

# Annual report on water quality data from the coastal areas of Gulf of Suez, Gulf of Aqaba and Red Sea Proper Year ٢٠٠٠.

## Summary

This report reviews the most significant results of the EIMP monitoring of water quality parameters from the coastal areas of the Gulf of Suez, Gulf of Aqaba and the Red Sea proper in the year ٢٠٠٠. The major findings were:

- The bacteriological water quality was poor at a quite large proportion of the visited stations in the Gulf of Suez, the Gulf of Aqaba and the Red Sea proper in year ٢٠٠٠.
- The bacteriological water quality deteriorated markedly in the entire region in ٢٠٠٠ compared to ١٩٩٨ and ١٩٩٩. The deterioration is most likely due to a significant increase of tourist activities
- High levels of nutrients ( $\text{NH}_4$ ,  $\text{NO}_3$  and  $\text{PO}_4$ ) and a high biomass of phytoplankton (measured as chlorophyll-a) were encountered in the northernmost part of the Gulf of Suez near the city of Suez (in Suez Bay at Su١-Su٢). The source of nutrients is domestic and industrial wastewater discharged from the city of Suez and possibly the many ships awaiting passage through the Suez Canal.
- Low levels of nutrients and a low biomass of phytoplankton were generally encountered at all other stations in the region.
- Generally, the levels of nutrients and plankton biomass measured as chlorophyll-a did not differ significantly from previous years. However there were a few exceptions: In the Gulf of Suez the chlorophyll levels decreased and the levels of dissolved inorganic nitrogen increased. The annual mean concentration of orthophosphate ( $\text{PO}_4\text{-P}$ ) increased markedly in the Red Sea proper. This was due to an increase in the concentrations encountered off the phosphate shipping facilities in Safaga and El-Hammarawein.

## 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 EIMP Coastal Water Monitoring Programme comprises ١) Monitoring of water quality parameters on water samples ٢) Monitoring of contaminants in sediments, shellfish and corals and ٣) Monitoring of benthic infauna and coral reefs.

This report reviews the most significant results of the monitoring of water quality parameters from the coastal areas of the Gulf of Suez, Gulf of Aqaba and the Red Sea proper in the year ٢٠٠٠.

The monitoring was carried out six times (i.e. in January, March, May, July, September and November). A total of ٣٩ stations were visited during each sampling campaign (١٣ in the Gulf of Suez, ١٥ in Red Sea and ١١ in the Gulf of Aqaba). The locations of the sampling stations are presented in Figure ١. On each sampling campaign the following parameters were measured: ١) Hydrographical conditions (water temperature, dissolved oxygen, salinity and pH), ٢) Bacteriological parameters (total coliform, *E. coli* and faecal streptococci bacteria), ٣) Eutrophication parameters (chlorophyll-a, total suspended matter, transparency, total nitrogen, nitrate, nitrite, ammonium, reactive and total phosphate and reactive silicate). Furthermore, visual observations on weather condition, oil pollution, and sewage impact were made. All measurements were carried out according to international standards.

*Figure \. Sampling stations for water samples in the Gulf of Suez, the Gulf of Aqaba and the Red Sea Proper in year \dots.*

## Bacteriological parameters

The occurrence of pollution indicator bacteria is used as sanitary parameters for evaluation of water quality (i.e. Total coliform bacteria, *E. Coli* and Faecal streptococci). High levels of these bacteria indicate a potential risk to public health. The data were compared with the levels stipulated in the Egyptian guidelines. The guidelines accept a content of  $10^2$  bacterial counts/ $100$  ml seawater for coliform bacteria and  $10^1$  bacterial counts/ $100$  ml seawater for *E. coli* and Faecal streptococci.

The bacteriological water quality was poor at a quite large proportion of the visited stations in year 2000 (Fig. 2, 3 and 4). The guideline values for indicator bacteria were thus exceeded at least once for at least one parameter at 23 of the 40 stations visited. Table 1 presents an overview of these stations, the percentage of samples exceeding the standards for Total Coliforms, *E. Coli* and Faecal streptococci as well as likely sources of the bacteria.

In the Gulf of Suez 16 of the 20 visited stations were slightly to heavily polluted by bacteria, the sources being primarily untreated domestic and industrial wastewater and anchored ships in the Bay of Suez. The most polluted sites were the stations closest to Suez (Su<sup>1</sup>b, Su<sup>1</sup>c and Su<sup>1</sup>r) and Ras Gharib (Su<sup>1</sup>v).

16 of 26 visited stations along the Red Sea coast were slightly to highly polluted by bacteria. The most polluted sites were Bir Shalatin (Re<sup>1</sup>o) and Quseir (Re<sup>1</sup>1). The sources of bacteria in the Red Sea are primarily tourist activities. However, at Safaga (Re<sup>1</sup>a) and at Bir Shalatin (Re<sup>1</sup>o) the main sources are harbour and fish processing activities, respectively.

In the Gulf of Aqaba 9 of 22 visited sites were slightly to heavily polluted by bacteria. The most polluted sites were Sharm El-Sheik harbour (Aq<sup>1</sup>a) and Taba (Aq<sup>1</sup>1). The major source of bacteria in the Gulf of Aqaba is tourist activities.

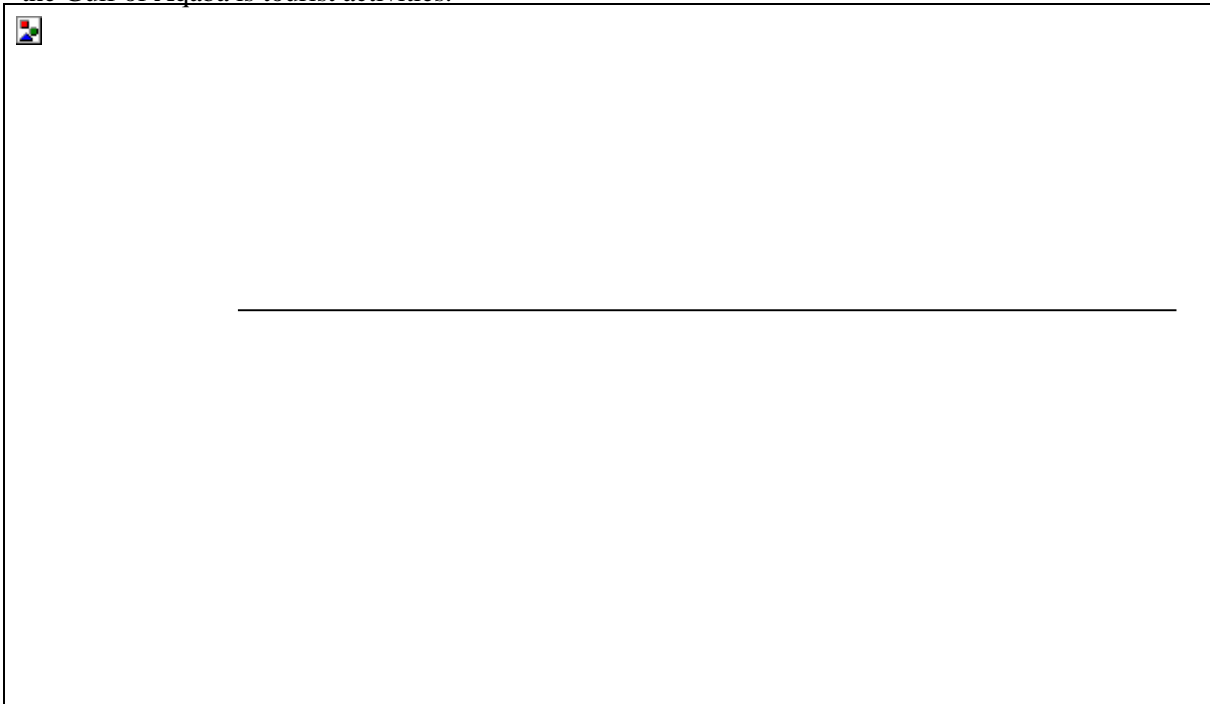


Figure 2 Coliform bacteria. Counts per  $100$  ml sea water in the Gulf of Suez, Red sea proper and Gulf of Aqaba in 2000 (logarithmic scale!). The horizontal line indicates the Egyptian guideline standard of  $10^2$  CfU/ $100$  ml.



Figure 3 *E. coli* bacteria. Counts per 100ml sea water in the Gulf of Suez, Red sea proper and Gulf of Aqaba in 2000 (logarithmic scale!). The horizontal line indicates the Egyptian guideline standard of 100 CFU/100ml).

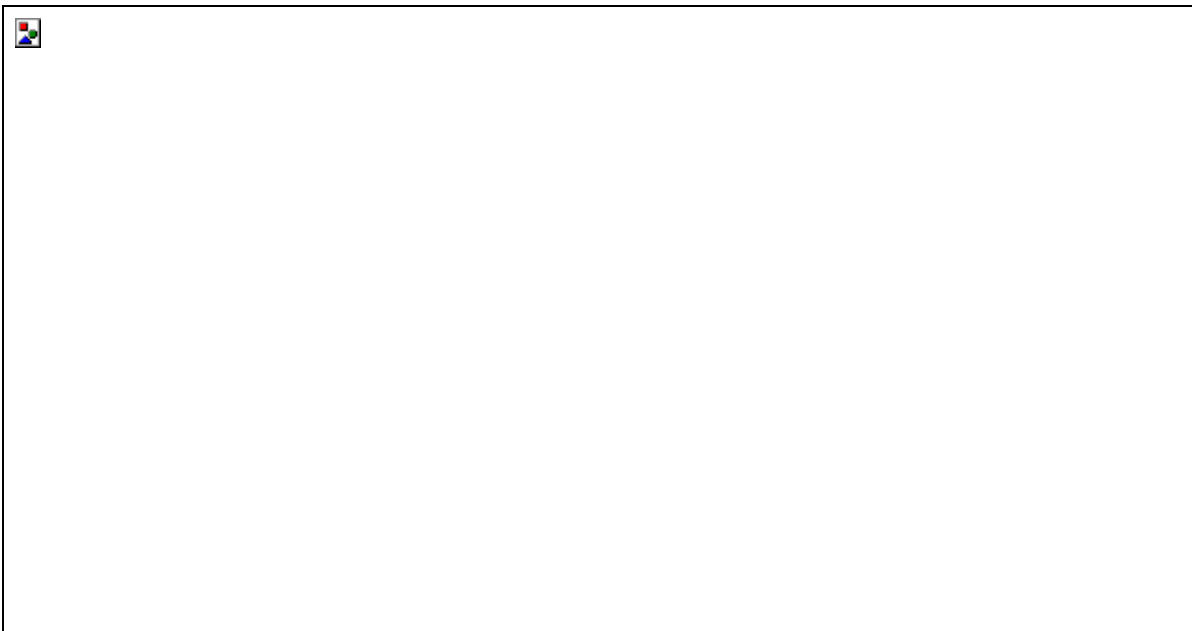


Figure 4 *Faecal Streptococci*. Counts per 100ml sea water in the Gulf of Suez, Red sea proper and Gulf of Aqaba in 2000 (logarithmic scale!). The horizontal line indicates the Egyptian guideline standard of 100 CFU/100ml).

**Table 1. Stations where the bacteriological water quality standards were exceeded on at least one occasion for at least one indicator bacteria (200 CFU/100ml for Total Coliforms and 100 CFU/100ml for *E. Coli* and *Faecal streptococci*. The Percentage of samples collected during the year, which exceeded the standards, is shown as well as likely sources of the bacteria.**

Station	Location of station	Percentage of samples exceeding the criteria for Total Coliform	Percentage of samples exceeding the criteria for <i>E. Coli</i>	Percentage of samples exceeding the criteria for <i>Faecal streptococci</i>	Degree of pollution by bacteria	Likely source of pollution
<b>Gulf of Suez</b>						
Su <sup>1</sup> b	Suez (Rex beach)	40	60	40	Polluted	Fishing harbour
Su <sup>1</sup> c	Suez (Kabanon beach)	100	100	80	Highly polluted	Wastewater from slaughter house
Su <sup>2</sup>	Suez (El-Ataka)	0	83	0	Polluted	Anchored cargo ships
Su <sup>3</sup>	Ain Sukhna-south	0	17	33	Slightly polluted	Tourist activities
Su <sup>4</sup>	Ras Gharib (city)	100	100	100	Highly polluted	Untreated sewage
Su <sup>5</sup>	Ras Shukeir	33	33	33	Relatively polluted	Anchored ships
Su <sup>6</sup>	Ras El-Sudr	17	33	17	Relatively polluted	
Su <sup>7</sup>	El Tur	17	33	17	Relatively polluted	Sewage
<b>Red Sea Proper</b>						
Re <sup>1</sup>	Hurghada(Sheraton)	33	0	0	Relatively polluted	Tourist activities
Re <sup>2</sup>	Sa <sup>1</sup> Hashish	17	17	0	Slightly polluted	Tourist activities
Re <sup>3</sup>	Safaga (north)	0	0	0	Slightly polluted	
Re <sup>4</sup>	Safaga (middle)	17	17	33	Relatively polluted	Safaga harbour
Re <sup>5</sup>	Quseir (north)	33	0	33	Polluted	Tourist activities
Re <sup>6</sup>	Quseir (middle)	0	0	17	Slightly polluted	
Re <sup>7</sup>	Quseir (south)	17	17	0	Slightly polluted	
Re <sup>8</sup>	Bir Shalatin	100	100	83	Highly polluted	Fishing harbour, sewage
<b>Gulf of Aqaba</b>						
Aq <sup>1</sup>	Ras Mohammed	0	17	0	Slightly polluted	Tourist activities
Aq <sup>2</sup> a	Sharm El Sheik (harbour)	67	83	67	Highly polluted	Tourist activities
Aq <sup>2</sup> b	Sharm El Sheik (public beach)	17	17	0	Slightly polluted	Tourist activities
Aq <sup>3</sup>	Naama bay	33	17	0	Slightly polluted	Tourist activities
Aq <sup>4</sup>	Nuweiba (El Sladin)	33	33	33	Relatively polluted	Tourist activities
Aq <sup>5</sup>	Nuweiba (Madina beach)	17	17	33	Relatively polluted	Tourist activities
Aq <sup>6</sup>	Taba	67	67	0	Polluted	Sewage

## Eutrophication Parameters

Sewage contains organic matter and nutrients ( $\text{NH}_4$ ,  $\text{NO}_3$ ,  $\text{NO}_2$  and  $\text{PO}_4$ ). Discharge of nutrients stimulates the growth of phytoplankton (microscopic algae) and seaweed. This process is called eutrophication. In addition microorganisms in the water column degrade the organic matter and release nutrients. The degradation of discharged organic matter, dead plankton algae and dead seaweed consumes oxygen, so when the load of organic matter and nutrients are very high, oxygen depletion may occur, which in turn may adversely affect the marine flora and fauna.

High levels of nutrients ( $\text{NH}_4$ ,  $\text{NO}_3$  and  $\text{PO}_4$ ) were encountered in the northernmost part of the Gulf of Suez near the city of Suez (in Suez Bay at Su<sup>1</sup>-Su<sup>3</sup>). The high nutrient levels form the basis of a high primary production of phytoplankton in Suez Bay. The source of nutrients is domestic and industrial wastewater discharged from the city of Suez and possibly the many ships awaiting passage through the Suez Canal.

Low levels of nutrients and a low biomass of phytoplankton were generally encountered at all other stations in the region. The individual parameters are described below.

### **Ammonia (NH<sub>4</sub>-N)**

Relatively high levels of Ammonia were found in the northern part of the Gulf of Suez close to the city of Suez. The annual mean was 12.9 uM with a range of 0.76-37.2 uM.

The levels of ammonia were generally low at the other stations in the Region; the annual mean being 0.73 uM (range 0.00-7.4 uM). The levels of ammonia in the southern part of the Gulf of Suez, the Red Sea proper and the Gulf of Aqaba were similar (Fig. 6).

Occasionally slightly higher levels of ammonia than the average were found at Ras Sukheir (Su<sup>4</sup>), Ras Gharib (Su<sup>5</sup> and Su<sup>6</sup>) and Abu Zenima (Su<sup>7</sup>), Hurghada (Re<sup>3</sup>), Safaga (Re<sup>4</sup>), Quseir (Re<sup>5</sup>), Bir Shalatin (Re<sup>6</sup>), Ras Mohamed (Aq<sup>1</sup>), Sharm El Sheik harbour (Aq<sup>2</sup>), Nahlat Al Tel (Aq<sup>3</sup>), Mersa Muqubila (Aq<sup>4</sup>) and Taba (AQ<sup>5</sup>)