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Research Article

A Study on the Epipelic and Epilithic Algae of Şana River (Trabzon/Turkey)

Saadet KOLAYLI, Arif BAYSAL
K.T.Ü. Sciences Fac., Department of Biology, Trabzon-TURKEY
Bülent ŞAHİN
K.T.Ü. Fatih Educational Fac., Department of Biology, Söğütlü,Trabzon-TURKEY

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Abstract: The epipelic and epilithic algae of the Şana river, were investigated during the period January 1995 to December 1995. Sity taxa belonging to the *Bacillariphyta*, *Chlorophyta, Cyanophyta* and *Euglenopnyta* divisions were identified.

Melosira varians Ag. *(Coscinodiscaceae), Cocconeis placentula* var. *euglypta* (Ehr.) Cleve *(Achnanthaceae), Cymbella minuta* Hilse ex Rabh. *(Cymbellaceae), Navicula cryptocephala* Kütz. and *N. cryptocephala* var. *veneta Kütz.* Grun. *(Naviculaceae),* were abundant among epipelic algae. Of the epilithic algae, it was observed that *Concconeis placentula* var. *euglypta, Cymbella minuta* and *Didymosphenia geminata* (Lyng.) M. S. *(Naviculaceae)* were abundant.

Key Words: Epipelic, Epilithic, Seasonal changes, River.

Şana Deresi (Trabzon/Türkiye) Epipelik ve Epilitik Algleri Üzerinde Bir Araştırma

Özet: Şana derecesi epipelik ve epilitik algleri Ocak 1995-Aralık 1995 tarihleri arasında araştırılmıştır. *Bacillariophyta, Cholorophyta, Cyanophyta* ve *Euglenophyta* divizyonlarına ait toplam 60 takson tesbit edilmiştir.

Epipelik algler arasında *Melosira varians* Ag. *(Coscinodiscaceae), Cocconeis placentula* var. *euglypta* (Ehr.) Cleve *(Achnanthaceae), Cymbella minuta* Hilse e Rabh. *(Cymbellaceae), Navicula cryptocephala* Kütz. ve *N. cryptocephala* var. *veneta* (Küntz.) Grun. *(Naviculaceae)* dominant olmuştur. Epilitik alglerden *Cocconeis placentula* var. *euglypta, Cymbella minuta* ve *Didymosphenia geminata* (Lyng.) M. S. *(Naviculaceae)* taksonlarının bol olduğu gözlenmiştir.

Anahtar Sözcükler: Epipelik, Epilitik, Mevsimsel Değişim, Dere.

Introduction

As Altuner (1) has pointed out, the first study of the algae of rivers in Turkey was done by Ehrenberg on the Murat River in 1845. Much Later, the density and seasonal variations of phytoplankton and benthic algae in the Konya-Meram River were studied by Yıldız (2-4). In the Porsuk (5,6), Kızılırmak (7) and Çubuk (8) Rivers, comprehensive taxonomic research was carried out by the same outhor. In addition, the phytoplankton and benthic algae of the Aras and Karasu Rivers in the eastern Anatolia region were studied by Altuner (1,9,10). In the Black sea region, there have also been studies of the seasonal variations of the phytoplankton and benthic algae of the Samsun-İncesu River (11) and the benthic algal composition of the Söğütlü, Değirmendere, Kalafa, Karadere, Sürmene and Solaklı Rivers in the Trabzon area (12,13).

The main aims of this study were to make a contribution to the largely unknown algal flora of Turkey and to examine the epipelic and epilithic algal flora and seasonal variations of the epipelic algae of the Şana River.

Materials and Methods

The Şana River, which has fast-flowing water, is about 13 km east of Trabzon.

In order to study the epipelic and epilithic communities, two sampling stations were chosen (Fig.

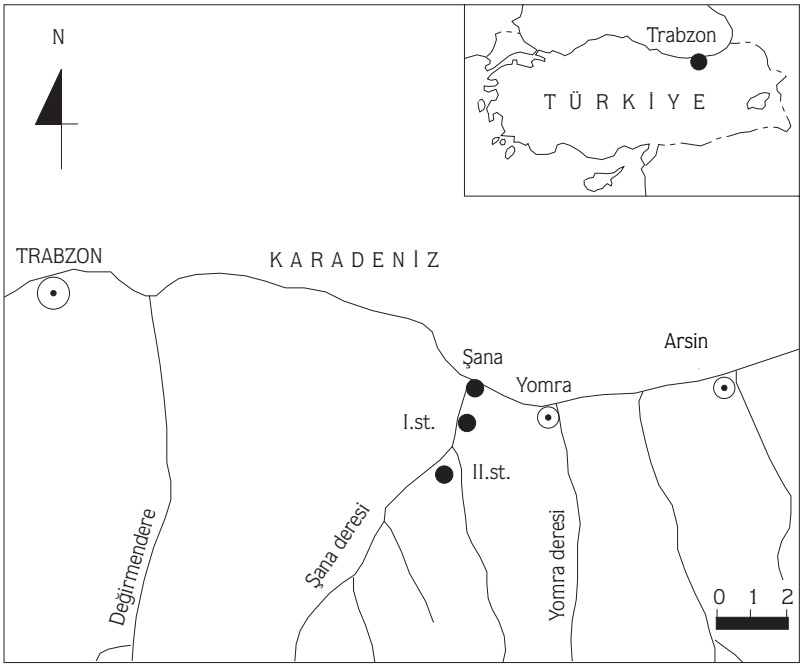


Figure 1. Sampling stations in Şana river.

1). Station I was located 1.5 km in from the coast riverbed at and Station II was located 2 km from Station I, further inland. The both stations was covered with all kinds of stones and sediment. The epiphytic algae were not studied because of the absence of higher plants at both stations. The samples were collected in 30-day-periods between January and December, 1995. The methods of collection and laboratory examination were those previously described by Round (14) and Slacdeckova (15).

With each sampling, the water temperature and pH were measured using a mercury thermometer and a WTW Dıgı 88 pH meter. The dissolved-oxygen concentration was measured using the method of Winkler.

Taxonomic identifications were made with reference to Husted (16), Cleve-Euler (17), Prescott (18) and Patrick and Reimer (19,20). Some algae were photographed with an Olympus BH-2 research microscope.

Results

Physical and chemical characteristics

The water temperature (mean mothly values) varied from 7 to 24˚C (X=15.5˚C). Low temperatures generally occured during December and the highest temperatures were found in August at both stations. The pH values fluctuated between 6.9 and 8.1 (X:7.5), indicating that the water had a circum-alkaline character. The dissolved oxygen fluctuated between 7.1 and 12 mg/lt (X:9.5 mg/lt), (Fig.2).

Algal flora

A total of 60 taxa were recorded. Of these, 44 belong to Bacillariophyta, 7 to Chlorophyta, 6 to Cyanophyta and 3 to Euglenophyta (Table 1). The

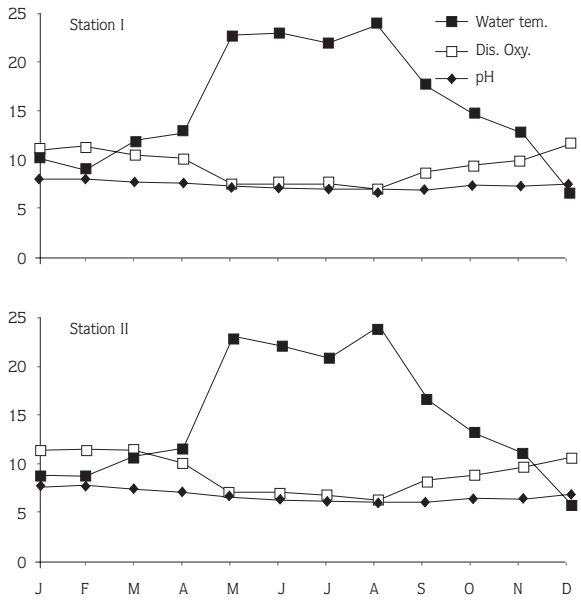


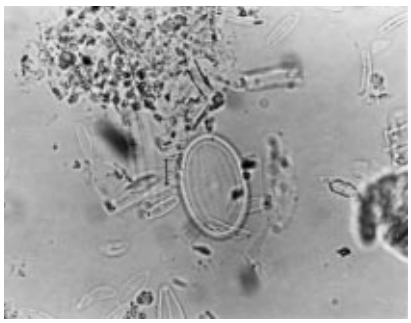
Figure 2. Seasonal changes in some physico-chemical parameters of Şana river.

Table 1. List of epipelic and epilithic algae collected in the Şana River.

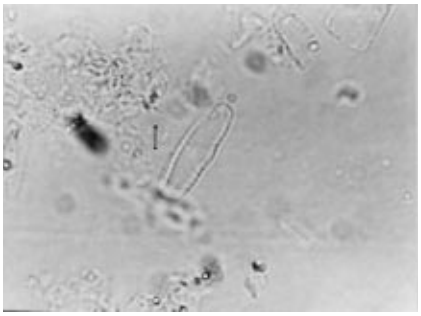
	Species	Epipelic	Epilithic
Divisio:	BACILLARIOPHYTA		
Classis:	CENTROBACILLARIOPHYCEAE		
	Melosira islandica O. Müll.	+	+
	M. varians Ag.		
Classis:	PENNATICABILLARIOPHYCEAE		
	Achnanthes lanceolata		
	var. elliptica Grun.	+	
	A. minutissima Kütz.	+	+
	A. minutissima Kütz.	+	+
	Amphora ovalis Kütz.	+	+
	A. veneta Kütz.	+	+
	Ceratoneis arcus Kütz. (Fig. 3a)	+	+
	C. arcus var. amphioxys Rabh. (Fig. 3b)	+	+
	C. arcus var. linearis Holmboe	+	
	Cocconeis placentula var. eughlypta	+	+
	(Ehr.) Cleve (Fig. 3c)		
	Cymatopleura solea (Breb.) W. Smith	+	
	Cymbella affinis Kütz.	+	+
	C. cymbiformis (Ag., Kütz) V.H.	+	
	C. minuta Hilse ex Rabh.	+	+
	C. minuta var. silesiaca (Bleisch ex Rabh.) Reim.	+	
	C. sinuata Greg. (Fig. 3d)	+	+
	C. tumida (Breb.) V.H. (Fig. 3e)	+	+
	C. turgida (Greg.) Cleve	+	+
	C. ventricosa Kütz.	+	+
	Diatoma vulgare Bory.	+	
	D. vulgare var. brevis Grun. (Fig. 3f)	+	+
	Didymosphenia geminata (Lyng.) M.S. (Fig. 3g)	+	+
	Gyrosigma acuminatum (Kütz.) Rabh.	+	
	Gomphonema olivaceum (Lyng.) Kütz.	+	+
	G. parvulum Kütz. (Fig. 3h)		+
	Hantzschia elongata (Hant.) Grun.	+	
	H. amphioxys (Ehr.) Grun.	+	
	Meridion circulare Ag.		+
	Navicula bacillum Ehr.	+	
	N. cryptocephala Kütz.	+	+
	N. cryptocephala var. intermedia Grun	+	
	N. cryptocephala var. veneta (Kütz.) Grun.	+	+
	N. hungarica var. capitata (E.) Cl.	+	
	N. radiosa Kütz. (Fig. 3ı)	+	+
	N. rhynchocephala Kütz.	+	
	Nitzschia palea (Kütz.) W. S.	+	+
	N. sigmoidea (Ehr.) W. S.	+	
	Pinnularia appendiculata (Ag.) Cl.	+	
	Rhoicosphenia cruvata (Kütz.) Grun (Fig. 3i)	+	
	Surirella angusta Kütz.	+	+
	S. ovata Kütz.	+	+
	S. robusta var. oxyrhynchus (Kütz.) V.H.	+	+
	Synedra ulna (Nitz.) Ehr. (Fig. 3j)	+	+
Divisio:	CHLOROPHYTA		
Classis:	CLOROPHYCEAE		
	Ulothrix aequalis Kütz.		+
	U. zonata (Weber, Mohr) Kütz. (Fig. 3k)		+
	Cladophora sp. (Fig. 3l)		+
	Closterium littorale Gay.		+
	C. moniliferum (Bory) Ehr. ex Ralps		+
	Cosmarium sp.	+	
	Spirogyra sp.		+
Divisio:	CYANOPHYTA		
Classis:	CYANOPHYCEAE		
	Merismopedia elegans A. Braun.		+
	Oscillatoria agardhii Gom.		+
	O. granulata Gardner		+
	O. limnetica Lemm.	+	+
	O. minima Gicklhorn		+
	O. subbrevis Sch.	+	
Divisio:	EUGLENOPHYTA		
Classis:	EUGLENOPHYCEAE		
	Euglena sp.	+	
	Trachelomonas volvocina Ehr.		+
	T. sp.	+	+

(a)

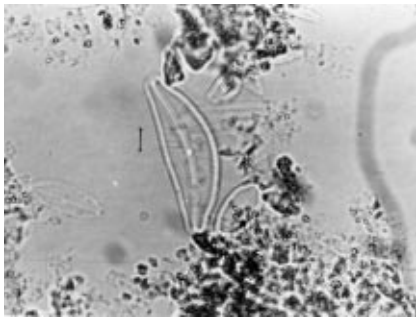
(b)



(c)



(d)



(e)

(f)

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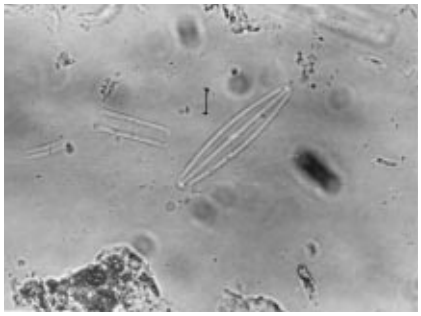
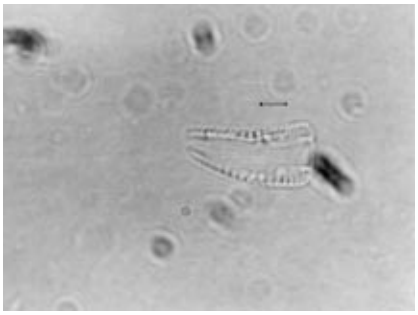


(ı)



(i)

(j)

(k)

(l)

Figure 3. a. Ceratoneis arcus, b. C. arcus var. amphioys, c. Cocconeis plancetula var. euglypta, d. Cymbella sinuata, e. C. tumida, f. Daitoma vulgare var. brevis g. Didymosphenia geminata, h. Gomphonema parvulum, ı. Navicula radiosa, i. Rhoicosphenia cruvata, J. Synedra ulna, k. Ulothrix zonata, l. Cladophora sp. (Scala 10 µm).

Table 2. Frequencies of some epipelic algae (The percentage of the number of samples in which organisms were detected from the total number of samples).
%100-80 Contantly present,
%80-60 Largely present,
%60-40 Generally present,
%40-20 Sometimes present,
%20-1 Seldom present.

		Sta.I	Sta.II
Organisms		12	12
	Centrales		
	Melosira spp.	75	67
	Pennales		
	Amphora spp.	50	17
	Ceratoneis spp.	42	67
BACILLARIOPHYTA	Cocconeis placentula		
	var. euglypta	42	67
	Cymbella spp.	67	75
	Navicula spp.	83	75
	Nitzschia spp.	33	50
	Surirelal spp.	58	67
	Synedra spp.	50	33
CHLOROPHYTA	Cosmarium sp.	–	8
CYANOPHYTA	Oscillatoria spp.	25	17
EUGLENOPHYTA	Euglena sp.	–	8
	Trachelomonas spp.	17	33

members of the Bacillariophyta division were dominant in the benthic communities and constituted 73% of the total algal taxa.

Epipelic communities

The epipelic communities consisted of 46 species, of which 41 were Bacillariophyta, 1 was Chlorophyta, 2 were Cyanophyta and 2 were Euglenophyta (Table 1). The most important diatoms were *Melosira varians, Cymbella minuta* (at Station II), *Navicula cryptocephala* (at Station I) and *N. cryptocephala* var. *veneta. Chlorophyta* was represented by an unidentified species of *Cosmarium. Oscillatoria limnetica* Lemm. *(Oscillatoriaceae)* and *Trachelomonas* sp. were the most common members of *Cyanophyta* and *Euglenophyta*. The frequencies of some epipelic algae are shown in Table 2.

The total density was almost the same at both stations. *Bacillariophyta* was predominant in the epipelic algal flora at both stations. During the *study period*, while the highest numbers of the total density was 26985 cells/cm^2 in May at Station I, this was found to be 26728 cells/cm^2 in December at Station II. The lowest total density was the same at both stations. This was 16962 cells/cm^2 July (at Station I) and November (at Station II). No algae could be found in June and September due to heavy flloding at both stations (Fig.4).

While *Melosira varians* reached its peak (16705 cells/cm^2) in August at Station II, this number was found to be 14906 cells/cm^2 in the same month at Station I. *Cymbella minuta* reached its highest level (8995 cells/cm^2) at Station II. The same pattern was exhibited by *Navicula cryptocephala* (10794 cells/cm^2)

Table 3. The abundance of some epilithic diatom communities at Station I (The numbers indicate the numbers of species present in 100 diatoms. Diatoms found in every count are marked +).

Months / Diatoms	26.1.1995	21.2.1995	22.3.1995	24.4.1995	23.5.1995	30.6.1995	22.7.1995	22.8.1995	29.9.1995	18.10.1995	16.11.1995	14.12.1995
Melosira islandica	2	-	-	-	-	-	-	-	-	4	-	+
M. varians	-	15	15	22	17	-	5	42	-	7	15	10
Amphora ovalis	5	3	-	2	-	-	-	-	-	-	-	-
Ceratoneis arcus	11	25	10	+	-	-	-	-	-	7	+	2
Cocconeis placentula var. euglypta	+	+	-	8	2	-	2	8	-	3	5	6
Cymbella minuta	4	9	15	23	30	-	8	-	-	2	8	10
C. sinuata	-	+	-	-	-	-	48	20	-	10	-	10
Diatoma vulgare var. brevis	-	3	-	8	-	-	-	-	-	3	-	-
Didyomosphenia geminata	-	-	-	20	45	-	-	-	-	-	-	-
Navicula cryptocephala	50	13	-	-	+	-	17	10	-	5	8	10
N. cryptocephala var.veneta	30	-	-	20	5	-	-	-	-	-	50	45
N. radiosa	24	19	33	9	-	-	13	12	-	4	-	-
Surirella ovata	-	8	6	+	3	-	-	-	-	17	10	15
Synedra ulna	2	-	-	-	-	-	7	8	-	-	5	5

Table 4. The abundance of some epilithic diatom communities at Station II (The numbers indicate the numbers of rspecies present in 100 diatoms. Diatoms found in every count are marked +).

Months / Diatoms	26.1.1995	21.2.1995	22.3.1995	24.4.1995	23.5.1995	30.6.1995	22.7.1995	22.8.1995	29.9.1995	18.10.1995	16.11.1995	14.12.1995
Melosira varians	-	22	20	21	6	-	10	57	-	21	10	2
Ceratoneis arcus	28	16	-	-	-	-	2	-	-	5	-	-
Cocconeis placentula var. euglypta	-	9	-	+	+	-	15	10	-	-	+	+
Cymbella minuta	12	19	20	12	8	-	5	-	-	-	+	+
C. sinuata	-	-	13	-	+	-	60	13	-	2	-	+
Didyomosphenia geminata	+	2	-	50	81	-	3	4	-	-	-	-
Navicula cryptocephala	16	29	40	8	+	-	4	+	-	4	-	-
N. cryptocephala var.veneta	90	40	-	-	-	-	-	-	-	-	50	82
Surirella ovata	-	3	7	+	+	-	-	-	-	8	-	2
Synedra ulna	+	-	-	5	+	-	-	12	-	9	5	+

in Jauary at Station I. *N. cryptocephala* var. *veneta* reached its peak (19532 cells/cm^2) in December at Station II and represented 73% of the total algal flora. At Station I, the maximum level of the same taxon was found to be 17990 cells/cm^2 in the same month and represented 71% of the total (Fig.5).

Epilithic communities

This community consisted of 40 species. The *Bacillariophyta* division predominated with 27 taxa, followed by *Chlorophyta* with 6, *Cyanophyta* with 5 and *Euglenophyta* with 2 (Table 1). The most common diatoms were *Cocconeis placentula* var. *euglypta, Cymbella minuta* and Didymosphenia geminata, which are typical attached algae. In addition to these, *Melosira varians, Caratoneis arcus* Kütz. *(Fragilariaceae), Navicula cryptocephala, N. cryptocephala* var. *veneta* and *N. radiosa* Kütz. *(Naviculaceae),* which are epipelic algae, were also common in the epilithic communities.

Not including diatoms, *Cladophora sp.* and *Oscillatoria limnetica* were the most common members of *Chlorophyta* and *Cyanophyta.* Especially, *Cladophora sp.* was found to be abundant on stones during the summer and autumn. The abundane of some epilithic diatoms is presented in Tables 3 and 4.

Discussion

In the Şana River, light and temperature controlled the development of the epipelic community. However, there is no doupt that the speed of the water current was the main factor influencing the development of the algal flora. For example, although light and temperature were found to be normal during the summer and autumn, no organisms could be found in June and September because of flooding.

Bacillariophyta was the predominant group in the

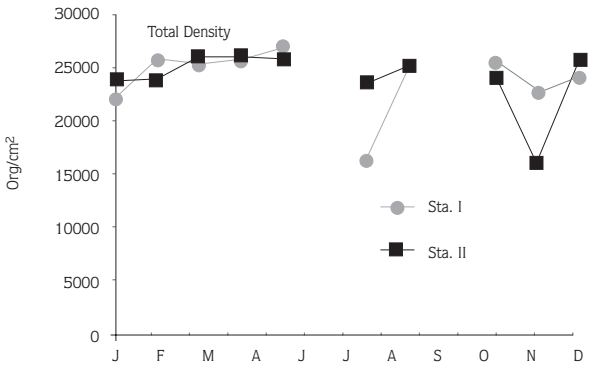


Figure 4. Seasonal changes in the total density of the epipelic communities.

algal flora of the Şana River. Similar conditions have been observed in the Aras (1), Meram (3,4), Porsuk (5), Kızılırmak (7), Çubuk (8), Karasu (10), İncesu (11), Rivers in Turkey and in other parts of the world (21). Moore (21) pointed out that in more temperate areas diatoms are usually the most common element of epipelic communities. The dominant epipelic diatoms of this study were fairly similar to those found in streams in Turkey and other parts of the world (21), due to the fact that these taxa tolerate a broadrange of light, temperature and other ecological factors (22).

From these taxa, *Melosira varians, Navicula cryptocephala* and *N. cryptocephala* var. *veneta,* which are genuine epipelic algae, together with *Cocconeis placentula* var. *euglypta* and *Cymbella* minuta, which are typical attached algae, were found in the epipelic algal flora. This phenomenon can be explained by the fact that the current and the adjacent stations caused a mixture of the epipelic and epilithic habitats. Similar conditions have been observed in other streams studied in Turkey (4,10,11). This complication is not observed in slow-flowing and deep rivers, were the epipelic flora is represented by genuine epipelic algae (23).

The members of *Chlorophyta, Cyanophyta* and *Euglenophyta* were not in the epipelic community. These algal groups were very important in the Meram, Karasu and İncesu Rivers (4,10,11).

In the epilithic algal communities, *Cocconeis placentula* var. euglypta, Cymbella minuta and *Didymosphenia geminata,* which are genuine epilithic algae, were predominant. At the same time, some epipelic algae were also observed in the epilithic communities, due to stones being covered in sediment.

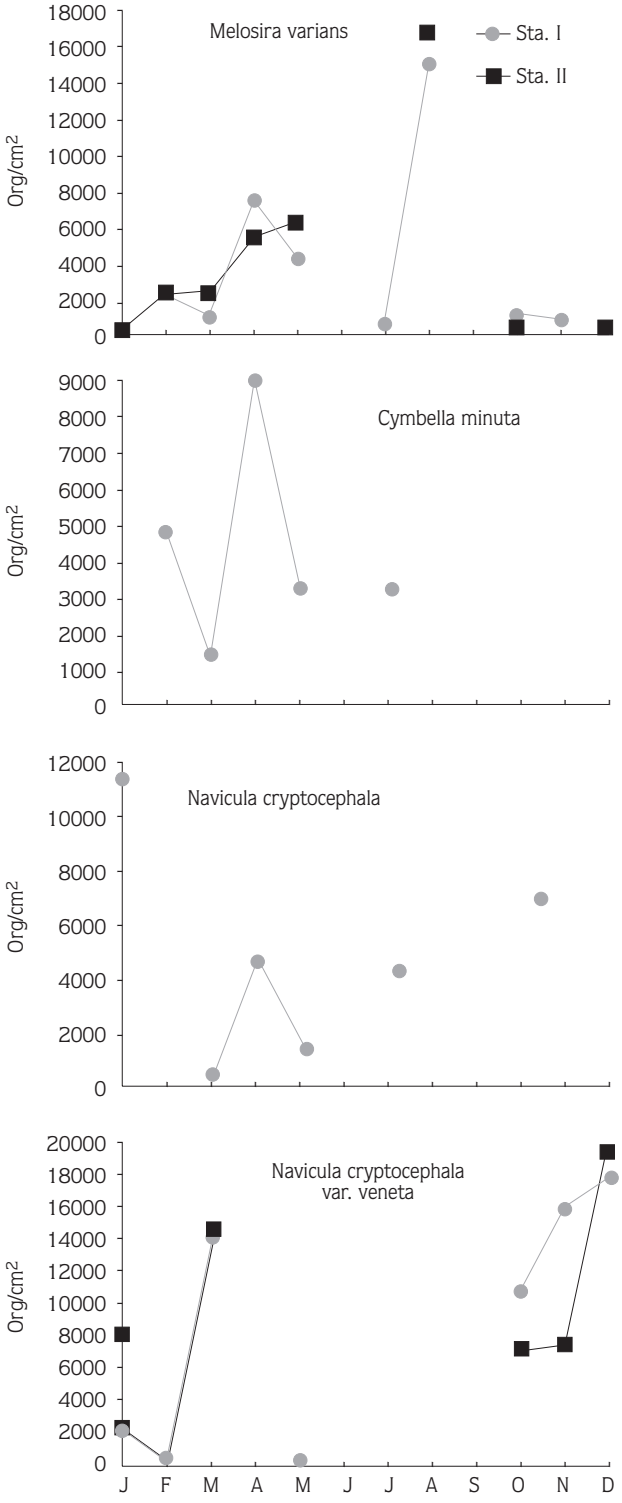


Figure 5. Seasonal changes in the density of common epipelic algae.

Similar conditions have been observed in other rivers in which epilithic algal communities have been studied (1,3,11).

The most common *Chlorophyta* was an unidentified species of *Cladophora* in the epilithic community. This taxon showed a gradual increase in abundance during the spring, summer and autumn. Moore (22) pointed out that in warmer environments flamentous *Chlorophyta* such as *Cladophora spp.* often become dominant in the epilithic community.

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