Annual Report of Environmental Data from Coastal Areas of the Gulf of Suez, Red Sea proper and Gulf of Aqaba in ١٩٩٩

Introduction

The aim of the Coastal Water Monitoring Program (CWMP) is to establish a marine monitoring system in the Egyptian coastal waters. The CWMP is part of the EIMP, which is directed by a Steering Committee with representatives from the EEAA and Danish International Development Assistance (Danida).

The monitoring is carried out six times a year on a bimonthly basis on a total of ٣٩ stations in the Gulf of Suez (١٣), Red Sea (١٥) and Gulf of Aqaba (١١). The data presented in this report is from the whole campaigns carried out in ١٩٩٩. On each sampling campaign the following parameters are measured; visual observations (weather condition, oil pollution, and sewage impact…etc), hydrogrphical conditions (water temperature, dissolved oxygen, salinity and pH), bacteriological parameters (total *coliform*, E. *coli* and Faecal *streptococci* bacteria). Furthermore, the following eutrophication parameters (chlorophyll-a, total suspended matter, transparency, total nitrogen, nitrate, nitrite, ammonium, reactive and total phosphate and reactive silicate). All methods are carried out according international standards.

Visual observation

The visual observation on the beach revered, lumps of old tar in moderate quantities at Ras Gharib City (Su٧) and Ras Sudr (Su١٠), and in small quantities at the beach of Ras Gharib Harbour (Su٨) in the Gulf of Suez. Different quantities of thin oil films, faeces, sewage and general litter was found in Suez (Su١, Su٢ & Su٣), Ras Gharib City (Su٧). Old tars and oil contamination was restricted to the beach area of petroleum companies and /or harbor areas. Meanwhile, the coastal area of the other locations of Gulf of Suez was almost clean.

The coastal water of the Red Sea proper was found clean, except few locations, which had only slight contamination of thin oil films in Safaga (Re٨). Faeces and sewage and its related debris were observed in Gifton (Re٥).

The Gulf of Aqaba region was in general, clean except few locations with slight contamination of oil films of Sharm El- Sheikh Harbour (Aq٢) and Sharm El- Sheikh Na ama bay (Aq٣). These may be due to human activities and increasing number of ships. Faeces were found on the beach in Dahab (Aq٥) and Mersa Muqibila (Aq١٠). General litter was

found in heavely quantities at the beach of Ras Mamlah (Aq٦) and Hibeiq-Ras Naber (Aq٧). These may be due to the effect of waves and current action on these locations

Hydrographical conditions

Dissolved oxygen levels indicate high and well-oxygenated water column with a tendency towards a slight decrease in oxygen content with increasing depth. However, level of DO was never even close to being depleted throughout all measured stations during ١٩٩٩. The present data of hydrographical conditions are comparable with those of ١٩٩٨.

Bacteriological Parameters

The occurrence of pollution indicator bacteria is used as sanitary parameters for evaluation of water quality. The interpretation of the detected bacterial indicators during ١٩٩٩ was made according to Egyptian Guidelines, which accept the guide values of investigated bacteria by ٥٠٠ bacterial counts/١٠٠ml sea water for coliform bacteria and ١٠٠ bacterial count /١٠٠ml sea water for E. coli and Faecal streptococci.

In general, most of the investigated areas have relative few bacteria, however seven stations show high counts of bacteria exceeding the acceptable levels in at least one or more sampling campaigns for the presence of one or more indicator bacteria.

The Gulf of Suez showed bacterial counts within the acceptable levels in most stations except in Ras Gharib City (Su٧) which showed very high counts exceeded the acceptable levels in all bacteriological parameters throughout the year. On few occasions as El-Ataka harbour (Su٣) exceeded the acceptable level of E. coli and Coliform bacteria in November, and Faecal streptococci in October and to some extent in August. This may be due to the increasing numbers of ships in that time in the harbor. However, in public beach of Ras Suder (Su١٠) high counts of E. coli in June and Faecal streptococci in June and and to some extent August, also to some extent in Coliform in June was observed. These may be due to increase numbers of visitor in summer season (Figures ١, ٢ & ٣).

Along the Red Sea proper, the bacterial counts was in general acceptable most of the year except in Abu Shar (Re١), Quseir Middle (Re١٢) and Bir Shalatin (Re١٥). In Abu Shar (Re١) the slight increase in the levels may be due to the high numbers of tourists/ visitors. In Quseir Middle (Re١٢) level of E. coli and Faecal streptococci was very high in April, and high to some extent in Coliform bacteria in April. However, Bir Shalatin (Re١٥), showed very high counts exceeded the acceptable levels in all bacteriological parameters in June.

In the Gulf of Aqaba, only few numbers of the investigated bacteria were recorded throughout the year except in Marina Sharm (Aq٢a). Here high numbers of bacteria exceeding the acceptable levels were recorded in October and April for Coliform and E. coli, including the levels of Faecal streptococci. These findings may be explained by the large number of boats used for tourist/recreational activities anchored in the area.

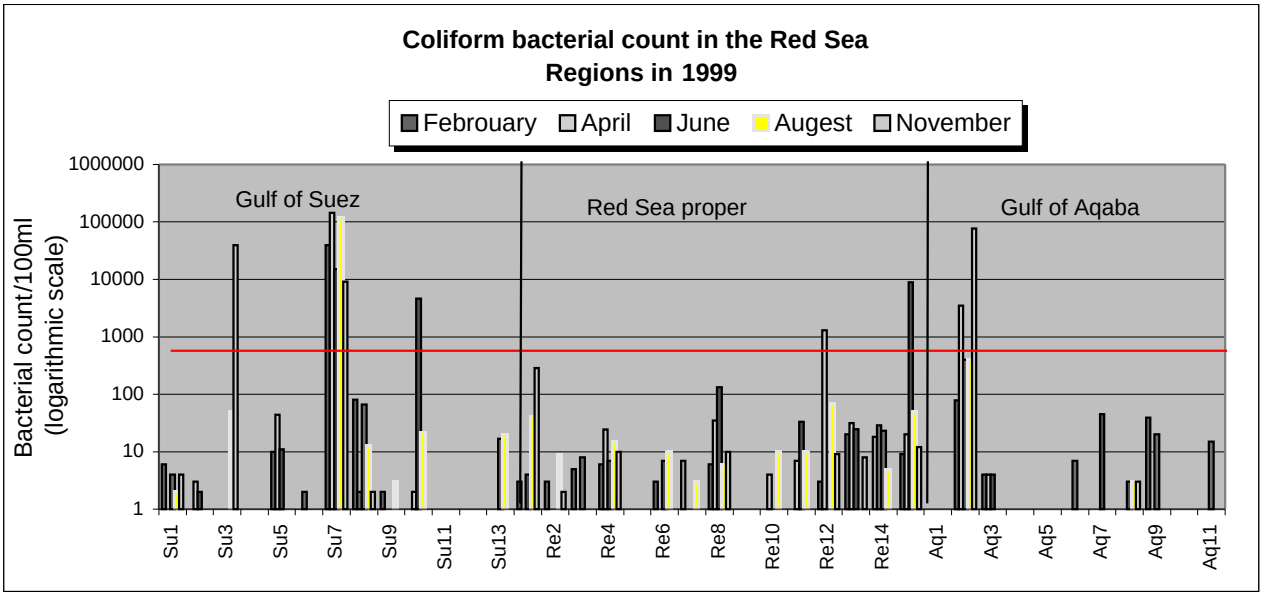

Figure ١, Coliform bacterial counts per ١٠٠ml sea water in the Gulf of Suez , Red sea proper and Gulf of Aqaba,* (logarithmic scale!) in ١٩٩٩ (*red line indicates the acceptable levels).

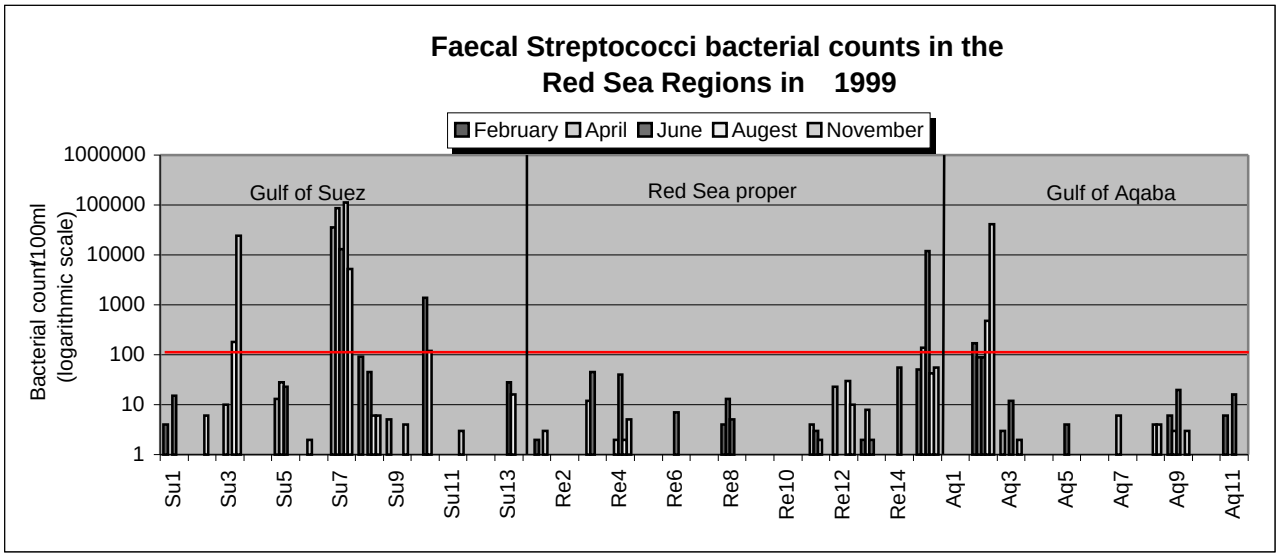

Figure ٢. Faecal Streptococci bacterial counts per ١٠٠ml sea water in the Gulf of Suez, Red sea proper and Gulf of Aqaba,* (logarithmic scale!) in ١٩٩٩ (*red line indicates the acceptable levels).

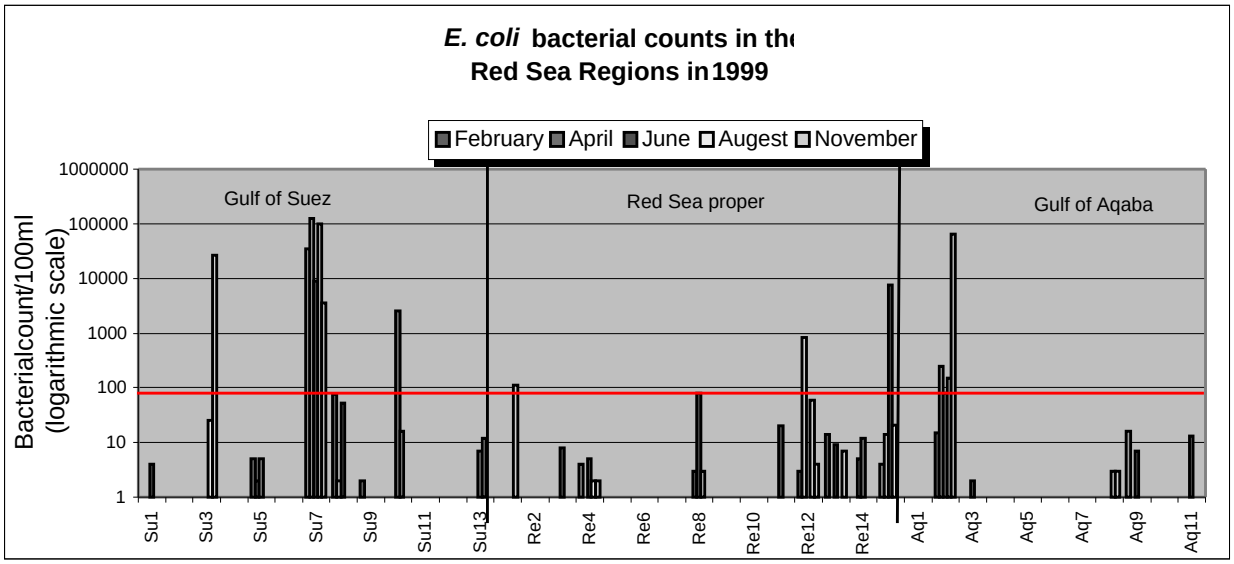

Figure ٣, E. coli bacterial counts per ١٠٠ml sea water in the Gulf of Suez, Red sea proper and Gulf of Aqaba,* (logarithmic scale!) in ١٩٩٩ (*red line indicates the acceptable levels).

Eutrophication parameters

Chlorophyll-a

In ١٩٩٩, chlorophyll-a concentration in the coastal waters of Gulf of Suez showed increased values at different sites on the stations around the urban areas of Suez City (Su١-٣) in comparison to the rest of the Gulf. The high levels of autotrophic biomass recorded in the upper part of Gulf of Suez may be explained by wastewater discharged to the area, providing nutrients favorable for the growth of phytoplankton.

Meanwhile, most stations in the Red Sea proper and Gulf of Aqaba present an oligotrophic situation with no pronounced seasonal variation. Figure ٤, represent chlorophyll-a concentration in the surface coastal water of Gulf of Suez, Red Sea proper and Gulf of Aqaba Regions in ١٩٩٩.

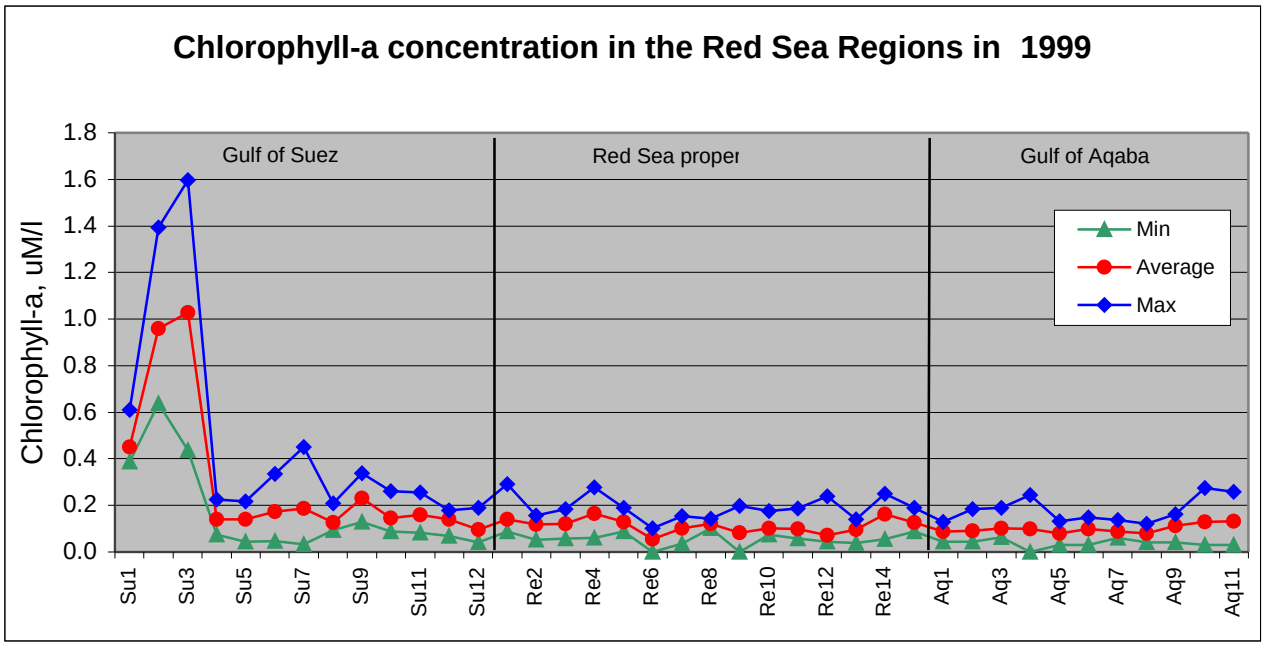

Figure ٤, Chlorophyll-a concentration in the Gulf of Suez, Red Sea proper and Gulf of Aqaba ١٩٩٩

Total Suspended Matter (TSM)

The level of TSM in the Gulf of Suez is relatively high as compared with those, which found in the Red Sea proper and Gulf of Aqaba Regions. The high values were usually recorded at stations (Su١, Su٢ and Su٣). The difference in TSM between the Red Sea proper and Gulf of Aqaba Regions was not pronounced.

TSM showed a patchy distribution at different locations of the Gulf of Suez. This may be due to water circulation in the area and the different rate of sewage discharge.

Transparency

Transparency values reached the whole depth of most stations of Gulf of Suez Red Sea proper and Gulf of Aqaba, except the upper part of Gulf of Suez. These may be due to the effect

of sewage discharge in the upper part of Gulf of Suez. Generally, the Gulf of Aqaba is characterized by its high clear water followed by the Red Sea proper and Gulf of Suez.

Ammonia

In Gulf of Suez, ammonia is found in relative high levels in the surface coastal water of the upper part than in those in the lower part. Occasionally slightly higher levels of ammonia than the average were found at Ras Sukheir (Su٩) and El Tour (Su١٣) in June and at Ras Suder (Su١٠) and Abu Zenima (Su١١) in November. Ammonia was completely depleted from many stations of the lower part of the Gulf of Suez especially during February.

The levels of ammonia were generally low in the Red Sea proper and Gulf of Aqaba surface coastal waters. There is a tendency of increasing ammonia values at Hurghada-NIOF (Re٢) of the Red Sea in February. Ammonia was slight higher than the average values in Sharm El-Sheikh harbour all over the year. Figure ٥, represent ammonia concentration in the surface coastal water of Gulf of Suez, Red Sea proper and Gulf of Aqaba Regions in ١٩٩٩.

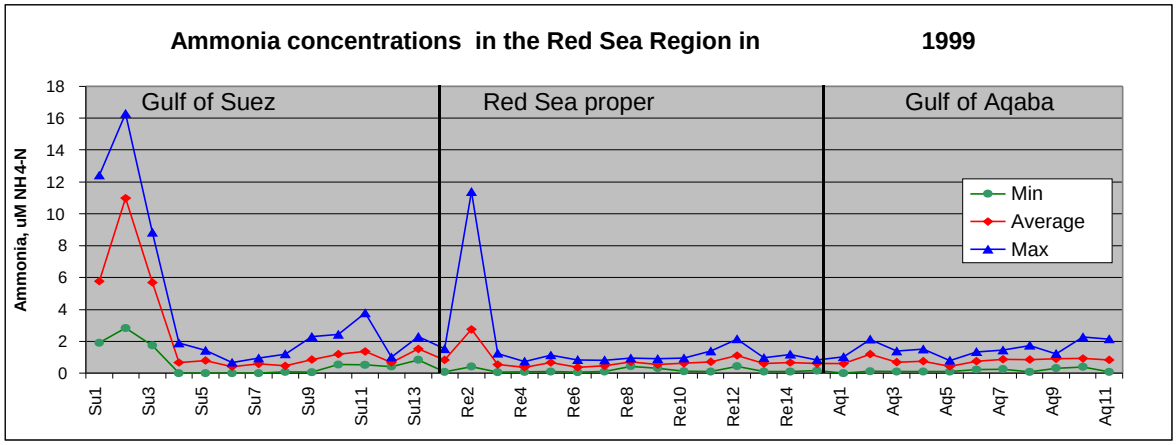

Figure ٥, Ammonia concentrations (µ M PÕ – P) in the surface coastal water at different sites of the Gulf of Suez, Red sea proper and Gulf of Aqaba in ٭ đđđ.

Nitrate (NO٣-N)

The general distribution pattern of nitrate in the Gulf of Suez, show that the upper part of the Gulf sustained relatively high nitrate values. This area is an exception to the Red Sea Region. In general the level of nitrate were relatively low at most stations of the Red Sea proper and Gulf of Aqaba. The same trend was found for nitrite.

An unexpected value (٩,٦٣ µM NO٣-N) was detected at the surface coastal water of Taba City (Aq١١) possible due to sewage contamination. Meanwhile, this value is an exceptional case and not representing the main trend of nitrate distribution in the Gulf of Aqaba during ١٩٩٩. Figure ٦, represent Nitrate (NO٣-N) concentration in the surface coastal water of Gulf of Suez, Red Sea proper and Gulf of Aqaba in the year ١٩٩٩.

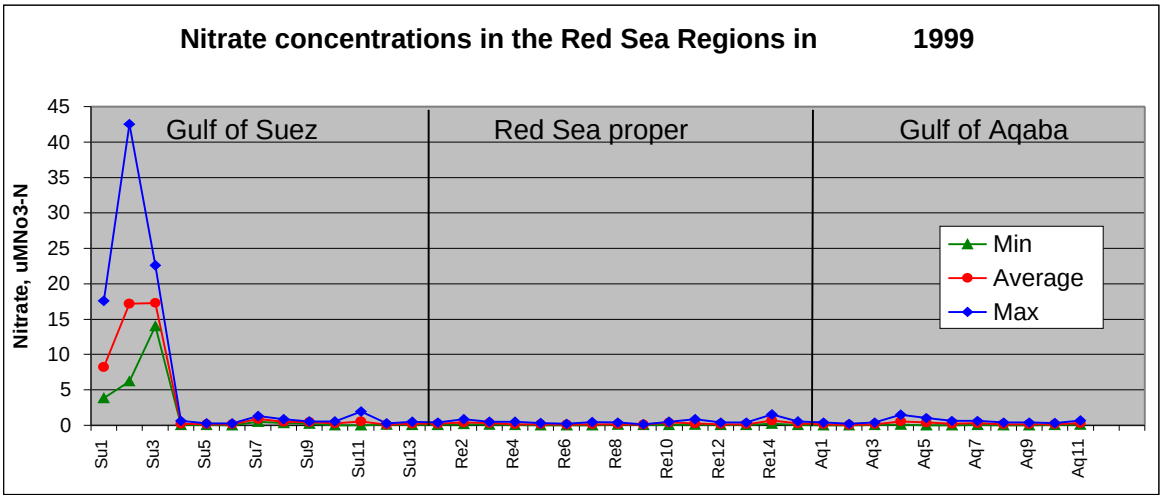

Figure ٦, The surface coastal water of nitrate concentrations at different sites of the Gulf of Suez, Red Sea proper and Gulf of Aqaba in ٩٩٩.

Reactive phosphate (PO٤-P)

The level of reactive phosphate in the investigated regions revealed very low concentrations throughout the year. Few exceptions of higher levels were found at Suez (Su٢) in February at Ras Suheir (Su٩) in November and at Ain Sukhna (Su٤) & Abu Zenima (Su١١) in April. This may be due to discharge of sewage at the area including detergents and decomposition of organic matter, which is a general component of urban sewage, may be important sources of reactive phosphate.

In the Red Sea proper a relative increase in phosphorus was observed in the middle and southern part as compared to its northern part of the region. El Hamraween (Re١٠) sustained the highest phosphorus concentration during November. This may be due to the location of the Red Sea phosphate harbor in the area where phosphate raw materials is discharge. Phosphorus was also high at Safaga and Quseir (Re٨, Re٩, Re١١, Re١٢ & Re١٣), where raw phosphate shipment take places. While the higher values in (Re١١) may be due to Movenpick hotel located in that area.

Unexpected high phosphorus concentration was obtained from the surface coastal water of Taba City (Aq١١) during August. This value is not representing the main trend of phosphorus concentration in the Gulf. In addition it was accompanied with high nitrate concentrations indicating possible sewage contamination. This effect was not registered during the following campaigns.

Except these locations phosphorus concentrations were almost near depletion or below the detection limit at most locations of the investigated regions. Figure ٧, represent reactive phosphate concentration in the surface coastal water of Gulf of Suez, Red Sea proper and Gulf of Aqaba Regions in the year ١٩٩٩.

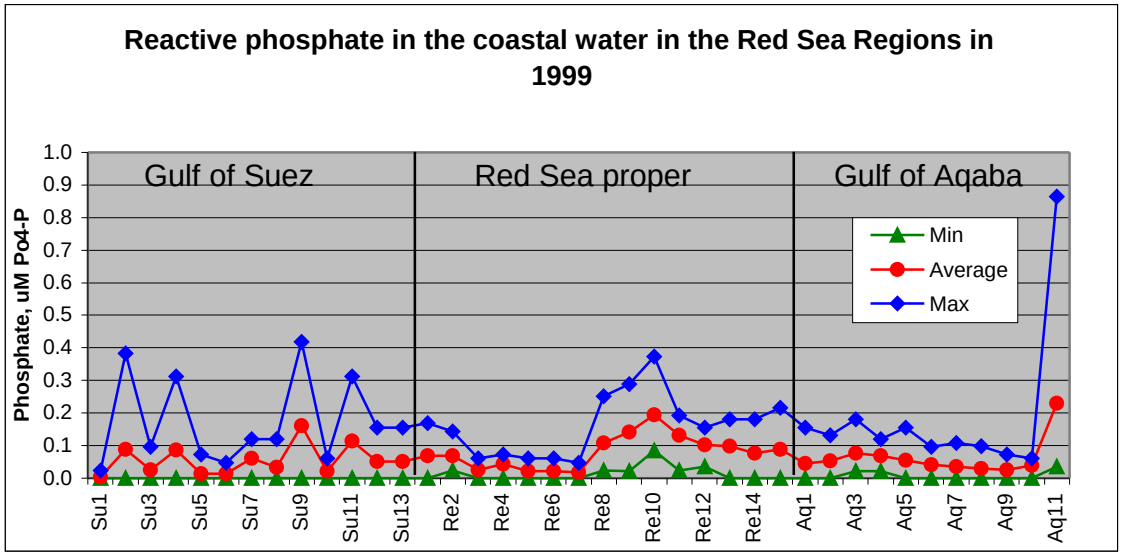

Figure ٧, The surface coastal water of reactive phosphate concentrations (µM PO – P) at different sites of the Gulf of Suez, Red sea proper and Gulf of Aqaba in .

Silicate (SiO٤ – Si)

Silicate is a good indicator of fresh water dispersion and of the potential for diatom blooms. In ١٩٩٩, relatively an increased values of silicate content was observed in the upper part of Gulf of Suez were levels of nutrients in general are high.

The distribution pattern of silicate concentrations at different locations of the Red Sea proper and Gulf of Aqaba showed spatial and monthly variations. In the Gulf of Aqaba the silicate concentrations are very low through out the year on all stations. The concentrations in the Gulf of Suez and the Red Sea proper show larger variation both between stations and within the year. Slight increase in silicate concentrations were recorded at Hurghhada area (Re١, Re٢, Re٣,

Re٤ & Re٥) and decreased southward then increased again at El Hamarawein (Re١٠), Quseir (Re١١ &Re١٣), Mersa Alam (Re١٤) and Bir Shalatin (Re١٥).

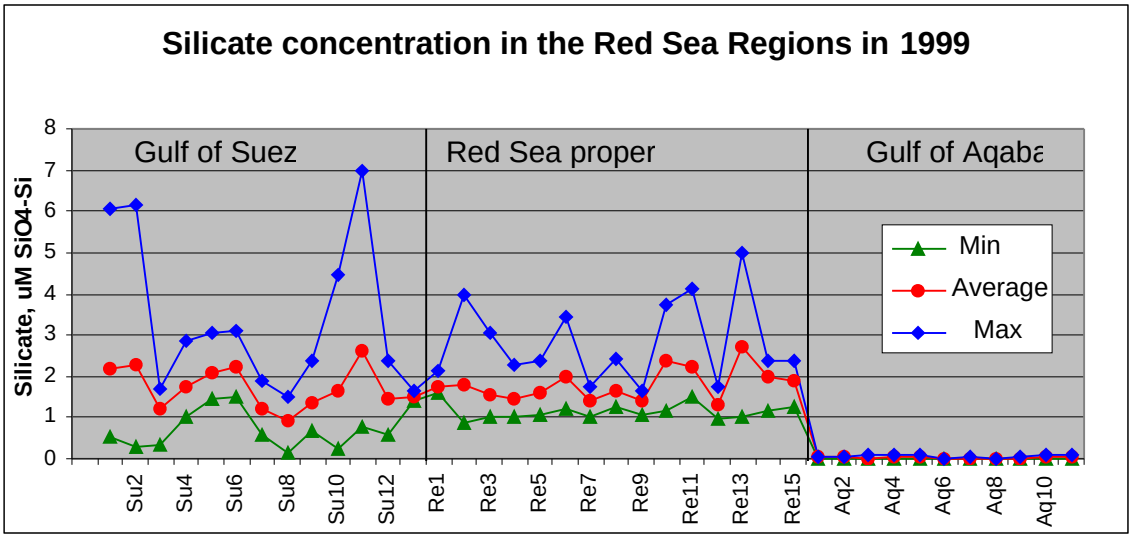

Figure ٨, The surface coastal water of Silicate concentrations at different sites of the Gulf of Suez., Red sea proper and Gulf of Aqaba in ّ ###

Conclusion:

The hydrographical and eutrophication data obtained during ١٩٩٩ follow with few exceptions the seasonal and geographical pattern form the observations in ١٩٩٨. The northern part of the Gulf of Suez (Su١, Su٢ and Su٣) is in general heavily influenced by wastewater discharge whereas the Red Sea region in general reveals low levels of the measured parameters.

In the northern part of the Gulf of Suez the levels of nutrients like nitrate-nitrite, ammonia and total-N are significantly higher in comparisons to the rest of the Gulf of Suez, including also the Red Sea proper and the Gulf of Aqaba. The biological response to these high levels of nutrients is found in the relative higher levels of phytoplankton biomass in the area measured as chlorophyll-a. The high levels of total suspended matter and low levels of transparency also support these findings in the vicinity of the city of Suez. The likely explanations to these findings are the discharge of untreated or partly untreated waster water form the city of Suez and the heavy maritime transportation in the area.

The same pattern is found in the bacteriological parameters, however here only Su٣ near city of Suez shows levels of bacteria above acceptable standards. The station at Ras Gharib, Su٧ shows very high levels of the measured bacteria, which is in accordance with earlier observations during ١٩٩٨. The explanation to these finding is again the discharge of untreated or only partly untreated waster water. In the Red Sea proper at Quseir (Re١٢) and Bir Shalatin (Re١٥), high counts of bacteria were observed, whereas in the Gulf of Aqaba the only high counts of bacteria were recorded in Marina Sharm (Aq٢a).

The annual average values obtained during the campaigns in ١٩٩٨ and ١٩٩٩ indicates no pronounced changes in the levels of hydrographical conditions in the investigated regions. However, the levels of some of the eutrophication parameters obtained during the present investigation (١٩٩٩) were lower than those obtained during the first year (١٩٩٨). This concerns specifically nitrate and ammonia.

Table ١ summarized the most important points for Red Sea Regions in the year ١٩٩٩.

Station	**Name**	**Remarks**
Su١	Suez	٢, ٣ , ٦, ٧
Su٢	Suez	٢, ٣, ٤, ٦, ٧
Su٣	Suez	١ , ٢, ٣ , ٦, ٧
Su٤	Ain Sukhna	
Su٥	Ain Sukhna	
Su٦	Ain Sukhna	
Su٧	Ras Gharib	١
Su٨	Ras Gharib	
Su٩	Ras Shukheir	٤, ٥
Su١٠	Ras Sudr	١, ٥
Su١١	Abu Zenima	٤, ٥
Su١٢	Ras Budran	
Su١٣	El Tur	٥
Re١	Abu Shar Hurghada	١
Re٢	Hurghada NIOF	٥
Re٣	Hurghada beach	
Re٤	Hurghada Sheraton	
Re٥	Gifton Island	
Re٦	Sahl Hashish	
Re٧	Safaga	
Re٨	Safaga	٤

Re٩	Safaga	٤
Re١٠	El-Hamarawein	٤
Re١١	Quseir	٤
Re١٢	Quseir	١, ٤
Re١٣	Quseir	٤
Re١٤	Marsa Alam	
Re١٥	Bir El-Shalatin	١
Aq١	Sharm El-Sheikh Ras Mohamed	
Aq٢a	Sharm El-Sheikh Harbour	١
Aq٢b	Sharm El-Sheikh Harbour	
Aq٣	Sharm El-Sheikh Naeama bay	
Aq٤	Nahlat Al Tel	
Aq٥	Dahab	
Aq٦	Ras Mamlah	
Aq٧	Hibeiq-Ras Nabar	
Aq٨	Nuweiba, El-Saidin	
Aq٩	Nuweiba	
Aq١٠	Mersa Muqibila	
Aq١١	Taba	٣

١. Bacteria above acceptable level.
٢. High Levels of chlorophyll-a
٣. High levels of nitrate
٤. High Levels of reactive phosphate
٥. High levels of ammonia
٦. High levels of total suspended matter
٧. Low levels of transparency