Ain-Shams University
Faculty of Girls

Environmental and Physiological Studies for the Impacts of Human Activities on Marine Environment in The Red Sea (Hurghada – Safaga)

A thesis

Submitted by

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B.Sc. Marine Biology & Ichthyology

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Abstract

The heavy metals; Cu, Zn, Pb, Mn and Cd were measured in the fine sediment fractions ($Ø_3$, $Ø_4$ and $Ø_5$), seawater and some benthos at six sites represent the main land-based activities at Hurghada, Safaga and El-Hamraween along the Red Sea coast. The fine sediment fractions recorded significant occurrence at the different sites, They were varied between 24.61% and 88.88% from the total sediment percentage depending on the oceanographic conditions of each locality. $Ø_3$ was the most dominant fraction (14.92%-28.3%) followed by $Ø_4$ (8.04-57.46%), subsequently they were considered the essential pollutant bearing fractions.

The different heavy metals recorded significant concentrations in the fine fraction sediments at all sites. . Cu recorded the highest average (248.69µg/g) at site I, Site II recorded the lowest average contents of all metals (96.41µg/g, 137.93µg/g, 100.10µg/g, 77.26µg/g and 10.66µg/g respectively) at site III, Mn (407.66) Zn (746.24µg/g) at site V, Pb (215.86µg/g) at site IV and Cd recorded the highest average (28.47 µg/g) at site VI. that may attributed to the continuous leaching of these metals by the long shore currents and waves. The obtained results illustrated that the seabed sediments of Safaga marine area was more polluted than and the sediments at both Hurghada and Al Hamraween marine areas. Also, $Ø_3$ was the most significant heavy metals bearing fraction in all sites followed by $Ø_4$. Subsequently, the different sites were differentiated between slightly polluted to heavy polluted areas.

In the seawater, Safaga sites recorded the highest average of Cu, Zn and Pb (10.49 µg/l, 63.02µg/l, and 42.49µg/l respectively). Also, the recorded data of faunal and floral communities indicated that Safaga sites were more polluted than Hurghada sites and El Hamraween Harbour. The direct stressors were; shipyard remains, phosphate shipments, terrestrial runoff, untreated domestic sewage, desalination stations flow out, maritime activities, fishing boat activities, boat mooring and ballast waters, construction remains and hydrocarbons.

Contents

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Introduction

1- **General**.

The marine environment is the largest aquatic system on the earth. It provides the rich and varied resources (living and non-living) for the human production and life. The marine environment is not only the domain of food for human being but also the legitimate concern of marine transport, offshore extraction of oil, gas and other minerals, climate control and recreational activities. Maritime shipping is involved in the transport of over 80% of the world's merchandise trade (Hedgepeth, 1957).

The marine ecosystem is a particularly fragile environment which is highly susceptible to the effects of human activity (Moreau et al. 2007).

The marine environment was divided into the pelagic realm (in which the pelagic organisms are live in the open sea away from the bottom) and the benthic realm (in which the organisms are related to the sea bottom). Horizontally, the pelagic realm can be divided into neritic and oceanic zones. The neritic zone encompasses the water mass that overlies the continental shelves. The oceanic zone includes all other open waters (Hedgepeth, 1957).

The benthic zone underlying the neritic pelagic zone on the continental shelf is termed the sublittoral or shelf zone. This

zone is illuminated and is generally populated with an abundance of organisms constituting several different communities, including seagrass beds, macro-algal flora and coral reef communities.The intertidal zone or the littoral zone is that shore areas lying between the extremes of high and low tides; it represents the transitional area from marine to terrestrial conditions. It is a zone of abundant of renewable coastal resources (biological communities) and human activities. The overexploitation of this zone and the overutilization of marine environment have led to consequence degradations; the resource degradation, environment pollution and ecosystem destruction.

The Red Sea constitutes a unique ecosystem with high biological diversity. its natural resources provide a substantial economic in addition to the fishery industry, which has ensured food security to many people of the region and created jobs for others. Tourism is an ever growing and increasingly important industry for commerce and other economic activities (UNEP, 1997).

The main sources of marine pollution come from land-based activities; over-population and urbanization and coastal dredging and filling operations, power and desalination plants and refineries, recreational and tourism, waste water treatment facilities, power plants, coastal mining and quarrying

activities, oil bunkering and habitat modification like dredging and filling of wetlands (UNEP, 1997).

Other operations like dredging and disposal of dredging wastes are of the major sources of induced environmental damage (Tull, 2006). Dredging can destroy the habitats of marine species. Mud, silt and sediment dredged from harbour bottoms are often highly polluted by hydrocarbons and heavy metals.

Sewage disposing can pose suspended solids and causes discolouration of water, reducing the amount of light that penetrates below the surface, and can cause eutrophication by introducing nutrients into the water which then stimulate the algal-growth (Moreau et al., 2007). Sewage effluent contains industrial waste, municipal wastes, animal remains and slaughterhouse wastes, water and wastes from domestic baths, utensils and washing machines, kitchen wastes, faecal matter and many others (Islam and Tanaka, 2004). Close to urban areas, metal pollution has been associated with sewage outlets (Chen *et al.* 2005; Wannaz *et al.* 2006).

APP(Antifouling paints particles) are applied to the hulls of boats and to many static structures that are submerged, including pontoons, piers, aquaculture nets, buoys, pipelines and drilling platforms, to prevent the growth of fouling organisms (Chambers *et al.* 2006; Almeida *et al.* 2007). Large

quantities of APP are generated in boatyards and shipyards during the repair, maintenance and cleaning of vessel hulls (Axiak *et al.* 2000; and Kotrikla, 2009).

The size of particulates produced depends on the method of paint removal (e.g. scraping, stripping, sanding, hydroblasting, sand-blasting, soda-blasting) and can range a few microns in diameter to several cm in length (Champ, 2003).APP are generated during boat maintenance and cleaning (the latter is undertaken both out of water and in water), flake off poorly maintained structures and abandoned boats, and are shed during the impaction or grounding of boats.

APP provides significant, localized sources and during subsequent resuspension or dredging of sediment, they liberate to the overlying water column and may be processed and accumulated by benthic epi-faunal and in-faunal invertebrates (Turner, 2010).

Monitoring the impact of pollutants on aquatic life forms is challenging due to the differential sensitivities of organisms to a given pollutant, and the inability to assess the long-term effects of persistent pollutants on the ecosystem as they are bio-accumulated at higher trophic levels (Torres *et al.* 2008). Among the various types of pollutants, heavy metals are of particular concern due to their environmental

persistence, biogeochemical recycling and ecological risks (Gavriil and Angelidis, 2005). Metals are introduced into the marine environment through flood and/or terrestrial runoff, atmospheric deposition, hydrothermal venting, diagenetic remobilization and anthropogenic activities (Libes, 1992). The near-shore environment, particularly adjacent to effluent outfalls of the industries shows accumulation of heavy metals (Gavriil and Angelidis, 2005). Consequently, the macro-benthic community, species diversity and population numbers show differences in response to anthropogenic pollution (Agard *et al.* 1993). Also, the high levels of heavy metals in aquatic ecosystems are regarded as serious pollutants because they can be toxic and get incorporated into the food chain (Alyahya *et al.* 2011) and pose a risk to humans and ecosystems (Pourang and Amini 2001; Szefer 2002; Rainbow 2002; El-Gendy 2003).

With increasing the urban occupation along the Red Sea coasts due to the progressive development throughout the last three decades, the rapid and uncontrolled human activities along the coast were increased intensively in some places causing a series of disturbances and demolish stresses on the tidal flat ecosystem (Madkour and Dar, 2007).

The major hazards in the marine environment of the Red Sea coast are; the dumping sediments for blocked

constructions of marinas, jetties, projection buildings, boat constructions and maintenance operations in the shipyards, green areas irrigation with treated wastewater, oil waste pollution from tankers and motorboats and the discharge of brine effluents from the desalination stations, paint remains and solid wastes of construction remains, iron pipe rusts, hydrocarbons, plastics, metal and wood remains (Frihy *et al*. 1996; Madkour and Dar, 2007). attributed the main sources of pollution in the tidal flat areas to the activities related to boat constructions, maintenances and operations in the area included marinas and shipyards. They added, the resulting wastes of these operations are known to be intensively hazardous to the marine environment especially those conservative wastes such as the released heavy metals to the marine environment through paints remains and solid wastes of construction remains, iron pipe rusts, hydrocarbons, plastic bags, metal and wood remains.

2- Aim of study

The present study aims to:

1- Studying the direct and indirect impacts of some jetties, marinas and shipyards on the coastal habitats along the Red Sea coast in the district between Hurghada and Qusier cities.

2- Evaluate the harmful effects of these activities on the benthos distribution and diversity in these areas.

3- Providing essential data base for longterm monitoring program for the faunal and floral recovery and diversity in the highly stressed zones.

4- The bio-accumulation effects of some heavy metals on some floral and faunal communities in these zones.

Literatures Review

1. General.

Abbas and Haddad (1984) investigated inorganic nitrogen forms as indicator of sewage pollution in the coastal water of the Red Sea near Jeddah. They studied the distribution of inorganic nitrogen forms, nitrate, nitrite, and ammonia for evaluating the state of pollution in the coastal water of Jeddah center. They also studied salinity, temperature, pH, transparency, and oxygen/ hydrogen sulfide. They found that the degree of variation from natural conditions was high in the coastal dead reef area bordering Jeddah Center. They indicated that the concentration of inorganic nitrogen forms and total nitrogen in the southeastern part was high and it approached concentration that exists in raw sewage. They cautioned from the continuous dispose the raw wastes into the coastal zones of the newly growing urban areas along the coast of the Red Sea coast near Jeddah that may affect recreation, utilization of seafood, public health and further damage the coral reef areas.

Abu-Aisha *et al*. (1995) studied impact of phosphorus loading on macro-algal communities in the Red Sea coast of Egypt at three sites (phosphate concentration at Safaga and Quseir compared to a control site at Ghardqa). The localized phosphate pollution at two sites significantly increased the

phosphate level in water, which led to significant decreasing in biomass of the macroalgae. The inter-tidal zone at one of the impacted sites supported very poor algae vegetation. The results obtained by them showed that the abundance of macro-algae reached its maximum in August at all the studied sites.

Gomaa (1995) investigated the effect of season and locality variation on the distribution of heavy metals in ecosystem components (fish, sediment and water) .

Frihy *et. al.,* (1996) delineated the human impacts on the coastal zone of Hurghada, northern Red Sea. The out investigations have involved three approaches, identification the existing coastal problems, categorizing the types of existing problems, andrelevant recommendations, considering the compatibility with the law of environmental conservation (L4/1994), future projects, and the current policy of encouraging national investment.

Abu Hilal (1997) studied the phosphate pollution and related problems in the unique and very sensitive coral reef area in the northern portion of the Gulf of Aqaba. The various sources and magnitude of pollution were pointed out. He reviewed and discussed the levels and distribution of phosphates and other pollutants taking into consideration the effects of phosphate dust spills during loading operations in Aqaba Port (Jordan).