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HYDROGRAPHY AND CHEMICAL CHARACTERISTICS OF THE COASTAL WATER ALONG THE GULF OF SUEZ

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Key words: Suez Gulf, coastal waters, hydrochemical, nutrient salts trophic states.

ABSTRACT

The present study was carried out bimonthly during 2003 to provide a background picture for the water quality as an indicator for the human impact on the coastal environment of Suez Gulf. Water samples were collected from fourteen coastal stations covering different hot spots as well as base-line locations along the Gulf. The hydrochemical parameters i.e water temperature, salinity, dissolved oxygen, pH, chlorophyll-a, total suspended matter, and transparency, as well as the nitrogen forms (ammonium, nitrite, nitrate and total nitrogen), reactive and total phosphate and reactive silicate were investigated. The obtained data signified that Suez Gulf can be distinguished into two main regions which can be considered separately. The northern as the first (Region A) and the rest of the Gulf as the second ones (Region B). The changes in salinity and pH values were not significant with highly oxygenated seawaters in the two regions. The northern side is locating under stress due to the continuous discharge of increasing amounts of the untreated domestic and industrial effluents. These can be indicated from the levels of total suspended matter TSM, Chl-a and nitrogen compounds. These levels were found relatively high at the northern as compared to those in the rest of the Gulf. Accordingly, the conditions at the northern part are eutrophic and completely different from that in the other part which found between oligotrophic to mesotrophic states like that in the proper Red Sea waters. The values of N:P ratios indicated that phosphate in region A and phosphate or nitrate in region B are mostly responsible for the limitation of phytoplankton growth in the main regions of Suez Gulf. Statistically, correlation coefficient and factor analysis were applied between different measured variables to evaluate the relationships between them from one side and to assess the principal components that effect the coastal water quality for each of the two regions.

INTRODUCTION

Suez Gulf is about 250 km long, 32 km width and 55-73 m average depth (Murty and El-Sabah, 1984). The main industry and planned expansions in Suez area are found in the northern and mid western coast of Suez Gulf. The northern area is receiving a heavy load of waste water from industrial and sewage effluents. The main industries in the area are pertrochemicals, fertilizers and power station. The amount of constituents (Ton/year) conveyed to the Gulf from this area through industrial and sewage effluents are 31.72 and 93.96 NH_4-N, 0.78 and 0.31 NO_2-N, 3.17 and 0.40 NO_3-N and 17.72 and 52.93 PO_4-P, respectively (Abdel Fattah, 1992). The mid western side is locating under the direct effect of sewage wastes and petrochemical effluents of Ras Gharib City. Whereas, the human impact on the eastern (Sinai peninsula) and southern (El-Tour City) sides are still insignificant due to the low population there. For this reason great and

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rapid development were taken place on these two sides as natural recreational areas for tourist trades and consequently national income. Accordingly, Environmental Information and Monitoring Program (EIMP) was established to assess the aesthetic quality of Suez Gulf coastal waters, and to initiate monitoring and database system for its sustainable use and coast line management.

MATERIAL AND METHODS

Within the framework of EIMP program, five field trips were performed during January, March, May, July and September 2003. A total of 14 stations along Suez Gulf coast were selected to represent different locations situated under the direct effect of human activities, public resort beaches and some reference sites (Figure 1). Water samples for some hydrochemical and nutrient parameters were collected in duplicate from 2m depth of about 10 m water column at each station, using a PVC Nisken's bottle. The hydrographical parameters water temperature, salinity, dissolved oxygen (DO) and pH were measured in situ at each station using CTD (YSI-6000). Water samples for NH_4 measurements were eluted first then fixed. The indophenol blue technique (IOC-1983) was used. Nitrite, NO_3, PO_4 and SiO_4 were determined in filtered seawater samples using GF/C filters following the techniques described by IOC (1993) and Strickland and Parsons (1972). Total –P and total –N were estimated in unfiltered water samples following the procedure described by Valderrama (1981). The summation of NH_4 + NO_2 + NO_3 is designated as DIN. Total suspended matter was collected from 3l portion of seawater sampled by filtration through washed, dried and weighed 0.45 µm membrane filter. The filter with the retained TSM were dried at 105°C until constant weight. The differences between the dry weight of membrane filters before and after filtration was expressed as mg/l total suspended matter. Another 3l seawater portion was used for Chl-a determination after filtration through 0.45 µm membrane filters. The Chl-a in the phytoplankton cells retained on the membrane filter was extracted using 90% acetone and measured spectrophotometrically at the wave lengths 630, 645,665 and 750 nm (Strickland and Parson 1972). Transparency was measured using a white enameled Secchi disk. Synthetic standards as well as reference materials (batch VKI 9-2-0894 for NH_4-N, NO_3-N and PO_4-P and batch 10-2-0894 for TP and TN) were intended as a quality control during the measurements.

RESULTS AND DISCUSSION

The ranges as well as average values of different studied physicochemical and nutrient characteristics of Suez Gulf surface coastal waters are listed in Tables 1 and 2, respectively. Their distribution pattern are represented graphically in Figures 2 to 5. Examining the Tables and Figures, one can easily see that, except few occasions, most of the physicochemical elements (water temperature, S‰, pH and DO) beside the P-forms are of more or less same level in all coastal waters of the Gulf. Whereas, the other studied elements (Chl-a, TSM, Trans. and N-forms) were distinguished this coastal waters into two distinct regions: the first one is designated as Region A and sustained high levels of these studied parameters (with the exception of transparency), it located in the northern side of the Gulf (Sts Su1, Su2 and Su3). The second one is designated as Region B and includes the rest of Gulf coastal waters (Sts from Su4 to Su13) that contained the lower levels (except of transparency).

Based on the physicochemical characteristics-as a consequence of seasonal variations, the records of water temperature were high in July and September and low in January and March the difference in water temp. between the highest and lowest ones is about 10°C.

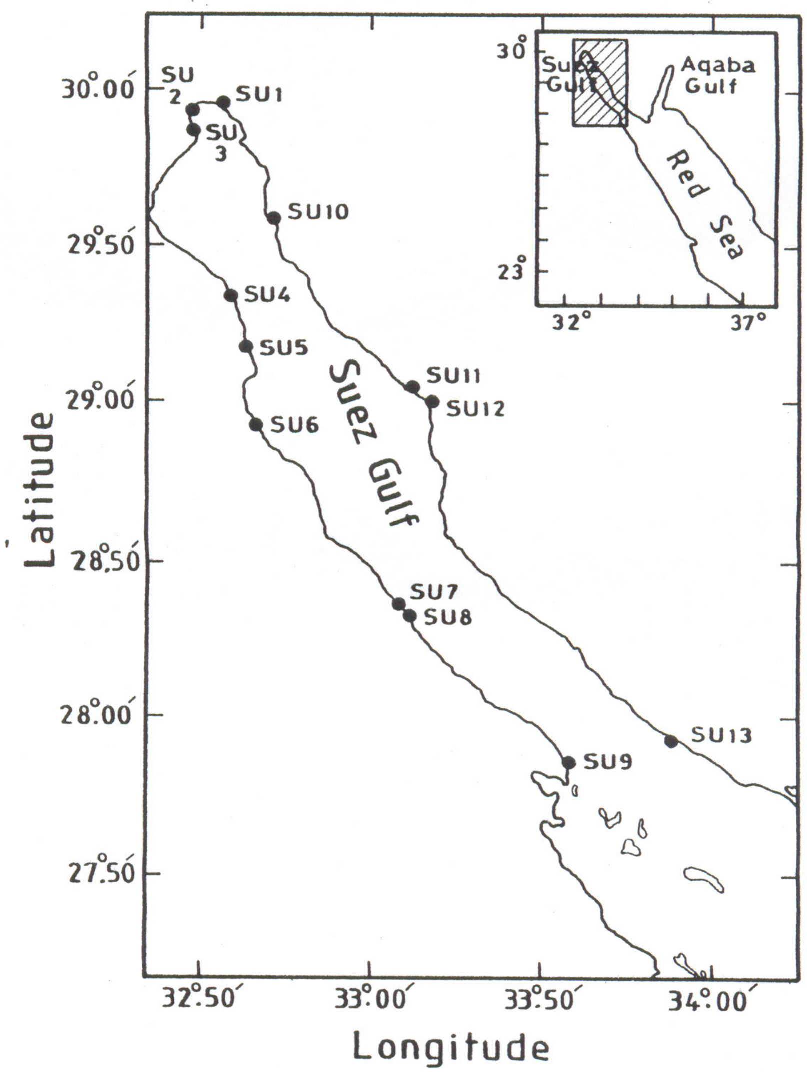

Figure 1: Map showing Suez Gulf and position of sampling locations

Table (1): Ranges and average values of some studied physicochemical parameters in Suez Gulf surface coastal waters during 2003

Regions	St. No.	Temp. °C	Salinity ‰	pH	DO mg/l	DO sat. %	Chl-a µg/l	TSM mg/l	Trans. m	Chl-a /TSM ratio
A	Su1	17.6-28.2	41.70-42.50 41.98	7.90-8.44 8.16	6.32-8.93 7.39	96.7-119.5 109	0.77-1.22 0.98	6.01-15.32 12.26	2.00-6.60 3.44	0.087
	Su2	17.8-27.9	41.60-42.30 41.88	8.13-8.53 8.25	6.56-9.54 7.58	101.3-128.0 111.9	0.81-4.43 2.03	8.38-20.18 15.01	2.40-6.80 4.24	0.177
	Su3	17.6-28.0	41.60-42.50 41.98	8.08-8.52 8.22	6.68-8.98 7.9	107.0-122.2 116.4	0.77-6.91 2.61	10.63-19.13 13.72	2.50-6.60 3.82	0.21
Annual averages		23.7	41.67-42.43 41.95	8.02-8.50 8.21	6.67-9.15 7.62	103.3-122.5 112.4	0.79-4.04 1.87	8.68-18.15 13.66	2.33-6.67 3.83	0.158
B	Su4	18.3-28.2	41.60-42.60 41.90	8.08-8.42 8.22	6.56-8.70 7.22	102.9-117.6 107.7	0.06-0.63 0.21	4.03-6.94 5.73	8.0-15.0 11.6	0.035
	Su5-a	17.5-28.5	41.30-42.40 41.82	7.83-8.19 8.09	6.44-8.42 7.24	103.2-112.2 107.5	0.07-0.27 0.15	9.76-11.09 6.67	5.0-8.0 6.4	0.022
	Su5	18.2-28.5	41.60-42.60 41.92	8.11-8.44 8.27	6.52-8.37 7.19	103.8-113.0 107.5	0.06-0.46 0.19	4.29-8.54 6.16	6.0-12.5 7.52	0.029
	Su6	18.1-28.1	41.60-42.50 41.88	8.10-8.43 8.26	6.48-8.42 7.26	102.7-113.5 108.2	0.07-0.26 0.15	4.63-7.87 6.67	5.90-9.00 6.76	0.022
	Su7	19.8-26.6	40.10-41.30 40.8	8.07-8.31 8.2	6.92-10.10 7.92	106.4-140.3 115.5	0.04-0.71 0.21	4.80-45.35 15.56	5.00-8.50 6.8	0.011
	Su8	19.8-27.4	40.10-41.60 40.76	8.15-8.24 8.2	6.76-8.79 7.47	107.5-122.2 111.5	0.08-0.70 0.23	4.69-6.57 5.83	5.00-7.50 6.24	0.038
	Su9	19.8-27.00	40.10-41.30 40.42	7.94-8.29 8.15	6.80-8.51 7.34	106.5-118.3 109.3	0.19-1.09 0.49	4.98-11.26 7.47	2.50-6.30 3.86	0.076
	Su10	18.6-27.7	40.80-42.50 41.58	8.03-8.36 8.2	6.16-8.36 7.29	92.5-117.1 107.4	0.09-0.14 0.12	4.53-12.80 6.94	5.90-8.50 7.08	0.019
	Su11	18.6-27.8	40.80-42.00 41.4	8.07-8.26 8.17	6.56-8.13 7.16	98.5-110.7 105.4	0.05-0.17 0.09	4.19-6.32 5.03	5.00-7.50 5.86	0.018
	Su12	18.6-28.00	40.80-42.00 41.42	7.99-8.33 8.18	7.23-8.70 7.77	106.1-119.9 114.5	0.05-0.32 0.14	4.55-24.96 9.44	5.00-9.50 6.3	0.023
	Su13	19.8-26.3	39.70-40.40 40.02	8.06-8.22 8.17	6.44-8.23 7.18	98.9-114.3 107	0.08-0.29 0.15	4.85-9.08 6.71	6.00-8.90 6.78	0.025
Annual averages		23.8	41.0-41.97 41.27	8.10-8.29 8.19	6.75-8.63 7.37	104.9-118.0 109.2	0.11-0.27 0.19	5.20-11.92 7.47	6.27-7.41 6.84	0.029

Table (2): Ranges and average values of different nutrients (µM) and DIN/P ratios in Suez Gulf surface coastal waters during 2003

Regions	St. No.	N-forms					P-forms		Si	N/P
		NH_4-N	NO_2-N	NO_3-N	DIN	TN	PO_4-P	TP	SiO_4-Si	
A	Su1	1.32-12.39 5.85	0.45-2.96 1.05	3.41-18.18 9.97	5.91-31.34 16.86	28.25- 58.79	<0.03-0.07 0.03	0.47-1.05 0.86	0.58-3.06 2.10	323
	Su2	6.03-23.12 12.26	0.41-3.28 1.37	13.84- 25.01	21.38- 41.65	52.70- 70.49	<0.03-0.44 0.15	0.88-2.33 1.33	0.38-5.47 2.08	167
	Su3	3.53-20.43 8.40	0.38-1.51 1.05	7.83-32.53 18.61	15.68- 28.06	38.18- 55.26	<0.03-0.13 0.05	0.38-1.45 0.86	0.33-2.45 1.35	372
Annual averages		3.87-14.82 9.84	0.52-2.49 1.16	10.29- 17.86	15.28- 28.86	45.72- 61.52	<0.03-0.21 0.08	0.85-1.42 1.01	0.43-3.66 1.84	223
B	Su4	0.21-2.63 1.43	0.06-0.13 0.1	0.16-2.77 0.85	0.80-4.34 2.38	16.41- 27.8	<0.03-0.13 0.04	0.30-1.45 0.72	0.54-1.16 0.77	21.3
	Su5-a	0.36-2.37 1.45	<0.01-0.29 0.12	0.92-1.85 1.25	1.38-3.40 2.69	14.96- 24.95	<0.03-0.12 0.04	0.23-0.79 0.56	0.42-4.49 0.93	31.3
	Su5	0.22-1.06 0.60	<0.01-0.13 0.09	0.14-0.85 0.5	0.68-1.83 1.19	14.99- 30.18	<0.03-0.09 0.04	0.37-1.75 0.94	0.44-4.37 0.65	12.5
	Su6	0.22-5.30 1.75	<0.01-0.13 0.07	0.16-0.87 0.43	0.47-5.65 2.26	20.51- 30.79	<0.03-0.09 0.04	0.30-0.98 0.57	0.60-1.50 0.85	10.8
	Su7	1.23-2.38 1.83	<0.01-0.25 0.14	0.15-1.86 1.36	2.29-4.37 3.17	28.90- 32.19	<0.03-0.13 0.09	0.50-1.75 1.27	0.46-3.17 0.75	15.1
	Su8	0.33-2.17 0.91	<0.01-0.11 0.08	0.16-1.04 0.53	0.59-2.52 1.53	26.62- 50.76	<0.03-0.08 0.05	0.73-1.23 0.88	0.27-1.47 0.65	10.6
	Su9	0.20-2.11 1.11	0.06-0.16 0.12	0.05-0.77 0.45	0.60-2.52 1.68	18.29- 36.97	<0.03-0.25 0.09	0.78-1.51 1.15	0.44-0.79 0.57	5
	Su10	0.42-1.71 0.90	<0.01-0.13 0.06	0.25-1.20 0.65	1.05-2.40 1.61	22.37- 36.54	<0.03-0.12 0.03	0.64-1.39 0.94	0.44-0.90 0.64	21.7
	Su11	0.22-1.61 0.81	<0.01-0.08 0.04	0.25-0.64 0.47	0.90-1.90 1.32	11.76- 17.62	<0.03-0.07 0.03	0.37-0.91 0.69	0.44-3.04 0.52	15.7
	Su12	0.56-1.62 1.12	<0.01-0.08 0.04	0.30-0.63 0.48	1.17-1.99 1.64	20.90- 23.86	<0.03-0.08 0.04	0.57-1.36 0.82	0.44-0.98 0.6	12
	Su13	0.11-1.26 0.65	<0.01-0.15 0.05	0.16-0.62 0.38	0.29-1.88 1.08	15.19- 25.39	<0.03-0.08 0.05	0.58-1.69 1.13	0.46-0.97 0.63	7.6
Annual averages		0.58-1.87 1.14	0.01-0.12 0.08	0.33-1.11 0.66	1.25-2.40 1.88	23.34- 30.64	<0.03-0.11 0.05	0.55-0.99 0.87	0.56-1.01 0.68	13.2

ND= not detected

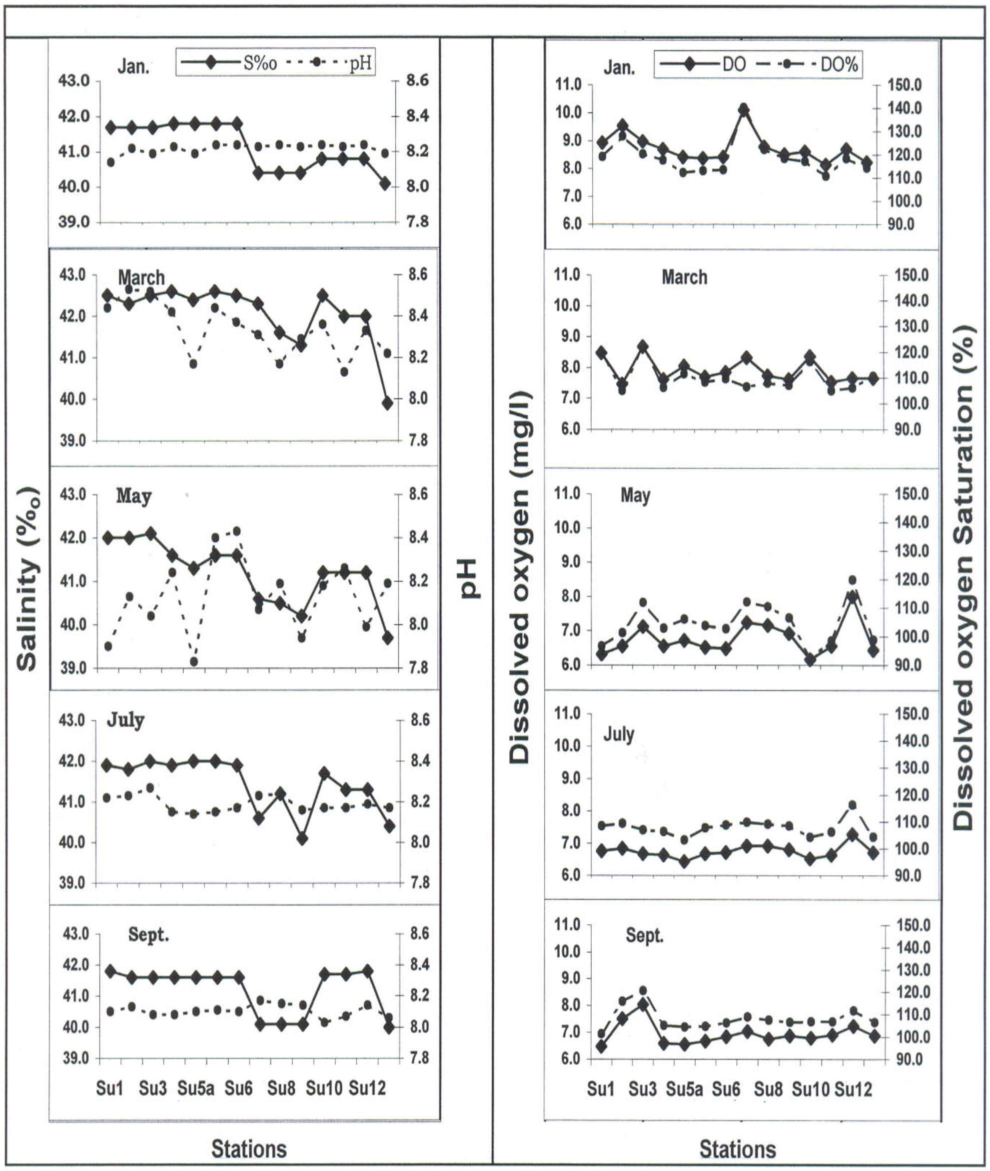

Fig.2 .the distribution pattern of some physicochemical characteristics of Suez Gulf Surface coastal waters during different periods of 2003

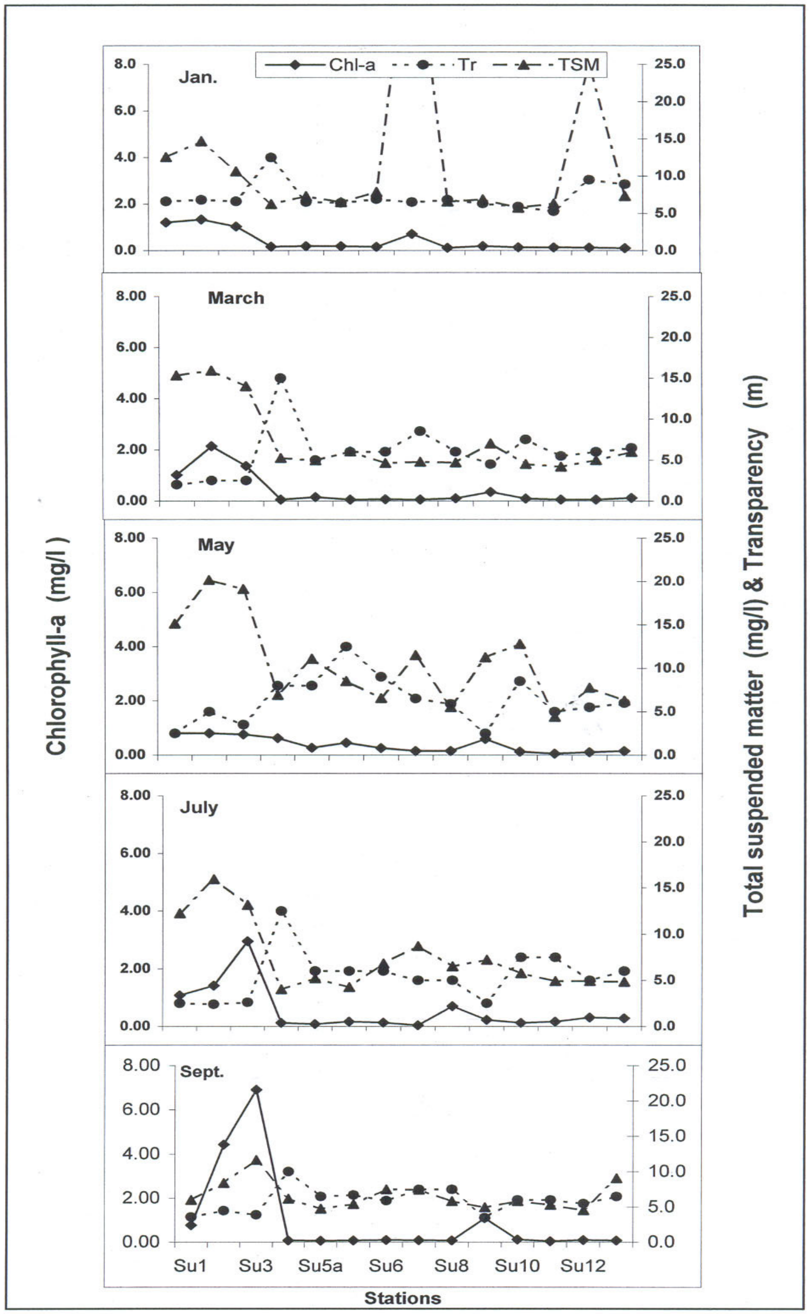

Fig.3. The distribution pattern of chlorophyll-a, total suspended matter and transparency values at Suez Gulf Surface coastal waters during different periods of 2003

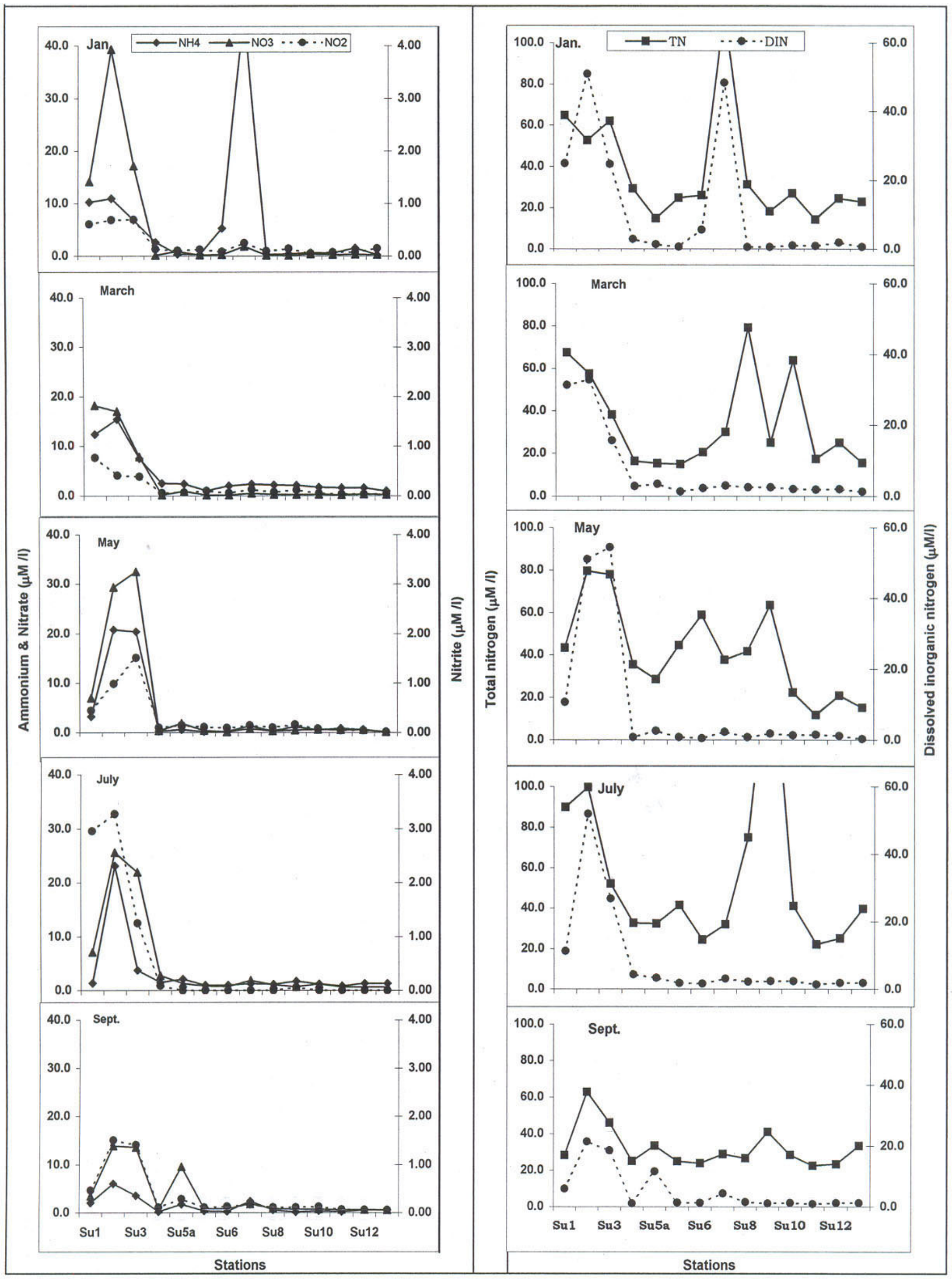

Fig. 4. The distribution pattern of nitrogen forms concentration at Suez Gulf Surface coastal waters during different periods of 2003.

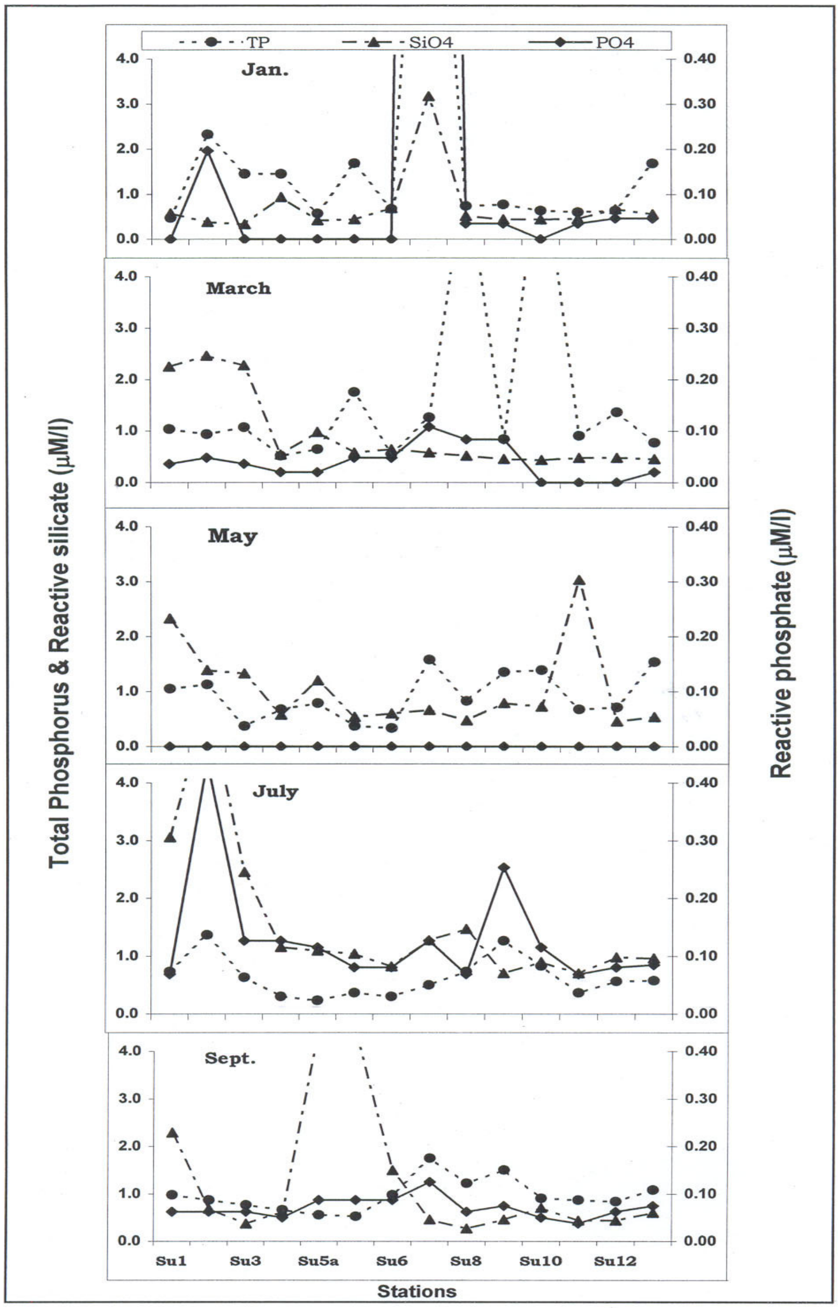

Fig .5. The distribution pattern of reactive and total phosphate and reactive silicate concentrations at Suez Gulf Surface coastal waters during different periods of 2003

The distribution pattern of salinity showed relative increase at the northern and western sides of the Gulf, which constituting the Suez Bay (Su1-Su6 and Su10-Su12). Whereas middle and southern parts are more or less comparable to those of the proper Red seawaters. The relative increase in S‰ of the Suez Bay is mainly accompanied with its configuration and shallowness, the conveyed water of higher salinity from Suez canal, the seasonal variation in its water level as well as the prevailing wind and cycle of heating on the Bay (Meshal, 1966). PH values were always on the slight alkaline side, their temporal and spatial variations were insignificant. The measurements of DO indicated well oxygenated surface water at different sites of the two regions. These can be justified from the annual mean values amounted 7.96 and 7.73 mg/l (equivalent to 116 and 112 of DO%) for Regions A and B, respectively.

The oxygen measurements clearly indicated that, the present load of organic matter and nutrients reached the Suez Gulf are below the level can bring the oxygen deficiency. El-Sabah and Beltagi (1983) reported that the surface S‰ in the shallow water of Suez Gulf was varied between a maximum of 42.85‰ at the Suez Bay in the north and a minimum of 40.14‰ at the south. Abdel Fattah (1992) demonstrated that, the physicochemical characteristics of the Suez Bay coastal waters were found between 17.5-28.5^{o}C for water temperature, 8.10-8.35 for pH, 40.83-42.73‰ for salinity and 3.94-5.98 mg/l for DO. These data are in consistence with those of the present study except DO concentrations which registered noticeable higher levels than reported. They concluded that, the human impact are still insignificant on the levels of these parameters for Regions A and B of Suez Gulf.

Chl-a concentrations were relatively, high in Region A than those of Region B. The peaks were observed in September for Region A and in May for Region B (4.04 and 0.27 µg/l), giving the annual means 1.87 and 0.19µg/l for these two regions respectively coincided principally, with the human impact which increased on Region A than Region B. This can be justified from the relative increase in TSM and decrease in secchi-disk visibility values for Region A (13.66 mg/l and 3.83 m) than those of Region B (7.47 mg/l and 6.84 m), respectively.

Based on the nutrient salt distribution, the surface coastal water of Region A sustained relatively the highest concentrations of different N-forms as compared with those in Region B. These can be signified from the annual averages of NH_4-N, NO_2-N, NO_3-N, DIN and TN registered 9.84, 1.16, 17.86, 28.86 and 61.53 µM/l in Region A and 1.14, 0.08, 0.66, 1.88 and 30.64 µM/l for Region B, respectively. Nitrite was rarely present in measurable quantities at Region B. The highest levels were found at Su7 during January for NH_4-N and TN (46.30 and 114.8 µM/l, respectively), Su5-a during September for NO_3-N (9.57 µM/l) and Su9 during July for TN (177.1µM/l). These levels were found relatively, too much high than those of the normal and general trend for each of these N-form and regions. According, they excluded from the calculations of their general averages (Table 2 and Fig. 4). Based on the seasonal variations of different N-forms, the minimum levels were found mainly in September (autumn) for Region A and during spring or summer for Region B. whereas, the maximum during May or July for Region A, but it was not clearly distinct for Region B.

Based on the annual averages, the abundance of inorganic nitrogen forms were in the order NO_3>NH_4>NO_2 for region A and NH_4 > NO_3 > NO_2 for Region B. The levels of these N-forms in the surface coastal water of Region B are comparable with those characterizing the oligotrophic and mesotrophic water bodies. Whereas, those in the other part of Suez Gulf (Region A) are comparable to those characterizing eutrophic water. These reflects the efficient role of discharged sewage and industrial effluents in providing and enrichment of Region A with different nitrogen forms. In oligotrophic water, the concentrations are about 0.5µM for each of NH_4 and NO_3 (Vucak Skrivanic & Strin, 1982). Whereas, in eutrophic waters, the concentrations are usually 2.0 µM NH_4-N and 4.0 µM NO_3-N (Franco, 1983). Through calculations the present data showed also big differences between TN and DIN values especially in Region B. Since DIN constituted 46 and 6.0% of TN in Regions A and B respectively. This may suggest that nitrogen is found in Suez Gulf coastal waters, principally in organic form which is quite in accordance with the general understanding of phytoplankton dynamics where NH_4, NO_2 and NO_3 are rapidly processed by phytoplankton and other components of the microbial food web. Meanwhile, the organic nitrogen is assimilating by aquatic organisms in a much slower rate than those of the inorganic species (Riley & Chester, 1971). Faganeli (1983) stated that, in the eutrophic Bay of Koper (North Adriatic) the relative composition of TN are 11.3% for particulate, 68.8% for dissolved organic and 20.1 for the inorganic forms. The levels of DIN obtained during the present investigation are noticeably higher in Region A and lower in Region B than those outlined above coincided with the relative amounts and effect of different land based sources on each of the two regions.

On the other hand, the level of reactive phosphate in both regions are generally very low. These levels were always below 0.10µM PO_4-P, few exceptions of relatively higher levels were found stations Su2 during January and July (0.20 and 0.44µM PO_4-P), Su3 during July (0.13 µM PO_4-P) from Region A and Su4 and Su5-a during July (0.13 and 0.12µM PO_4-P), Su7 during January, March, July and September (4.80, 0.11, 0.13 and 0.13µM PO_4-P) Su9 and Su10 during July (0.25 and 0.12µM PO_4-P), respectively from Region B. The value 4.80 µM PO_4-P was found too much high and not representing the general trend of phosphate concentrations at Su7 accordingly it excluded from the calculations of general averages Region B.

These findings may be as a consequence of discharged sewage wastes into these locations. Detergents and decomposition of organic matter which is a general components of urban sewage my be the important source of reactive phosphate (EIMP, 2001). Except these locations, phosphate concentrations were almost near depletion or below the detection limit (<0,03µ M), to the extent made the N/P ratios varied with respect to that of Redfield's (16.1), since they constitute 223 : 1 and 13.2 for regions A and B respectively (Table 2). This finding suggests that phosphate in region A and phosphate and/or nitrogen in region B are mostly responsible for limitation of phytoplankton growth in Suez gulf. Low phosphate contents could be associated, principally to their sorption and deposition on iron born dust conveyed to the basin from the levels of TP at stations Su7 in January, Su8 and Su10 in March were found out of range as compared to those of the common trend, therefore they excluded from the calculations of TP general average of Region B surrounding desert. Suzumura *et al.,* (2000) signified the principle effect of composition and physicochemical characteristics of natural particles on phosphate adsorption-desorption processes under various aquatic environment.

The spatial and temporal distribution pattern of TP concentrations was variable, they fluctuated between 0.38-2.33µM at Sts Su1 and Su2 in May and January, respectively, with an annual mean 1.01 µM for Region A and 0.23 µM at st Su5-a in July to 1.75 µM at Su5 and Su7 in March and September with an annual mean 0.87 µM for Region B.

Based on the annual mean values, reactive phosphate constituted 7.0 and 5.0% of TP for Regions A and B respectively. It implies that, phosphate is present in Suez Gulf coastal waters principally in particulate and organic forms. It was reported that in natural as well as moderately polluted coastal waters, the relative composition of phosphorus forms are particulate of 28.5-98% colloidal of 1.2-4%, reactive phosphate of 0.1-22% and dissolved organic of 0.1-6% of TP (compiled from numerous sources, basically, from Nalewjko & Lean 1980).

The level of reactive silicate is relatively high in Region A where the levels of N-forms are high too. They fluctuated between 0.33-5.47µM at Sts Su3 and Su2 in January and July and 0.27-1.50µM at Sts Su6 and Su8 in September giving the annual means 1.84 and 0.68µM for Regions A and B respectively.The levels of SiO_4 at stations Su7 in January, Su11 in May, Su5-a and Su5 in September were found out of ranges and average calculations (Fig. 5). The seasonal distribution pattern of different nutrient salts are not clearly distinct, since the rate of human impact are varied with time on Region A and the levels for each of these nutrients are relatively very low for Region B.

Abdel Fattah (1992) stated that the nutrient levels in the northern part of Suez Gulf and nearby area of the Suez Canal were fluctuated between 0.21-25.21µM for NH_4-N, 0.09-2.00µM for NO_2-N, 0.43-18.0µM for NO_3-N and 0.11-4.32 µM for PO_4-P. These levels are more or less, comparable to those of N-forms and too much high for PO_4 than those of the present study. They revealed that, no big changes in the amounts of N-forms released from fertilizer industry into the Bay, whereas the amounts of PO_4 coincided with sewage discharges are sharply decreases as compared to those of the last decade.

In Region A statistically, correlation matrices showed highly positive associations between different nitrogen forms, implies that the main source for each of them are the same. Water temperature was concluded significantly positive with NO_2 and negative with each of DO and transparency (r=0.58, -0.82 and -0.50, respectively). Reactive silicate was associated negatively with each of DO and transparency and positively with each of NO_2 and PO_4 (r=-0.56, -0.73, 0.56 and 0.64, respectively). Total suspended matter was associated positively with each of NH_4 and NO_2 (r=0.76 and 0.62 respectively). They revealed the increasing levels of the nutrients at turbid waters of relatively less DO concentration. Factor analysis treatment revealed the presence of three factors affected the water quality of this region, the first one represented by DO respective water temperature and transparency (constituted of 91,84 and 74% respectively of their total effect) as physical conditions and SiO_4, NO_2 and TP(constituted 89,53 and 51% respectively). The second one was dominated by 5‰ ,PH and transparency (constituted 89, 72 and 59%respectively) and the third one was associated with NH_4, NO_3, TN, PO_4 and transparency (constituted 86, 70, 76, 54 and 71% respectively). These conditions reflect the complicated system of Region A which subjected to different types of untreated wastes throughout the year.

In Region B; significant relationships where found between NH_4 and each of PO_4 and TP(r=0.99 and 0.82, respectively), SiO4 and NO_3 (r=0.65), TSM with each of DO, NH_4, PO_4 and TP (r=0.59, 0.85, 0.85 and 0.66 respectively). Meanwhile, the principal components that affect water quality of this region were TSM, DO, NH_4, NO_2, TN, PO_4 and TP (constituted 87, 59, 94, 51, 53, 94 and 84% respectively) as the principle factor. Water temperature, DO, NO_3 and SiO4 (Constituted 77, 67, 74 and 67%, respectively) as the second factor.

Due to the high fertility of Region A, it can be considered as an essential area which provide the whole Suez Gulf with different biological life. The harmful effect of fertilizer and domestic effluents conveyed to this region was demonstrated by Abdel Fattah (1992). He reported that the 72 hr LC50 of fertilizer and domestic effluents for Mugil seheli Juveniles, under the Suez Bay conditions, were 2.32 and 38.8% dilution for each of them respectively. Accordingly, a proper treatment of these effluents are highly desired before their disposal into this Region.

CONCLUSION

* The data obtained during the present study signified that the northern side of Suez Gulf is locating under stress due to the discharge of untreated domestic and industrial effluents, so the condition at this part is highly eutrophic and completely different from that found in the rest of the Gulf, which is fluctuating between oligotrophic to mesotrophic states like that of the proper Red Sea waters. Accordingly they must be considered separately.

* Due to the fish fertility of Region A it can be considered as an essential area which provide the whole Suez Gulf with different biological life. But where as the harmful effects of the increase of demonstic industrial effect, reached this area are principally, responsible for sharp decreasing in the stock assessment total catch of many fish species. Accordingly proper treatment of these effect are highly designed before their disposed into this Region.

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