lagünü, Ege Denizi, Doğu Akdeniz.

Introduction

Many terms are used to distinguish groups of benthic organism that live in different aquatic habitats. Terms such as biofilms, benthos, periphyton and epilithon have been used synonymously for several researches, but many of these terms have also been linked to more specific definitions varying with time and geography, among research groups (Weitzel, 1979; MacIntyre *et al*., 1996). The term benthos has a broad meaning, since it includes the entire assemblage of organisms associated with the solid-liquid interface in aquatic systems. Today, the term most often used in the aquatic scientific literature is 'Periphyton', but still the definitions vary considerably and may specify either microfloral communities or entire microcommunities (including both living and dead components) attached to substrata that are either natural or artificial. The term epilithon include non-living materials and living organisms on stones, rocks and similar substrates (Kelly and Whitton, 1998).

Taking into account these definitions, epilithon is considered as an important base of the food chain, and in some aquatic systems can comprise the most abundant producers. Although the term encompasses a great diversity of microalgal taxa, diatoms constitute a large portion of epilithic community. Diatoms generally are the primary colonies in the whole littoral zone. The importance of diatoms as primary colonies in natural and artificial substrata was first suggested by Scheer (1945) and followed by Hendey (1951), Santelices *et al*. (1981), and Falciatore *et al*. (2002).

There are about 80 lagoons in Turkish coasts and many studies conducted in these lagoons. Some of those are focused on phytoplankton (Çevik *et al*., 2008; Soylu and Gönülol, 2006; Taş and Gönülol, 2007) and some of them are about benthic diatoms (Gönülol *et al*., 2009; Polge *et al*., 2010; Sıvacı *et al*., 2008). There have been few researches carried out on Homa Lagoon. The limnological features such as zooplankton (Pulat and Özel, 2003), macrobenthos (Önen and Yaramaz, 1991), physical and chemical properties (Ünsal *et al*., 2000) of the lagoon were investigated by many researchers. The number of algological surveys in the study area is scarce. Research work on this subject has been carried out by Cirik *et al*. (1991), Çolak Sabancı and Koray (2010) and Çolak Sabancı *et al*. (2011), but for epilithic algae, the present work constitutes the first floristic study. Although our samples contained a mixture of forms growing on the stones themselves, on silt accumulated on the stones and forms epiphytic on other algae, I will refer to this collective community as epilithon. The objective of this work was to investigate the taxonomical composition of the epilithic diatom assemblages in Homa Lagoon and to make a contribution to the largely unknown algal flora of Turkey.

Materials and Methods

Gediz Delta region (38°30′ N, 26°55′ E) is located within the boundaries of Izmir. While Izmir Bay and Aegean Sea are found in the South and west respectively, the hills of Foça exists in the north and Menemen in the east. Gediz Delta (20400 ha) consists of freshwater and salt water marshes (5000 ha), bays and saltpans (3300 ha) and lagooner areas which makes it the typical Mediterranean delta ecosystem. The average rainfall and temperature of the area are 544.2 mm and 16.8°C respectively (Anonymous, 2007). In the Gediz Delta region that includes the study area, there are four lagoons: Homa (1800 ha), Çilazmak (725 ha), Tas (500 ha) and Kırdeniz (450 ha). Homa Lagoon (38°33′10″ N, 26°49′50″ E) is located 25 kilometers to the northwest of the Gulf of Izmir and within the borders of the town of Menemen (Figure 1). Located adjacent to Çamaltı Saltpan and Izmir Bird Paradise, the lagoon has a surface area of 1800 hectares and its depth mostly varies between 0.5 and 1 meter. Homa lagoon is one of the most important lagoons and a biodiversity hotspot in the Aegean coast of Turkey. Because of the enormous species diversity and natural habitats, the lagoon was included in the important wetlands list in terms of international “Ramsar Site”.

Epilithon samples were collected from four stations in Homa lagoon as seasonal (2006: June, September, December; 2007: March, June, September) between 2006 and 2007. Station 1 is deeper than the other stations. It’s open to the waves and the bottom is covered especially with broken sea shells. Station 2 is located in the region of which the mixture of the sea water and lagoon water. According to the station 2, station 3 is less affected by seawater and has the same bottom structure with station 2. Station 4 is located in an area completely sheltered. For defining the species composition of epilithic diatoms, stones of 15-20 cm in diameter in the lagoon were collected. Stones were chosen as randomly as possible amongst those that are not smoothered with filamentous algae and in which the diatom film was

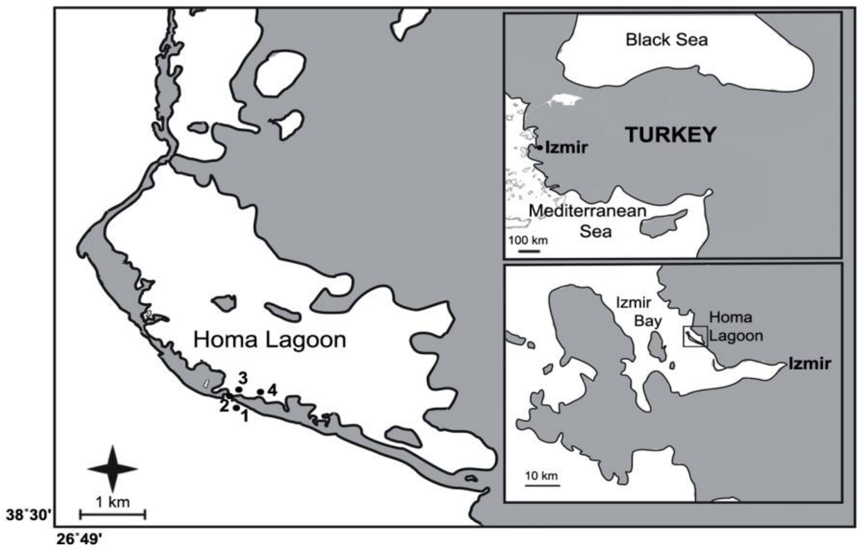

Figure 1. Location of stations in the Homa Lagoon.

evident. Selected stones were taken into a plastic bath of 1l in which 200 ml of distilled water was added. The upper parts of the stones were rubbed with a toothbrush and the mixture was decanted into the 250 ml polythene bottles (Winter and Duthie, 2000). Finally sample bottles were fixed with formaldehyde until the concentration was 4%. Materials obtained were subjected to chemical process with HCl %10, H_2SO_4 %30, $KMnO_4$ and oxalic acid (Lauriol *et al*., 2006). Samples entirely cleaned from organic material were made ready as permanent preparations. Diatoms were identified to species level at x1000 magnification by phase-contrast optics with OLYMPUS x100 PlanApo oil immersion objective. Identification of detected diatoms was made following Foged (1985a, b), Hartley (1996), Hendey (1964), Peragallo and Peragallo (1897-1908) and Witkowski *et al*. (2000).

Water samples were taken from the same zones in order to determine the overall structure of the Homa Lagoon. Water temperature and pH were measured *in situ* with mercury thermometer and HANNA HI 8314 model pH meter respectively. Water samples for analysing salinity, nitrite, nitrate, ammonium, phosphate and silicate were taken into 1l plastic bottles and transferred to the laboratory immediately.

Salinity and dissolved oxygen concentration were analyzed according to the methods of Martin (1972) and Winkler (1888), respectively. Chlorophyll a and nutrient concentrations were determined colorimetrically with an HACH DR/ 4000 U model spectrophotometer. The method of Strickland and Parsons (1972) was followed for the colorimetric analysis. The data obtained was analyzed using one-way ANOVA to test for inter site differences.

Results

Physical and Chemical Characteristics

The seasonal variations of the physical and chemical properties of the lagoon in June 2006-September 2007 are given in Figure 2. During the sampling period, surface water temperature of the lagoon varied between 4 and 28.8°C, and maximum was recorded in June 2006 at station 4, but minimum in December 2006 at station 2 and 3. The salinity ranges between 34.42 psu in September 2007 at station 1 and 64.12 psu in December 2006 at station 3. Dissolved oxygen concentrations were measured between 6.00 (station 1) and 28.00 (station 4) mg l^{-1}. There were fluctuations in pH values throughout the sampling period, and the highest value (8.17) was detected in September 2006 at station 4. Throughout the sampling period, the maximum amounts of nitrogen (TNO_x-N), o.phosphate-phosphorus (o.PO_4-P), and silicate [$Si(OH)_4$-Si] were 12.59 μM (June 2007, station 4), 4.22 μM (March 2007, station 1) and 25.10 μM (September 2007, station 2) respectively.

Epilithic Algal Flora

During the study period, total of 67 diatom taxa belonging to 34 genera were identified to the genus or species level (Table 1). *Achnanthes longipes* C. Agardh, *Cocconeis placentula* Ehrenberg, *Cocconeis*

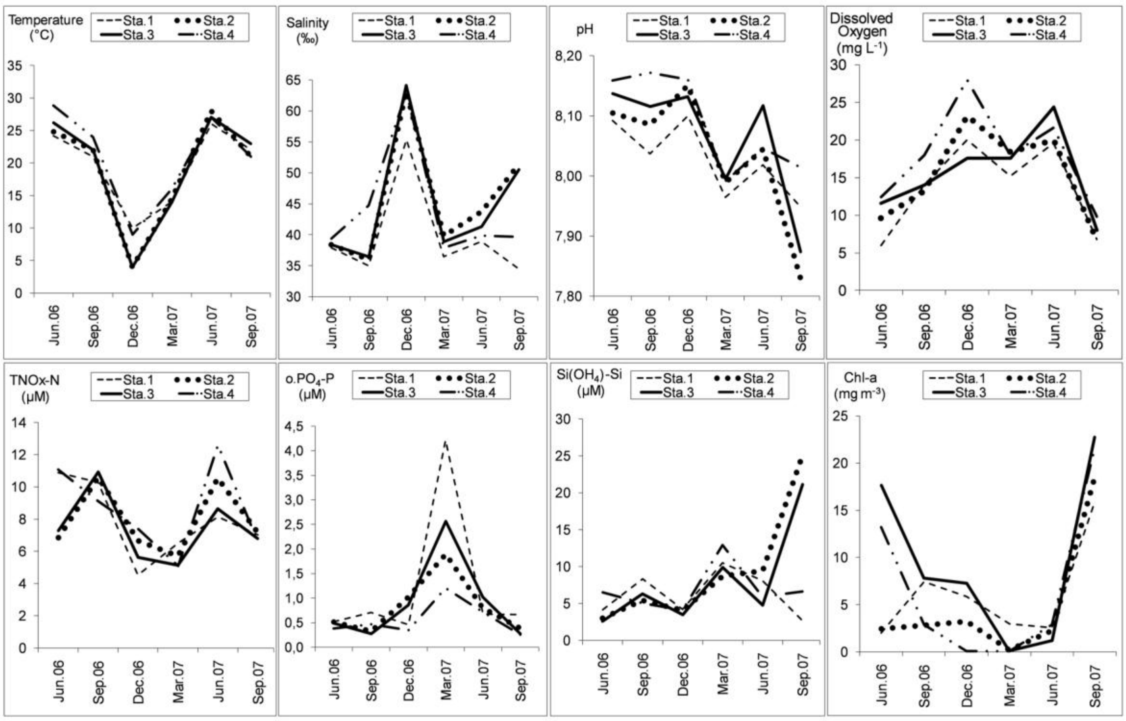

Figure 2. The seasonal change of some physical and chemical parameters in Homa lagoon.

Table 1. List of the recorded taxa indicating the presence/absence at the 4 sampling stations in Homa lagoon.

Taxa	Station 1	Station 2	Station 3	Station 4
Achnanthes brevipes C.Agardh	X	X*		X
Achnanthes brevipes var. *intermedia* (Kützing) Cleve		X		
Achnanthes longipes C.Agardh	X	X	X	X
Achnanthes parvula Kützing		X		
Amphora proteus Gregory			X	
Berkeleya scopulorum (Brébisson ex Kützing) E.J.Cox	X	X		
Cocconeis dirupta var. *flexella* (Janisch & Rabenhorst) Grunow		X	X	
Cocconeis pediculus Ehrenberg	X			
Cocconeis placentula Ehrenberg	X	X*	X*	X
Cocconeis pseudomarginata Gregory		X		
Cocconeis scutellum Ehrenberg	X*	X*	X*	X
Coscinodiscus nitidus W.Gregory	X	X	X	
Cosmioneis pusilla (W.Smith) D.G.Mann & A.J.Stickle	X		X	X
Craticula cuspidata (Kützing) D.G.Mann		X	X	
Ctenophora pulchella (Ralfs ex Kützing) D.M.Williams & Round	X	X	X	
Cymbella affinis Kützing		X		
Delphineis surirella (Ehrenberg) G.W.Andrews			X	
Eunotogramma marinum (W.Smith) H.Peragallo	X		X	X
Fallacia forcipata (Greville) Stickle & Mann	X	X		
Fogedia sp.	X	X		
Grammatophora angulosa Ehrenberg	X			
Grammatophora oceanica Ehrenberg	X*	X	X	X
Gyrosigma balticum (Ehrenberg) Rabenhorst				X
Halamphora exigua (Gregory) Levkov		X		X
Halamphora turgida (Gregory) Levkov	X	X	X	
Hantzschia amphioxys (Ehrenberg) Grunow	X			
Karayevia clevei (Grunow) Bukhtiyarova	X	X		
Licmophora ehrenbergii (Kützing) Grunow	X		X	X
Licmophora flabellata (Greville) C.Agardh	X			
Licmophora gracilis (Ehrenberg) Grunow			X	X
Licmophora hyalina (Kützing) Grunow			X	
Mastogloia binotata (Grunow) Cleve		X		
Mastogloia braunii Grunow		X	X	
Mastogloia lanceolata Thwaites ex W.Smith		X	X	X
Mastogloia pumila (Cleve & Möller; Grunow) Cleve	X	X	X*	X*
Mastogloia smithii Thwaites ex W.Smith		X	X	X
Navicula abrupta (W.Gregory) Donkin	X		X	X
Navicula arenaria Donkin	X		X	X
Navicula cincta (Ehrenberg) Ralfs	X*	X*	X*	
Navicula cryptocephala Kützing var. *veneta* (Kützing) Rabenhorst	X	X	X*	X*
Navicula cryptotenella Lange-Bertalot		X	X	X
Navicula forcipata Greville var. *densestriata* A.W.F.Schmidt	X	X		
Navicula johanrossii Giffen	X	X		X
Navicula ramosissima (C.Agardh) Cleve var. *mucosa* (Aleem) Hendey	X		X	
Navicula scabriuscula (Cleve & Grove) Mereschkowsky			X	X
Navicula tripunctata (O.F.Müller) Bory de Saint-Vincent	X			
Navicymbula pusilla (Grunow) K.Krammer		X		
Nitzschia angularis W.Smith	X*			
Nitzschia frustulum (Kützing) Grunow	X	X		
Nitzschia intermedia Hantzsch ex Cleve & Grunow	X			X
Nitzschia linearis (C.Agardh) W.Smith	X	X		
Nitzschia lorenziana Grunow		X		
Nitzschia punctata (W.Smith) Grunow var. *coarctata* (Grunow) Hustedt		X	X	
Nitzschia scalpelliformis Grunow			X	X
Parlibellus bennikei Witkowski	X*	X	X	
Petrodictyon gemma (Ehrenberg) D.G.Mann		X		
Pleurosigma salinarum (Grunow) Grunow	X	X	X*	X
Psammodictyon panduriforme (W.Gregory) D.G.Mann	X	X	X*	X
Rhabdonema adriaticum Kützing	X	X	X	X
Rhopalodia musculus (Kützing) Otto Müller	X	X	X	X*
Scoliopleura peisonis Grunow		X		
Staurophora amphioxys (Gregory) D.G.Mann	X	X	X	X
Tabularia fasciculata (C.Agardh) D.M.Williams & Round	X	X	X*	X
Trachysphenia australis P.Petit	X			
Tryblionella acuminata W.Smith	X	X	X	X*
Tryblionella apiculata Gregory	X			
Tryblionella compressa (J.W.Bailey) M.Poulin	X	X	X	

X, present, * present in over 2/3 of total samples for each stations.

scutellum Ehrenberg, *Grammatophora oceanica* Ehrenberg, *Mastogloia pumila* Cleve, *Navicula cryptocephala* Kützing var. *veneta* (Kützing) Rabenhorst, *Pleurosigma salinarum* (Grunow) Grunow, *Psammodictyon panduriforme* (W.Gregory) D.G.Mann, *Rhabdonema adriaticum* Kützing, *Rhopalodia musculus* (Kützing) O. Müller, *Staurophora amphioxys* (Gregory) D.G.Mann, *Tabularia fasciculata* (C. Agardh) D.M.Williams and Round and *Tryblionella acuminate* W.Smith were the diatom species which were found at all stations.

There were no marked differences among stations in respect to species number. The maximum number of species were determined in station 2 with 45 taxa of which 19 were also identified at station 4. The number of species in this station was observed as 29. In terms of exclusive taxa number, stations 1, 2, 3 and 4 had 8, 9, 4 and 1 taxa respectively. Except *Nitzschia angularis* W.Smith, which was determined only in station 1, these exclusive taxa did not have a high frequency of presence.

Taxa most frequently found in the studied samples are shown in Table 1, where a set of 14 different species is present. This table displays encountered species from decreasing order of occurrence, from 100 to 62%. In terms of the frequency of species, *G. oceanica* (67%), *Parlibellus bennikei* Witkowski (83%) and *N. angularis* (67%) were more frequently found in station 1 and *Achnanthes brevipes* C. Agardh (67%) has a high frequency in station 2. Besides these species, *C. placentula* (100%), *Navicula cincta* (Ehrenberg) Ralfs (100%), *P. salinarum* (67%), *P. panduriforme* (67%) and *T. fasciculata* (67%) were more frequently found in station 3. In station 4, *R. musculus* (67%) and *T. acuminata* (83%) were more frequent than in other stations. *C. scutellum* and *N. cryptocephala* var. *veneta* were frequently found in all stations according to the ratio of number of samples where species occurred to total number of samples observed.

It is difficult to determine the possible seasonal fluctuations in the assemblages based on qualitative data. Some taxa such as *C. placentula*, *C. scutellum*, *M. pumila*, *N. cincta* and *N. cryptocephala* var. *veneta* were reported for at least thirteen of the research period and they did not show any kind of marked seasonality. At the same time, the majority of the other taxa reported, such as *A. brevipes*, *G. oceanica*, *P. bennikei*, *P. salinarum*, *P. panduriforme*, *R. musculus*, *T. fasciculata* and *T. acuminata* although not as frequent, did not show any apparent preference for a given season during the sampling period.

Many species listed in Table 1 have never been reported for the Homa lagoon, moreover, *Berkeleya scopulorum* (Brébisson ex Kützing) E.J.Cox, *Parlibellus bennikei* Witkowski, *Navicula forcipata* Greville var. *densestriata* A.W.F.Schmidt, *Navicula johanrossii* Giffen, *Navicula scabriuscula* (Cleve and Grove) Mereschkowsky, *Fallacia forcipata* (Greville) Stickle and Mann, *Fogedia* sp., *Delphineis surirella* (Ehrenberg) G.W.Andrews, *Grammatophora angulosa* Ehrenberg from Bacillariophyceae, were recorded for the first time from the Turkish coasts. Except the genus *Fogedia*, the species of the other genera have been previously reported many times by various researchers (Gönülol *et al*., 2009; Sıvacı *et al*., 2008). However the genus *Fogedia* has not been recorded before in Turkish seas. All of the species were also checked at the AlgaeBase website (Guiry and Guiry, 2009). The descriptions of such species are as follows;

Ochrophyta
Bacillariophyceae

Naviculales
Berkeleyaceae

Berkeleya Greville
Berkeleya scopulorum (Brébisson ex Kützing) E.J. Cox (Figure 3a)

Cell solitary, valves linear, elongated, slightly convex in the middle, with rounded and a little inflated apices. Axial area quite narrow, indistinct, central area rounded, small. Valve surface striate, striae finely punctate, radiate in the middle, convergent at the apices, 21 in 10 μm. Valves 80 μm in length and 5.17 μm in width.

Parlibellus E.J. Cox
Parlibellus bennikei Witkowski (Figure 3b)

Valves lanceolate to linear-lanceolate with acutely rounded apices. Axial area narrow, central area relatively large, always circular. Valve surface striate, transapical striae punctate, in the middle rather apart, towards apices becoming intenser, 23 in 10 μm. Valves 17.08 μm in length and 6.05 μm in width.

Naviculaceae

Navicula Bory de Saint-Vincent
Navicula forcipata Greville var. *densestriata* A. Schmidt (Figure 3c)

Cells solitary. Valves elliptical, with wide, rounded apices. Lateral areas narrow, constricted in the middle of the valve. Valve surface striate, finely punctate. Striate 21 in 10 μm. Valves 32.05 μm in length and 9.35 μm in width.

Navicula johanrossii Giffen (Figure 3d)

Valves lanceolate with obtusely rounded. Axial area narrow, central area square through shortening of the three median striae. Transapical striae radiate in the middle, convergent at the apices, 16 in 10 μm. Valves 33.07 μm in length and 7.50 μm in width.

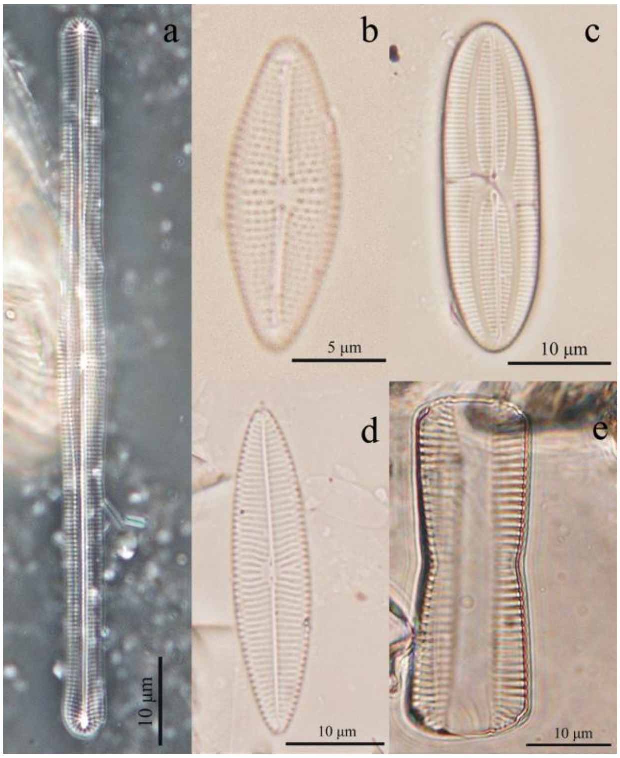

Figure 3. Phase contrast micrographs of diatoms.
a) *Berkeleya scopulorum*; b) *Parlibellus bennikei*; c) *Navicula forcipata* var. *densestriata*; d) *Navicula johanrossii* e) *Navicula scabriuscula*

Navicula scabriuscula (Cleve and Grove) Mereschkowsky (Figure 3e)

Valves in girdle view convex, narrowly lanceolate with acute apices. Raphe straight, axial area indistinct, central area small, rounded. Transapical striae slightly radiate, 10 in 10 µm. Valves 40.30 µm in length.

Sellaphoraceae

Fallacia Stickle and D.G. Mann
Fallacia forcipata (Greville) Stickle and Mann (Figure 4a)

Valves linear to linear-elliptic with broadly to obtusely rounded apices. Axial area quite narrow, central area transverse, connected to the lateral areas constricted in the middle, becoming somewhat narrower towards apices. Transapical striae parallel in the middle, radiate at the apices, 24 in 10 µm.Valves 16.36 µm in length and 6.80 µm in width.

Rhaphoneidales
Rhaphoneidaceae

Delphineis G.W. Andrews
Delphineis surirella (Ehrenberg) G.W. Andrews (Figure 4.c)

Valves broadly elliptical to elliptical-lanceolata. Valve surface punctate, puncta large. Valves 32.70 µm in length and 14.40 µm in width. Striae, 9 in 10 µm.

Striatellales
Striatellaceae

Grammatophora Ehrenberg
Grammatophora angulosa Ehrenberg (Figure 4.d)

Valve linear with weakly convex sides and rounded apices. Valve surface striate, striae transverse, 18 in 10 µm, clearly punctate. Valves 22.10 µm in length and 11.50 µm in width.

Bacillariophyceae Incertae Sedis

Fogedia Witkowski, Lange-Bertalot, Metzeltin and Bafana 1997
Fogedia sp. (Figure 4.b)

Valves broadly lanceolate with acute apices. Axial area narrow, central area transversely expanded, rectangular, connected to lateral areas narrowly linear terminating at a certain distance below apices. Transapical striae in the middle paralel, towards apices becoming radiate, radiate, 17 in 10 µm. Valves 21.15 µm in length and 7.69 µm in width.

Discussion

Diatoms are a very important component of the

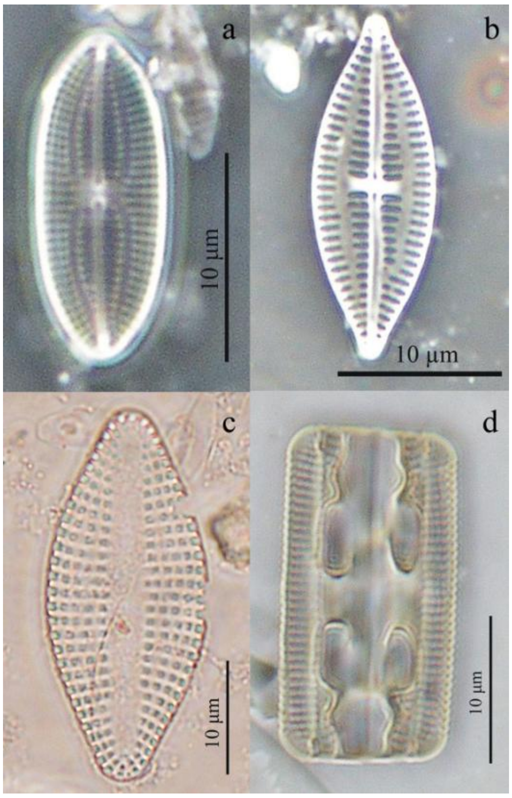

Figure 4. Phase contrast micrographs of diatoms a) *Fallacia forcipata*; b) *Fogedia* sp.; c) *Delphineis surirella*; d) *Grammatophora angulosa*.

epilithon in estuarine and shallow coastal wetlands (Sullivian, 1999; Sullivan and Currin, 2000). Despite their importance, especially because of the continuous fluctuations and interactions between physical-chemical factors, the study on coastal wetlands is complex. Nevertheless, the fluctuating conditions and the high number of environmental factors involved make the study of these transitional environments very useful for specifying the factors affecting diatom distribution and for refining on the knowledge of diatom ecology.

A total of 67 epilithic diatom species have been identified during the study period at the Homa lagoon and nine of them were new records for Turkish coastal waters. All the stations had a similar number of species and shared approximately 2/3 of the taxa, and also 19% of the taxa reported in station 1, 20% in station 2, 11% in station 3 and 3% station 4 were exclusive to each station. According to the results of one-way ANOVA, except the percentage of carbon in sediment, no significant differences were found between the sites ($P<0.05$). The reason for the difference was because of the bottom structure of station 1 which was covered with gravel and sand, especially with broken sea shells (Çolak Sabancı *et al*., 2011). However, in terms of hydrological characteristics, station 2 and station 4 were different from the other stations. Station 2 was located in the region where seawater and lagoon water was mixed and it has a higher water depth. Also having a softer substratum made this station sorting from others. Station 4 is located in an area completely sheltered. The bottom structure is covered with muddy sediment in which during the tide, drying and fracturing is seen.

During the sampling period, the maximum values of chemical parameters were determined at stations inside the lagoon. The Gediz River is thought to be the most important reason for this situation. Gediz River is under the influence of many factors. It is polluted by leather industry, residential wastes and wastes of organized industrial zones and also agriculturing along river causes an increase in nutrient concentration. Applied fertilizers reaches the lagoon especially with the rains by means of the mouth of Gediz from the sea. This lead to an increase of the chemical parameters at the stations inside the lagoon. Homa lagoon is characterized by a highly dynamic environment, basically because of the frequent changes of physical characteristics due to shallowness. The study area is an active lagoon, and during the June and December periods fish traps are closed, and seawater input is reduced. Significant freshwater input into the area was provided by rainfall. During the autumn, depending on the evaporation and less rainfall, high salinity values were observed during this period.

Çolak Sabancı *et al*. (2011) identified that, the most effective parameters in affecting the epipelic species composition in the Homa Lagoon were the water temperature, the concentration of nitrite and the percentage of total organic carbon in sediment ($\rho r=0.15$). In the same study, according to the results of the cluster analysis, no significant difference between the seasons was observed in terms of species occurence. Nevertheless, environmental factors which had great variability in lagooner region, were identified as affecting the species occurrence (Coelho *et al*., 2007), but it was reported by Ribeiro *et al*. (2003) that these changes could be seen at higher latitudes where yearly light and temperature changes are marked. This gave a big handicap for presenting which factors having greater effect on species occurence. On the other hand, as our study was a qualitative study, it was difficult to infer the possible environmental factors which affected the species occurence and the seasonal fluctuations in the assemblages without quantitative data.

This confusion continues in the studies about the habitat of diatoms. For instance, *P. panduriforme* was reported to be planktonic (Sagan *et al*., 2000), but in this study it was found in the epilithic community and also previously have been reported in epipelic community (Çolak Sabancı *et al*., 2011). In the study conducted by Admiraal (1984), motile epipelic species were dominant in muddy estuarine tidal flats but they were not exclusive of these substrata. The epilithic species were mentioned to be first observed on an artificial substratum (Munda, 2005). The author reported that sand particles accumulated on these plaques over time, depending on water movements, and, consequently, epipelic and epipsammic species were seen in addition to the epilithic ones.

All species identified in this study were epilithic diatoms with a dominance of polyhaline forms and few mesohaline and oligohaline taxa (Hustedt, 1959; Tomas, 1997). These taxa were well adapted to this changing environment with long time periods. For example, *G. angulosa* and *D. surirella* were marine species (Hartley, 1996). However, in this study, *G. angulosa* was found at the entrance of the lagoon (station 1) and *D. surirella* was found on the inside of the lagoon (station 3). These results support the idea that there is a general overlapping pattern in the species distribution along the transitional waters and that some species may have a specific set of environmental conditions (Underwood *et al*., 1998; Ribeiro *et al*., 2003).

The reported parameters (length, width and striae) in this study have shown some similarities and differences with the parameters given by other researchers (Foged, 1985a, b; Hartley, 1996; Hendey, 1964; Peragallo and Peragallo, 1897-1908; Witkowski *et al*., 2000). The majority of diatom species found in wetlands with high salinity are small forms mostly belonging to some of the most taxonomically complex genera (*Navicula*, *Nitzschia* and *Amphora*) and most of the individual taxa show considerable morphological variability (Sullivan and Currin, 2000). Taxonomic confusion in the diatom species is largely caused by the absence of detailed documentation on nomenclatural types and unknown ranges of morphological variability.

The taxonomic literature on brackish water diatoms is particulary unclear and scattered. In this sense, it's important to describe the species in sufficient details to permit the correct species identification. The occurrence of these species for the first time in this study may be related to the lack of adequate studies in this region. Also, consistent quantitative and qualitative data are still needed to determine the seasonal and spatial changes of the epilithic assemblages better in the Homa lagoon.

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