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FULL LENGTH ARTICLE

Seasonal fluctuations of phytoplankton community and physico-chemical parameters of the north western part of the Red Sea, Egypt

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KEYWORDS

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Abstract Phytoplankton community structure and some environmental parameters in the coastal water of the north western part of the Red Sea were studied seasonally during 2013. A total of 145 species were recorded with clear dominance of Bacillariophyceae, which formed about 76.4% of the total phytoplankton counts with annual average of 3654 cell/L and Dinophyceae (14.63%) with annual average of 700 cell/L. Other algal classes; like Cyanophyceae, Chlorophyceae, Euglenophyceae and Silicoflagellates sustained low counts, forming collectively about 9.0% of the total abundance of phytoplankton. Autumn was the most productive season recording an average of 5916 unit/L, followed by spring (average of 5282 unit/L) and winter (average of 4329 unit/L), while summer showed the lowest counts (average of 3607 unit/L). The species diversity fluctuated between 3.36 in the summer and 3.97 in autumn, with an annual average of 3.76.

The physico-chemical properties of surface water exhibited seasonal and spatial variations. The dissolved nitrate (0.07–2.27 μM), ammonium (1.82–8.80 μM), reactive silicate (0.41–5.22 μM) and water salinity (39.9–42.9‰) were the most effective factors that controlled the seasonal fluctuations of phytoplankton during 2013. The multiple regression model was: phytoplankton counts = $28{,}564 + 0.69\ NO_3 + 0.284\ NH_4 - 0.13\ SiO_4 - 0.30$ Salinity (M.R. = 0.91, $N = 24$ and $p < 0.07$). This equation could be applied in the future to predict the total phytoplankton counts in the coastal waters of the northern part of the Red Sea, Egypt.

Introduction

The Red Sea is a large marine ecosystem and it is an important economic and environmental asset (Longhurst, 2007 and Belkin, 2009). It is lying between the African and the Asian continental shelves, and is about 2250 km long (Fig. 1). At

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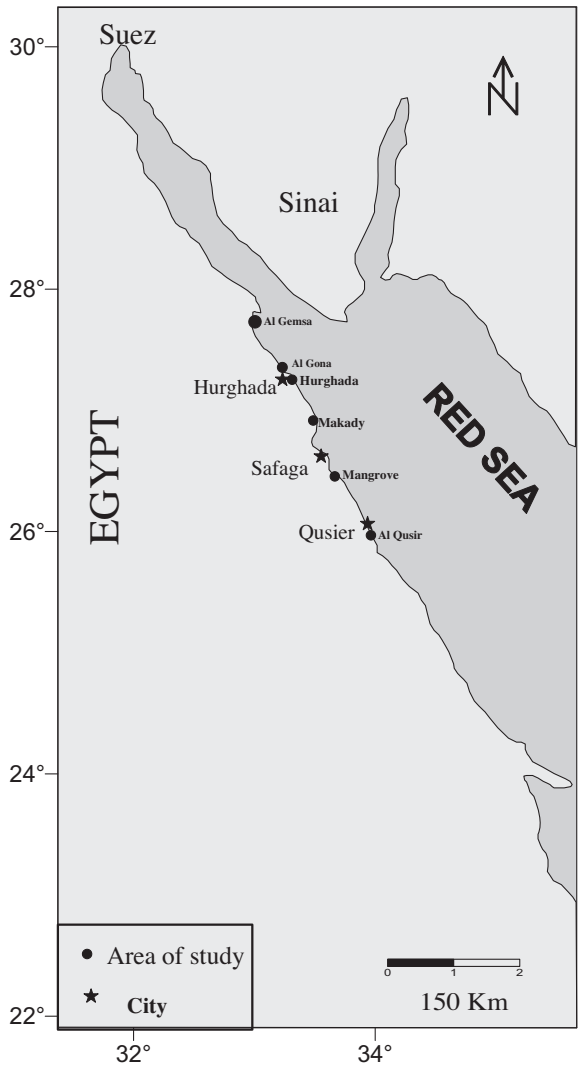

Figure 1 Positions of the sampling stations.

the northern extremity it is divided by the Sinai Peninsula into the Gulfs of Suez and Aqaba. The Suez Canal connects the Red Sea with the Mediterranean Sea, while the southern region exchanges waters with the open Indian Ocean through the Gulf of Aden and the Arabian Sea via the strait of Bab-el-Mandeb (Sofianos and Johns, 2002).

The Red Sea provides habitats for a wide range of marine species some of which are endemic (Baars et al., 1998) and can be considered a highly productive ecosystem. The pollution in the north western part of the Red Sea induced by the anthropogenic activities including oil spills and excessive loading of nutrients through addition of fertilizers and industrial wastewater and sewage has been reported (Abou-Aisha et al., 1995).

The phytoplankton plays an important role in the marine food web, biogeochemical cycle and climatic processes (Paerl et al., 2003 and Armbrust, 2004). In the oceanic waters of the central Red Sea, Halim (1969) reported 125 dinoflagellate species and 84 diatoms and Shaikh et al. (1986) detected 110 dinoflagellates and 137 diatoms. In the coastal waters of the Red Sea, El-Sherif and Abo El-Ezz (2000) examined the distribution of plankton at Taba, Sharm El-Sheikh, Hurghada and Safaga on the Red Sea, recording 41 diatom species, 53 dinoflagellates, 10 cyanophytes and two chlorophytes. Sommer (2000) studied the relationship between larger nanophytoplankton and microphytoplankton and the nutrient limitation and grazer in the Gulf of Aqaba and the open northern Red Sea. AL-Qutob et al. (2002) followed the relationship between nitrite and phytoplankton in the Gulf of Aqaba. Deyab et al. (2004) recorded 200 phytoplankton species along the Suez Canal, Suez Gulf and the northern part of the Red Sea with the clear dominance of diatoms. Nassar (2007a) studied the phytoplankton dynamics in the coastal waters of Suez Gulf and recorded a total of 144 species of different groups, and Nassar (2007b) conducted a similar study on the phytoplankton abundance in the coastal waters of the Aqaba Gulf, recording 127 taxa. Also, Al-Najjar et al. (2007) studied the seasonal dynamics of phytoplankton in the Gulf of Aqaba. Toulibah et al. (2010) studied the phytoplankton community and physico-chemical characters of Jeddah coast, Red Sea. They reported that the coastal waters were found to be oligotrophic in some areas, while other areas were mesotrophic with high phytoplankton density. Madkour et al. (2010) studied the phytoplankton population along the southern part of Sinai Peninsula and the Gulfs of Suez and Aqaba. The phytoplankton population was fairly diversified (181 species) and comprised mainly two groups; dinoflagellates (116 species) and diatoms (60 species). There were relatively low variations in the phytoplankton composition in the study area. Spatial distribution of phytoplankton showed that Gulf of Suez differs in the dominant species and timing of abundance from both Gulf of Aqaba and the southern sites of Sinai Peninsula. Recently, Qurban et al. (2014) indicated that, the coastal waters in the Saudi Arabia of the northern Red Sea were oligotrophic and the primary production was strongly nitrogen-controlled.

Aim of work

The aim of the present study is to follow up the species composition and abundance of phytoplankton in the coastal water from Al Gemsha to Al Qusir along the north western part of the Red Sea in relation to the seasonal fluctuations of some physicochemical parameters.

Material and methods

The sample collection for phytoplankton study and physico-chemical measurements was carried out seasonally in winter (January), spring (April), summer (August) and autumn (November) during 2013 at six stations representing different ecological habitats along the northern Red Sea (Fig. 1). Al Gemsha (St.I) is located about 60 km north of Hurghada City and is subjected to low oil and sewage effluents of Al-Gemsha and the General Petroleum Companies, Al-Gona (St.II) lies at about 20 km north Hurghada City and near to the human and tourist activities, Hurghada (St.III) is found in front of the National Institute of Oceanography and Fisheries and is subjected to land filling and weak sewage effluents, Makady (St.IV) is located about 30 km south of Hurghada City and is relatively far from the pollution sources. Mangrove (St.V) is situated about 17 km south Safaga City (Pristine station) and Al Qusir (VI) is located about 140 km south of Hurghada City and is subjected to fishing activities and sewage impacts.