

Chapter 6

Coastal and Marine Zones





Coastal and Marine Zones

Introduction

The Egyptian coasts are approximately 3000 km in length of which some 1150 km extend along the Mediterranean, from Salloum, west, to Rafah, east, and 1850 km covering Egyptian Red Sea coasts on the main Red Sea basin (some 1200 km) and both Gulf of Suez and Gulf of Aqaba (about 650 km).

Marine environment and coastal zones in Egypt are considered a renewable source for living and nonliving wealth and a pivotal point of attraction for many projects in different economic and social fields such as recreational and tourist projects and others related to fish wealth, manufacturing, exharboration and international trade projects which are mostly affected by several terrestrial and marine sources of pollution.

It has been well known, as noted by the UN Reports (GESAMP, 1990) and later confirmed by many field studies and research, that almost 80% of marine environment pollution and coastal deterioration attributed to different land activities whether industrial, agricultural, urban or physical, especially those producing wastes and emissions that are not treated in a sound environmental manner. The remaining 20% is due to other sources ahead of which are marine sources: i.e. different offshore activities such as oil, mineral and natural gas exploration and drilling operations, besides fishing, shipping and uploading and maritime transportation. Moreover, there are other sources such as wastes and leakages due to the increasing number of ships, yachts and other recreational and tourist boats. It has been well stated that such activities, if not environmentally rationalized, will have a negative impact not only on marine environment and wealth but also on different aspects of developmental activities and investment activities. They also impose several threats to human health as well.

Egyptian Coastal Water Environmental Monitoring Program

Egyptian Coastal Water Environmental Monitoring Program is one of the sustainable programs which the MSEA and EEAA are adopting to monitor marine and coastal environment area status. Within this program marine samples from selected stations along the Egyptian coasts are collected and analyzed four times a year in March, May, July and September so as to represent physical, chemical and biological conditions in the four seasons. The Program, implemented in collaboration with specialized stakeholders in Egypt, focuses on the monitoring of bacterial counts and nutrient salt concentrations (ammonia, nitrates, nitrites, phosphorous and chlorophyll). In addition, other hydro-geographic measurements are also made as they might help in explaining phenomena affecting marine environment conditions. Map (6.1) shows monitoring stations in the Red and Mediterranean Seas, Gulf of Suez and Gulf of Aqaba.

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Map (6.1) Monitoring stations in the Red Sea and the Mediterranean and the Gulf of Suez and Gulf of Aqaba

The main results of the 2007 monitoring program are illustrated as follows compared with previous years to reach some conclusions on the improvement, settlement or deterioration of marine environment status during this period, in addition to highlighting the potential reasons for such improvement or deterioration.

Mediterranean Coastal Water Quality

Within the framework of coastal water monitoring program, four field trips were made in the Mediterranean zones in March, May, July and September in 2007 to 31 monitoring stations along the Egyptian coast from Salloum, west, to Rafah, east. The different stations were chosen to cover all the affecting activities all along the Egyptian coasts such as population areas, harbors, tourist villages and companies, in addition to some benchmarking stations far from any external influences.

This program targeted monitoring all the visual observations and remarks on the beaches and coasts of these areas, measuring some hydro-geographic changes for water column (temperature, salinity, pH and dissolved oxygen) and revealing the existence of some kinds of pathogens that indicates the existence of sewage discharge. In addition, it performs different chemical measurements (chlorophyll-a, suspended matters, transparency, nitrogen salts, phosphorus and silicates) of surface coastal water to have a complete vision of the status of the Egyptian Mediterranean coasts under different conditions and times during the year.



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Visual observations

Generally, there were no abnormal visual observations along the study area in 2007. Concerning hydrogen-ion concentrations in sea water, samples showed very little alkalinity which was within the normal level of sea water. As for salinity measurements, a relative decrease was observed in the Mediterranean water in front of drainages and the Nile delta. For example, it was (Me8) (37.73) in front of Nubaria drainage, (Me11) (35.87) in El-Max Gulf where Omoum drainage exists, (Me23) (37.32) in front of Abou Qir power station, (Me25) (36.52) in front of Edku Lake drainage at Maadia zone, (Me29) (36.42) in front of Rosetta branch drainage, (Me39) (27.99) and (Me40) (31.93) in front of Borollos Lake in Borg al-Arab and in front of Manzala Lake in Gamel area in Port Said respectively.

Concerning the concentration of dissolved oxygen in sea water, a decrease was observed in its concentration (less than 3mg/l) in the fourth sampling cruise only in El-Shatby (Me17a) (5.29 mg/l), El-Montazah (Me19) (5.6mg/l), Abou Qir Gulf (Me 20) (5.76, 6.58 mg/l). The relatively high temperature in the fourth sampling cruise was the main reason behind this phenomenon.

Regarding water transparency, the highest transparency level was recorded in the western zone extended from Salloum to El Bitash (west of Alexandria) and the eastern zone extended from El Arish to Rafah, whereas, the lowest level was recorded in front of Nile Delta as well as drainages and lakes exits.

Bacteriological Count Results in 2007

Twenty seven monitoring stations were used to identify the rate of faecal contamination along the Egyptian Mediterranean Coast, as three bacteriological indicators were measured which indicate faecal contamination. These bacteria are Coli form group (colon), E-coli bacteria and streptococci. It is known that the Egyptian European standards state that the number of Coli form bacteria shall not exceed 500 Colony Formin Unit (CFU)/100 ml, whereas E-Coli bacteria and faecal streptococci shall not exceed 100 CFU for each 100 ml of sea water.

In general, the results demonstrated different patterns of faecal contamination ranging between very clean stations such as Salloum, Bagoush and Rafah and other clean stations where the number of bacteria did not exceed the permissible limits, except in one trip of the four in Matrouh, Marina, Sidi Krair, El-Nubaria, El-Hanoville, El-Bitash, in front of the National Institute of Oceanography and Fisheries, Eastern Harbor area in Alexandria, Shatby, Sidi Gaber, Montazah, Western Abou Qir, New Damietta and Arish. There were other contaminated stations such as Gameel in Port-Said and Gamasa. El-Dekhela, El-Max, Western Harbor, East of Abou Qir stations showed high level of Faecal contamination caused by the discharge of agricultural run off or sewage discharge or both in these areas.

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Figures (6.1), (6.2), (6.3) show results of bacterial measurements in 2007.

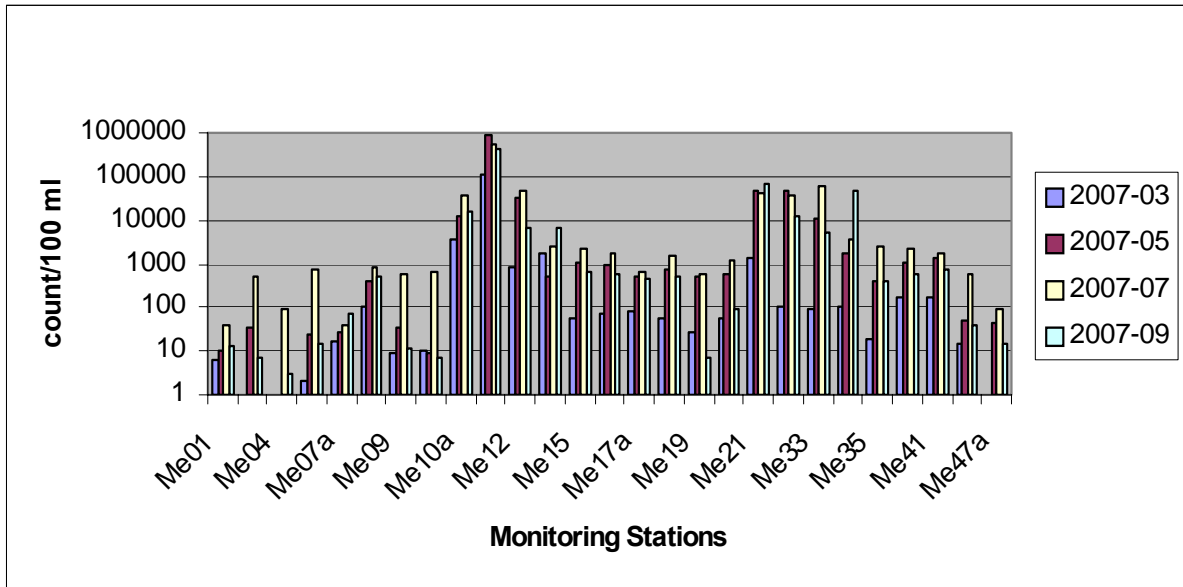


Figure (6.1) Bacteriological count of coliform bacteria at monitoring stations on the Mediterranean in 2007

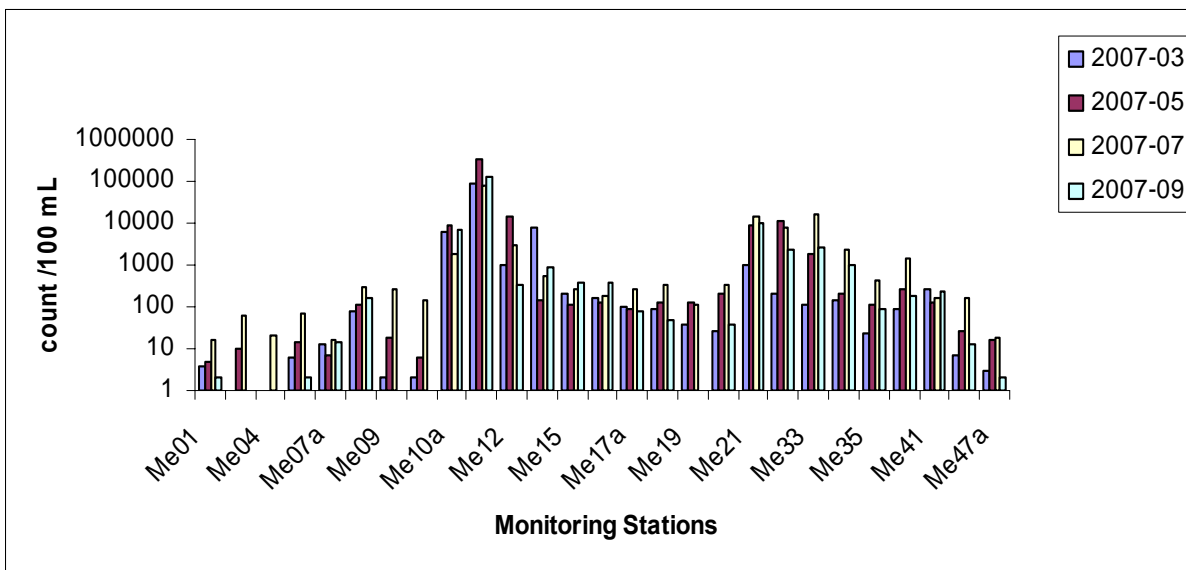


Figure (6.2) Bacteriological count of E-Coli bacteria at monitoring stations on the Mediterranean in 2007



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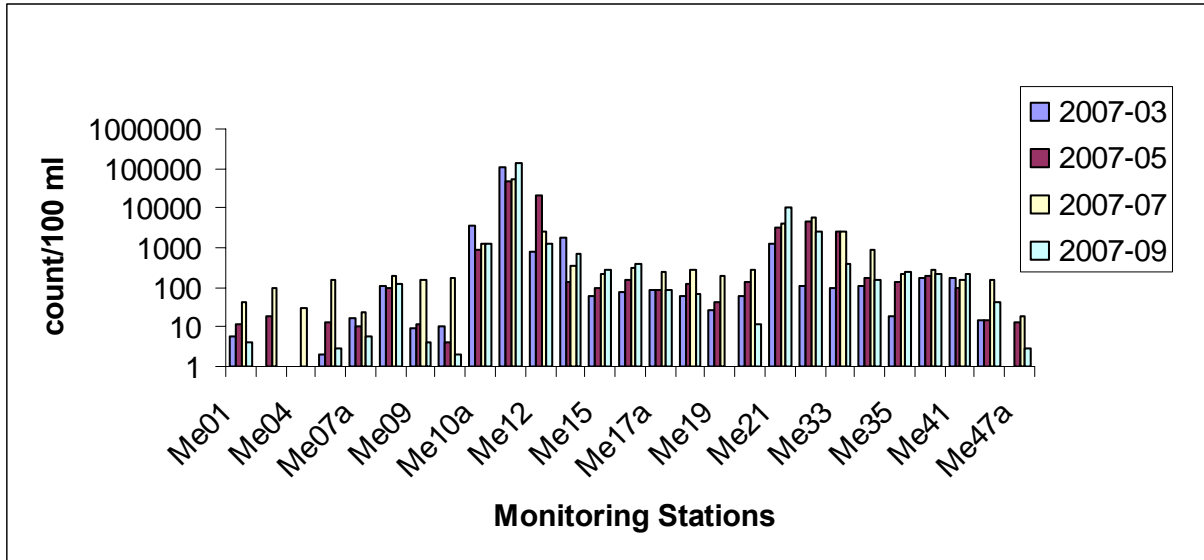


Figure (6.3) Bacteriological count of Fecal Streptococci bacteria at monitoring stations on the Mediterranean in 2007

Nutrient Salts and chlorophyll-a Concentrations Results in 2007

Figures (6.4), (6.5), (6.6), (6.7) and (6.8) show nutrient salts and chlorophyll-a concentrations in the Mediterranean Sea as follows:

1. The northern coastal water in the western zone of the Mediterranean from El-Salloum to Marina and the eastern zone from Arish to Rafah is clean and unpolluted. The results showed that the annual nitrates concentrations in 2007, are low along the coast and increase at drainage areas. There was a slight decrease in nitrates concentrations in Alexandria region compared to the last year (2006). The decrease is due to the role played by Ministry of State for Environmental Affairs, through environmental inspection on facilities discharging into the sea and encouraging them for compliance.
2. Ammonia concentrations decreased in the eastern and western zones of the Mediterranean compared to last year (2006) (as EEAA prepare quarter reports and send them to officials in charge in coastal governorates so that they would get to know the water quality in their governorates and participate in coastal water quality improvement). On the other hand, the highest ammonia concentrations were recorded at El-Daqahlia (Me10a), El-Max (Me11) and the Western Harbor (Me12). This is caused by industrial activities and population density at these areas. In this regard, the Ministry is performing environmental inspection on industrial facilities and encouraging them for compliance.
3. In 2007, the results indicated that inorganic nitrogen (nitrite, nitrates, and ammonia) distribution was low in the western zone extended from El-Salloum to Marina (stations from 1 to 6) and eastern zone extended from El-Arish to Rafah as its content was less than 4 micromoles. However, the concentration were high at El-Dekhela

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(Me10a), El-Max (Me 11), electrical power station (Me 23), Maadia station (Me 25), Gamil (Me 39, Me 40) and Port Said (station Me 41).

- The reactive phosphate concentrations all along the coast reached 0.25 micromole /l in the western zone and the average annual values are equivalent to concentrations during the period from 2003 -2005 and similar to the results in 2000.
- Chlorophyll-a concentration, along the Mediterranean Coast of Egypt in 2007, showed high variation in the concentrations among different stations, and these variations are related to the nutrient content of the discharged wastewater. It has been noticed that high chlorophyll-a concentration was detected in Alexandria, Delta and eastern area compared to the western.

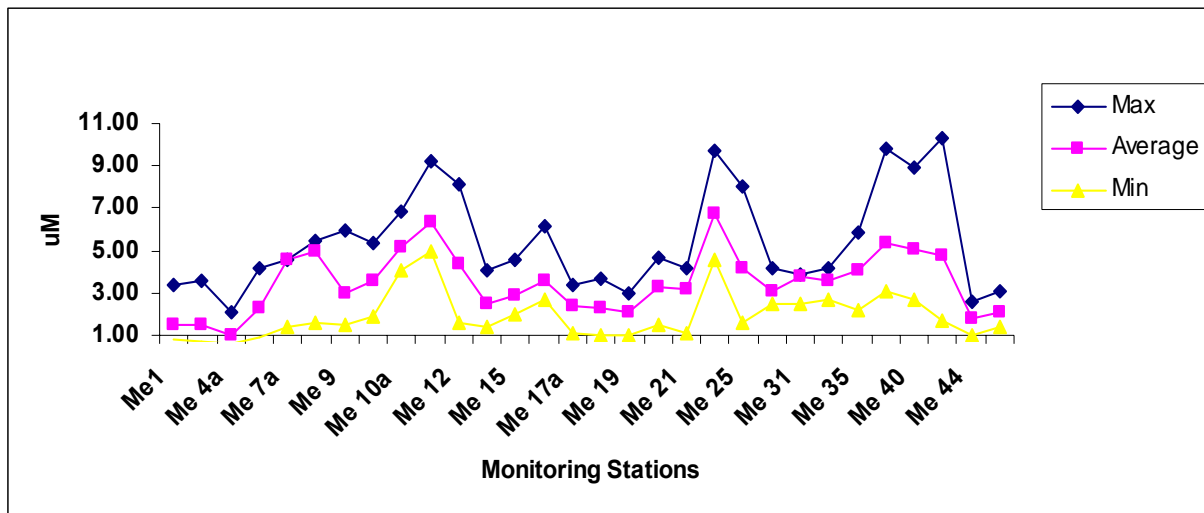


Figure (6.4) Nitrate and Nitrite Concentration at monitoring stations on the Mediterranean in 2007

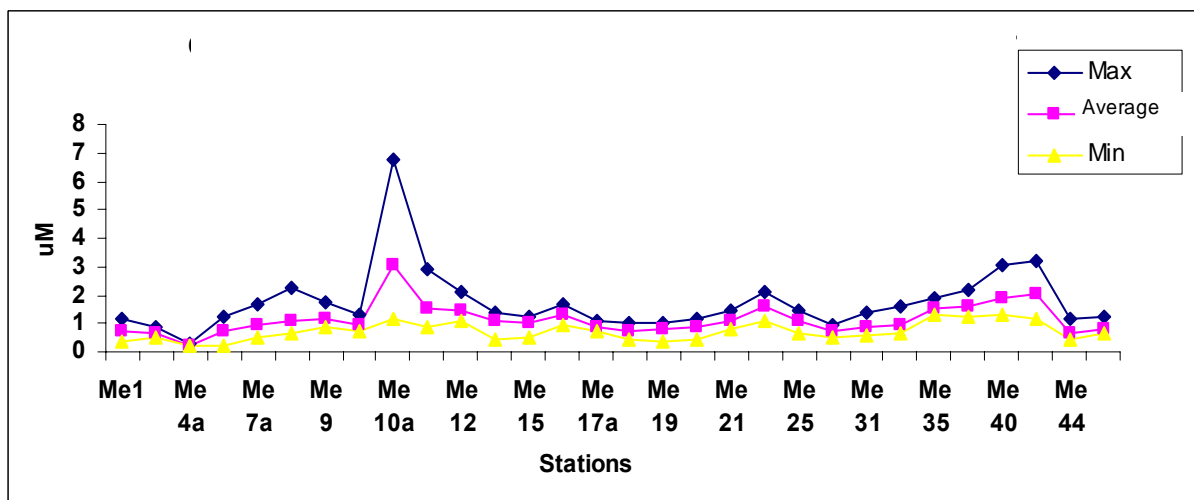


Figure (6.5) Ammonia Concentration at monitoring stations on the Mediterranean in 2007



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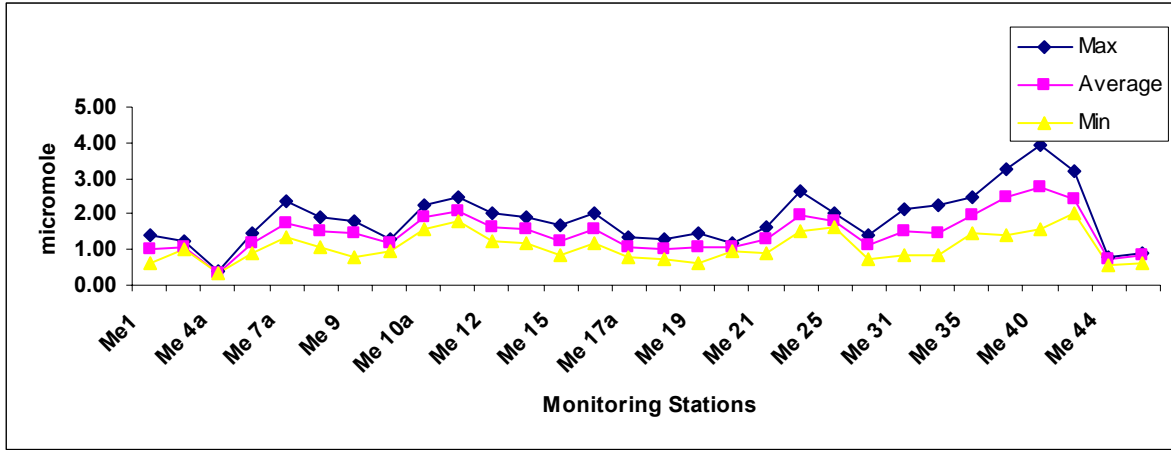


Figure (6.6) Total phosphorus concentration at monitoring stations on the Mediterranean in 2007

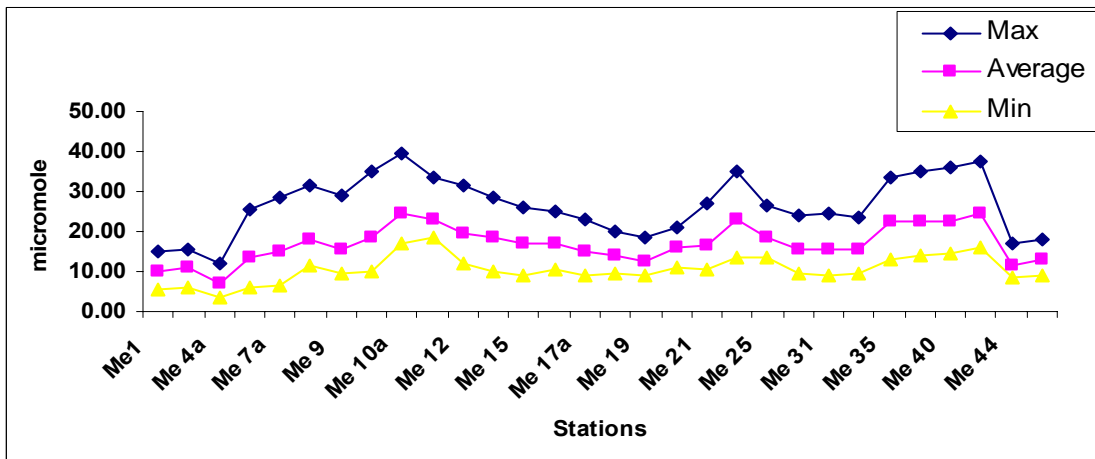


Figure (6.7) of Total nitrogen concentrations at monitoring stations on the Mediterranean in 2007

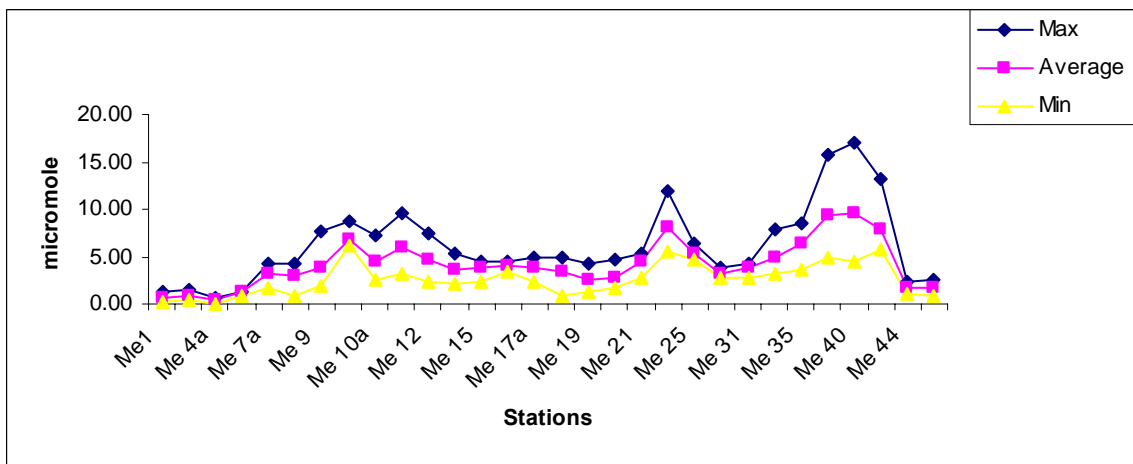


Figure (6.8) Chlorophyll Concentrations at monitoring stations on the Mediterranean in 2007



Comparing monitoring results in 2007 with the results of previous years the followings are revealed:

1. Bacteriological analysis demonstrated some improvements in the situation compared to the previous four years. While the results were less than that recorded during 1998-2002 concerning contaminated station number to the total number of stations or average bacteriological counts, which indicates a significant improvement in coastal water quality monitored since the beginning of the program.
2. Chemical analysis results of Mediterranean coastal water generally prove that water is clean and unpolluted except for some stations close to the drainage.
3. Total Nitrogen concentration values in the western and eastern zones are similar to those recorded in 2006. On the other hand, some sites in Alexandria had a significant high nitrogen concentration namely, El-Daqahlia (Me10a), El-Max (Me 11) and the Electrical power station (Me 23).

Red Sea Proper, Gulf of Suez and Gulf of Aqaba Coastal Water Quality

Within the framework of the coastal water monitoring program, 4 field trips were made in March, May, July and September in 2007, for 8 stations in the Red Sea proper, 8 stations in the Gulf of Suez and 6 stations in the Gulf of Aqaba. The stations locations were chosen to cover all the activities affecting water such as highly populated areas, harbours, industrial facilities and tourist villages in addition to some benchmarking stations far from external factors. Map (6.1) shows the monitoring sites.

This program targeted monitoring all the observations and remarks on the beaches and coasts in these areas, measuring the hydro geographic changes of water (temperature, salinity, PH and dissolved oxygen) and revealing the existence of some kinds of harmful bacteria which indicate sewage discharge. In addition, it measures different chemical parameters (chlorophyll-a suspended matter, transparency, nitrogen salt, phosphorus, and silicates) in surface coastal water to know the conditions of the Egyptian coast along the Red Sea Proper, Gulf of Suez and Gulf of Aqaba under different conditions and times during the year.

Visual observations

Some pollutants in different quantities were observed during the different times of the study as follows:

Gulf of Suez : there were old tar and thin oil film spread in the stations of Middle Suez (SU2), South Suez (SU3), Ras Ghareb (SU7), El-Tor City (Su13). Moreover, there were hu-



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man and animal wastes in South Suez (Su3), Ras Ghareb city (Su 7), and some traces of sewage in middle Suez (Su2), Ras Ghareb City (Su7) and El-Tour city (SU13)

Gulf of Aqaba : thin oil films were found in all stations except in Dahab (Aq5) and Taba (Aq11)

Red Sea Proper: Old tars were found in different quantities, few quantities of human and animal wastes in stations of Middle of Safaga (Re8), North Qusseir (Re11), Bir Shalateen (Re15) and few to medium quantities of thin oil films in Middle of Safaga (Re8).

In general, there were some different quantities of accumulated grease and petroleum spots in the western zone close to oil companies or harbors of heavy human activities. Gulf of Aqaba was distinguished by the existence of large quantities of coral reefs compared to the Red Sea proper and gulf of Suez.

Accordingly, visual observations of this year and the previous one showed that (Su2) station in Suez, El-Gouna , Ras Ghareb (Su 7), El-Tour Harbor (Su 13) in Gulf of Suez, Sharm El-Sheikh harbor in Gulf of Aqaba (AQ2), Safaga (Re8) north of Qusseir city, Fishing harbor in Shalateen (Re15) are exposed to external effects due to increasing human activity in these areas.

Bacteriological Count Results in 2007

Bacteriological Count results demonstrated 3 kinds of bacteria in figures (6.9), (6.10), (6.11) carrying the following characteristics:

Gulf of Suez: The number of bacteria exceeds the permissible limits in 9 stations as follows:

1. (Suez - Rex Beach - Su 1b) located at the north of Suez and affected b the nearby Bahary harbor, the number of bacteria exceeded a little bit the permissible limits in July and September
2. (Suez - Kabanon beach– Su 1b) affected by El-kabanon drainage to the north of the beach which carries the wastes of slaughter houses as it recorded high number of bacteria in May, July and September
3. (Ras Ghareb - Su7) always records high number of bacteria all the year round resulting from discharging of non-treated sewage wastes of Ras Ghareb city directly into the sea
4. (El-Tour - Su 13) affected by boat activities of the nearby fishing harbor and the swimming beach especially in July and September due to beach visitors coming from the city.

Gulf of Aqaba: the Egyptian coast at Gulf of Aqaba is clean because of the presence of a large number of protectorates except for the following stations:

1. (Sharm Sheikh– Marina Sharm– Aq2) recorded high counts of bacteria exceeding the permissible limits due to the increase in diving boats harbored and the number of divers.

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2. (Sharm Sheikh– Nama Bay– Aq3) affected by tourist activity including swimming, diving, skating). They recorded high numbers of bacteria exceeding permissible limits.

Red Sea Proper: The counts of investigated bacteria were acceptable at most of the sampling cruises during the year in 3 of 8 stations. However, 5 stations recorded bacteria count exceeding permissible limits as follows:

1.(Bir Shalateen– Re15) recorded high bacteria counts as it is affected by fishing activities in the fishing harbor that has a large number of primitive fishing boats.

2.(Qusseir– Movenpick resort—Re11) due to the high number of tourists and guests and the presence of camels and horses near the beach. The bacteria count exceeded permissible limits in March, July, and September.

3.(Hurghada Sheraton - Re4) and Re3 (Hurghada- public beach) recorded bacteria count exceeding permissible limits in July being affected by the number of tourists and swimming and diving activities.

4.(Safaga– down town– Re8) recorded a large count exceeding the permissible limits in March and May. The sampling station is located directly south of Safaga harbor and affected by its activities.

5.(North of Safaga City– Robinson resort– Re7) recorded a large count of bacteria exceeding permissible limits and affected by tourist activities (swimming, diving, skating).

(Qusseir– Public beach– Re12) recorded bacteria count slightly higher than permissible limits in March only, due to the increase in the number of swimmers.

The current bacteriological results show improvement compared to last year. However, in 2007, 12 from 23 stations have recorded bacteria count exceeding permissible limits once or more for a microbe or more; i.e. 52% of the stations compared to 56%, 56%, and 60% in 2006, 2005, and 2004 respectively. This indicates improvement compared to the previous years. The reason behind this is EEAA role in issuing quarterly reports of monitoring results and submitting them to stakeholders in each coastal governorate, preparing environmental impact assessment studies for facilities, developing plans for environmental compliance of facilities discharging into water canals, and performing environmental inspection to check compliance to permissible limits stated by the Law.



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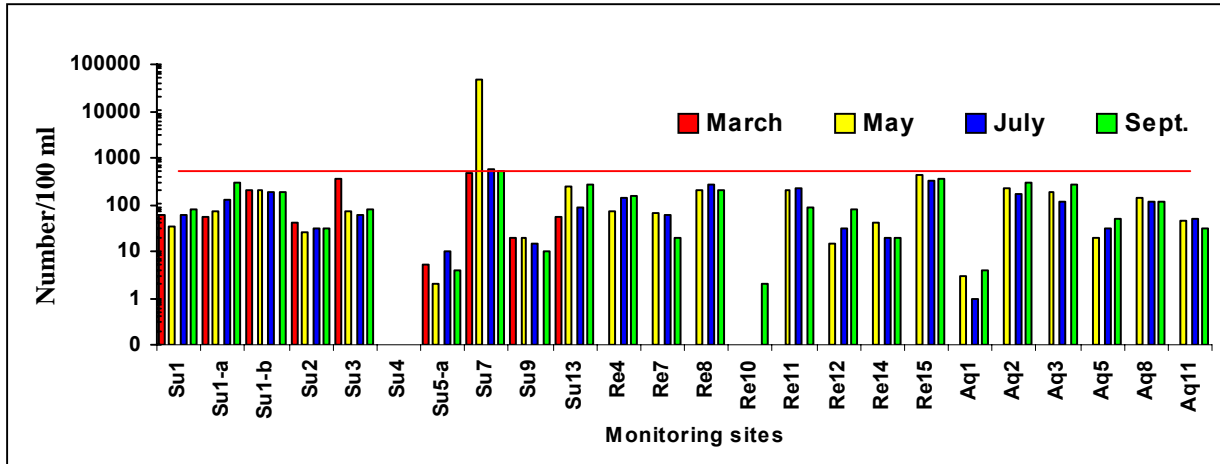


Figure (6.9) Bacteriological count of Coliform bacteria at monitoring stations on the Red Sea in 2007

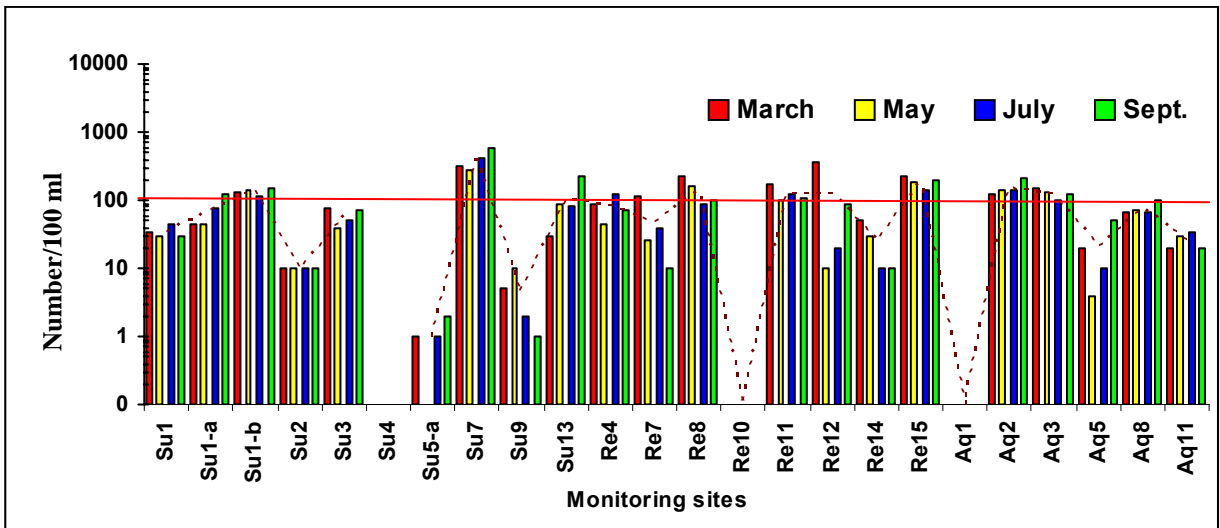


Figure (6.10) Bacteriological count of E-Coli at monitoring stations on the Red Sea in 2007

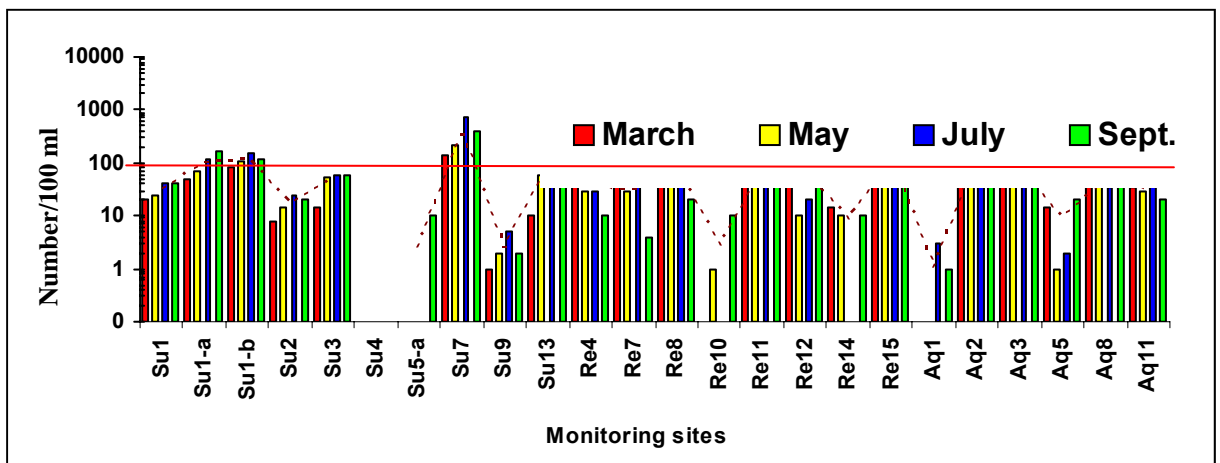


Figure (6.11) Bacteriological count of Faecal Streptococci at monitoring stations on the Red Sea in 2007



Nutrient Salts and chlorophyll– A concentration Results in 2007

Figures (6.12), (6.13), (6.14), (6.15) and (6.16) show the concentrations of nutrient salts and chlorophyll-a in Red Sea coastal water as follows:

- Inorganic nitrogen results show that the northern part in Gulf of Suez and Ras Ghareb recorded high concentrations of nitrates, nitrite, and ammonia compared to the rest of the locations which recorded lower concentrations of these components. Based on these results, the Red Sea Coast can be divided into two areas. The first is the northern area of Gulf of Suez engulfed between Port Tawfiq and El-Adabia harbors which are directly affected by untreated industrial and sewage discharge, accordingly the concentration of these components increased. The second area includes the rest of Gulf of Suez, except Ras Ghareb, in addition to Gulf of Aqaba and the Red Sea Proper. This area recorded low concentrations as a result of lower external inflows, and thus it is not contaminated by these components. The coastal water of Ras Gharib harbor recorded a significant increase in the concentration of nutrient salts also in Ain Sokhna harbor but to a lesser extent, which indicates an increase in the effect of human activities in this area.
- Total Nitrogen distributions indicate relative differences in their concentrations and the percentages of its components. Consequently, the annual averages reached 103.42, 58.38, 41.70, 38.22 micromol/L in the areas A, B of Gulf of Suez, Gulf of Aqaba and the Red Sea Proper, respectively.
- High concentrations of total phosphates are measured in Ras Ghareb station (2.08, 2.49, 3.17 and 4.00). This could be explained by the relative increase in human activity in this area, especially that this increase is linked to the increase in concentrations of other elements. In addition, total phosphate concentrations are relatively high in the middle of Suez in May (2.27 micromol), Dahab (2.06 micromol) in May, Gulf of Aqaba, El-Hamrawen station in March (4.10 micromole), and North of Qusseir (4.44, 3.20, 8.64 micromol) in March, May and July. These levels are considered high compared to the general level of total phosphorus distribution in each of these areas. The significant increase recorded in the middle area of the Red Sea located between Safaga and Qusseir cities results from the increase in phosphate shipping and manufacturing in this area considered one of the largest areas in Egypt utilized for this purpose. Red Sea Phosphate Company and El-Hamrawen Harbor Phosphate Company export phosphate. However, in some areas, these levels are linked to high levels of nutrient salts which indicate an increase in the effect of human activity in this area. In



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general, active phosphate recorded very low or absent levels in the rest of monitoring sites.

- Chlorophyll-a concentration is used as an indicator for organic activity level in coastal water. This element recorded high concentrations in the northern part of the Gulf of Suez including the stations in north, middle and south of Suez in addition to Ras Gharib. The concentrations in the remaining areas (Gulf of Suez, Red Sea Proper, and Gulf of Aqaba) were very little. This resulted from the direct effect of different industrial and sewage discharge on the northern area of the Gulf of Suez compared to other areas. This asserted the presence of a relative increase in suspended matter amounts and decrease in transparency compared to the remaining areas where the whole water column is clear in most cases.

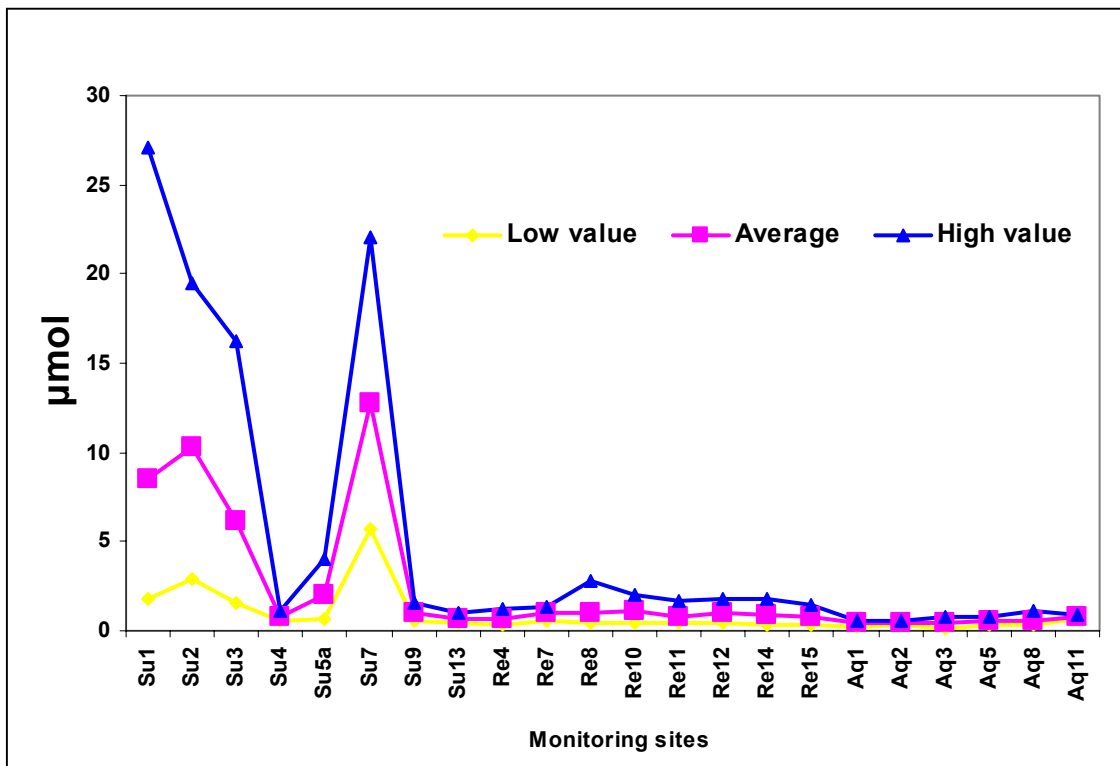


Figure (6.12) Ammonia concentrations at Red Sea monitoring stations in 2007

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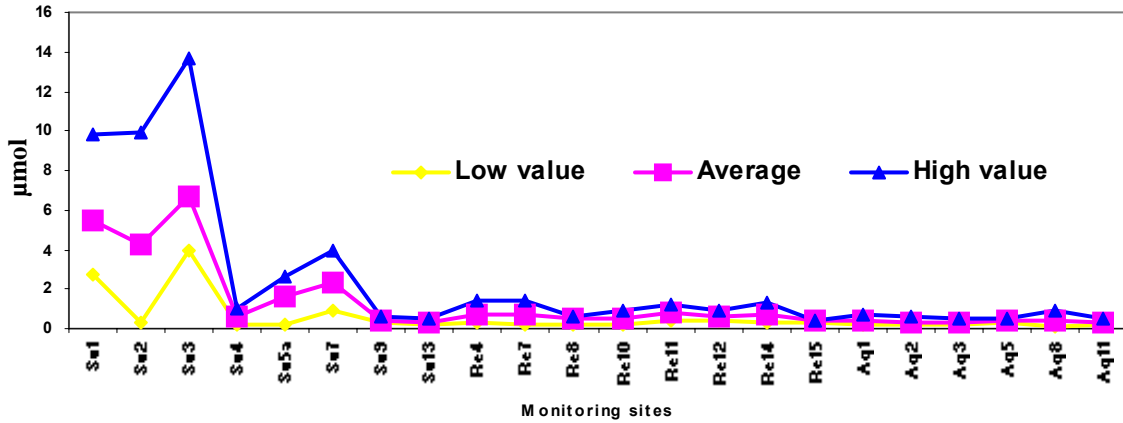


Figure (6.13) Nitrite concentrations at Red Sea monitoring stations in 2007

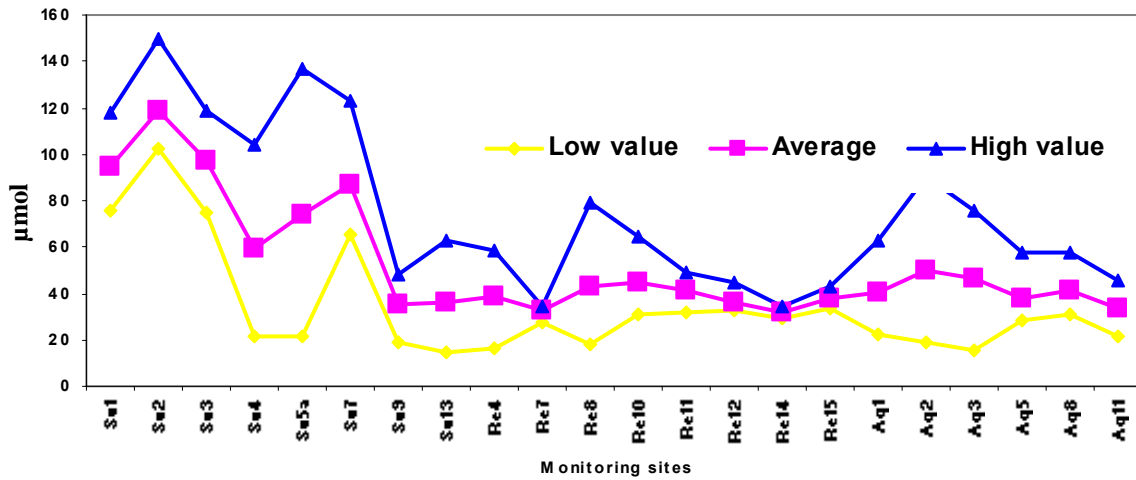


Figure (6.14) Total nitrogen concentrations at Red Sea monitoring stations in 2007

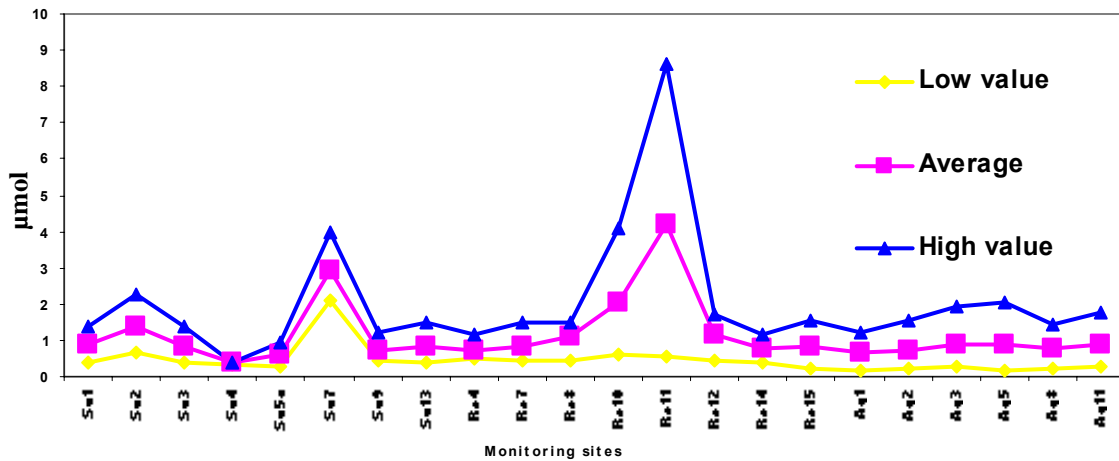


Figure (6.15) Total phosphorus concentrations at Red Sea monitoring stations in 2007



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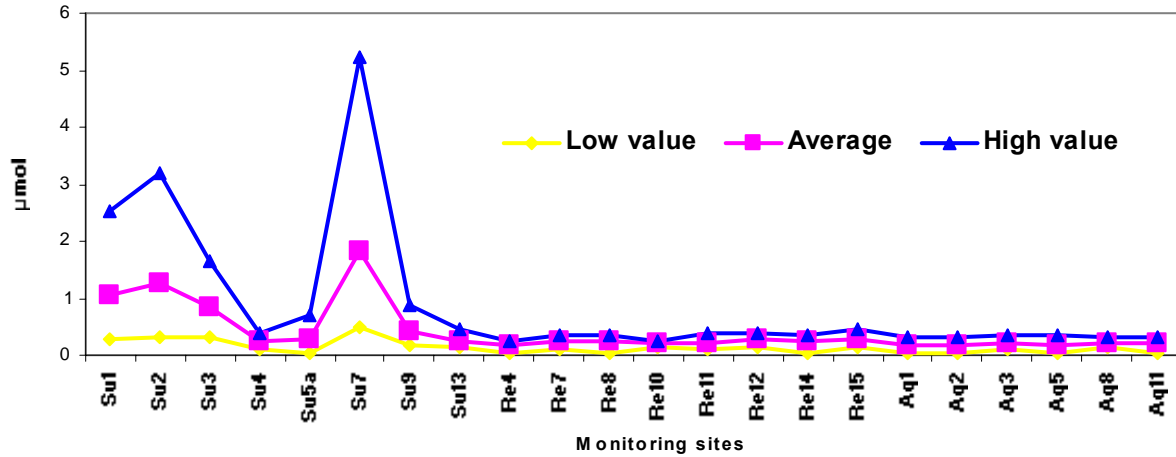


Figure (6.16) Chlorophyll-a concentrations at Red Sea monitoring stations in 2007

Under the marine monitoring program, chlorophyll-a concentration was classified as per the following scale:

Categorization of chlorophyll-a concentration as follows:

- Low concentration is less than 1 mg/L
- Average when concentration is from 1-2 mg/L
- High concentration is from 2-5 mg/L
- Extremely high concentration is more than 5 mg/L

Nutrient Salt Concentration was classified as per the following :

- Low when concentration of nitrates and ammonia is less than 0.5 µmole /L scale
- Average ammonia concentration is more than 0.5 or less than 2 µmole /L
- Average nitrates concentration is more than 0.5 or less than 4 µmole /L
- High ammonia concentration is more than 2 µmole/L
- High nitrates concentration is more than 4 µmole/L

General remarks

The annual averages of different variables are compared in the study areas from 1998 to 2007, this comparison has shown the following:

1. There are no tangible differences in different hydro-geographic parameters in the study areas except for slight increase in temperature in all stations.
2. The northern areas of Gulf of Suez recorded a significant increase in suspended matter level, as well as a considerable increase in the concentration of inorganic and total nitrogen. This indicates a relative increase in the amount of discharge inflows.
3. The results indicate a slight increase in the level of total suspended matter and inorganic nitrogen in coastal areas of the Gulf of Aqaba and Red Sea Proper. However, this in-



crease has no effect on eutrophication quality. Also, the effects of human activities in this area are still within permissible limits.

4. In Qusseir (middle) bacteria counts have been below permissible limits in 2007 compared to 2001, 2002, as the number of tourist boats decreased .
5. A special quay was established in Marina Sharm, Sharm el-Sheikh, in March 2001. It is provided by a system for extracting human wastes discharged by tourist cruises. This decreased bacteria counts to a great extent in 2007.
6. In Nuweiba (Sayadeen), the levels of bacteria were below permissible limits in 2007, this might be due to small number of tourists visiting this area compared to previous times.

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- (3) **GESAMP (Group of Experts on Scientific Aspects of Marine Pollution) (1990). The State of the Marine Environment – London, United Kingdom.**