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ECOLOGICAL STUDIES ON MACROBENTHIC INVERTEBRATES ASSOCIATED WITH MACROPHYTS IN RIVER NILE, EGYPT

A Thesis
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Abstract

Macrobenthic invertebrate's species are differently sensitive to biotic and abiotic factors in their environment. Consequently, they were commonly used as bioindicators of the conditions and water quality of aquatic systems. During the period from spring 2007 to winter 2008, eleven stations along the River Nile; from Aswan to Cairo , five stations in Damietta branch and six stations in Rosetta branch were selected to study the effect of water quality conditions on the macrobenthic invertebrates associated with aquatic macrophytes. Some physico-chemical parameters were studied in the River Nile as temperature, electrical conductivity (EC), total dissolved solids (TDS), pH value, dissolved oxygen (DO), biological oxygen demand (BOD).

Thirty eight macrobenthic invertebrates' species were identified in the present study. The macrobenthic fauna in the investigated area were rich and diverse. This Community comprised three phyla namely Arthropooda, Mollusca and Annelida, in addition to some rare forms represented mainly by fish fry. Arthopoda ranked the highest percentage of population density of the community 52.7%. , 79.3% and 94.7% by number of the total macrobenthic fauna at the River Nile, Damietta branch and Rosetta branch, respectively. Mollusca ranked the second group represented by 38.5%, 11.7% and 3.4% of the total macrobenthic fauna at the River Nile, Damietta branch and Rosetta branch, respectively. Annelida formed only 8.6%, 8.5% and 1.7% of the total population at the River Nile, Damietta branch and Rosetta branch, respectively. The average total density of the macrobenthos was 648 org.m^{-2}. The main Nile course harbured the highest density of macrobenthos at station 10 (1767 org.m^{-2}). A sharp decline in the average of macrobenthos population was noticed at station 8, that counted 3 org.m^{-2}. *Chironomus* sp. was the most dominant species during the study and it is considered to be potential bioindicator for polluted ecosystem, indicating that the water quality of the River Nile is deteriorated. A regular program for biomonitoring is recommended which will allow future changes to be detected.

Key word: macrobenthic invertebrates, aquatic macrophytes, indicators, water quality, physico-chemical parmeters, River Nile, Damietta branch and Rosetta branch.

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I. INTRODUCTION

The River Nile is one of the world's longest rivers flowing a distance of over 6625 km from source to mouth (Zahran & Willis, 2003). Pollution in the River Nile System (main stem Nile, drains and canals) has increased in the past few decades due to increases in population, several new irrigated agricultural projects, and other activities along the Nile (APRP, 2002).

Both the Rosetta and Damietta branches extend north-wards from Cairo to the Mediterranean over distances exceeding 200 km, along their course, they provide for the needs of agriculture, industrial activities and supply drinking water for the most populated area of Egypt (Dumont, 2009).

Damietta branch of the River Nile has a great vital importance, since it serves as a source of water for municipal, industrial, agricultural, navigation and feeding fish farms dispersed between El-Serw to Faraskour region**.** The earthen Faraskour Dam divides this branch at Damietta city; 20Km south of Mediterranean Sea to cut off the flow of the Nile water to the Mediterranean Sea**.** The water characteristics after the Faraskour Dam is completely different compared with the water before the dam (Ali, 1998). Along Damietta branch, there are about six main industrial plants. These are Talkha fertilizer plant, Talkha Electric power station, Kafer Saad Electric Power Station, Delta Milk, discharge their effluents directly to the branch besides the sewage and domestic wastes discharging from the neighboring villages without any treatment (Ali, 1998).

Also, Rosetta branch of the River Nile has a great vital importance as an important source of water for municipal, industrial, agricultural, navigational and feeding fish farms. Rosetta branch subjects mainly to three sources of pollution which potentially affects and deteriorates the water quality of the branch; El-Rahway drain which disposes mixture of agricultural, domestic waste and sanitary drainage from large area of Great Cairo. The impact of this drain on the water quality of the branch is extended to a long distance from its source. Also Kafr El-Zayat industrial area which receives the industrial effluents from factories of super phosphate and sulfur compounds, oil and soap industries and pesticides factories. In addition to the polluted effect of several small agricultural drains that discharge directly into waters, besides sewage discharged from several cities and its neighboring villages that are distributed along the two banks of the Rosetta branch (Mancy and Hafez, 1979 a &b)

Rosetta branch is divided into two ecological sectors; freshwater sector extending from branching of the river at El-Qanater El-Khyria Barrage until behind Edfina Barrage (approximately 200 km north Cairo). The second sector represents mixed water (saline to fresh water) extending from below Edfina Barrage until the branch outlet in the Mediterranean Sea. Nature of the later community depends on time, space and efficiency of barrage operating system. The bottom topography of the estuary is irregular, representing a succession of depressions; the middle is reaching 18 m in depth. The silt depth at the outlet rises to about 6 m from the surface (Mancy and Hafez, 1979 b)

Biological criteria to develop a biotic pollution index can be used in conjunction with physicochemical data. Many biotic indices are based on the pollution tolerance of macroinvertebrates. Benthic invertebrates are useful in such indices because they are long- lived, sessile, and the diversity of species may indicates water quality conditions over a period of time, while chemical records are relevant only for the time of their measurement. Also, intermittent pollution can be easily missed by chemical sampling. Macroinvertebrates are fairly easy to identify and do not require the skills of highly specialized taxonomists (Hellawell, 1986).

The use of biotic indicates for pollution monitoring in rivers was developed in Europe and in United States (Rosenberg & Resh, 1993). Indices have been developed using Protozoa (Jian & Yun, 2003), Diatoms, macrophytes and fish (Planfkin *et al.*, 1989, Iliopoulou-Georgudaki *et al., 2003).*

Sampling large rivers such as River Nile is carried by Logistic difficulties. Fishar & Williams (2006) used three sampling methods [Ekman Grab, macrophytes sweep netting and Artificial substrate sampling (ASS)] for monitoring macroinvertebrate diversity. The study found that the average number of taxa collect per sample from banks by each method indicated that the ASS were by far the most efficient with 7.2, followed by macrophytes with 3.4 and only 2.4 for the grab samples.

The Nile was characterized by its large number of plant species that from a mosaic of communities (Zahran, 2009). The habitats created by the combination of emergent plants and open water are prolific area for insect development (Magee *et al*., 1999). Since apart of providing habitat, decaying plant material supplies food for aquatic detritivores (some midges and mayflies), and creates refuges, allowing successful avoidance of predation in vegetated area (Evans *et al.*, 1999). Macroinvertebrate assemblages appear to be strongly influenced by vegetation (Battle *et al.*, 2001).

However, in Egypt, many studies were carried on the aquatic insect fauna and were mainly concerning with the study of macrobenthic invertebrate's taxonomy, while the knowledge about the ecology and role of aquatic macrobenthic invertebrates as indicators of water quality is still poor. The present investigation aimed to study certain ecological and taxonomic aspects of macrobenthic invertebrates in the River Nile that include:

1. Determination the ecological conditions of the selected stations including the study of physico-chemical parameters of the water.
2. Survey of aquatic macrobenthic invertebrates associated with machrophytes in the area of study.
3. Recording the distribution and seasonal variation of macrobenthic invertebrates associated with machrophytes.
4. Determination the relationship between the collected aquatic macrobenthic invertebrates associated with machrophytes and water quality parameters in the area of study.

II. LITERATURE REVIEW

1. Water quality analysis

The main factors which affect water quality characteristics of the River Nile include: (a) upstream changes south of Lake Nasser, (b) changes in Lake Nasser, and (c) localized changes in the river basin. Furthermore, the Nile receives increasing amounts of waste discharges, from point and non-point sources, as the river travels northward. The discharge of waste effluents is usually accompanied by localized effects of water quality deterioration immediately downstream from the waste outfall. The industrial sector is an important user of water and contributor in pollution. Industrial activities are concentrated around big cities such as Cairo and Alexandria, Sugar cane industries exert significant influence on water quality in the south of Upper Egypt, while hydrogenated oil and onion-drying factories affect water quality in the north of Upper Egypt. The river exhibits its worst conditions in the Delta due to reduction of the river velocity in certain locations to complete stagnation, industrial and domestic waste discharges and return flow of agricultural drainage water. At Kafr EI Zayat there are three factories discharging their waste water directly into the Rosetta branch. These factories are: Salt and Soda Company, Pesticides Company and Superphosphate fertilizer plant. As the river reaches the Edfina barrage, it slows down and bottom septic conditions occur during the summer months. Similarly, the Damietta branch receives industrial waste from the Talkha fertilizer plant, and stagnant waters at the Faraskour earth Dam exhibit septic conditions in the summer months (Mancy and Hafez, 1979a). In order to evaluate the present situation and use it as a guide for future evaluation concerning the River Nile and drinking water at River Nile, the fundamental information from any source should be taken into account. For this purposes, it is very important to evaluate the possible significance of environmental contamination by a substance, to determine its form and quantity.

Many studies concerning the physical and chemical characteristics of the River Nile water, with much information about the water quality of the River Nile were reported by several authors.

A- Physical and chemical charachteristics of River Nile water and its branches:

Temperature is very important parameter, which influences all physical, chemical and biological transformations in aquatic environment; it affects the growth, survival, distribution and rate consumption by aquatic organisms (Hamza, 1985), and the change of temperature is necessary to induce the reproductive cycles of aquatic organisms and to regulate other life factors (Mount 1969). Talling (1976) mentioned that the water temperature of the River Nile is governed by the large range of latitude and altitude, and it is mostly within 15-30°C. Saad (1980) recorded that the thermal stratification was absent in the River Nile water and it might be related to the continuous mixing of the River Nile water. Abdo (1998) revealed the changes in the physicochemical characteristics of water due to the thermal pollution of the Electric Power Station at Shoubra El-Khema, the effluent's temperature of the station fluctuated between 35– 40 °C. Abdel-Satar (1998) found that the temperature of the River Nile at the Greater Cairo region fluctuated between 17.5- 31.5 °C. Ghallab (2000) found a slight variation in water temperature in the River Nile downstream of Delta Barrage at El-Rahawy drain. Sabae and Rabeh (2007) recorded that the highest temperature value (29.7°C) was recorded during summer, while the lowest one was (17°C) detected in winter in Damietta branch and the results showed a noticeable seasonal trend of temperature.