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DISTRIBUTION OF NUTRIENT SALTS IN THE COASTAL EGYPTIAN MEDITERRANEAN WATERS AFTER 30 YEARS OF THE HIGH DAM ERECTION

BY

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Key Words: Marine Chemistry, Nutrient salts, Mediterranean.

ABSTRACT

The level of the nutrients (NH_4, NO_2, NO_3, TN, PO_4, TP and SiO_4) along the water column of 34 stations, distributed in seven sections perpendicular to the Egyptian cost-line in a belt area of depths < 60m, extending between El-Arish (north of Senai Penensula) and Mersa Matruh sectors were studied during the autumn of 1994. The data obtained indicate that the belt area can be classified into two main parts one is the western side (west of Alexandria) area sustained relatively higher NH_4, NO_3, TN, PO_4 and TP and lower NO_2 and SiO_4 contents than the other eastern part. This reflects the probable efficient role of upwelling movements occurring in the western side in providing this area with nutrients. Surprisingly, Mersa Matruh sector sustained relatively higher nutrient levels associated with large amounts of sewage discharged into this area. Also the abundance of the N-species in the studied area is generally in the order: organic-N >> NH_4-N> NO_3-N >NO_2-N reflecting the preference of the phytoplankton organisms for uptake of NO_3 than NH_4 for their N-assimilation, or in other words the rate of the NO_3 supply is much less than its consumption rate. In addition the PO_4 is the most depleted one among the other nutrients to the extent makes the TIN/DRP and Si/DRP ratios become extremely higher with respect to the of Redfileds ratio (16:1), suggesting that the area under investigation is strongly P-limited.

Moreover, the level of the nutrients compared with those previously made in the same area of study and in the Eastern Mediterranean waters indicates a noticeable declination with time, mostly due to the continuous decrease of the Nile water discharge to this coastal area in front of Egypt. This also interpretates the statement of its oligotrophicy.

INTRODUCTION

The River Nile before 1964, i.e. before the construction of Aswan High Dam, used to contribute of $34x10^9$ m^3 of fresh water to the Mediterranean Sea during the flood period between August and November every year (Morsi, 1994). As the result, the discharge was extending northward to about 100 km north of the Nile delta and more westwards affecting, as far as, the coastal area off Palastine and Lebanon (Sharaf El-Din, 1977). This has led to observed peaks in the concentrations of the nutrients and in the plankton standing crop in the Mediterranean areas affected by the Nile discharge (Halim *et al.*, 1967). However, after the damming of most of the Nile water in front of the High Dam, the amount of the discharged fresh water to the sea has sharply declined to reach values < 12×10^9 m^3/y (Dowidar, 1983), leading to a considerable drop in the amount of nutrients and fish production and a considerable change in the hydrographical features of the Mediterranean waters off the Egyptian coast (Dowidar, 1965 and 1983; Halim *et al.*, 1967; Hassan, 1969; Emara, 1969; El Rayis, 1973 and Sharaf El-Din, 1977). Such drops attracts the attention of many scientists to follow up and to monitor the change in the water quality of this Mediterranean waters and to see the impacts on the productions. Therefore a condensed sampling programme for the water and other abiotic and biotic matter from the whole Egyptian Mediterranean waters was suggested. This plan was partly conducted in 1984 (Moustafa, 1985; Abdel Moati and Said, 1987 Morsy; 1994).

The present work is a result of the secondary monitoring programme conducted in autumn 1994 i.e. after 10 years of the first sampling programme. The present paper concerned with the evaluation of the current levels and spatial distribution pattern of nutrients in the Egyptian coastal waters extending from El-Arish (north of Senai penensula) at the east to Mersa Matruh from the west. The nutrients studied are; the N-species, NH_4, NO_2 and NO_3 as well as phosphorus, silicate and total phosphorus and total nitrogen.

MATERIAL AND METHODS

Seven sections, representing different parts of the coastal belt were selected, their positions are shown in Fig. 1. The Mediterranean shore belt area extending between 27 °E and 33 °E and of depths less than 60m in front of the Egyptian coast line is the area under investigations. Each section is perpendicular to the Egyptian coast. Four in front of Abu Qir Bay (sts. 1-3), Lake Burullus (sts. 4-8), Damietta (sts. 9-13), and Lake Bardawil (sts. 14-19) (these stations are lying on the Nile Delta, east of Alexandria). The other three sections are Arab Bay (sts. 20-24), Ras El Hekma (sts. 25-28) and off Mersa Matrouh (sts. 30-34) (stations relatively far from the Nile effect and lie west of Alexandria). Surface as well as subsurface water samples from 10, 20 and 50 m levels, depending on the depth at each station were collected using Nikin's bottle. The nutrients NH_4, NO_2, NO_3, PO_4 (dissolved reactive phosphate, DRP) and silicate were measured in the filtered water samples (after filtration, using 0.45 μm membrane filters), following the procedures of Strickland and Parsons (1975). Total nitrogen (TN) and total phosphorus (TP) were commenced but on unfiltered water samples according to the method described by Valderrama (1981). This means that the TN = TIN + Dissolved and particulate organic-N and TP= DRP + DIP + Dissolved and particulate organic-P.

RESULTS AND DISCUSSION

The distribution of NH_4, NO_2, NO_3 and TN as well as TP and SiO_4 in the surface 10, 20 and 50m levels in the waters of the Mediterranean coastal belt area, extending between Arish and Mersa Matruh are given in Figs. 2(a-f). Their average values in the whole water column at each of the different stations and the sectors are given in Table 1.

Nitrogen compounds:

a- Horizontal distribution

The distribution of NH_4 at different water levels (Fig. 2-a) was rather patchy, each zone had its own characteristic feature. Surprisingly the relatively high NH_4 contents found at certain locations were accompanied with lower nitrite and nitrate concentrations. This may suggests occurrence of ammonification and denitrification processes in this area. Addition of NH_4 as an

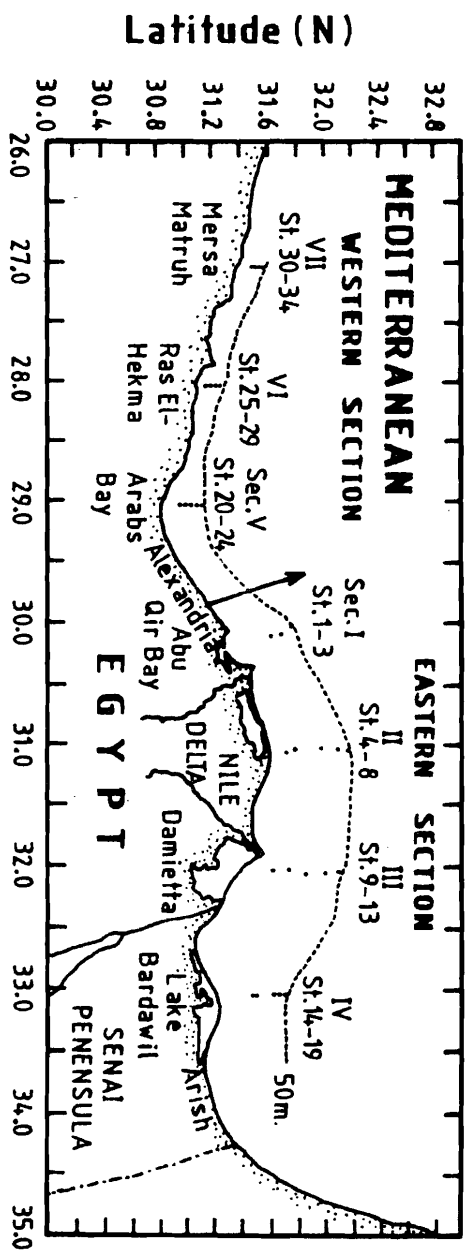


Fig. 1. Study area (Mediterranean Sea belt area off the Egyptian coast line) and position of stations.

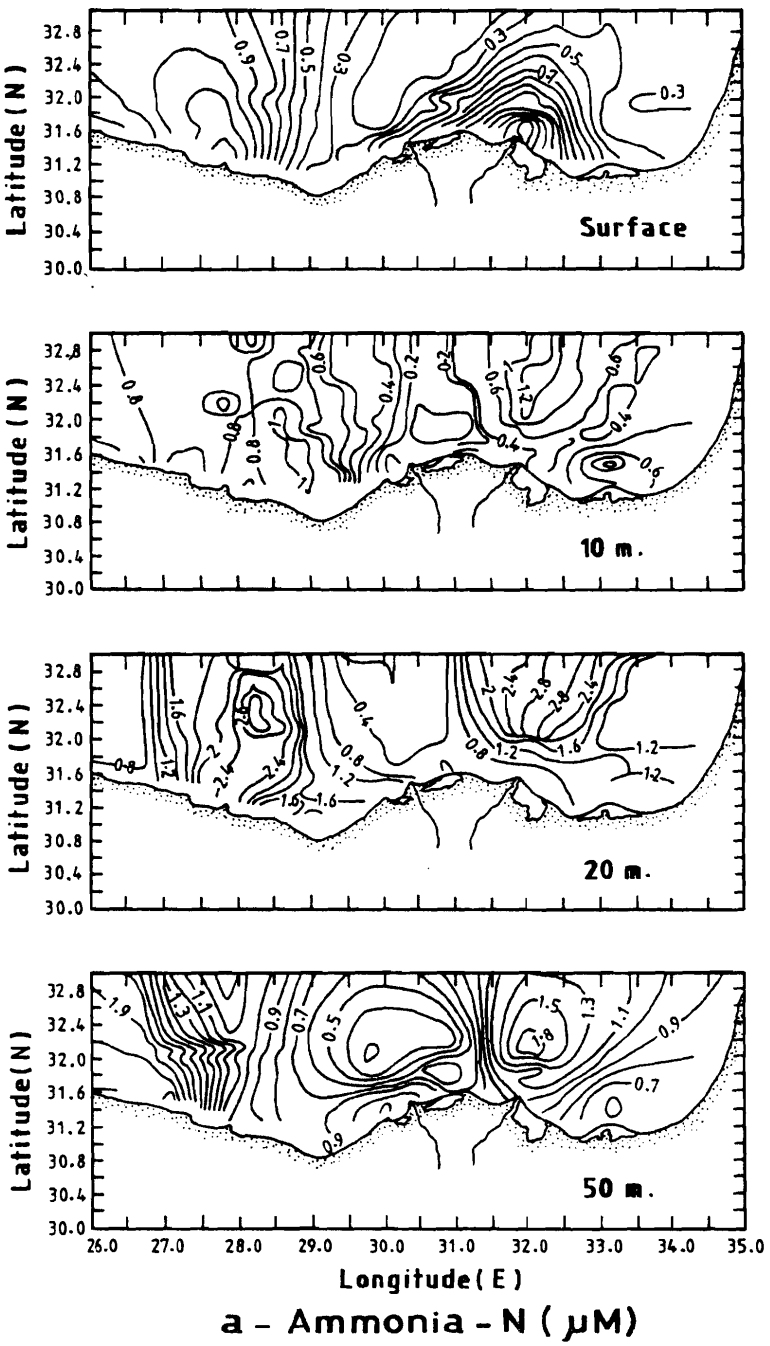


Fig. 2(a-f). Horizontal distribution of nutrients (µM) at different levels of the Egyptian, Mediterranean coastal waters during autumn 1994.

Table 1. Water column and sectional average values as well as the range of absolute readings for each section, of the nutrients ($\mu M.l^{-1}$) in the Mediterranean coastal belt waters off Egypt extending from Arish to Mersa Matruh during Autumn 1994.

Section No.	Stations (Depth m)	NH_4	NO_2	NO_3	TIN	TON	TN	DRP	TP	SiO_4
Eastern Area										
Off Abu Qir Bay	1 (50)	1.43	0.01	0.37	1.80	2.8	4.6	0.01	0.23	2.7
I	2 (50)	ND	0.03	0.29	0.32	1.0	1.3	ND	0.09	1.0
	3 (50)	0.31	0.01	0.43	0.74	0.5	1.2	ND	0.05	0.9
	Mean	0.57	0.02	0.36	0.95	1.5	2.4	0.00	0.12	1.6
	Range	ND-2.10	ND-0.11	0.22-0.70	0.22-2.63	0.1-3.8	0.7-6.1	ND-0.02	ND-0.30	0.6-4.3
Off L. Burullus	4 (10)	0.40	0.01	0.31	0.71	0.2	0.9	ND	0.06	1.6
II	5 (20)	0.32	0.01	0.51	0.83	0.4	1.2	ND	0.05	1.7
	6 (50)	0.29	0.01	0.18	0.45	1.4	1.8	ND	0.04	1.9
	7 (50)	0.67	0.07	0.10	0.84	1.2	2.0	ND	0.05	1.8
	8 (50)	0.17	0.01	0.33	0.51	2.3	2.8	ND	0.03	1.0
	Mean	0.37	0.02	0.29	0.68	1.0	1.7	ND	0.05	1.6
	Range	ND-1.24	ND-0.18	0.05-0.94	0.07-1.83	0.1-3.3	0.7-3.6	ND-0.01	ND-0.14	0.1-3.1
Off Damietta	9 (10)	0.35	0.02	0.25	0.62	1.7	2.3	ND	0.09	3.9
III	10 (20)	0.76	0.01	0.16	0.93	1.5	2.4	ND	ND	1.9
	11 (50)	1.17	0.03	0.14	1.34	3.7	5.0	ND	0.02	0.6
	12 (50)	0.65	0.02	0.28	0.95	4.9	5.8	ND	ND	1.6
	13 (50)	2.01	0.11	0.08	2.19	2.6	4.8	ND	ND	1.1
	Mean	0.99	0.04	0.18	1.21	2.9	4.1	ND	0.05	1.8
	Range	0.05-3.21	0.01-0.36	ND-0.49	ND-3.47	0.3-5.7	0.9-6.8	ND-0.01	ND-0.12	ND-4.9
Off L. Bardawil	14 (10)	0.76	0.02	0.07	0.85	3.8	4.6	ND	0.02	2.1
IV	15 (20)	1.34	0.02	0.07	1.43	3.1	4.5	ND	ND	0.9
	17 (50)	0.59	0.02	0.10	0.72	3.8	4.5	ND	0.01	1.4
	18 (50)	0.35	0.02	0.08	0.46	1.8	2.3	ND	ND	1.2
	19 (50)	0.10	0.03	0.10	0.23	3.4	3.6	ND	ND	2.0
	Mean	0.63	0.02	0.08	0.74	3.2	3.9	ND	0.01	1.5
	Range	ND-1.75	0.02-0.03	0.02-0.19	0.09-1.91	0.2-6.6	0.8-8.4	ND-0.01	ND-0.4	ND-3.5
	Area Mean	0.64	0.02	0.23	0.89	2.10	3.00	ND	0.04	1.6
	±SD	0.26	0.01	0.12	0.51	1.36	1.58	0.00	0.05	0.1
	Range	ND-3.21	ND-0.36	ND-0.94	0.07-3.47	0.1-6.6	0.7-8.4	ND-0.02	ND-0.30	ND-4.9

Table 1 (Cont.)

Table 1. Water column and sectional average values as well as the range of absolute readings for each section, of the nutrients ($\mu M.l^{-1}$) in the Mediterranean coastal belt waters off Egypt extending from Arish to Mersa Matruh during Autumn 1994.

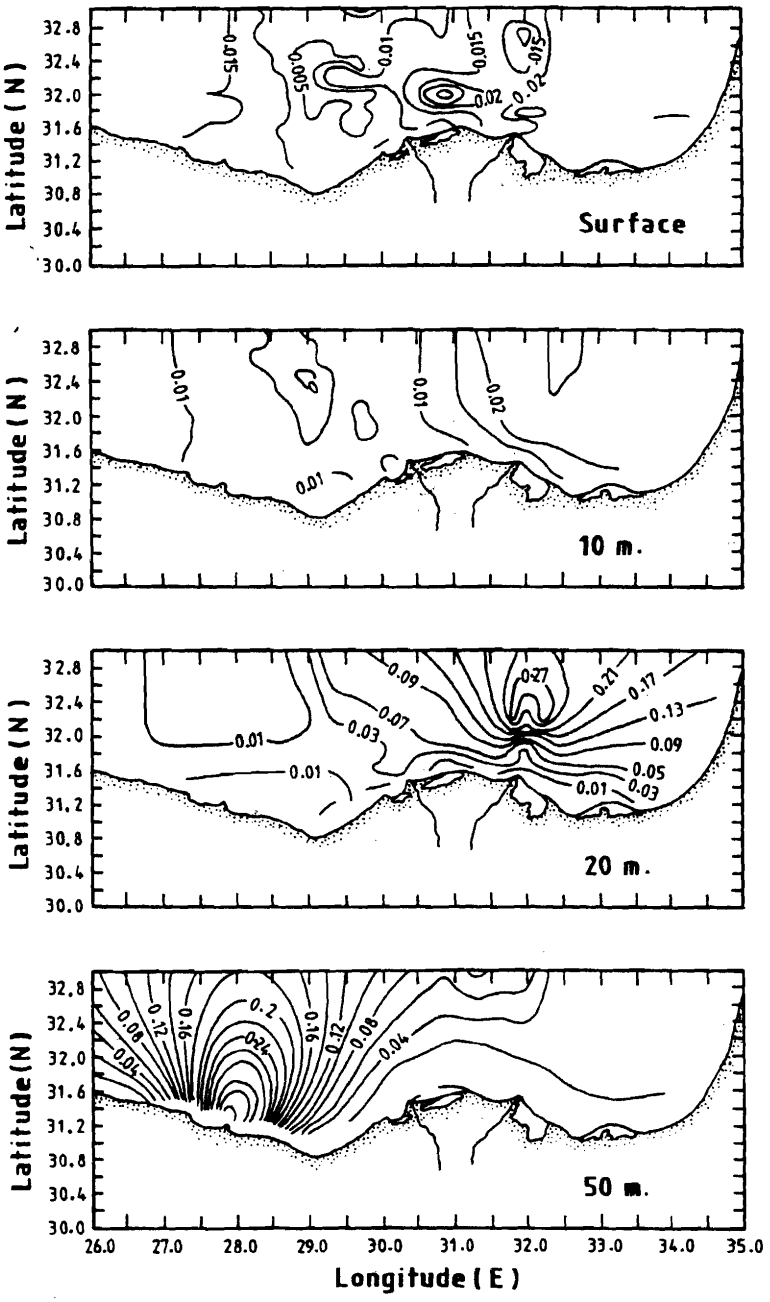
Section No.	Stations (Depth m)	NH_4	NO_2	NO_3	TIN	TON	TN	DRP	TP	SiO_4
Western Area										
Off Arabs Bay	20 (10)	0.97	0.01	0.60	1.59	0.2	1.8	ND	0.13	1.2
V	21 (20)	0.67	0.01	0.43	1.11	1.2	2.3	ND	0.01	1.3
	22 (50)	0.56	0.01	2.10	2.68	3.0	5.7	ND	0.06	1.2
	23 (50)	1.19	0.01	0.66	1.87	5.1	7.0	ND	0.05	1.2
	24 (50)	1.10	0.01	0.51	1.63	0.2	1.8	ND	0.08	1.7
	Mean	0.90	0.01	0.86	1.77	1.9	3.7	ND	0.07	1.3
	Range	0.07-2.57	0.01-0.02	0.02-3.95	0.17-5.20	0.0-12.7	0.6-14.0	ND	ND-0.26	0.8-1.9
Off Ras- El- Hekma	25 (10)	0.48	0.02	0.08	0.58	1.3	1.9	ND	0.08	1.3
VI	26 (20)	0.58	0.01	0.04	0.63	1.2	1.8	ND	0.07	1.5
	27 (50)	1.42	0.01	0.29	1.72	12.9	14.6	0.01	0.09	1.6
	28 (50)	1.63	0.01	0.04	1.68	10.4	12.1	0.04	0.07	1.5
	Mean	1.03	0.01	0.11	1.15	6.5	7.6	0.03	0.08	1.5
	Range	0.29-4.17	ND-0.02	ND-0.72	0.30-4.21	0.3-25.2	1.5-27.4	ND-0.13	0.02-0.16	1.2-1.9
Off Mersa Matruh	30 (10)	0.96	0.01	0.41	1.38	12.7	14.1	0.02	0.06	1.7
VII	31 (20)	0.99	0.01	0.02	1.03	3.2	4.2	0.02	0.12	1.4
	32 (50)	0.96	0.01	0.23	1.20	7.0	8.2	0.03	0.27	1.3
	33 (50)	0.89	0.01	0.02	0.92	2.2	3.1	0.04	0.57	1.2
	34 (50)	1.48	0.01	0.15	1.64	1.8	3.3	0.06	0.73	1.0
	Mean	1.06	0.01	0.16	1.23	5.4	6.6	0.03	0.35	1.3
	Range	ND-2.86	0.01-0.02	ND-0.81	0.01-3.16	0.0-25.3	1.2-26.9	ND-0.07	0.02-1.07	0.6-2.2
	Area Mean	0.99	0.01	0.38	1.39	4.60	6.00	0.03	0.16	1.4
	± SD	0.07	0.00	0.38	0.55	4.35	4.51	0.00	0.05	0.1
	Range	ND-4.17	ND-0.02	ND-3.95	0.01-5.20	0.0-25.3	0.6-26.9	ND-0.13	ND-1.07	0.6-2.2

excretory product of the authogenic aquatic organisms especially zooplankton to the ambient water could be a possible mechanism (Aboul Kassim, 1987).

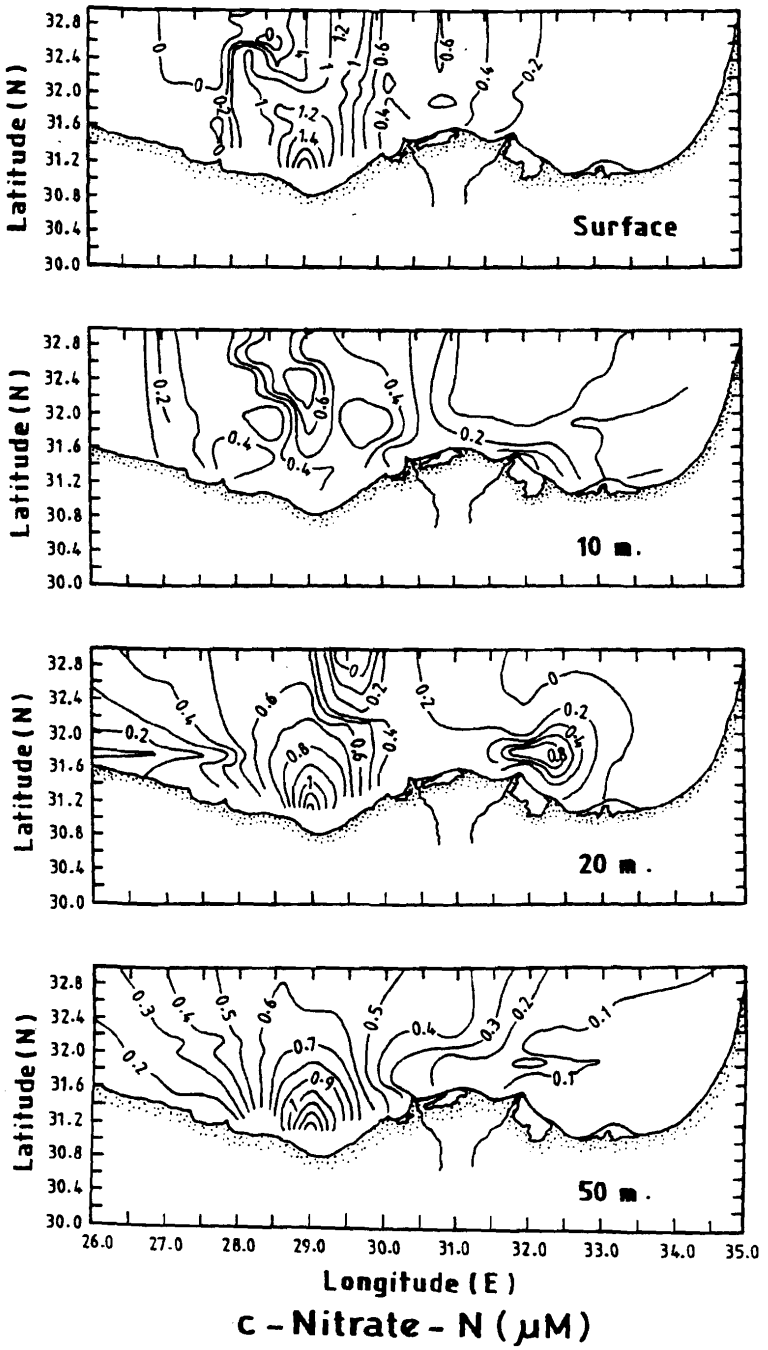
NO_2 was detected only at certain locations. It showed zonation features e.g. at 20 and 50m water layers (Fig. 2-b). Most of NO_2 values > 0.1 $\mu M\ N.l^{-1}$ were detected in the water layer at the level of 20m depth at the eastern side of study area.

NO_3 showed the same pattern of distribution as NO_2, in which it was discontinuous at the upper 20m and showed zonation below this layer, with a noticeable decrease in the concentrations eastward in the eastern side and westward in the western side of study area (Fig. 2-c). Abu Qir (sector 1) at the eastern side and Arabs Bay (sector 5) at the western side sustained the highest nitrate concentrations among the other sectors. This observation could be resulted mostly from the inflowing waters continuously discharge to these regions as indicated from the decreasing NO_3 concentrations away from them (Table 1). Low NO_3 levels were detected at surface and subsurface waters of some locations and could be attributed to the sedimentation processes as justified from the lower values of particulate materials detected in the water column of the present study. Based on the above, NH_4 is more abundant in the eastern and western parts than $NO_3 >> NO_2$, reflecting preference of the uptake of NO_3 than NH_4 by the phytoplankton organisms as N-source (El Rayis, 1993)

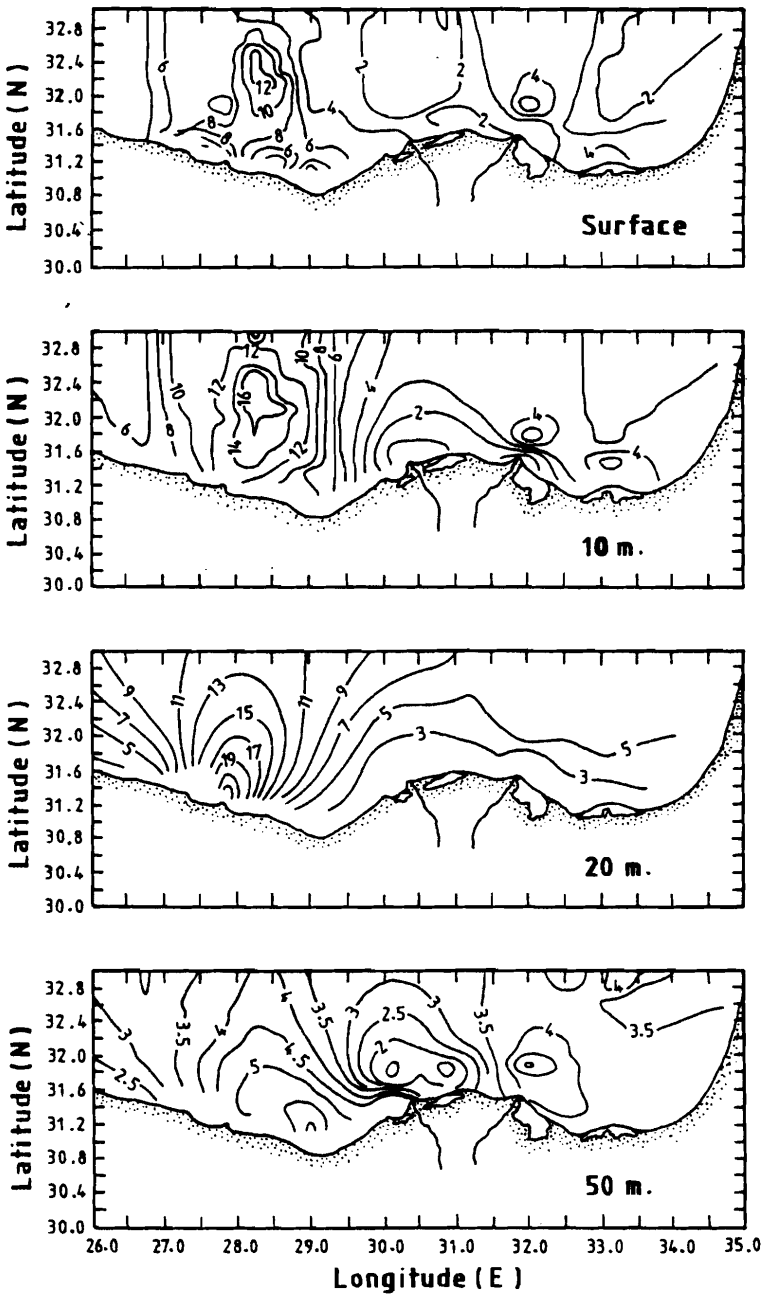
The absolute surface values of total nitrogen (TN) in the eastern side fluctuated between 6.3 μ M $N.l^{-1}$ at st. 12 of Damietta and 0.8 $\mu M\ N.l^{-1}$ at st.3 of Abu Qir. However, in the western side, these values varied between 26.9 $\mu M\ N.l^{-1}$ at st. 30 of Mersa Matruh sector and 0.6 $\mu M\ N.l^{-1}$, at st. 24, the offshore water of the Arab's Bay sector. i.e. the level of TN is higher in the western side than in the eastern side of the coastal belt area (Fig. 2d). This could attributed to occurrence of upwelling phenomenon noticed in this particular zone of the belt area (NIOF, 1995). Total organic-N (dissolved and particulate) is calculated from the difference between TN and TIN ($\Sigma NO_3 + NO_2 + NH_4$) and is also shown in Table 1. Its values ranges from 0.1 to 6.6 and 0.0 to 25.3 with a mean value of 2.1 and 4.6 μM^{-1} at the eastern and western sides, representing 70 and 77% of the TN respectively. This is because the organic nitrogen seems assimilated by aquatic organisms in a much slower rate than that of the inorganic species. Some organic matter containing nitrogen usually resists



b - Nitrite - N (μM)



c - Nitrate - N (μM)



d - Total nitrogen (μM)

bacterial attack and remains in the water or sink to the sediment as bottom humus (Riley and Chester, 1971).

b- Vertical distribution

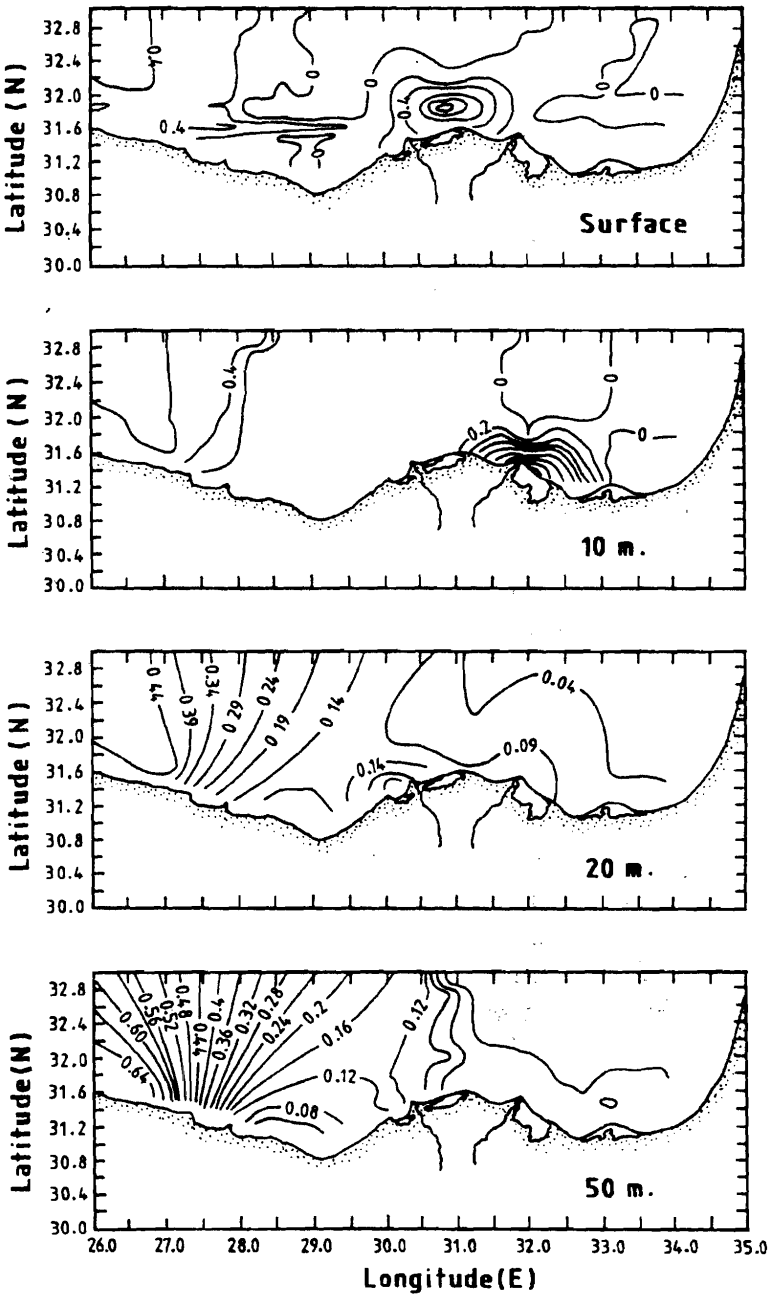
Vertically, the distribution pattern of nutrient along the Egyptian coast line is mainly presented in the coastal and middle zones of each section(Fig.3), to define the role of the present run-off from the different outlets on the coast. The vertical NO_3 distribution was, more or less, homogeneous in all cases except, the middle zone of Arabs Bay which maintained the highest NO_3 concentrations in their surface and 50m water layers. The effect of land run-off was significant on Abu Qir Bay from the eastern as indicated from the relative increase of NH_4 and TN contents in its surface coastal water, there is a general decrease in the concentrations seaward as well as with depth in the upper 20m layer. An interesting feature was found in the western area when Mersa Matruh coastal water sustained relatively the highest TN content in the surface then decreased sharply with depth in the upper 10m layer. This is often associated with sewage discharge in large quantities (Joze Stirn, 1988), since Mersa Matruh is received the attention and became one of the main summer resort in Egypt. A layer of TN enhancement was also detected at 10m level of the middle zone of Mersa Matruh and Ras El-Hekma and 20m level of the off shore water of Ras El Hekma (Fig. 3).

Phosphorus compounds (DRP and TP)

Most of the concentrations of DRP in this area of the Mediterranean Sea were almost depleted or below the detection limit. Ras El Hekma and Mersa Matruh sectors of the western side are the ones have detectable amounts of the DRP of 0.01 μMl^{-1}. On the other hand TP shows mean values ranged from 0.02-0.72 μMl^{-1} (Table 1).

a- Horizontal distribution of TP

The horizontal distribution of TP (Fig. 2-e) shows a seaward decrease in the concentrations in the eastern side and coastward in the western side of the coastal belt area. Abu Qir coastal water (st. 1) harboured the highest TP contents in its surface and 20 m levels (0.24 and 0.30 $\mu M\ P.l^{-1}$ respectively). This can be attributed mostly to the external discharges as reflected from the gradual decrease demonstrated away from this location. Relatively, high concentrations recorded in the middle and deep waters can be related to the



e- Total phosphorus(μM)

precipitation of phosphate compounds from the surface layer (Lucotte and D'Anglejan, 1983). Moreover, the exchange between bottom sediments and the overlying water could be possible mechanism leading to the observed increase of TP in the deep waters. Values below detection limits were recorded mainly at Damietta and El Bardawil sectors. This can be resulted from the adsorption of phosphorus particularly on iron and aluminum hydroxides which considered as an abiotic process responsible for the depletion of phosphate compounds from the water column (Lucotte & D'Anglojan, 1983). In the Mersa Matruh sector (at the western side) seems to sustained the highest TP contents particularly in the surface water of st. 33 (0.55 μM $P.l^{-1}$) and at the 10m level of st. 34 (1.07 $\mu M.P.l^{-1}$). It seems likely that the upwelling movements measured in this area may be responsible for these high values, by bringing up some of the deposited matter containing-P.

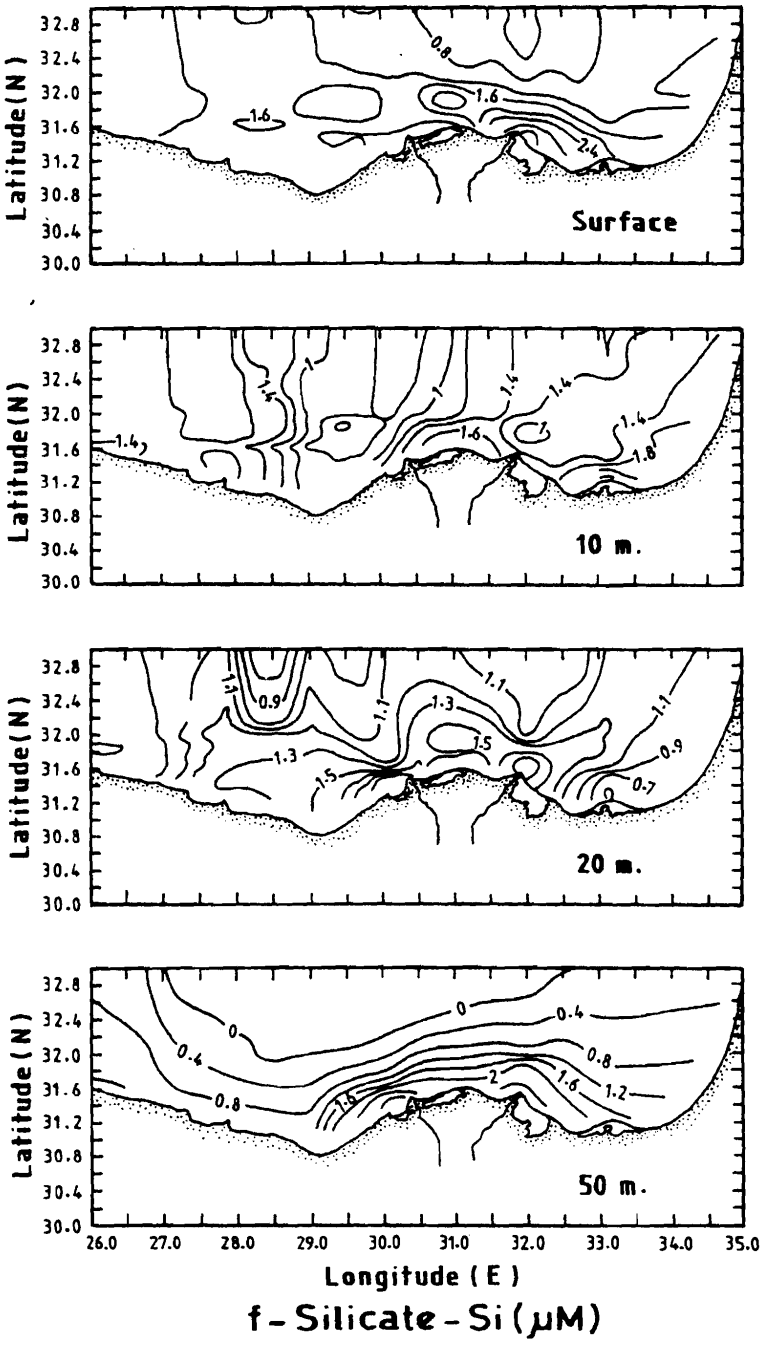
b- Vertical distribution of TP

The vertical distribution of TP (Fig. 3) showed elevated values in the upper 20m layer of Abu Qir and 50m layer of the middle and offshore waters of Mersa Matruh sector. These reflect the effects of land run off on Abu Qir Bay and the upwelling movement recorded at Mersa Matruh (NIOF, 1995).

Reactive silicate (SiO_4)

a- Horizontal distribution:

The horizontal distribution of SiO_4 showed a trend of zonation pattern at the upper 20m layer and parallel stratification to the coast at 50m depth with decreasing concentrations seaward (Fig. 2-f). In the eastern side, the coastal water in front of Lake Manzalah (st. 9) sustained the highest surface SiO_4 content of 4.9 μM $Si.l^{-1}$, coincided mainly with silicate enriched inflowing Lake waters Morsy (1994). High value of 3.1 $\mu MSi.l^{-1}$ was also recorded at the middle zone (st. 6) of Burullus sector. In the western side, the coastal water of Mersa Matruh sector (st. 30) harboured the highest surface SiO_4 content (2.2 μM $Si.l^{-1}$), a trend of decreasing concentrations seaward is observed (Fig.4).



f - Silicate - Si (μM)

b- Vertical distribution:

Vertical variation in SiO_4 concentrations was obvious, reached its maximum value of 4.3 μMl^{-1} at 50m depth of Abu Qir coastal zone (st. 1). High value, 3.5 μMl^{-1}, was also obtained at 50m level for the offshore water of Bardawil sector (st. 19). Regeneration of silicate from the bottom sediments and diffusion into the overlying bottom water could be responsible for these high values recorded there. SiO_4 enrichments obtained at the middle waters of certain locations may be resulted from the precipitation and dissolution of diatom frustules at the same locations. In the western, the highest vertical silicate content, 1.9 $\mu M\ Si.l^{-1}$, was found at 10m level from the middle zone of Ras El Hekma sector (st. 27).

N:P: Si ratios

Changes in the mean N:P: Si ratios for each section of the studied eastern and western parts of the coastal belt of Egypt are shown in Table 2. Generally, the mean TIN($\equiv NH_4+NO_2+NO_3$)/ DRP and Si/DRP ratios are extremely higher (> 36) than that of the Redfield ratio N:Si:P $\equiv$ 16:16:1 (Redfield *et al.*, 1963). This indicates that this area of the southeastern Mediterranean is strongly P-limited, which is in agreement with that found in the eastern Mediterranean Sea (Krom *et al.*, 1991). They also added that the degree of P-limitation in the SE-Mediterranean increases from the west to east along the entire Levantine Basin. The TIN/DRP ratios obtained in the present investigation are even higher than the recorded value (38.5) given in the area ten years ago (Dowidar and Abdel Moati, 1986). Higher ratios could be raised from the decreasing rate of phosphorus regeneration than those of nitrogen and silicon. The depletion in the PO_4-P in the area is mostly due to 1- the decrease in the amounts contributed from the River Nile as a result of the damming of the Nile water in front of the Aswan High Dam. 2- the removal of PO_4 by adsorption on Fe-rich dust particles (Krom et al., 1991). DIN/S: ratios in the eastern side fluctuated between 0.48 to 0.66 giving a mean value of 0.54 while in the other side this ratio ranged from 0.79 to 1.36 with a mean value of 1.03. Which is quite close to the normal Redfield ratio (1:1). The low ratio in the western side could be due to the effect of the upwelling processes that brings up more Si due to acceleration of the diffusion process of dissolved silica from the bottom sediments to the overlying waters.

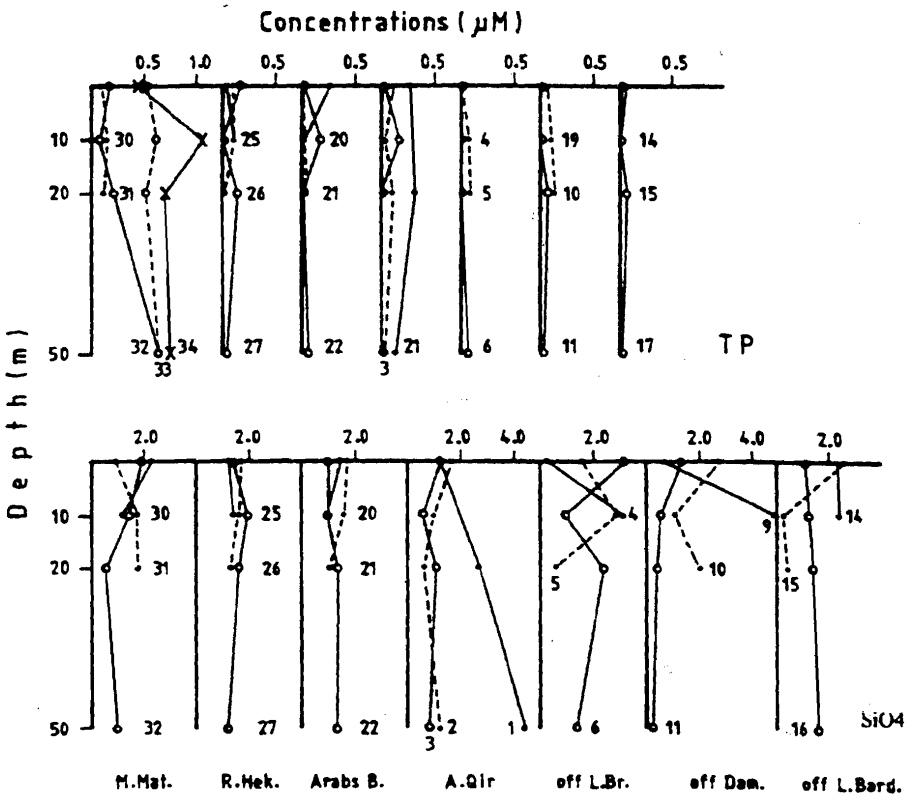
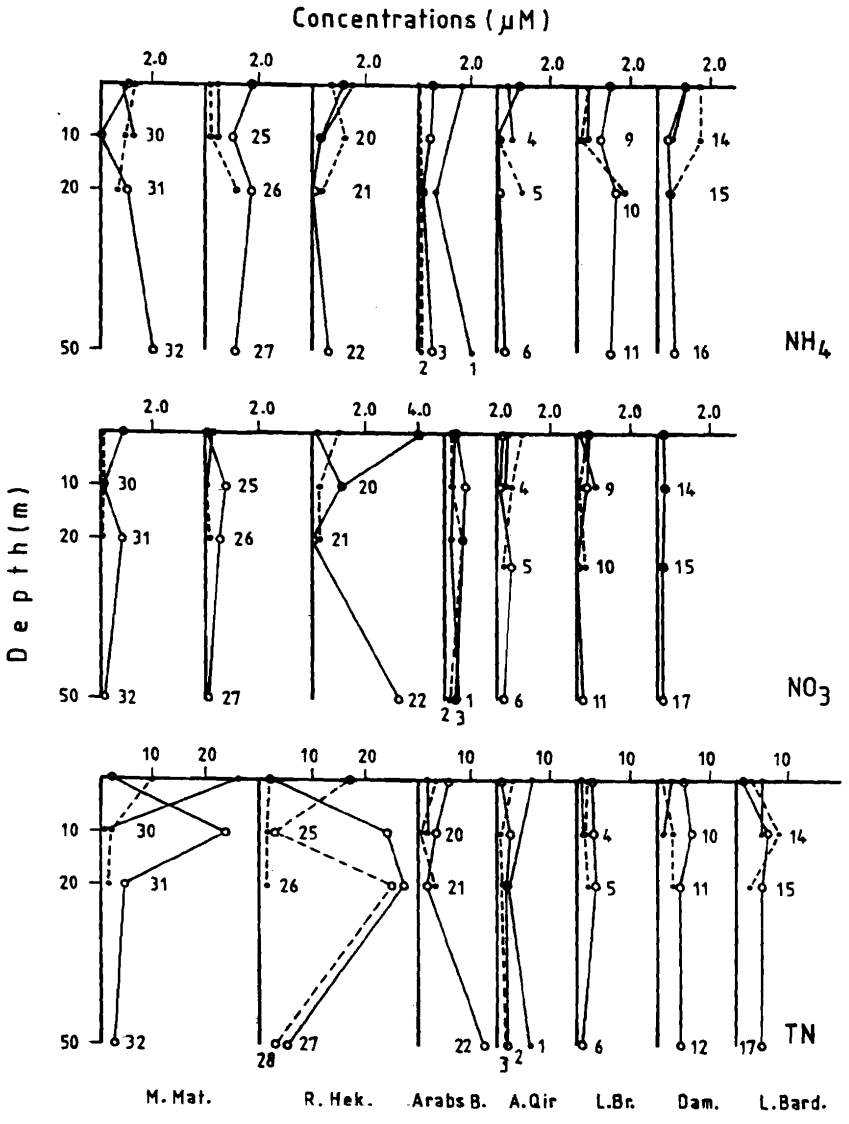


Fig. 3. Variations of the vertical nutrient level (µM) in the coastal and middle zones of each section along the Egyptian coast of the Mediterranean Sea during Autumn 1994.


Concentrations (μM)
Depth (m)
NH4
NO3
TN
M. Mat.
R. Hek.
Arabs B.
A.Qir
L.Br.
Dam.
L.Bard.

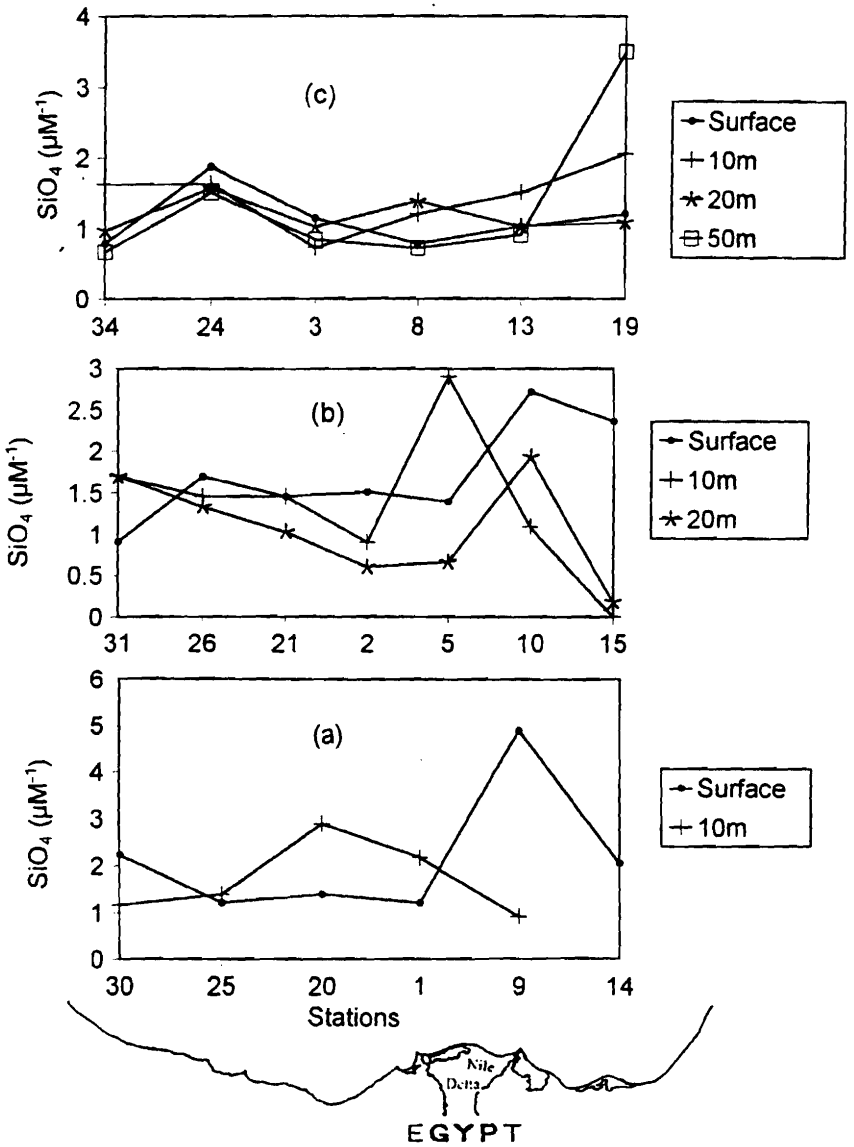


Fig. 4. Variations of SiO_4 concentrations (μMl^{-1}) in the coastal (a), middle (b) and deep stations (c) along the sections extending from El-Arish to Mersa Matruh, during Autumn 1994.

Table 2. The mean DIN/DIP, Si/DIP, DIN/Si and TN/TP ratios for the whole water column of different sections as well as for the eastern and western sides of the study area during autumn 1994.

Sections	TIN/DRP	Si/DRP	TIN/Si
Eastern area			
Off Abu Qir Bay	237	393	0.6
Off. L. Burullus	339	795	0.43
Off Damietta	1207	1820	0.66
Off. L. Bardawil	736	1520	0.48
Mean area	629.7	1132.0	0.5
Western Area			
Off Arabs Bay	---	---	1.36
Off Ras- El- Hekma	89	112	0.79
Off Mersa Matruh	36	39	0.94
Mean area	62.5	75.5	1.03

Table 3. Range and mean values of the nutrients (μM) in the Mediterranean waters off the Egyptian coast obtained during the present and previous studies as well as the mean values of oligotrophic and eutrophic waters.

Regions	NH_4	NO_2	NO_3	NH4 TIN %	TIN/TN %	DRP	TP	DRP/TP	SiO_4	References
Eastern area	ND-3.21 (0.64)	ND-0.36 (0.03)	ND-0.94 (0.23)	(72)	(30)	ND-0.02	ND-0.30 (0.05)	(4)	ND-4.9 (1.63)	Present study
Western area	ND-4.17 (1.00)	ND-0.02 (0.01)	ND-3.95 (0.38)	(81)	(21)	ND-0.13 (0.02)	ND-1.07 (0.16)	(10)	0.6-2.2 (1.4)	Present study
South east Med.	---	---	---	---	---	0.09-0.21 (0.14)	---	---	6.2-8.9 (7.9)	Halim et al., 1967
South east Med.	0.10-0.92 (0.37)	0.09-0.86 (0.29)	0.42-2.94 (1.64)	(16)	---	0.03-0.20 (0.06)	0.09-0.25 (0.16)		0.7-4.8	Morsy, 1994
NE Med.	---	0.8-3.0 (NO2+ NO3)		---		0.04-0.5	----	(38) ---	0.5-3.0	Basturk, 1988
Open Med. (upper 100 m)	---	---	< 0.05-5.34	---	---	< 0.02-0.29	---	---	---	Kremling and Petersen, 1981
Oligotrophic	0.5 [1]	---	0.5 [1]	---	---	0.05 [1]	---	---	---	1
Eutrophic	2.0 [2]	---	4.0 [2]	---	---	0.3 [3]	---	---	---	2 and 3

1. Skrivanic and Strin. 1982 2. Franco. 1983. 3. Marcheti. 1984

In order to assess the effect of the damming of the Nile water on the level of the nutrients in the Egyptian coastal waters, a comparison between the present values and those recorded in the literature were made (Table 3). The present data show a general decrease in the nutrient levels than the previous ones on the Egyptian coastal waters as well as the open Mediterranean water. It reflects also, a continuous decrease in the nutrients level of the Egyptian coast of the Mediterranean Sea with time coincided with the continuous decrease in the amount of the Nile water discharged into the sea since it is planned to divert the total surplus of flood water for agricultural purpose. Based on the data of the present investigation it is suggested that, except few locations situated under the direct effect of land run-off, the Mediterranean coastal water off Egypt is generally under oligotrophic conditions (Table 3).

CONCLUSIONS

The data of the present investigation indicated that:

1. The western side of the study area are harboured relatively higher NH_4, NO_3, TN, DIP and TP and lower NO_2 and SiO_4 contents than the other side (eastern).
2. Most of the N-compounds are present in the organic forms rather than in the inorganic ones.
3. The order of abundance of the inorganic N-species is NH_4-N > NO_3-N >>NO_2-N. The studied area shows noticeable depletion in DRP. The TIN/DRP and Si/DRP ratios are extremely high than those of the Redfiled ratios. This lead us to conclude that, the present coastal area is strongly P-limited.
4. A continuous decrease in nutrient levels of the Egyptian coast of the Mediterranean Sea was observed coincided, essentially, with the continuous decrease in the amount of Nile water discharged into the sea.
5. The area under investigation is suffering from the impoverishment with nutrients to the extent make this area in oligotrophic conditions.

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