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Original Research Article

Kovada Channel Phytoplankton (Isparta- Turkey)*

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ABSTRACT

In this study, phytoplanktonic compositions and some water parameters were investigated from selected stations representing Kovada Channel. Twenty three taxa belonging to Bacillariophyta, 15 taxa belonging to Chlorophyta, 3 taxa belonging to Cyanophyta; 2 taxa belonging to Euglenophyta, a total of 43 taxa were identified. Average water temperature as 14.5 °C, pH 7.9, dissolved oxygen as 6.3 mgL^{-1}, electrical conductivity as 370.7 µmhos/cm, organic matter as 18.8 mgL^{-1}, total hardness as 22.4 mgL^{-1}, carbonate 11.6 mgL^{-1}, bicarbonate 234.5 mgL^{-1}, sulfate 9.8 mgL^{-1}, nitrate 2.0 mgL^{-1} and phosphate as 0.3 mgL^{-1} were measured.

Key Words: Phytoplankton, Channel, Freshwater, Water quality, Pollution, Indicator

Kovada Kanalı Fitoplanktonu (Isparta- Türkiye)

ÖZET

Bu çalışmada, Kovada Kanalı'nı temsilen seçilen 5 istasyonda bazı su kalitesi parametreleri ve algolojik özellikler incelenmiştir. Algolojik bulgularda Bacillariophyta'ya ait 23, Chlorophyta'ya ait 15, Cyanophyta'ya ait 3 ve Euglenophyta'ya ait 2 olmak üzere 43 takson belirlenmiştir. Kovada Kanalı'nda seçilen istasyonlarda yıllık ortalama su sıcaklığı 14,5 °C, pH 7,9, çözünmüş oksijen 6,3 mgL^{-1}, elektriksel iletkenlik 370,7 µmhos/cm, organik madde 18,8 mgL^{-1}, toplam sertlik 22,4 mgL^{-1}, karbonat 11,6 mgL^{-1}, bikarbonat 234,5 mgL^{-1}, sülfat 9,8 mgL^{-1}, nitrat 2,0 mgL^{-1} ve fosfat 0,3 mgL^{-1} olarak tespit edilmiştir.

Anahtar Kelimeler: Fitoplankton, Kanal, Tatlısu, Su Kalitesi, Kirlilik, İndikatör

INTRODUCTION

One of the components needed by people and other creatures for sustaining their lives is fresh water resources. Turkey, with its inland water resources and paleo-geographical and hydro geographical properties of these resources, is one of the most important locations in the Palearctic Region (Demirsoy 1996). Kovada Channel, which is located in the important carstic region of this country, is a channel formed graben at the south end of Lake Egirdir and it feeds Lake Kovada (Yuce 1999).

Algae are the most fundamental component of the biosphere and balance element and make up the first link of the food chain. Microalgae make up a section of algae world and have an extremely rich carbohydrate and especially fatty acid content. These organisms have high nutritional value and the most significant resource of macronutrients, vitamins and trace elements for water communities.

Biological and chemical characteristics of waters are important for planktonic taxon succession, and taxa are important for nutritional values. Therefore, microalgae being the fundamental organic producers in water environments and having high nutritional value are the most significant reasons for studying ecological, physiological and biochemical characteristics of these. In the present study, taxonomical and ecological structure of phytoplanktonic organisms were studied formed in Kovada Channel, which is graben formed at the south end of Egirdir Lake located in the most important carstic region of this country.

MATERIALS AND METHODS

Research Area

Kovada Channel remains in Isparta City limits. Kovada Lake is fed into Kovada Channel, which is formed at the

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south end of Egirdir Lake graben located in the most important carstic region of this country. The research was conducted in 5 stations selected to represent Kovada Channel and positions of the stations are shown in Figure 1.

1st Station: It is the entry of Kovada Lake and the water is slow flowing and the base is muggy. This station is rather rich in terms of vegetation and there are populations of *Myriophyllum* sp., *Potamogeton* sp.,*Phragmites* sp., and *Juncus* sp.

2nd Station: It is located down Upper Gokdere Reeds, in the region where Kocapinar Spring extension mixes the Channel. The water has medium flow, the base is muggy and covered on top with small pebbles. There are *Lemna minör* and *Myriophyllum* sp., populations at the shore regions.

3rd Station: It is under Serpil Bridge and the water has medium flow, the base is muggy and there are small pebbles on top. There are *Myriophyllum* sp., population at the shore regions.

4th Station: It is located 50m down of Asya fruit juice factory on the Channel. The water flow has medium speed. There is wide distribution of *Lemna minor* species at the shore regions and *Myriophyllum* sp., populations are seen in the water.

5th Station: It is the region of the connection of Lake Egirdir with Kovada Channel. The water is slow flowing here, the base is muggy and there are small pebbles on top. Although vegetation is poor, there are extensive *Phragmites* sp. and *Juncus* sp. populations.

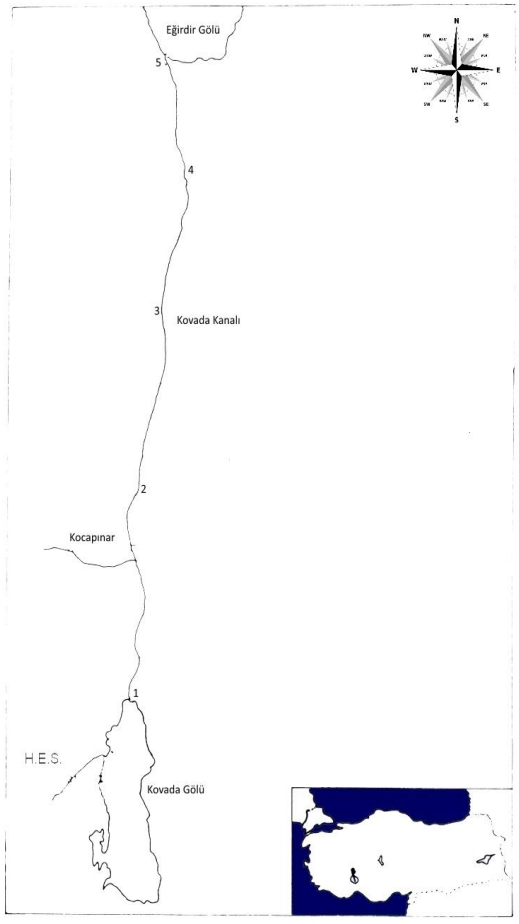

Figure 1. Research area and sample collection stations.

Some Physical and Chemical Characteristics of the Research Stations

Samplings were collected at the selected stations for determining some physical and chemical characteristics of Kovada Channel. Some physical and chemical parameters of the stations, such as O_2, pH, temperature and electric conductivity, organic substance mg/l, total hardness mg/l, CO_3^{-2} mg/l, HCO_3^- mg/l, SO_4^{-2} mg/l, NO_3 - N mg/l, and

PO_4 - P mg/l were determined by using standard techniques and methods (Alpar 1982, Atay 1996, Yuce 1999).

Phytoplanktonic Samples

Samples were collected at the stations selected as representatives of the Channel by using plankton net. Collected samples were fixed in 4% formaldehyde and brought to the laboratory. Standard techniques and methods were used for identifying planktonic algae. Diatom samples were identified by permanent preparations, and samples belonging to the others were identified by temporary preparations by using resources on the subject (Huber-Pestollozi, 1968, 1969, 1972, 1974, 1982, Patrick and Reimer, 1966, 1975). Moreover, checks of species identifications were made by using the relevant resources as well (http://www.algaebase.org., Aysel 2005, Gonulol 1996). The following scale was used for algae taxa, whose abundance is determined roughly, in the charts: A: Rare, B: Few, C: Reasonably abundant, D: Abundant, E: Superabundant

RESULTS

In the stations selected in Kovada Channel, average annual water temperature was determined to be 14.5 °C, pH 7.9, dissolved oxygen was 6.3 mgL^{-1}, electrical conductivity 370.7 µmhos/cm, organic substance 18.8 mgL^{-1}, total hardness 22.4 mgL^{-1}, carbonate 11.6 mgL^{-1}, bicarbonate 234.5 mgL^{-1}, sulfate 9.8 mgL^{-1}, nitrate 2.0 mgL^{-1} and phosphate was 0.3 mgL^{-1} (Table 1).

Table1. Some physical and chemical characteristics of Kovada Channel.

Parameters	**Mean**	**Maximum**	**Minimum**
Water temperature (°C)	14,5	25,7	1,8
PH	7,9	9,5	6,0
Dissolved oxygen (mgL^{-1})	6,3	12,3	0,08
Conductivity (µmhos/cm)	370,7	658,0	237,0
CO3= (mgL^{-1}l)	11,6	45,0	0,0
HCO3- (mgL^{-1})	234,5	427,0	106,3
Total hardness (°F)	22,4	38,5	0,0
Organic substance (mgL^{-1})	18,8	46,8	7,2
SO4= (mgL^{-1})	9,8	35,0	1,0
NO3-N (mgL^{-1})	2,0	19,0	0,0
PO4-3 – P (mgL^{-1})	0,3	2,2	0,0

Phytoplankton

In samples collected in 5 stations that were selected in Kovada Channel, phytoplanktonic taxa were examined qualitatively and quantitatively during March 1999-February 2000. In the algological findings, 43 taxa were determined, 23 belonging to Bacillariophyta, 15 belonging to Chlorophyta, 3 belonging to Cyanophyta, and 2 belonging to Euglenophyta. Distribution of the determined species according to the stations is shown in Table 2-4.

Table 2. Phytoplanktonic taxa and abundance levels according to months

	March					**April**					**May**					**June**				
Taxa / Stations	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Ochrophyta																				
Cyclotella ocellata Pantocsek									A				**A**					**A**	**A**	
Aulacoseria granulata (Ehr.)Sim.								B						**A**					**A**	**A**
Melosira varians C.A. Ag.				**B**	**A**				**A**	**B**										
Asterionella formosa Hass.	**A**					**A**														
Cocconeis pediculus Ehr.			**B**	**A**	**C**		**C**	**B**	**B**	**C**	**C**	**C**	**B**	**C**	**B**	**C**	**D**	**C**	**D**	**C**
Cocconeis placentula Ehr.													**B**						**C**	
Cymatopleura elliptica (Breb.) W. Smith						**B**														
Cymatopleura solea (Breb.) W. Smith					**A**						**C**								**C**	
Cymbella cymbiformis C.Agardh						**A**					**B**	**B**				**B**				
Denticula tenuis Kütz.							**C**													
Gomphonema olivaceum (Horn.)Kütz.							**A**				**B**					**C**	**C**			
Gyrosigma attenuatum (Kütz.) Rabh.						**C**					**C**									
Navicula cryptocephala Kütz.																	**B**			
Nitzschia linearis W. Smith			**A**			**B**														
Nitzschia sigmoidea (Nitz.) W. Smith			**B**	**C**	**B**	**D**			**B**	**C**	**C**	**C**				**B**				**B**
Rhoicosphenia abbreviata (C.Ag.) Lange-Bertalot																				**B**
Surirella robusta Ehr.														**B**		**C**				
Surirella spiralis Kütz.				**C**																
Synedra ulna (Nitz.) Ehr.				**D**	**B**		**B**		**C**			**D**	**C**		**C**		**A**	**B**		**D**
Chlorophyta																				
Cladophora sp.						**A**					**C**		**C**		**A**			**C**	**B**	**C**
Closterium lunula Ehrenberg & Hemprich ex Ralfs						**B**					**B**	**C**						**B**		
Dictoysphaerium pulchellum Wood.											**C**									
Pediastrum boryanum (Turp) Meneghini.											**A**					**C**	**B**	**B**	**C**	**C**
Pediastrum duplex Meyen			**C**	**B**							**A**					**C**	**B**	**B**	B	C
Scenedesmus ecornis (Ehr.) Chod.																	**C**			
Spirogyra sp.																	**B**	**A**	**B**	
Spirogyra weberi Kütz.		**C**				**B**	**C**				**D**	**C**				**B**				
Zygnema sp.											**C**	**C**								
Cyanobacteria (=Cyanophytaphyta)																				
Kamptonema formosum (Bory de Saint-Vincent ex Gomont) Strunecký, Komárek & J.Smarda		**E**	**A**			**D**	**E**													
Oscillatoria limosa C.Agardh ex Gomont								**C**		**D**					**B**	**B**	**B**			
Euglenophyta																				
Euglena limnophyla Lemm.				**B**			**B**													

Table 3. Phytoplanktonic taxa and abundance levels according to months**.**

	July					**August**					**September**					**October**				
Taxa / Stations	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Ochrophyta																				
Melosira varians C.A. Ag.														**B**	**B**			**A**	**B**	
Cocconeis pediculus Ehr.			**C**		**C**			**A**					**A**	**B**			**B**		**B**	
Cymatopleura elliptica (Breb.) W. Smith			**B**										**B**	**B**					**B**	
Cymatopleura solea (Breb.) W. Smith	**A**				**B**	**A**						**A**	**A**					**B**		
Cymbella affinis Kütz.		**A**											**A**		**A**			**A**		
Cymbella cymbiformis C. Agardh						**A**														
Encyonema ventricosum (C.Agardh) Grunow in A.Schmidt												**A**	**B**	**B**				**A**		
Denticula tenuis Kütz.													**B**	**A**			**A**	**A**		
Gomphonema olivaceum (Horn.) Kütz.						**A**														
Gyrosigma attenuatum (Kütz.) Rabh.			**A**			**A**					**A**	**A**						**A**		
Meridion circulare (Greville) C.Agardh			**B**																	
Navicula arenaria Donkin										**A**	**A**				**B**			**B**		
Navicula radiosa Kütz.		**B**	**B**				**B**	**A**				**B**		**B**						
Nitzschia sigmoidea (Nitz.) W. Smith		**B**	**C**	**B**	**B**		**A**	**A**					**B**				**B**			
Rhoicosphenia abbreviata (C.Ag.)Lange-Bertalot	**A**		**C**	**B**					**D**			**B**	**B**				**B**			
Synedra ulna (Nitz.) Ehr.		**B**						**B**	**D**				**B**	**C**	**B**	**A**		**C**	**B**	
Chlorophyta																				
Closterium acerosum Ehr. Ex. Ralfs				**B**	**C**					**B**		**A**	**A**	**A**	**A**		**B**	**B**		
Closterium lunula Ehrenberg & Hemprich ex Ralfs				**B**	**B**								**A**		**A**			**B**		
Cosmarium obtusatum (Sch.) Sch.								**B**												
Cosmarium reniforme (Ralfs) Arch.								**B**											**A**	
Hyrodiction sp.		**B**	**A**		**B**															
Pediastrum boryanum (Turp) Meneg.		**A**	**A**	**B**	**B**															
Spirogyra condensata (Vauch) Kütz.						**A**	**A**				**A**			**A**		**A**				
Spirogyra weberi Kütz.	**A**					**A**	**A**				**B**			**B**		**A**				
Cyanobacteria (=Cyanophytaphyta)																				
Kamptonema formosum (Bory de Saint-Vincent ex Gomont) Strunecký, Komárek & J.Smarda											**B**	**A**	**B**	**C**	**C**					
Oscillatoria limosa (Roth) C.A.Ag.	**A**	**B**	**B**	**B**		**A**	**B**	**B**	**B**							**A**	**B**		**C**	
Oscillatoria tenuis C.Agardh ex Gomont	**B**	**A**	**A**	**A**	**A**		**A**	**A**			**B**	**B**	**C**	**D**	**C**		**B**	**C**	**C**	**D**
Euglenophyta																				
Lepocinclis acus (O.F.Müller) Marin & Melkonian		**A**			**B**															

Tablo 4. Phytoplanktonic taxa and abundance levels according to months**.**

	November					December					January					February				
Taxa / Stations	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Ochrophyta																				
Amphora ovalis (Kütz) Kütz.	**A**					**A**												**A**		
Cocconeis pediculus Ehr.	**B**		**A**					**B**	**B**											
Cymatopleura elliptica (Breb.) W. Smith											**B**									
Cymbella affinis Kütz.											**A**					**A**				
Encyonema ventricosum (C.Agardh) Grunow in A.Schmidt	**A**					**A**														
Gomphonema olivaceum (Horn.)Brebisson	**B**																			
Gyrosigma attenuatum (Kütz.) Rabh.	**A**										**A**									
Melosira varians C. Ag.								**A**	**B**	**A**										
*Craticula cuspidata (*Kütz.)D. Mann		**B**	**B**			**B**	**B**	**A**	**A**		**A**		**A**			**C**	**C**	**B**		
Navicula radiosa Kütz.		**C**	**B**	**B**			**A**	**A**	**B**		**A**	**B**	**A**	**A**	**A**	**C**	**D**	**C**	**B**	**B**
Nitzschia sigmoidea (Nitz.) W. Smith											**A**							**A**	**A**	
Synedra ulna (Nitz.) Ehr.	**B**			**B**	**C**	**B**	**B**	**C**	**C**	**B**		**A**		**A**	**A**	**B**		**A**	**A**	
Divisio: Chlorophyta																				
Closterium acerosum Ehrenberg ex Ralfs	**A**																			
Closterium lunula Ehrenberg & Hemprich ex Ralfs			**C**				**B**													
Closterium parvulum Naegeli			**B**	**B**	**C**	**A**	**A**	**B**												
Cosmarium reniforme (Ralfs) Arch.					**B**															
Spirogyra condensata (Vauch) Kütz.					**A**															
Spirogyra sp.		**A**		**A**							**A**	**A**								
Spirogyra weberi Kütz.	**B**	**B**		**B**																
Zygnema sp.											**A**									
Cyanobacteria (=Cyanophytaphyta)																				
Kamptonema formosum (Bory de Saint-Vincent ex Gomont) Strunecký, Komárek & J.Smarda	**B**	**C**	**D**	**C**	**C**	**B**	**C**	**B**	**B**		**B**	**A**	**A**			**B**	**B**	**B**	**A**	**A**
Oscillatoria limosa (Roth) C.A.Ag.																**A**	**A**			
Euglenophyta																				
Euglena limnophyla Lemm.		**C**		**B**		**A**										**A**	**A**			

DISCUSSION

In the stations chosen in Kovada Channel, average annual water temperature was 14.5 °C, pH 7.9, dissolved oxygen 6.3 mgL^{-1}, conductivity 370.7 µmhos/cm, organic substance 18.8 mgL^{-1}, total hardness 22.4 mgL^{-1}, carbonate 11.6 mgL^{-1}, bicarbonate 234.5 mgL^{-1}, sulfate 9.8 mgL^{-1}, nitrate 2.0 mgL^{-1} and phosphate was 0.3 mgL^{-1}. Values determined about water quality show similarities with the studies conducted in Kovada Channel previously and values determined in water systems in the region as well (Atay1996, Karasahin 1998, Yuce 1999). According to our measurements in the Channel, average pH value is mildly basic with pH 7.9 (6.0 – 9.5) value. Our findings are also appropriate to pH and the presence of carbon dioxide in water environment. Dissolved oxygen value was determined to be on the average 6.3 (0.08-12.3) mgL^{-1}. It was found that organic material in the Channel was on the average 18.8 mgL^{-1}, and this value changed between 7.2 - 46.8 mgL^{-1}. High level of organic material in water systems is an indication that the said environment is polluted (Yıldız 1984).

43 taxa were determined in algological findings, 23 belonging to Bacillarophyta, 15 belonging to Chlorophyta, 3 belonging to Cyanophyta, and 2 belonging to Euglenophyta. Although abundance rates of the taxa *Cocconeis pediculus, Navicula radiosa, Nitzschia sigmoidea, Rhoicosphenia abbreviata, Synedra ulna, Kamptonema formosum , Oscilatoria limosa, O. tenuis, Spirogyra. weberi,* change according to months and the

stations in Kovada Channel phytoplankton, it was determined that *Kamptonema formosum* was the most abundant, and other taxa were determined in abundant rates. Among the determined taxa, *Kamptonema formosum*, which is a pollution indicator, was found in abundance especially in the 2nd station. When abundance rates are examined roughly, *S. ulna* taxon, which is a pollution indicator, was determined in the 2nd, 4th and 5th stations, and taxa belonging to *Oscillatoria* was shown to have a distribution abundantly in all stations in general. In the 1st station, *N. sigmoidea* and *S. weberi* taxa were abundant, and it was deduced that pollution level was at a lower level in comparison to other stations when compared with the other stations. When algological characteristics of the Channel are evaluated generally; there was similarity in the studies conducted in fresh water ecosystems in this country (Morkoyunlu and Ertan 1995, Morkoyunlu et.al 1996, Gonulol 1996, Turna *et al.* 1998,Yildiz 1984, Karasahin 1998, Yuce 1999).

Based on the research conducted on water quality and algological structure in Kovada Channel; Channel water is included in highly polluted (4th quality) water class. Algological structure also supports this result. Although the pollution in the water system is effective on water creature species which are distributed in this area especially, it also generates disadvantage for health of humans and animals that are present in the environment. In this context, it is considered that measurements and applications to be taken in the scope of environmental effect evaluation regulation and water pollution and control regulations are required for a sustainable water ecosystem, and these measurements should be implemented for the Channel.

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