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PHYTOPLANKTON IN AN AREA OF MULTI-POLLUTING FACTORS WEST OF ALEXANDRIA, EGYPT

By

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ABSTRACT

A year cycle of phytoplankton community in polluted inshore area of the Egyptian Mediterranean water, west of Alexandria, was followed. Seasonal and regional variations of the physico-chemical characteristics were studied and correlated with the variations of the species composition and biomass of the phytoplankton.

The study indicated the high level of eutrophication, domestic and industrial pollution of the study area. Several species were recorded as ecological or hydrological indicators. The phytoplankton standing crop was significantly low compared to other areas of the Mediterreanean Sea.

INTRODUCTION

Phytoplankton population in the Egyptian Mediterranean waters off Alexandria has attracted the attention of several authors (El-Maghraby & Halim 1965, Dowidar 1965, Aleem & Dowidar 1967, Hassan 1972, Halim *et al* 1980 and Dowidar 1984). Most of these studies were concerned with the qualitative and quantitative structures of the different phytoplankton components in the offshore waters and/or the Eastern Harbour of Alexandria (EH). The previous observations covered year cycles without tackling the problem of pollution in the area and its impact on the phytoplankton. However, Halim *et al* (1980a) followed the species composition and standing crop of the planktonic and benthic diatoms over a year in the EH as an eutrophic bay.

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The present work traces the temporal and spatial distribution of the phytoplankton communities and their biomass in a very inshore water affected directly by different land-based effluents. Such effluents are loaded with variable types and quantities of pollutants (Aboul-Dahab *et al* 1984 and El-Rayis *et al* 1984).

The Site

The study area is the western part of Alexandria coastal waters. It extends about 15 km between the EH to the east and Agami headland to the west (Fig. 1). The width of the area was limited by 15m depth perpendicular to the shore line. The investigated area is topographically undividable, but its water could be actually distinguished into 3 regions: Al-Anfoushi, Al-Mex and Agami. Such division is based on the difference in the water quality of the three regions.

Al-Anfoushi and Al-Mex regions receive great volumes of waste waters disposed from different sources. In Al-Anfoushi region,the main sewer of Alexandria City discharges an average of 170,000 m^3 day^{-1} of domestic wastes. Al-Mex region, on the other hand, is subjected to several sources of wastes. A huge volume of brackish water ($7.7X10^6$ m^3 day^{-1}) is discharged through Umoum drain from the neighbouring Lake Maryout. These waters are loaded with industrial, agricultural and domestic wastes. In its western side, Al-Mex Bay receives directly industrial wastes from chloro-alkali plant and other wastes from tanneries and slaughterhouse. According to El-Rayis *et* al (1984) the load of mercury on the suspended particles in the effluent of Umoum drain was $38\mu g$ g^{-1}, while that of chloro-alkali plant was $660\mu g$ g^{-1}. The same authors recorded $234\mu g$ Hg in kg of the mixed plankton from Al-Mex Bay. Other trace metals (Cu, Pb, Cd & Zn) were detected significantly by Aboul-Dahab *et al* (1984) in this Bay. On the other hand, Agami region was more or less far from the effect of the above mentioned sources of pollution. However, the wastes somtimes reach the Agami waters under the action of the wind and current.

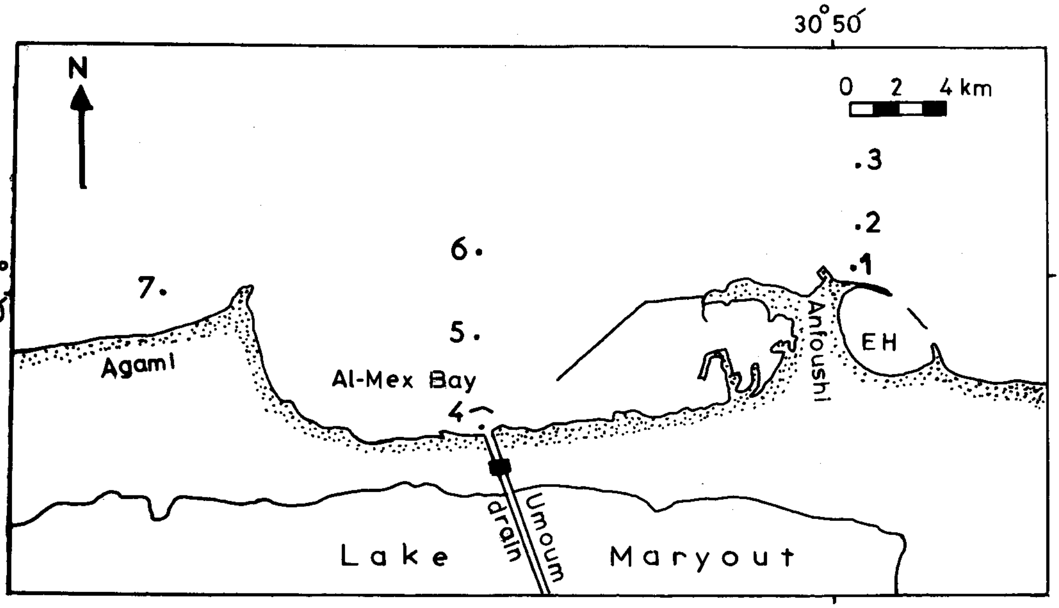

Fig. 1 : The study area and locations of the sampling stations.

MATERIALS AND METHODS

Throughout the period from October 1982 to August 1983 bimonthly samples were collected from 7 stations for the study of the physico-chemical parameters and phytoplankton. Sampling stations were arranged in three sections: Al-Anfoushi (Sts.1, 2 & 3), Al-Mex (Sts. 4, 5 & 6) and Agami (St. 7) (Fig. 1). Temperature, salinity, BOD and nutrients (NH_4^+, NO_2^- + NO_3^- & PO_4^{-3}) were measured in samples from the surface water.

Salinity was measured by the salinometer. BOD was determined according to Anonymous (1982). Nutrients were analysed according to Grasshoff (1976).

Qualitative samples of phytoplankton were collected by hauling a fine net of 60 μm mesh size in the uppermost 50 cm of sea water. Quantitative samples were collected from the surface water by Niskin's bottle. The qualitative samples of the phytoplankton were examined under the research microscope and the species of the different groups were identified according to the following references: Van Heurck (1896), Lebour (1925), Geitler (1932), Smith (1933), Hustedt (1930–1966), Cupp (1943), Kisselev (1950),Massuti and Margalef (1950), Tregouboff and Rose (1957), Hendey (1964), Shirota (1966), Sournia (1967 & 1968), Taylor (1976), Rampi and Bernard (1980), Dodge (1982), and Dowidar (1983). Cell count was carried out by Utermohl method (1936) and chlorophyll extraction and measurement according to Strickland and Parsons (1969).

RESULTS AND DISCUSSION

A. Physico-chemical parameters

The different land-based effluents in the study area showed significant impact on its physical and chemical characteristics. The variations in these characteristics were related to the seasonal variations and to the quantities of the discharged wastes.

The temperature of the surface water showed wide seasonal variations. The winter minimum was 14°C (February) and the summer maximum 28°C was in August. However, the maximal magnitude of the regional variations was 1.5°C (Table 1).

Table 1

Seasonal variations of temperature, salinity and BOD (ranges) in the study area.

	Al-Anfoushi	Al-Mex	Agami
		Temperature (°C)	
Autumn	25.0–25.5	25.5–26.5	26.0
Winter	14.0–19.0	15.0–17.5	16.5–18.5
Spring	20.0–25.5	19.0–23.5	19.0–23.5
Summer	27.0–27.5	27.0–28.0	28.0
		Salinity (%o)	
Autumn	36.08–39.33	5.20–37.35	39.50
Winter	35.48–39.44	12.27–29.57	38.81
Spring	35.38–38.95	5.45–38.44	35.94–36.92
Summer	36.79–36.96	4.78–35.31	38.85
		BOD ($mg\,O_2\,l^{-1}$)	
Autumn	4.04–9.66	5.92–15.92	1.85
Winter	3.70–17.04	3.70–14.44	2.60–4.08
Spring	4.07–11.85	5.55–18.88	2.59–4.44
Summer	10.37–10.74	4.07–9.63	0.74

The surface salinity was subjected to significant seasonal and regional variations. At Al–Anfoushi section, the lowest salinity was always observed near the outfall of the domestic wastes (St. 1). The regional amplitudes of the salinity variations in this section was nearly the same in winter, spring and autum (3.25 – 3.96%o), while in summer it was significantly lower (0.17%o). In Al–Mex Bay, salinity increased also seawards but with very large magnitude. The lowest difference between the inshore and offshore salinities (17.30%o) was detected in winter, whilst in other seasons such difference ranged from 30.53 to 32.99%o (Table 1). The salinity of Agami water was subject to moderate seasonal variations, which were mainly related to the extent of the brackish water outflow through Umoum drain.

The BOD level in the study area indicated the occurrence of high concentration of organic matter, particularly in Al–Anfoushi and Al–Mex regions. Al–Anfoushi water was chararerized by the highest values of BOD during winter and summer, but these values were observed in Al–Mex Bay in spring and autum. Agami water showed the lowest values of BOD all the year round (Table 1). Regional distribution of BOD pointed to the high values at St. 1 polluted with the domestic wastes compared to other stations in Al–Anfoushi region. In Al–Mex Bay,the great values of BOD were often observed at offshore St. 6 and sometimes at St. 5. Seasonal and regional variations in the concentration of the organic matter, detected by BOD, were attributed to similar variations in the quantities of the waste water discharged to the area.

As shown in Figures 2 and 3 the concentrations of nutrient salts were exceptionally high in the investigated area indicating the eutrophication conditions.

Seasonal and regional variations of ammonia were highly significant. The maximum value (92.69 μg at ℓ^{-1}) was detected during spring in Al–Anfoushi and it was about 4 times that recorded in Al–Mex water (21.5 μg at ℓ^{-1}) during the same season. Except in winter, the level of ammonia in Al–Anfoushi water was always obviously higher than in Al–Mex and Agami waters. This may be related to the high ammonia content in the domestic waste at Al–Anfoushi. On the other hand, agami water was often characterized by the lowest content of ammonia among the three regions.

Regional ditribution of nitrate and nitrite showed that Al–Mex water contained the highest concentrations over the year, which were 2–30 times that in other two regions. The magnitude of variations vibrated very widely seasonally and regionally. Such situation was attributed to the great quantities of nitrate and nitrite transported to Al-Mex Bay from Lake Maryout.

Regarding the phosphate content, Al-Anfoushi water was the richest attaining its maximum in winter. The lowest phosphate in both Al-Anfoushi and Al-Mex regions were detected in summer. Agami water showed lower phosphate content than in the other two regions (Fig.2).

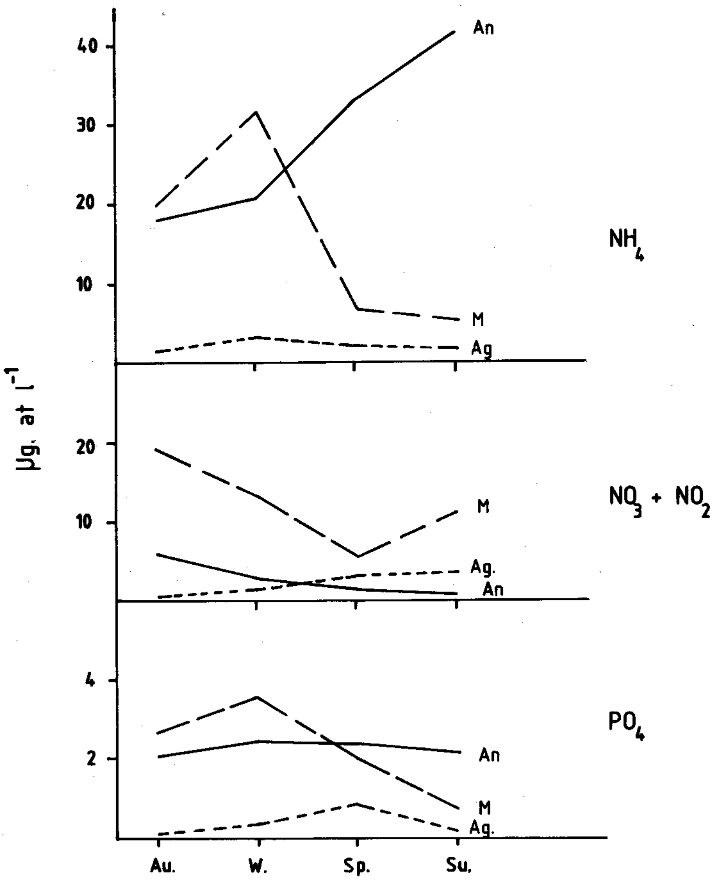

Fig. 2 : Seasonal variations of the nutrients at different regions of the investigated area.

(Sp. = Spring, Su. = Summer, Au. = Autumn, W = Winter)

(An. = Anfoushi, M = Mex, Ag. = Agami)

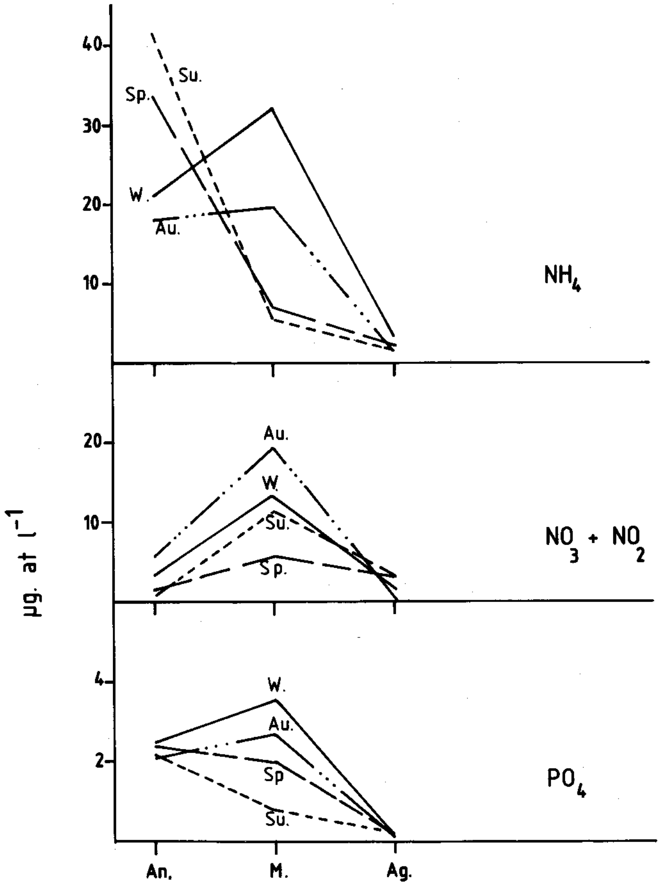

Fig. 3: Regional variations of the nutrients in different seasons.

(Sp. = Spring, Su. = Summer, Au. = Autumn, W = Winter)

(An. = Anfoushi, M = Mex, Ag. = Agami)

B. Phytoplankton

i. Species composition

Phytoplankton community was composed of 275 taxa belonging to Diatoms, Dinoflagellates, Silicoflagellates, Cyanophyceae, Euglenophyceae and Chlorophyceae. Diatoms formed 50–71% by the species number over the year and dinoflagellates 25–34%. Seasonal variations in the community structure showed significant diversity of species in winter and spring compared to summer and autum (Table 2). The fresh water forms were mostly limited in their occurrence by the low salinity water near the outlets.

Table 2

Seasonal fluctuation in the species number of phytoplankton groups.

Area	Winter			Spring			Summe r			Autumn		
	Diat.	Dinof.	FW	Diat.	Dinof.	FW	Diat.	Dinof.	FW	Diat.	Dinof.	FW
Al-Anfoushi	70	42	7	46	26	8	43	34	7	30	17	-
Al-Mex	57	18	34	80	29	26	46	28	22	43	11	3
Agami	41	14	6	30	18	6	23	19	4	19	11	-
Total	94	49	35	93	44	27	66	46	23	64	23	3

As shown in Table 3, 38.5% of the recorded diatom species were represented by 4 genera, while 56.5% of dinoflagellates belong to 2 genera only. The fresh water species were dominated by the blue-green genus *Oscillatoria* and the green genera *Scenedesmus* and *Closterium.*

Table 3

Number of species belonging to the important genera of the phytoplankton groups.

Parameter	Diatoms	Dinoflagellates	FW
Total No.	146 sp.	85 sp.	44 sp.
Important Genera	*Chaetoceros* (23 sp.)	*Ceratium* (25 sp.)	*Oscillatoria* (5 sp.)
	Biddulphia (11 sp.)	*Protoperidinium* (23 sp.)	*Scenedesmus* (8 sp.)
	Rhizosolenia (13 sp.)		*Closterium* (5 sp.)
	Nitzschia (9 sp.)		

Table 4 shows that 31 phytoplankton species were persistent in the 3 regions and 50 species were recorded in sporadic seasons as common to the whole area. However, significant number of species were observed to be restricted to each region.

Table 4

Seasonal variations of the phytoplankton species in the different regions of the investigated area.

Species	Autumn			Winter			Spring			Summer		
Diatoms:	**An**	**M**	**Ag**	**An**	**M**	**Ag**	**An**	**M**	**Ag**	**An**	**M**	**Ag**
Achnanthes brevipes	–	–	–	–	–	–	–	+	–	–	–	–
A. longipes	–	–	–	+	–	+	–	–	–	–	–	–
Actinoptychus ehrenbergii	–	–	–	+	+	–	–	–	–	–	–	–
A. splendens	–	–	–	–	–	–	–	+	–	–	–	–
Amphiprora gigantia	–	–	–	–	+	+	–	+	–	+	+	+
Amphora hyalina	–	–	+	–	–	–	–	–	–	–	–	–
A. ovalis	–	–	–	–	–	+	–	–	–	–	–	–
A. turgida	–	–	–	–	–	–	–	–	+	+	–	–
A. sp.	+	+	–	+	–	–	+	–	+	+	–	–
Asterionella japonica	+	+	–	+	+	–	–	+	–	–	–	–
Bacillaria paxilifer	–	–	–	–	+	+	–	+	–	–	+	–
Bacteriastrum delicatulum	–	–	–	+	+	–	–	+	–	–	–	–
B. hyalinum	–	–	–	+	+	–	–	–	–	–	–	–
Bellerochea malleus	+	–	–	–	–	–	+	–	–	+	+	–
Biddulphia alternans	–	–	–	+	+	+	–	–	–	+	–	–
B. antideluvianum	+	–	–	–	–	–	–	–	–	+	–	–
B. aurita	–	+	–	–	–	–	+	–	–	+	–	–
B. dubia	–	+	–	–	–	–	–	–	–	–	–	–
B. laevis	–	+	+	–	–	–	–	+	–	+	–	–
B. longicruris	–	–	–	+	+	+	–	–	–	–	–	–
B. mobiliensis	–	–	+	+	+	+	–	+	+	–	–	–
B. obtusa	–	–	–	+	–	–	–	–	–	–	–	–
B. pulchella	–	–	–	–	+	–	–	–	–	–	–	–
B. sinensis	–	–	–	+	+	+	+	+	+	–	+	–
B. thuomeyi	–	–	–	–	–	–	+	–	+	–	–	–
Campylodiscus echeneis	–	–	–	–	–	+	–	–	–	–	–	–
Cerataulina pelagica	–	+	–	+	+	–	–	–	–	+	+	–
Chaetoceros affine	+	+	–	+	+	+	–	+	–	+	+	+
Ch. breve	–	+	–	+	+	+	+	+	+	+	+	–
Ch. compressum	+	+	–	–	+	–	–	+	–	–	–	–
Ch. constrictum	+	–	–	–	–	–	+	–	–	+	+	–
Ch. convulatum	–	–	+	–	–	–	+	–	–	–	–	–
Ch. costatum	–	–	+	+	+	–	–	–	–	–	–	–
Ch. crinitum	–	–	–	+	+	–	–	–	–	–	–	–
Ch. curvisetum	–	–	–	+	+	+	+	+	+	–	–	–
Ch. danicum	–	+	–	–	–	–	+	+	–	–	–	–
Ch. decipiens	+	+	–	+	+	+	+	+	+	+	+	+
Ch. didymum	–	–	–	+	+	–	–	+	–	–	–	–
Ch. diversum	–	–	–	+	–	–	–	–	–	–	–	–
Ch. fragile	–	–	–	+	–	–	–	–	–	–	–	–

An = Anfoushi , M = Mex , Ag = Agami + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
Ch. gracile	–	+	–	–	–	–	–	+	–	–	–	–
Ch. holsaticum	–	–	–	+	–	–	–	–	–	–	–	–
Ch. lauderi	–	–	–	–	+	–	–	+	–	–	–	–
Ch. lorenzianum	–	–	–	+	–	+	–	–	–	+	+	–
Ch. mitra	–	–	–	+	–	–	–	–	–	–	–	–
Ch. rostratum	–	–	–	–	–	–	+	–	–	–	–	–
Ch. simplex	+	–	–	–	+	–	–	–	–	+	+	–
Ch. sociale	–	–	–	+	+	–	+	–	–	–	–	–
Ch. tortissimum	–	–	–	+	–	–	–	+	–	–	–	–
Ch. willei	–	–	–	–	–	–	–	+	–	–	–	–
Climacosphenia elongatum	+	–	–	–	–	–	–	–	–	+	+	+
Cocconeis scutellum	–	–	–	–	–	–	–	+	–	–	–	–
C. placenata	–	–	–	–	+	–	–	–	–	+	–	–
Coscinodiscus excentricus	–	+	–	+	+	–	+	+	–	+	+	+
C. gigas	–	–	–	+	+	+	+	+	+	+	+	+
C. granii	–	+	–	+	+	+	+	+	+	–	–	–
C. nitidus	–	–	–	–	–	–	+	+	–	+	+	+
C. oculus iridis	+	+	–	–	–	–	–	+	–	–	–	–
Coscinosira polychorda	+	+	–	+	–	–	–	–	–	–	–	–
Cyclotella catenata	–	–	–	–	+	–	–	–	–	–	–	–
C. maneghiniana	+	+	–	+	+	+	–	+	+	+	+	+
C. nana	–	–	–	–	+	–	–	–	–	–	–	–
Cylindrotheca gracile	–	–	–	–	–	–	–	–	–	–	+	–
Detonula confervacea	–	–	–	–	+	–	+	+	–	+	–	–
Ditylum brightwelli	+	–	–	+	+	+	+	+	+	+	+	+
Ethmodiscus gazellae	–	–	–	–	–	–	–	–	–	+	–	–
Grammatophora angulosa	–	–	–	–	+	–	–	–	–	–	–	–
G. marina	+	–	–	+	+	+	+	–	–	+	+	–
G. oceanica	–	–	–	+	+	+	–	–	+	+	–	–
Guinardia blavyana	–	–	+	–	–	–	–	+	–	–	–	–
G. flaccida	+	–	–	+	–	+	+	+	+	–	–	–
Gyrosigma attenuatum	–	–	–	–	–	–	+	+	–	–	–	–
G. balticum	–	–	–	–	–	+	–	+	–	–	–	–
Hantzschia amphioxys	–	–	–	–	–	–	–	+	–	–	–	–
Hemiaulus hauckii	–	+	+	+	+	–	+	+	+	+	+	+
H. sinensis	–	+	+	+	+	+	–	+	–	–	–	+
Hemidiscus cuneiformis	–	+	+	–	–	–	–	+	–	–	–	+
Lauderia borealis	–	+	–	+	+	–	+	+	+	+	–	–
Leptocylindrus danicus	–	+	+	+	+	+	+	+	+	–	–	–
L. minimus	–	+	–	+	+	+	+	+	+	+	+	+
Licmophora angulosa	+	–	–	–	+	–	–	–	–	–	–	–
L. flabellata	+	+	–	+	+	+	+	+	+	+	+	–
L. lyngbyei	+	–	–	+	–	+	+	+	–	+	–	+

An = Anfoushi , M = Mex , Ag = Agami + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
L. paradoxa	–	–	–	+	–	–	–	–	–	+	+	–
Lithodesmium undulatum	+	+	–	+	+	+	+	+	+	+	+	+
Melosira granulata v. angustissima	–	+	–	+	+	+	+	+	–	+	+	–
M. juergensis	–	–	–	+	–	–	–	–	–	–	–	–
M. moniliformis	–	–	–	–	–	–	+	+	–	–	+	+
M. varians	–	–	–	+	–	–	+	+	–	+	–	–
Navicula distans	–	–	–	–	–	–	–	+	–	–	–	–
N. lyra	–	–	–	+	–	–	+	–	–	–	–	–
Nitzschia apiculata	–	–	–	–	–	–	–	–	–	+	–	–
N. bilobata	–	+	–	+	–	–	–	–	–	–	–	–
N. closterium	+	+	–	+	+	–	+	+	–	+	+	+
N. delicatissima	–	–	–	–	–	–	–	+	–	–	+	–
N. frigida	–	–	–	–	+	–	–	–	–	–	–	–
N. longissima	–	+	+	–	+	–	–	+	–	+	+	–
N. lorenziana	–	–	–	–	–	–	–	–	–	–	+	–
N. seriata	–	–	–	–	–	–	–	+	–	–	+	–
N. sigma	–	+	–	–	+	+	–	+	–	–	+	–
Plagiogramma vanheurckii	–	–	–	–	–	–	–	–	–	+	+	–
Planktoniella sol	+	–	–	–	–	–	–	–	–	–	–	–
Pleurosigma decorum	–	–	–	–	–	–	–	–	–	–	+	–
P. formosum	–	–	–	–	–	–	–	–	–	–	–	+
P. macrum	–	+	–	–	–	–	–	+	–	–	–	–
P. rigidum	–	–	–	–	–	+	–	–	–	–	–	–
P. spenceri	–	–	–	–	–	–	–	+	–	–	–	–
Pleurosigma sp.	+	–	–	+	+	–	–	–	–	–	–	–
Podosira laevis	–	+	–	–	–	–	–	–	–	–	–	+
P. stelliger	–	+	–	–	–	–	–	+	–	–	–	–
Porosira gracilis	–	–	–	–	+	–	–	–	–	–	–	–
Rhabdonema adriaticum	–	–	–	–	–	+	–	+	+	+	–	+
Rhizosolenia acuminata	–	–	–	+	–	–	–	–	–	–	–	–
Rh. alata	–	+	–	–	–	–	–	+	–	–	–	–
Rh. alata f. gracilima	+	+	–	–	–	–	–	+	–	–	–	–
Rh. alata f. indica	+	–	–	+	–	–	–	+	+	–	–	–
Rh. calcar–avis	+	+	+	+	–	+	–	+	+	–	–	–
Rh. castracanei	–	–	–	+	–	–	–	–	–	–	–	–
Rh. fragilissima	–	–	–	–	–	–	+	+	–	+	+	–
Rh. hebetata f.semispina	–	+	+	–	–	–	–	–	–	–	–	–
Rh. robusta	–	+	+	+	–	+	–	–	–	–	–	–
Rh. setigera	–	–	+	–	–	+	+	+	+	–	+	–
Rh. shrubsolei	–	–	+	–	–	–	+	+	+	–	–	+
Rh. stolterfothii	–	–	–	+	+	–	+	+	–	–	–	–
Rh. styliformis	–	–	–	+	–	+	+	+	–	–	–	–
Skeletonema costatum	+	+	+	+	+	–	+	+	+	+	+	+

An = Anfoushi , M = Mex , Ag = Agami + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
Staurastrum gracile	–	–	–	+	+	–	–	–	–	–	–	–
Stauroneis gracile	–	–	–	–	+	–	–	–	–	–	–	–
S. membranacea	–	–	–	+	–	–	–	+	–	–	–	–
Streptotheca thamesis	–	–	–	+	+	–	–	–	–	–	–	–
Striatella unipunctata	–	–	+	–	–	–	+	+	+	–	+	+
Surirella robusta	–	–	–	+	–	–	–	–	–	–	–	–
S. striatula	–	–	–	–	+	+	–	+	–	–	+	–
Synedra acus	–	+	–	–	+	–	–	+	–	–	–	–
S. closteroides	–	–	–	–	+	–	–	+	–	–	+	–
S. pulchella	–	–	–	+	–	+	–	+	–	–	+	–
S. ulna	–	–	–	+	+	+	+	+	–	–	+	–
Thalassionema nitzschioides	–	–	–	–	–	–	+	+	–	–	–	–
Thalassiosira condensata	–	–	–	–	+	–	–	–	–	–	–	–
Th. decipiens	+	+	–	+	+	+	+	+	+	+	+	–
Th. nordenskioldii	–	+	+	–	–	–	–	–	–	–	–	–
Th. rotula	–	–	–	+	–	–	–	+	+	–	+	–
Th. subtilis	+	+	+	–	–	–	–	+	–	–	+	–
Triceratium favus	–	–	–	–	–	+	–	–	–	–	–	–
T. pentacrinus	–	–	–	–	–	–	+	–	–	–	–	–
Tropidoneis lepidoptera	–	–	–	–	+	–	–	–	–	–	–	–
Dinoflagellates:												
Ceratium arietinum	–	–	–	+	–	+	–	–	–	–	–	–
C. breve	–	–	–	–	–	–	+	+	–	–	–	–
C. candelabrum	–	–	–	+	+	–	–	–	–	+	+	–
C. concilians	–	–	–	+	+	–	–	–	+	–	–	–
C. contrarium	+	–	–	+	–	–	+	–	+	+	–	–
C. declinatum	–	–	–	+	–	–	–	–	–	–	–	–
C. euarcuatum	–	–	–	+	–	–	–	–	–	–	–	–
C. falcatum	–	–	–	–	–	–	–	–	–	+	–	–
C. furca	+	+	+	+	+	–	+	+	+	+	+	+
C. fusus	+	+	+	+	–	+	+	+	+	+	–	–
C. gibberum	–	–	–	–	+	–	–	–	–	–	–	–
C. hexacanthum	–	–	–	–	–	+	–	–	–	–	–	–
C. horridum	–	–	–	+	+	–	–	–	–	–	–	+
C. karsteinii	–	–	–	+	–	+	–	–	–	–	–	+
C. lineatum	–	–	–	+	–	–	–	–	–	–	–	–
C. macroceros	+	–	–	+	–	+	–	–	–	+	+	–
C. massiliense	+	–	–	+	+	–	–	–	+	+	+	–
C. minutum	–	–	–	–	–	–	–	–	–	+	–	–
C. pentagonum	–	–	+	+	+	–	–	–	–	–	–	–
C. pulchellum	–	–	–	+	+	+	+	+	–	+	+	+
C. setaceum	–	+	+	+	+	–	–	–	–	–	–	–

An = Anfoushi , M = Mex , Ag = Agami . + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
C. symmetricum	–	–	–	+	–	–	–	–	–	–	–	–
C. teres	–	–	–	+	+	+	+	–	–	+	+	–
C. trichoceros	–	–	–	+	–	–	–	–	–	–	–	–
C. tripos	+	+	+	+	+	+	+	+	–	+	+	–
Ceratocorys geurreti	–	–	–	–	–	–	–	–	–	+	–	–
C. horrida	–	–	–	–	–	–	–	–	–	+	–	–
Dinophysis acuta	–	–	–	–	+	–	–	–	–	–	–	–
D. caudata	+	+	+	+	+	–	+	+	+	+	+	–
D. diegensis	–	–	–	–	–	–	–	–	+	–	–	–
D. sacculus	–	–	–	–	–	–	+	+	+	–	+	–
D. sphaerica	–	–	–	–	–	–	–	+	–	–	–	–
D. tripos	–	–	–	+	–	–	–	–	–	+	–	–
Gonyaulax monocantha	–	–	–	+	–	–	–	–	–	+	–	–
G. orientalis	–	–	–	+	–	–	–	–	–	–	–	–
G. pacifica	–	–	–	–	–	–	–	–	+	–	–	–
G. polyedra	+	–	–	+	–	–	+	–	–	–	–	+
G. polygramma	–	–	–	–	–	–	+	+	–	+	–	–
G. spinifera	–	–	–	+	–	+	–	–	–	–	–	–
G. sp.	+	+	–	+	–	–	–	–	–	–	+	–
Leucosolenia blanca	–	–	–	–	–	+	–	+	–	+	+	–
L. falcata	–	–	–	–	–	–	+	–	–	–	–	–
Ornithocercus magnificus	–	–	–	+	–	–	–	–	–	+	–	–
Oxytoxum constrictum	–	–	–	–	–	–	+	–	+	–	–	–
O. diploconus	–	–	–	–	–	–	–	–	–	+	–	–
O. longiceps	–	–	–	–	–	–	–	–	–	–	+	–
O. milneri	–	–	–	–	–	+	–	–	–	–	–	–
O. scolopax	–	–	–	–	–	–	+	–	–	+	+	–
O. tesselatum	–	–	–	–	–	+	–	–	–	–	–	–
Peridiniopsis rotunda	–	–	–	+	–	–	–	–	–	–	–	–
Peridinium trochoideum	–	–	–	+	–	–	+	+	+	+	+	+
Phalacroma operculoides	–	–	–	+	–	–	–	–	+	–	–	–
P. ovatum	–	–	–	–	–	–	+	–	–	+	+	+
P. parvulum	–	–	–	+	–	–	–	–	–	–	–	–
P. rapa	+	–	–	+	–	–	–	–	–	–	–	–
P. rotundatum	+	–	–	+	–	–	–	–	–	–	–	–
Podolampas bipes	–	–	–	+	–	–	+	–	–	–	–	–
P. palmipes	–	–	+	+	–	+	–	+	–	+	+	+
Prorocentrum micans	+	+	+	+	+	–	+	+	+	+	+	+
P. schilleri	–	–	–	–	–	–	–	+	–	–	–	–
Protoperidinium brochii	–	–	–	–	+	–	–	–	–	–	+	–
P. cerasus	–	+	–	–	–	–	–	–	–	–	–	–
P. conicoides	–	+	–	–	–	–	–	+	–	–	–	–
P. conicum	–	–	–	–	–	–	+	–	–	–	+	–

An = Anfoushi , M = Mex , Ag = Agami . + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
P. depressum	+	+	+	+	+	–	+	+	+	–	+	–
P. diabolus	–	–	–	–	–	–	+	+	+	–	–	+
P. excentricum	–	–	–	–	–	–	–	+	–	+	–	+
P. globulum	+	–	–	+	+	–	–	+	–	+	+	–
P. leonis	–	–	–	–	–	–	–	+	+	+	+	+
P. mite	–	–	–	–	–	–	–	+	–	–	–	–
P. murrayi	–	–	–	–	–	–	–	+	–	–	–	–
P. nipponicum	–	–	–	–	–	–	+	+	–	–	–	–
P. nudum	–	–	–	–	–	–	–	–	–	–	+	–
P. oblongum	–	–	–	+	–	–	+	+	–	–	–	–
P. obtusum	–	–	–	–	–	–	+	–	–	–	–	+
P. pellucidum	–	–	+	–	–	–	–	–	–	+	–	+
P. pentagonum	–	–	–	–	–	–	+	+	–	–	–	–
P. robustum	+	–	–	–	–	–	–	+	–	–	–	–
P. rotunda	+	–	+	–	–	–	–	–	–	–	–	–
P. steinii	+	+	–	+	–	+	+	+	+	+	+	+
P. subinerme	–	–	–	–	–	–	–	–	–	+	+	+
P. thorianum	–	–	–	–	–	–	–	+	–	–	–	–
Pyrophacus horologium	–	–	–	–	–	–	+	+	–	+	+	+
Triadinium polyedricum	–	–	–	–	–	–	–	–	–	+	+	–
T. sphaericum	–	–	–	+	+	–	–	–	–	+	+	+
Silicoflagellates:												
Dictyocha fibula	–	–	–	+	–	–	–	–	–	–	–	–
D. octonaria	–	+	–	–	–	–	–	+	–	–	–	–
D. polyactis	–	–	–	–	–	–	–	+	–	–	–	–
Cyanophyceae:												
Chrococcus turgidus	–	–	–	–	+	–	–	+	–	–	+	–
Lyngbya contorta	–	–	–	–	+	–	–	–	–	–	–	–
L. limnetica	–	–	–	–	+	–	–	–	–	–	–	–
L. sp.	–	–	–	–	+	–	–	–	–	–	–	–
Merismopedia punctata	–	–	–	–	–	–	–	–	–	+	+	–
Microcystis sp.	–	–	–	–	–	–	–	–	–	–	+	–
Oscillatoria formosa	–	–	–	–	+	–	–	–	–	–	–	–
O. irrigua	–	–	–	–	–	–	–	+	–	–	–	–
O. limnetica	–	–	–	–	+	–	–	+	–	+	+	–
O. princeps	–	–	–	–	–	–	–	–	–	–	+	–
O. tenuis	–	–	–	–	+	–	–	–	–	–	+	–
Euglenophyceae:												
Euglena acus	–	–	–	+	+	–	+	+	–	+	+	–
E. granulata	–	–	–	–	+	–	–	+	–	–	+	–
E. sp.	–	–	–	+	–	–	+	+	–	+	+	–
Phacus triqueter	–	–	–	–	+	–	–	–	–	–	–	–

An = Anfoushi , M = Mex , Ag = Agami + = Present , – = Absent

Table 4 (cont.)

Species	Autumn			Winter			Spring			Summer		
	An	M	Ag	An	M	Ag	An	M	Ag	An	M	Ag
Chlorophyceae:												
Ankistrodesmus falcatus	–	–	–	–	+	–	–	+	–	–	+	–
A. longissimus	–	–	–	–	+	–	–	+	–	–	+	–
Botrydiopsis arhiza	–	–	–	–	+	–	–	–	–	–	–	–
Characiochloris sp.	–	–	–	+	+	–	+	+	+	+	–	–
Chlorogonium sp.	–	–	–	–	+	–	–	–	–	–	–	–
Closterium kiitzingii	–	–	–	–	–	–	–	+	–	–	–	–
C. lineatum	–	–	–	–	–	–	–	+	–	–	–	–
C. moniliformis	–	–	–	–	+	+	–	+	–	–	–	–
C. setaceum	–	–	–	–	+	–	–	–	–	–	–	–
C. sp.	–	–	–	+	+	+	+	+	+	–	–	–
Cosmarium sp.	–	–	–	–	–	–	–	+	–	–	–	–
Crucigenia rectangularis	–	–	–	–	+	–	–	–	–	–	+	+
C. tetrapedia	–	–	–	–	+	–	–	–	–	+	+	–
Dispora sp.	–	–	–	–	+	–	–	–	–	–	–	–
Pandorina sp.	–	–	–	–	+	–	–	+	–	–	+	–
Pediastrum biradiatum	–	–	–	–	+	+	–	+	–	–	–	–
P. siplex	–	+	–	+	+	–	+	–	–	–	+	+
Scenedesmus acuminatus	–	–	–	–	+	–	–	+	–	–	+	–
Sc. armatus	–	–	–	–	+	–	+	+	+	–	–	–
Sc. bijugatus	–	+	–	–	+	+	–	+	+	–	+	+
Sc. dimorphus	–	+	–	+	+	+	–	+	+	–	+	+
Sc. incrassatulus	–	–	–	–	+	–	–	+	–	–	+	–
Sc. obliquus	–	–	–	–	+	–	–	–	–	–	–	–
Sc. opoliensis	–	–	–	–	+	–	–	+	–	–	+	–
Sc. quadricauda	–	–	–	+	+	+	+	+	–	+	+	–
Sphaerocystis schroeteri	–	–	–	–	+	–	–	+	–	–	–	–

An = Anfoushi , M = Mex , Ag = Agami + = Present , – = Absent

The dominant species of phytoplankton showed more or less significant temporal and spatial variations. From figure 4, it is clear that the dominant species in Al–Anfoushi region were distinguished to the following categories:

a – Species decreased in abundance offshore in all seasons. These were *Skeletonema costatum, Melosira granulata v. angustissima, Prorocentrum micans, Leptocylindrus danicus, Thalassionema nitzschioides, Protoperidinium diabolus* and *Chaetoceros affine.* This trend may reflect the tolerance of those species to the domestic wastes.

b – Species decreased in abundance seaward in a season and increased in another, a trend which may be related to the seasonal variations. Such species were *Ch. curvisetum, Lithodesmium undulatum, Ch. decipiens, Protoperidinium subinerme* and *Pyrophacus horologium.*

c – Species increased in abundance offshore or dominated only at the offshore St. 3 like *Ch. breve, Guinardia flaccida, Coscinodiscus gigas, Ch. sociale, Rhizosolenia calcar–avis, Asterionella japonica* and *Protoperidinium depressum.* The occurrence of such species more abundant away from polluted station may indicate their susceptibility to the municipal wastes.

In Al–Mex region, similar categories of the distribution of the dominant species were observed with more or less the same variations (Fig. 4). The tolerance or susceptibility of these species may be related mainly to the effect of the industrial wastes discharged into Al–Mex Bay. It is to be noted that, the region of brackish water at St. 4 (S‰ : 5‰) was dominated absolutely by fresh water forms, which sometimes extended to Agami. Some of these forms were recorded in significant frequency among the dominant species at Agami. That may indicate the extention of the brackish water in the study area. These species may be considered as "Hydrological indicators".

Regarding the dominant species at the polluted stations (Sts. 1 and 5) it was observed that *Sk. costatum* dominated at the 2 stations from April to October, while *M. granulata v. angustissima* dominated at St. 1 from December to June. *Lauderia borealis, Protoperidinium steinii, L. undulatum, Ch. curvisetum* and *Ch. decipiens* codominated the phytoplankton at St. 1 during different periods including more than one season (Table 5). Several other species were observed as codominant during one season either at St. 1 or/and at St. 5 (Table 5). Whatever, the dominance of any species in the polluted water for one season or more may be considered as indicator species. Mihnea (1985) supposed that species expanded their biological cycle and represented constantly over 10% from the total community should be reckoned among the indicators.

The dominance of the phytoplankton species in polluted waters has been discussed by several authors. Many species of the Euglenophyta were developed at a BOD range 2–7 mg 0_2 l^{-1} (Mihnea 1978). In the study area, Euglenophytes codominated at BOD up to 14.4 mg 0_2 l^{-1}. The occurrence of *Sk. costatum* as indicator of eutrophication was admitted by Smayda (1965), Purcher–Petkovic and Marasovic (1980), Mihnea (1985) and Revelante & Gilmartin (1985). Moreover, *Nitzschia closterium* was observed among the indicators (Ignatiades & Pagou 1985). *Cerataulina pelagica* (Mihnea 1985) and *P. micans* (Revelante & Gilmartin 1985 and Pagou 1985) were also recorded as indicators of eutrophication. All the above mentioned indicators were found in large numbers in the study area.

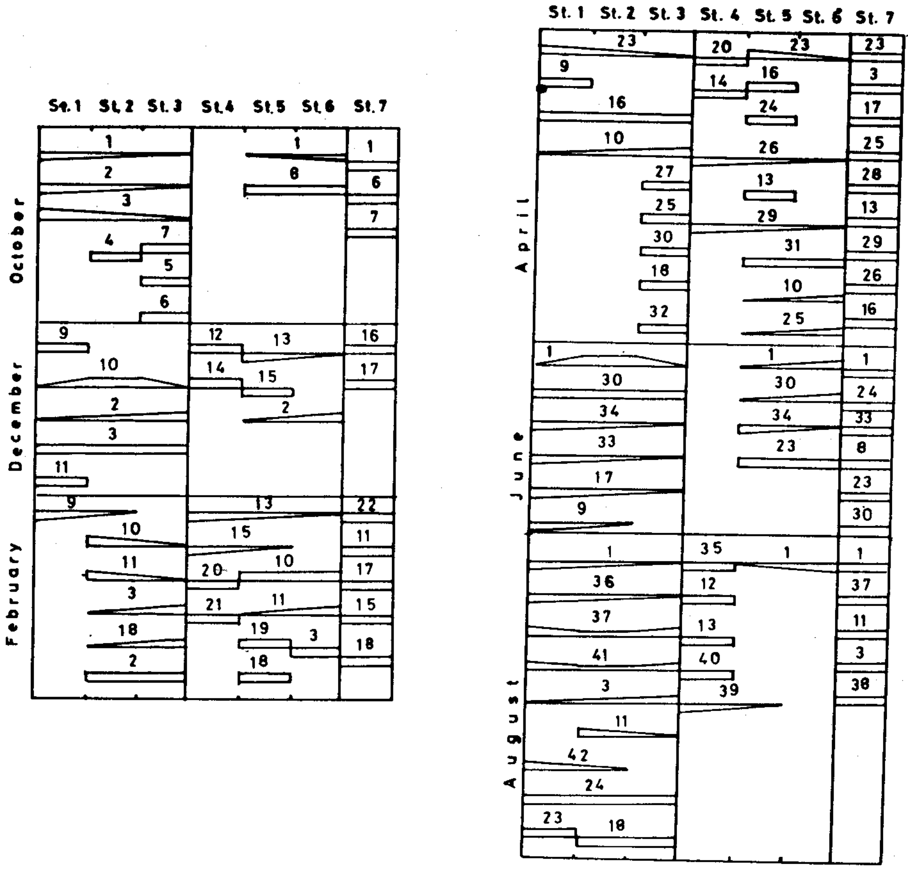

Fig. 4 : Temporal distribution of the dominant species at different regions of the study area.

1. *Skeletonema costatum,*
2. *Lithodesmium undulatum,*
3. *Chaetoceros decipiens,*
4. *Bellerochea malleus,*
5. *Asterionella japonica,*
6. *Rhizosolenia calcar–avis,*
7. *Protoperidinium depressum,*
8. *Protoperidinium steinii,*
9. *Melosira granulata v. angustissima,*
10. *Chaetoceros curvisetum,*
11. *Ch. affine,*
12. *Crucigenia tetrapedia,*
13. *Cyclotella meneghiniana,*
14. *Scenedesmus quadricauda,*
15. *Bacillaria paxillifer,*
16. *Lauderia borealis,*
17. *Leptocylindrus danicus,*
18. *Ch. breve,*
19. *Ch. compressum,*
20. *Pandorina sp.,*
21. *Euglena sp.,*
22. *Leptocylindrus minimus,*
23. *Prorocentrum micans,*
24. *Peridinium trochoideum,*
25. *Coscinodiscus gigas,*
26. *Closterium sp.,*
27. *Guinardia flaccida,*
28. *Scenedesmus dimorphus,*
29. *Sc. armatus,*
30. *Rhizosolenia setigera,*
31. *Thalassiosira subtilis,*
32. *Ch. sociale,*
33. *Protoperidinium diabolus,*
34. *Thalassionema nizschioides,*
35. *Oscillatoria limnetica,*
36. *Cerataulina pelagica,*
37. *Pyrophacus horologium,*
38. *Coscinodiscus nitidus,*
39. *Nitzschia closterium,*
40. *Sc. bijugatus,*
41. *Protoperidinium subinerme,*
42. *Licmophora lyngbyei.*

Table 5

Dominant phytoplankton species at the polluted stations 1 and 5 and at Agami over the year.

Species	St. 1	St. 5	St. 7
Asterionella japonica	A	—	—
Bacillaria paxilifer	—	W	W
Bellerochea malleus	—	SU	—
Biddulphia mobiliensis	—	—	W
B. sinensis	—	—	W
Cerataulina pelagica	Su	—	—
Chaetoceros affine	W	W+Sp	W+Su
Ch. breve	—	W	W
Ch. compressum	—	W	—
Ch. curvisetum	W+Sp	W+Sp	W
Ch. decipiens	A+W	Su	W+Sp+Su
Coscinodiscus gigas	—	Sp	Sp+Su
Cyclotella meneghiniana	—	W+Sp	Sp
Guinardia flaccida	—	—	Sp
Lauderia borealis	W+Sp	Sp	W+Sp
Leptocylindrus danicus	*Sp*	—	*W+Sp*
Leptocylindrus minimus	—	—	W
Licmophora flabellata	W	—	—
Licmophora lyngbyei	Su	—	—
Lithodesmium undulatum	A+W	W	W+Sp
Melosira granulata v angustissima	W+Sp	—	—
M. varians	W	—	—
Rhizosolenia calcar–avis	A	—	A
Rh. setigera	Sp	Sp	Sp
Skeletonema costatum	Sp+Su+A	Sp+Su+A	Sp+Su+A
Thalassionema nitzschioides	Sp	Sp	—
Thalassiosira decipiens	—	—	Sp
Prorocentrum micans	Sp+Su	Sp	Sp
Peridinium trochoideum	Su	Sp+Su	Sp
Protoperidinium depressum	—	Sp	—
P. diabolus	Sp	—	Sp
P. steinii	Sp	Su+A	Sp
P. subinerme	Su—	—	—
Pyrophacus horologium	Su	Su	Su
Closterium sp.	—	Sp	Sp
Euglena sp.	W	—	—
Scenedesmus armatus	—	Sp	Sp
Sc. dimorphus	—	—	Sp
Spirulina simplex	—	Sp	—

A = Autum, W = Winter, Sp = Spring, Su = Summer.

From another point of view, diatoms and fresh water species in Al–Mex were more diversified than in Al–Anfoushi and Agami (Table 6). This may be attributed to the expected high silicon content in the effluent of Umoum drain and the allochthonous fresh water forms. On the other hand, the diversified community of the dinoflagellates in Al–Anfoushi region compared to the other two regions may indicate their preference of the domestic wastes.

Table 6

Number of phytoplankton species recorded at different regions of the study area over the year.

Types	Al–Anfoushi	Al–Mex	Agami
Diatoms	98	117	61
Dinoflagellates	67	50	37
Fresh water species	13	42	10

ii. Standing crop

The values of the phytoplankton standing crop by cell count and chlorophyll content showed obvious convenience or significant contradiction in the 3 regions (Figs. 5 & 6). In Al–Anfoushi, the average cell count showed 2 unequal peaks. The large peak was observed during autumn and mainly due to *Sk. costatum.* The small peak was detected in spring and formed by *P. micans* at the beginning of the season and by *Th. nitzschioides* and *M. granulata v. angustissima* at the end of the season. Chlorophyll values showed distinct a peak during autumn, which coincided with a large peak of the cell count. In Al–Mex water, the peak of the cell count was contradicted with that of the chlorophyll. The maximal cell count was observed in spring with the dominance of *P. micans,* while the chlorophyll peak was recorded in summer when the phytoplankton was dominated by the fresh water forms *Crucigenia tetrapedia, Cyclotella meneghiniana, Scenedesmus bijugatus* and the diatom *Sk. costatum.* The phytoplankton biomass in Agami water showed time coincidence between the peaks of the cell count and chlorophyll. Both peaks were observed in spring with the dominance of *P. micans* and *Peridinium trochoideum.*

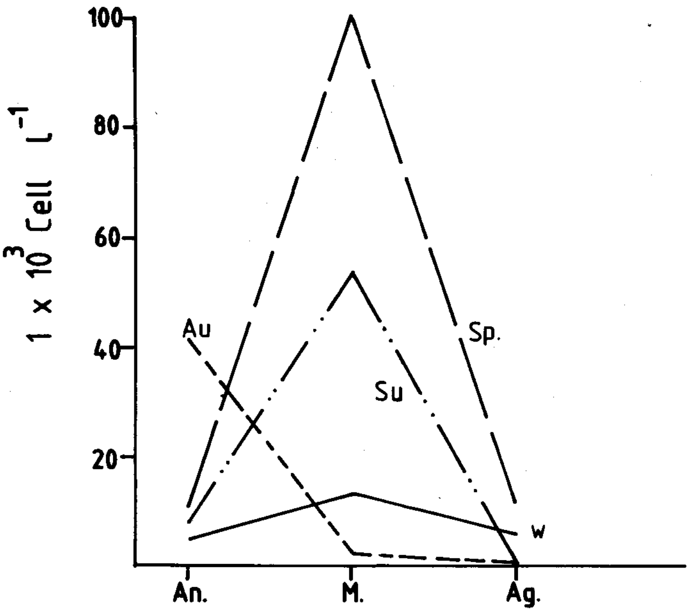

Fig. 5 : Regional variations of the cell count in different seasons.

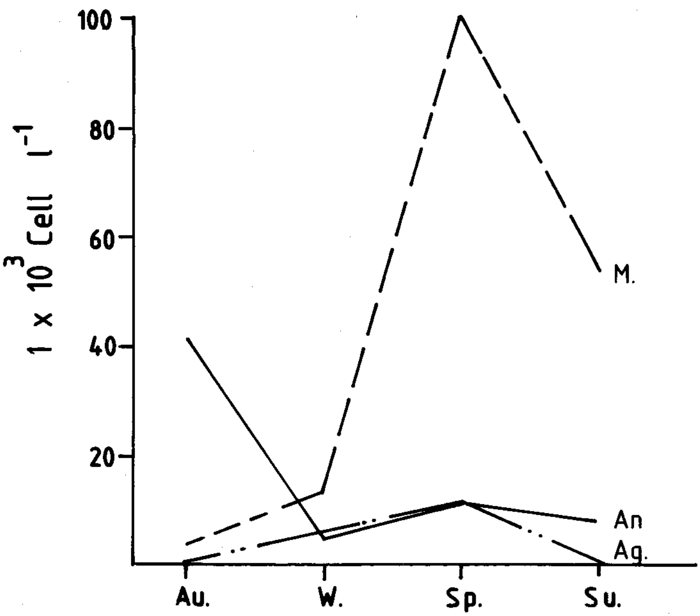

Fig. 6 : Seasonal variations of the cell count at different regions of the investigated area.

The regional variations of the phytoplankton standing crop indicated that Al–Mex region was the most productive part of the investigated area most of the year (Figs. 7&8). This may be related to the high nutrient concentration in that part. However, excluding the large biomass of the fresh water species in Al–Mex region, the standing crop of the phytoplankton in the study area was significantly low compared to other areas of the Egyptian and Mediterranean waters (Table 7). This observation is contradicted with the presumably high biomass in such area rich in nutrients. The concerned contradiction is undoubtedly related to the impact of the great volumes of domestic and industrial wastes. On the other hand, the large standing crop observed in Al–Mex water was mainly due to the fresh water species transferred fom Lake Maryout.

Table 7
The maximum standing crop of the phytoplankton in different regions of the Mediterranean Sea.

Region	Time	$X10^3$ Cell^{-1}	Reference
Egyptian inshore waters:			
Rosetta	Winter 1977	149	Anonymous 1979
Mex	Winter 1977	220	Anonymous 1979
Rosetta	Spring 1977	70	Anonymous 1979
Mex	Spring 1977	219	Anonymous 1979
Hammam	Autumn 1977	122	Anonymous 1979
Mex Bay (Alex.)	Spring 1983	206	Present Work
Kastella Bay (Adriatic)	1976	410	Marasovic & Pucher–Petkovic 1983
Kastella Bay (Adriatic)	1980	495	Marasovic & Pucher–Petkovic 1983
Gulf of Salerno (Italy)	April 1982	420	Marino et al 1985
Gulf of Naples (Italy)	Summer 1983	112	Zingone et al 1985

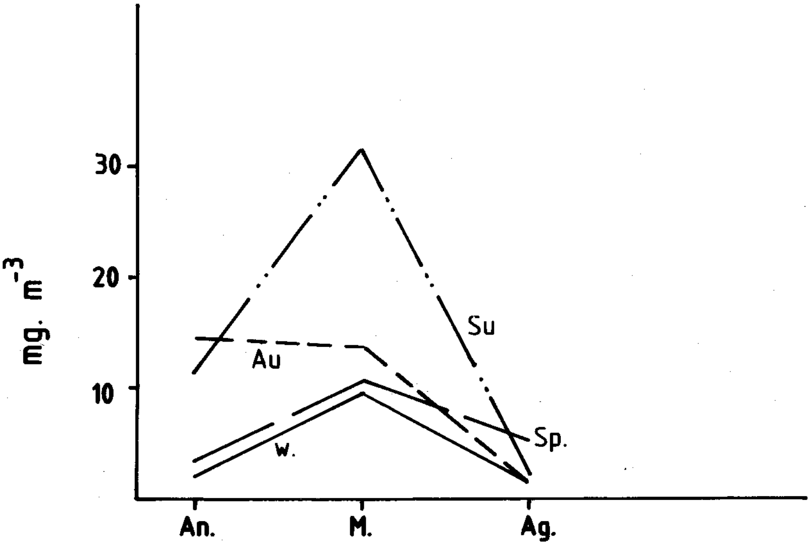

Fig. 7 : Regional variations of chlorophyll in different seasons.

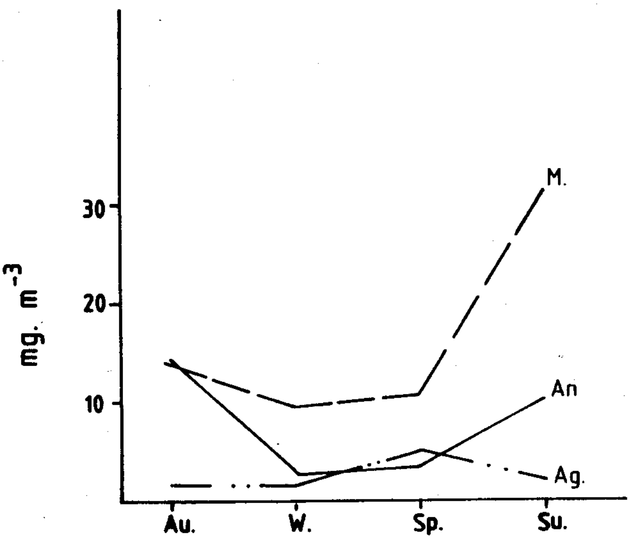

Fig. 8 : Seasonal variations of chlorophyll at different regions of the study area.

CONCLUSION

The investigated area is characterized by receiving huge quantities of different land-based effluents carried with several types of pollutants. Great concentrations of nutrients are transferred to the area through these effluents causing the eutrophication of the water. In relation to the differences in the nature of the effluents, salinity, BOD and nutrient contents were subjected to significant temporal and apatial variations. Al-Anfoushi region was mostly characterized by the highest level of ammonia and phosphate, while Al-Mex region had the highest nitrate and nitrite content.

The variations in the physico-chemical characteristics were obviously reflected on the diversity and dominance of the phytoplankton species and their biomass. Diatoms were more diversified in Al-Mex region, while dinoflagellates were more diversified in Al-Anfoushi. According to the extention of the Umoum drain effluent fresh water forms were sometimes found as codominants at Agami. Several phytoplankton species were admitted as hydrological or ecological indicators.

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REFERENCES

Aboul-Dahab, O., O. El-Rayis and Y. Halim 1984. Environmental conditions in Mex Bay west of Alexandria 1 – Physical speciation of four trace metals in coastal water. In: 7th workshop on Marine Poll. Medit. Lucerne.

Aleem, A.A. and N.M. Dowidar 1967. Phytoplankton production in relation to nutrients along the Egyptian Mediterranean coast. Trop. Oceanogr. Miami 5/XX: 305-323.

Anonymous, 1979. Fisheries investigations of the Sardine and other Pelagic fish along the Egyptian Mediterranean Coast from Rashid to El-Sallum. Inst. Ocean. Fisher., Alexandria, Tech. Rep. 2/2:

Revelante, N. and M. Gilmartin 1985. Possible phytoplankton species as indicators of eutrophication in the northern Adriatic Sea. Rapp. Comm. Int. Mer. Medit., 29(9): 89–91.

Shirota, A. 1966. The Plankton of South Vietnam. Overseas Tech. Coop. Agency, Japan. 462 pp.

Smayda, T. 1965. A quantitative analysis of the phytoplankton of the Gulf of Panama. III–On the relationship between C^{14} assimilation and the diatom standing crop. Inter. Amer. Tropical Tuna Comiss. Bull., 9(7): 467–531.

Smith, G.M. 1933. The fresh water algae of the United States. New York. 716p.

Sournia, A. 1967. Le genre *Ceratium* (peridinien Planctonique) dans le Canal de Mozambique. Contribution a une revision mondiale Vie et Milieu, Serie A: Biologie marine, 18(2–3): 375–499 pp.

Sournia, A. 1968. Diatomees Planctonique du Canal Moazambique et de l'ile Maurice, Memoire O.R.S.T.O.M., 31: 1–120.

Strickland, J.O.H. and T.R. Parsons 1969. A practical handbook of Sea water analysis. Bull. Fisher. Res. Board, Canada, 167, 311 pp.

Taylor, F.J.R. 1976. Dinoflagellates from the International Indian Ocean Expedition. A report on material collected by the "R.V. Anton Brunn" 1963–1964. E. schweizerbart Sche Verlags–buchandlung, Stuttgart.

Tregouboff, G. and M. Rose 1957. Manuel de Planctonologie Mediterraneenne. Centre National de la Recherche Scientifique, Paris.

Utermohl, H. 1936. Quatitative methoden untersuchung des nannoplankton in adderheldens. Handbuch der Biolog Arb Methoden Abt. IX(I).

Van Heurck, H. 1896. A Treatise on the Diatomaceae. Translated by W. E. Baxter. William Wesley & Son, 28, London, 558 pp.

Zingone, A., M. Monstresor and D. Marino 1985. Temporal and spatial variations of phytoplanton communities from the inner part of the Gulf of Naples, Summer 1983. Rapp. Comm. Int. Mer. Medit. 29(9) : 103–105.

العوالق النباتية في منطقة متنوعة التلوث
غرب الاسكندرية - مصـــــر

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تقع منطقة البحث في المياه الشاطئية للبحر المتوسط غرب مدينة الإسكندرية وتصب فيها عدد من التدفقات الأرضية المحملة بأنواع مختلفة من المخلفات الزراعية والصناعية والصرف الصحي .

تتعرض الدراسة لأنواع العوالق النباتية وكتلتها الحية وعلاقتها بالعوامل الفيزيائية والكيميائية المميزة لمياه البحر في هذه المنطقة . كما تستعرض التغيرات الموسمية والمكانية في التركيب النوعي والكمي للعوالق النباتية وفي العوامل البيئية تحت تأثير الملوثات المتعددة .

وقد أوضحت الدراسة أن الكميات الكبيرة من الملوثات التي تصرف إلى منطقة البحث قد أثرت بصورة ملحوظة على نوعية المياه بها وخواصها الفيزيائية والكيميائية الأمر الذي أدى إلى تركيب متميز لمجتمع العوالق النباتية نتج عنه سيادة مجموعات معينة من هذه العوالق في كل جزء من أجزاء المنطقة حسب نوع المخلفات التي تصب فيه . كما لوحظ ظهور بعض أنواع العوالق النباتية بكثرة واضحة عند المحطات الملوثة حيث يمكن إعتبارها « دلائل تلوث » .