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A STUDY ON THE ALGAE IN THE SHATT AL-ARAB ESTUARY, SOUTHERN IRAQ

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ABSTRACT

A study was made on the algal communities in the Shatt Al-Arab estuary and five of its major side canals south of Basrah city centre. The phytoplankton community was dominated by diatoms. Most of the taxa were of benthic origin. Among six macrophytes studied, *Ceratophyllum demersum* showed the highest number of epiphytic taxa. The chlorophyll a content and primary productivity of the canals were 2-3 folds that of the estuary.

INTRODUCTION

The rivers Tigris and Euphrates join together at Garmat Ali to form the Shatt Al-Arab estuary. The estuary runs for about km and empty into the Arabian Gulf. There are several hundred canals on either side of the estuary. These canals are the major source of its back water. Some of these canals which run through the centre of Basrah city are highly polluted and carry the untreated sewage and industrial effluents of Basrah city into the estuary. Most of the canals, however, run through dense plantation of date palms and carry into the estuary the agricultural and industrial wastes. On the beds of these canals and in the shallow parts of the estuary there are large numbers of aquatic plants along with epiphytic and other algae. The environmental background of the area was given by (Hadi et al., 1984; Al-Mousawi et al., 1986).

Several studies have been made on the Shatt Al-Arab estuary during the last ten years. Most of these studies were focused on the physico-chemical properties, ecology of phytoplankton and pollution (Mohammed, 1965; Arndt and Al-Saadi, 1975; Huq et al., 1978; Al-Saadi et al., 1979 ; Al-Saadi & Antoine, 1981). Algal communities of the estuary , however , received little attention. The diatoms from different habitats in the main stretch of the Shatt Al-Arab estuary was studied by Hadi et al. (1984). Hadi & Al-Saboonchi (in press) studied the seasonal succession of algae in one station in the Shatt Al-Arab estuary at Basrah city. Islam & Hameed (1982) gave some information on the epizoic algae in the Shatt Al-Arab estuary. Islam & Haroon (1983) studied Chaetophoraceae in southern Iraq including the Shatt Al-Arab estuary. Few publications were available on the algae of the canals. Most of these publications were about the phytoplankton of four highly polluted canals (Al-Saadi et al., 1979; Antoine & Al-Saadi,1982; Antoine, 1983). No information so far available on the algae of the majority of the canals.

The present study was planned with the following aims :

1. To get some information, for the first time, about the algae of Seragi, Mehejran, Hamdan, Al-Yahoadi and Abu-Mughira canals.

2. To show the relationship between phytoplankton, epiphytic & epipelic communities in the studied area.

3. To evaluate the contribution of the studied canals to the algal flora and primary productivity of the estuary.

MATERIALS and METHODS

Study Area

Eleven stations were selected in the main stretch of the Shatt Al-Arab estuary and its major canals south of Basrah city centre (Figure 1). The canals about 3 to 4 km long and about 6m wide in the mouth. The canal system connected by a series of subsequent small size ones about 1 m wide and 1.5 m deep. The beds of these canals are muddy and hampered a large number of hydrophilic higher plants along with different types of algae.

Physical and Chemical Factors Measurements

The physical and chemical measurements were made on 7/5/1986. Air and water temperatures were measured by a simple thermometer graduated to 0.1 ^{o}C. Light penetration was estimated using a Sechi disc of 30 cm in diameter. The pH values were measured in situ by a digital portable pH meter (Schatt Gerate Model CG817). The dissolved oxygen content of water samples was determined by the azide modification of the standard Winkler's method as described by Mackereth et al. (1978).

Water samples for chemical analysis, phytoplankton identification and primary productivity measurements were collected in clean polyethylen bottles (ca 4.5 L). Collection was made 10 cm below water surface. Two replicates were used for all treatments except for dissolved oxygen contents where three replicates were used. The total available carbon dioxide were determined according to the method of Golterman et al. (1978) as described by Hadi (1981).Salinity was measured by digital laboratory salinometer (Tsuruni Seiki Model E202) .

Major nutrients measurements were made on samples filtered through GF/C filter paper and as follow :
nitrite-nitrogen following the method of Bendschneider and Robinson (1952), nitrate-nitrogen was determined after reduction to nitrite using a cadmium column as described by Wood et al. (1967). Phosphate-phosphorus was

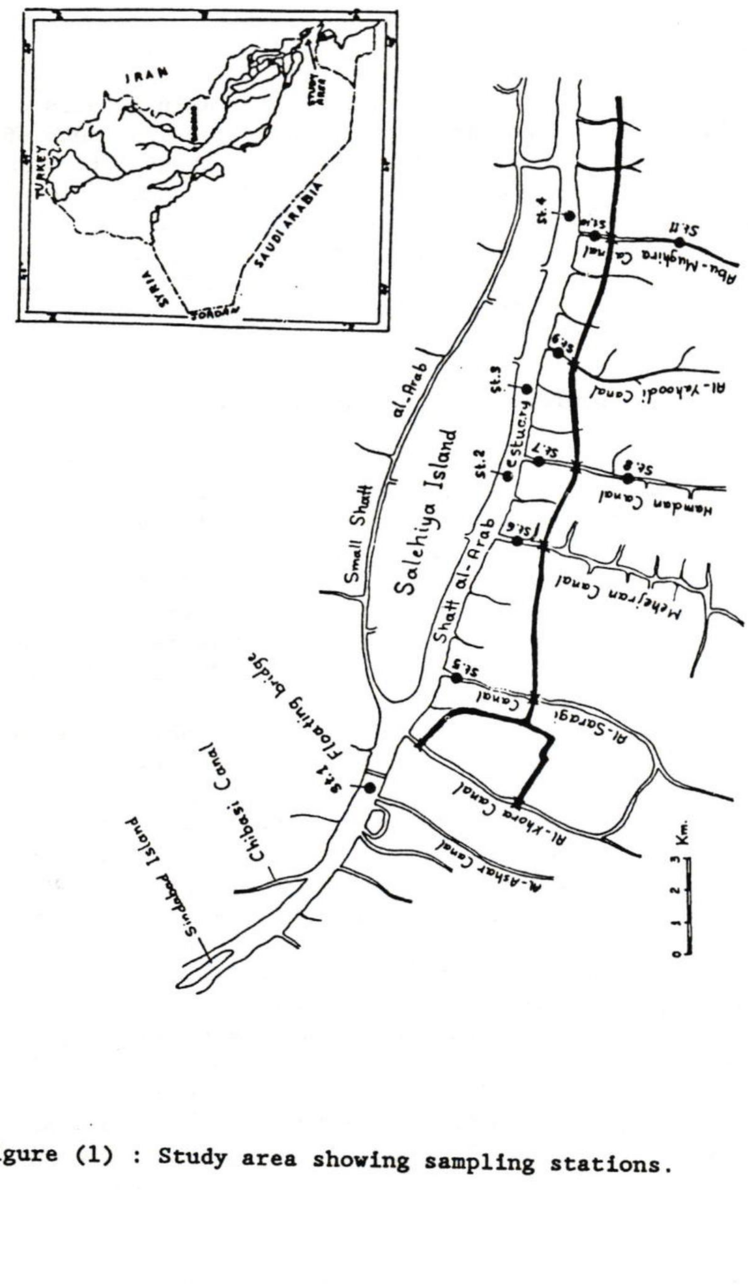

Figure (1) : Study area showing sampling stations.

determined according to Murphy and Riely (1962) method as described by Parsons et al. (1984). Silicate-silicon was determined as described by Parsons et al. (1984). Chlorophyll a was extracted using 90% acetone and calculation was made according to Lorenzenks equations (Vollenweider, 1969).

Phytoplankton

One litre of water sample from each station was used for identification of phytoplankton taxa. Samples were preserved by addition of 10 ml Lugol's solution and concentrated by sedimentation technique.

Epipelic Algae

Samples of epipelic algae were collected from the uppermost 1 cm of the muddy bed of the canals and the estuary bank and treated as described by Eaton and Moss (1966).

Epiphytic Algae

Samples from six most abundant aquatic plants were collected for the study of epiphytic algae. A number of branches from each plant were cut into small pieces and four grams was taken at random. Epiphytic algae were removed by a combination of shaking and sonication method of bell (1976).

Identification of algal taxa other than diatoms were made according to Smith (1950); Prescott (1962, 1976) ; Desikachary (1959) and the published works on Iraqi algal flora (See Islam & Hameed, 1985 for references).

Diatoms were cleared using concentrated nitric acid and fixed in naphrax. Identification was made at 100x magnification. The literature used for identification was given by Hadi et al. (1984).

Primary Productivity

Primary productivity was measured by the ^{14}C method. 4 uCi $NaH^{14}CO_3$ per 100 ml water sample incubated for two hours. Simulated *in situ* technique was made using artificial light incubator (supplied by carbon 14 centralen. The Danish Academy of Technical Sciences , Denmark) at 20 °C and 400 lux. After incubation, samples were filtered and dried over silica gel in a desiccator over concentrated hydrochloric acid. The radioactivity was measured by the Liquid Scintillation Counter (Philips LSC PW 4700). Calculations were carried out as described by Hadi (1981).

RESULTS and DISCUSSION

Physico - Chemical Parameter

The physical and chemical data for studied stations are given in Table (1). Little differences can be seen in water temperature between stations. Differences in air temperature between stations are due to time of measurements. Secchi disc readings ranged from 80 - 112.5 cm. It is generally higher in stations of the Shatt Al-Arab (stations 1,2,3 & 4) than stations of the canals. This is likely due to the high content of suspended matters (including phytoplankton) in the water of the canals. The high Chl. *a* content of canal's stations support the above assumption. The pH values for all stations lie in alkaline side and in agreement with previous studied in the Shatt Al-Arab and most of southern Iraqi ecosystems (Arndt & Al-Saadi, 1975 ; Huq et al., 1978; Maulood et al., 1979 and Al-Mousawi et al., 1986). The concentration of dissolved oxygen ranged from 5.6 to 8.16 mgl^{-1}. The values are generally higher in the stations of the estuary than stations of canals. Non of the readings reached the critical values of 4 mgl^{-1} stated by Hynes (1974) as an indicator of polluted water. The total available carbon dioxide content ranged from 61.82 to 102.96 mgl^{-1}.The contents of canal's station are

Table (1) : Physical and chemical data for studied stations in the Shatt Al-Arab estuary and its major canals south of Basrah city centre.

	Stations										
	1	2	3	4	5	6	7	8	9	10	11
Temperature (^oC)											
Air	31.50	32.40	33.40	24.20	34.00	31.40	33.00	32.80	28.70	25.20	27.40
Water	26.00	26.40	26.00	25.00	26.00	25.50	25.20	25.60	25.25	25.00	25.00
pH	7.75	7.74	7.69	7.87	7.85	7.65	7.65	7.60	7.68	7.71	7.68
Secchi disc readings (cm)	98.00	112.50	95.00	85.00	92.00	105.00	80.00	80.00	77.00	85.00	102.00
Dissolved oxygen (mgl^{-1})	6.08	6.34	6.24	8.16	7.66	6.50	6.02	6.13	5.60	5.76	6.13
Dissolved oxygen (% saturation)	74.89	78.76	76.85	98.79	94.33	79.37	72.88	74.85	68.38	69.33	74.21
Total available CO_2 (mgl^{-1})	80.74	61.82	65.45	93.06	74.80	86.24	83.60	102.96	85.25	88.33	97.68
NO_2 - N umol l^{-1}	0.16	0.22	0.15	0.16	0.20	0.20	0.24	0.14	0.21	0.20	0.13
NO_3 - N umol l^{-1}	1.44	2.00	1.89	2.24	0.74	0.96	0.95	0.37	0.57	1.54	0.63
PO_4 - N umol l^{-1}	0.41	0.41	0.52	0.61	0.52	0.45	0.44	0.34	0.58	0.45	0.50
SiO_2-Si umol l^{-1}	47.11	67.40	69.54	73.55	36.91	56.24	63.91	53.61	78.35	86.30	61.10
Salinity (%.)	1.56	1.60	1.58	1.63	1.92	1.92	2.23	2.61	2.10	1.89	2.34
Chlorophyll a (gm m^{-3})	1.34	1.70	1.70	1.43	3.83	4.52	5.10	6.58	6.51	4.52	5.89
Primary productivity (mg C $m^{-3}h^{-1}$)	24.77	52.77	29.03	28.57	57.66	63.76	62.47	102.48	87.19	41.24	78.18

higher than that of estuary stations except station 4. The high content of canal's stations is likely due to the decomposition of organic matter of aquatic plants and those falling from trees growing on either side of the canals.

Nitrite values were low and showed little variations between stations. Nitrate values were much higher than nitrite in all stations. Nitrate values in the Shatt Al-Arab were higher than those of the canals. The values of nitrate found in the present study were, generally, lower than those recorded by Maulood et al. (1979); Al-Saadi & Antoine (1981); Antoine & Al-Saadi (1982) and Hadi et al. (in press). The results, however, are similar to those reported by Al-Asadi (1983) for the Shatt Al-Arab estuary. The phosphate concentrations ranged from 0.41 to 0.61 umol l^{-1} in the Shatt Al-Arab and from 0.34 to 0.58 umol l^{-1} in the canals. The silicate concentrations are variable and ranged from 36.91 to 86.30 umol l^{-1} . The major source of phosphate and silicate in the studied stations is the sewage disposal (including disposal of detergents). Another source may be the agricultural runoff (Casey and Newton, 1974 ; Wilson et al. 1975 ; Al-Asadi, 1973; Antoine,- 1983 and Al-Mousawi et al., 1986). The values of salinity ranged from 1.59 to 1.63% in the Shatt Al-Arab and from 1.89 to 2.61% in the canals. The values of the Shatt Al-Arab estuary are similar to those reported by Al-Mousawi et al. (1986) and Hadi et al. (in press) but higher than those reported by Huq et al. (1978) and Maulood et al. (1979) indicating a gradual increase in the salinity of the estuary during the last years. The salinity of the canals although higher than those of the estuary but lower than those of polluted canals (Hadi et al., in press).

The values of chlorophyll a ranged from 1.34 to 1.70 mg m^{-3} in the Shatt Al-Arab estuary and from 3.83 to 6.58 mg m^{-3} in the canals. The results of the Shatt Al-Arab estuary are within the range given by Hameed (1977); Al-Issa (1981) and Al-Asadi (1983), but higher than those reported by Hadi et al. (in press). On the other hand , the values of the canals although higher than those of the estuary but much lower than those of polluted canals

(Al-Issa, 1981; Antoine, 1983; Al-Asadi, 1983 and Hadi et al. , in press).

The results of primary productivity ranged from 24.77 to 52.77 $mgCm^{-3}h^{-1}$ in the Shatt Al-Arab and from 41.24 to 102.48 $mgCm^{-3}h^{-1}$ in the canals. The values of the Shatt Al-Arab estuary are similar to those given by Hadi et al. (in press) but much higher than those given by Hameed (1977); Schiwer et al. (1982) and Al-Saadi et al. (1989). The obvious differences between the present study and those of Schiewer et al. (1982) and Al-Saadi et al. (1989) is the temperature which was around 12 ^{o}C in the letter studies. Hameed (1977) used oxygen method for the measurement of productivity. The productivity of the canals is much lower than those reported in polluted canals (Schiewer et al., 1982; Antoine, 1983; Al-Saadi & Antoine, 1981 and Hadi et al., in press). The low values of primary productivity of the estuary are in agreement of views of Lewis & Weibezahn (1976).

Algal Communities

A total of 70 taxa were identified during the present study (Table 2). The majority is diatoms (75.77%) especially pennate ones. Second in importance is blue - green algae which comprise 11.42% followed by green algae (7.14%). Red algae, euglenoids and cryptomonads were represented by a single species each. Dinoflagellates were represented by two taxa.

Thirty four taxa were found as benthic (epiphytic and epipelic) and 18 as phytoplankton. The present findings support the fact that in running waters phytoplankton species are mainly benthic in origin (Blum, 1956; Hynes,1970; Whitton, 1975; Hadi, 1981; Anber,1984).

The most obvious feature of the studied canals is the abundance of aquatic macrophytes. Six plants were sampled during the present study and their epiphytes were examined. The results (Table 3) showed that the highest number of taxa was found on *Ceratophyllum demersum* followed by *Cyprus longus*. *Phragmites australis* and *Potamogeton leucens* showed equal number of taxa. The

Table (2) : List of algal taxa identified in the studied stations together with their habitat.

	plankton	epiphytic	epipelic
Cyanophyta			
Anabaena sp.			+
Lyngbya aeruginea-coerulea (Kuetz.) Gem.		+	
L. majuscula Harv.		+	
Lyngbya spp.	+	+	+
Merismopedia glauca (Ehrenb.) Nag.	+		
Oscillatoria jasorvensis Vouk		+	
Oscillatoria spp.	+	+	+
Spirulina major Kuetz.	+		
Rhodophyta			
Compsopogon sp.		+	
Euglenophyta			
Euglena sp.	+		
Cryptophyta			
Cryptomonas sp.	+		
Pyrrophyta			
Ceratium sp.	+		
Peridinium sp.	+		
Bacillariophyta (Centrales)			
Coscinodiscus sp.	+	+	
Cyclotella atomus Hust	+		
C. menenghiniana Kuetz.	+	+	
C. striata (Kuetz.) Grun.	+		
Cyclotella sp.	+		
Melosira sp.		+	
Stephanodiscus sp.			

Cont.

	plankton	epiphytic	epipelic
Bacillaniophyta (Pennales)			
Amphiprora alata Kuetz.	+		
Amphora ovalis Kuetz.			+
A. perpusill Gurn.		+	
Amphora sp.		+	+
Anomoeonies exilis (Kuetz.) Cleve		+	
Bacillaria paradoxa Gmelin	+	+	
Cocconeis placentula var. *suglypta* (Ehr.) Cleve	+	+	+
C. placentula var. *lineata* Cleve		+	
Cymatopleura solea (Breb) W. Smith		+	
Cymbella affinis Kuetz.		+	
C. tumida (Breb) Van Heurek		+	
Denticula rainierensis Sov.			+
Gyrosigma attenuatum (Kuetz.) Rabh.		+	+
G. tenuirostrum (Gurn.) Cleve	+		
Gyrosigma sp.			+
Mastogloia braunii Grun.	+		
M. smithii var. *amphicephala* Grum.		+	+
Navicula inflata (Donk.) Cl.		+	
N. mutica var. *undulata* (Hilse) Grun.		+	
N. parva (Menegh.) Cl.		+	+
N. rhyncocephala Kuetz.			+
N. viridula var. *rostellata* (Kuetz.) Cleve		+	
Navicula spp.	+	+	+
Nitzschia apiculata (Greg.) Grun.		+	
N. fasciculata Grun.		+	+
N. filiformis (W.Sm.) Hust.		+	

Cont.

	plankton	epiphytic	epipelic
N. fonticola Grun.	+		
N. frustulum var. *perminute* Grun.	+		
N. granulata Grun.			+
N. hungarica Grun.			+
N. hustediana Salah		+	+
N. longissima (Breb) Ralfs	+		
N. microcephala Grun.		+	+
N. obtusa W. Smith		+	
N. palea (Kuetz.) W. Smith	+	+	+
N. punctata var. *coartctata* Grun.	+	+	
N. sigma (Kuetz.) W. Smith	+	+	+
N. sigmoidea (Ehr.) W. Smith		+	
N. tryblionella var. *victoriae* Grun.		+	
Pleurosigma delicatulum Grun.	+		
P. salinarum Grun.		+	
Rhoicosphenia curvata (Kuetz.) Grun.		+	+
Synedra pulchella Kuetz.		+	
S. ulna (Nitz.) Ehr.		+	
Surirella ovata Kuetz.		+	+
Chlorophyta			
Oedogonium sp.		+	
Rhodomonas ldcustris var. *nannoplanktonica* Pascher	+		
Scenedesmus bijuga (Turp.) Lagerheim		+	
S. quadricauda (Turp.) de Brebisson	+		
Stigeoclonium sp.		+	
Total	27	44	22

Table (3) : Epiphytic algae recorded at the studied stations.

	Ceratophyllum demersum	*Cyprus longus*	*Phragmites australis*	*Potamogeton crispus*	*Potamogeton leucens*	*Vallisneria spiralis*
Cyanophyta						
Lyngbya aeruginea-coerulea	+	+				
L. majuscula			+			
Lyngbya sp.	+	+	+	+	+	+
Oscillatoria jasorvensis	+			+		+
Rhodophyta						
Compsopogon sp.		+				
Bacillariophyta (Centrales)						
Coscinodiscus sp.		+		+		
Cyclotella menenghiniana	+				+	
Melosira sp.	+			+		
Stephanodiscus sp.	+	+		+	+	+
Bacillaniophyta (Pennales)						
Amphora perpusill					+	
Amphora sp.	+	+		+		+
Anomoeonies exilis	+					
Bacillaria paradoxa	+	+	+			
Cocconeis placentula var. *suglypta*	+	+	+	+	+	+
C. placentula var. *lineata*	+		+	+	+	+
Cymbella affinis			+			
C. tumida				+		

Cont.

	Ceratophyllum demersum	*Cyprus longus*	*Phragmites australis*	*Potamogeton crispus*	*Potamogeton leucens*	*Vallisneria spiralis*
Gyrosigma tenuirostrum	+					
Mastogloia smithii var. *amphicephala*	+					
Navicula inflata				+	+	
N. mutica var. *undulata*	+	+	+			
N. parva	+	+	+	+	+	+
N. viridula var. *rostellata*		+				
Navicula spp.	+	+	+	+	+	+
Nitzschia apiculata				+		
N. fasciculata		+	+			
N. filiformis			+			
N. hustediana	+	+				
N. microcephala	+	+	+	+	+	+
N. obtusa	+					
N. palea	+	+	+	+	+	+
N. punctata var. *coartctata*	+					
N. sigma	+		+		+	+
N. tryblionella var. *victoriae*				+		
Pleurosigma delicatulum	+					
Rhoicosphenia curvata	+	+	+	+	+	+
Synedra pulchella	+					
S. ulna	+	+	+	+	+	+
Surirella sp.					+	
Chlorophyta						
Oedogonium sp.	+					
Scenedesmus bijugatus	+	+	+			
Stigeoclonium sp.			+			
Total	28	19	18	18	15	13

lowest number was found on *Vallisneria spiralis*. The relationship between periphyton and their host macrophytes is poorly understood (Morin & Kimbell, 1983) Hynes (1970) stated that different species of macrophytes are very differently colonized by epiphytes and that different parts of the same plant offer different qualities of surface for colonization. The identified 70 species throughout this study may well be extended in future to much more species if more sample are studies on epiphytic algae in Iraq is rather limited. Maulood et al. (1981) mentioned that the most obvious features of algal communities in southern marshes of Iraq is the abundance of epiphytes. Hadi & Al-Saboonchi (in press) found 45 taxa on *Ceratophyllum demersum* in the Shatt Al-Arab estuary at Basrah city. They found that the diatoms form the main bulk of the algal flora (over 80%).Kassim (1986) recorded 125 species as epipelic and 150 species as epiphytic in some marshes areas in southern Iraq.

The present study showed that the studied canals has little effect on the primary productivity of the Shatt Al-Arab estuary but may contribute largely for its algal flora.

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دراسه عن الطحالب في مصب شط العرب ، جنوب العراق

المستخلص

جرت دراسة عن المجاميع الطحلبية في مصب شط العرب وخمسة من قنواته الرئيسية جنوب مركز مدينة البصرة. سادت الدايتومات مجموعة العوالق النباتية وكانت اغلب العوالق ذات منشأ قاعي. ومن بين ستة نباتات راقية درست، اظهر النبات Ceratophyllum demersum اعلى عدد من الطحالب الملتصقة. وكانت قيم كلوروفيل ا والانتاجية الاولية في القنوات المدروسة بين ٢-٣ اضعاف القيم التي سجلت في المصب.