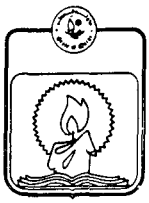

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ECOLOGICAL STUDIES ON THE BOTTOM FAUNA OF LAKE MANALA, EGYPT

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Key words: Ecological Studies, Bottom Launa, Lake Manzala

ABSTRACT

An ecological survey has been conducted for the benthic Community in Lake Manzala during May and June, 1985. The diversity and distribution of organisms are largely determined by salinity.

Mean abundance of benthic fauna ranged from 1494 to 2820 organisms/m^2 for sampling transects. *Pisidium* and *Melanoides* mollusca dominate the low salinity southern regions, while *Cerastoderma, Abra* and *Alvania* species dominate the saline sectors.

Two other species of considerable importance in the lake are the gastropods *Bulinus truncatus* and *Biomphalaria alexandrina* as both function as schistosomiasis vectors. It appears that areas of the highest incidence of the disease in humans correspond with lake areas characterized by the presence of these snails. The snails are most abundant in the low salinities and high waste loading in the southern sector of the lake.

INTRODUCTION

Lake Manzala is a highly dynamic aquatic system that has evolved from brackish to a more freshwater state over the past fifty years. Long-term water quality patterns and associated fisheries changes of the Lake are reasonably well documented. However, few base line data are available for aquatic biota at other trophic levels (Fouad, 1926; Montasir, 1937; El-Maghraby *et al.*, 1963; Youssef, 1973; Bishai and Youssef, 1977). Such data are of prime importance in evaluating the Lake productivity and its exact capacity as a fishing ground.

The main aim of this study is to determine the composition of the bottom macro

fauna, the distribution of the different species, and if possible, to relate the findings to physical and chemical conditions.

Lake Location and Morphometry

Lake Manzala is located in the north-eastern extremity of the Nile Delta (Fig. 1). The northern border is a narrow sandy fringe which separates the lake from the Mediterranean Sea. The Lake is bordered by the Suez Canal to the east, Damietta Branch of Nile to the west, and cultivated lands to the south.

Lake Manzala is the largest of the coastal lakes. It covers an area of approximately 100,000 hectares and has a maximum length of 64.5 km, a maximum width of 46 km, and has a total shoreline of 293 km. The lake contains numerous islands which consist of former shorelines, sand dunes and clay hummocks.

Fresh and drainage water flows to the lake via seven main sources (Fig. 1). The total annual input from all these is approximately $6657x1010^6$ m^3. Bahr El-Baqar and Hadous drains contribute about 75 % of the total inflow to the lake.

Bahr El-Baqar drain carries the partially treated sewage of Cairo to the lake. Theseflows constitute an important source of nutrients to the lake, which in turn promote the high level of fish productivity.

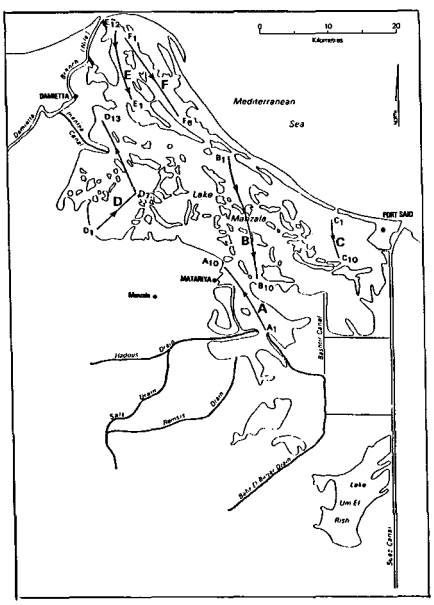

Fig. 1: Location of benthic sampling transects

MATERIALS AND METHODS

A total of 122 benthic samples (two per station) were taken on Lake Manzala during May and June, 1985, along five transects as detailed in Fig. 1. This study is a part of a complete ecological investigation on the Lake, which has been conducted betwen May, 1985 to June, 1986.

Sampling was carried out with a 0.066 m^2 Ekman dredge. Mud samples were screened through a No. 30 Sieve (30 meshes to the inch). Benthic fauna were picked and preserved in 70 % ethyl alcohol. In the laboratory, the organisms were washed once more, then identified and enumerated.

At the time of collection, temperature, conductivity and salinity were measured directly by portable S.C.T. meter YSI model 33, while the oxygen concentration was measured by DOM, YSI model 57.

RESULTS AND DISCUSSION

Hydrography

(a) Salinity

Generally, the annual mean salinity of Lake Manzala is about 2900 mg/l. In the southern region (Transect A), the salinity is relatively low at the range of 1000 to4000 mg/l with an average value of 1600 mg/l. In fact, low salinity levels in this region are the direct result of the southern drains which supply the lake with about 90 % of the total freshwater inputs. The eastern section of the lake (Transect C) exhibits higher salinity values, ranging from 1250 mg/l in the south (C_{10}) to 22000 mg/l in the north (C_1). This is, primarily, due to the lack of freshwater input and the periodic intrusion of sea water through the Gamil outlet (Fig. 1). The salinity of the middle region (Transect B) varies from 2000 to 5000 mg/l. Salinity of the western region (Transect D) is lower than of the middle one, ranging from 400 to 1800 mg/l. This is due to the direct input of freshwater from Inaniya canal (Fig. 1) and two pumping stations. Salinity levels of the northwestern region reach more than 35000 mg/l, specially during summer months. This is due to the high evaporation losses, the relatively enclosed area and sea-water intrusion from Souffara and Ratama canals (Fig. 1).

(b) Oxygen

The mean oxygen concentrations are at super saturation levels for most regions with exception of the southern region (Transect A), where a mean saturation value of 70 % was recorded. Of greater significance from a biology viewpoint is the low level of oxygen recorded during the day time in summer (32 % saturation) when the water

temperature reaches to about 30°C . Such concentrations are marginal for many less-tolerant species such as mullets.

(c) pH value

The mean pH values of Lake Manzala fluctuate around 8, and the seasonal changes in some northern stations are very high, reach sometimes to 10. This is mainly due to the low concentration of organic matter at these stations, and the periodic intrusion of sea water through shallow areas. The pH values of southern region are lower than others and this seems to be due to the fermentation of organic matter which enriched this sector.

(d) Nutrient salts

Phosphate levels range from 0.302 in the southern region (Transect A) to 0.050 mg/l in the western region (Transect D). The mean nitrate level during 1985 has increased twice that of the 1960's to an average of 0.548 mg/l (Khalil & Salib, 1986). The magnitude of change was highest in the southern region, where the concentration has increased four-fold, from 0.510 to 2.310 mg/l, due to the drainage water.

Nature of the bottom

Studies of Lake Manzala bottom (Omar, 1975; Kishk et al., 1975; Maclaren, 1982) indicate that the soils have developed on a variety of sediments modified by aeolian activity. In general terms, they are best described in relation to the geomorphological units of the region.

The northwest corner and the northeast side are extensions of the Mediterranean coastal strip which is made up of loose, fine sands, rich in shells and shell fragments, with occasional thin layers of gypsum and a salt crust on the surface. These sandy sediments are highly saline and sodic.

The sediments of the southern and eastern regions of the lake are made up of sodic silty clays covered with a thin, fluffy layer of clay. The salinity of the sediments is variable, ranging from high (28%) to virtually non-existent in many areas. The sediments show a relatively high organic content and a high percentage of $CaCO_3$. The latter is related to the abundance of shell fragments. The amount of gypsum varies from a trace to about 2% .

The sediments of the western region are non-saline, sodic clays. The percentage of clay ranges from mid-60 % to mid-70 % , and only slight traces of gypsum are present. Sediments of the south-western region of the lake are silty clays with occasional silty and clay loam layers in some areas. Gypsum is not present and salinity is very low (2%). In the middle region, the sediments consist of fine to coarse sands containing

many gypsum crystals and layers of pure gypsum. Many areas are covered with silty loam layer and salinity varies greatly from one part to another.

Species composition and distribution of bottom fauna

Standing crop estimates of benthic fauna in Lake Manzala varied from about 1500 organisms/m² along trnsects B, D and F to 2400 to 2800 for transects A, C and E (Table 1).

A total of 22 species were recorded in the benthic macro-fauna of Lake Manzala. Roughly 80 % (15 species) consisted of bivalves and gastropod molluscs. Two species of annelids represented 14 % of the total fauna by number while six species of arthropods accounted for 6.5%.

Six species are extensively distributed throughout the lake: the pelecypods *Ceratoderma glaucum, Pisidium* sp. and *Abra ovata,* the gastropods *Melanoids tuberculata* and *Alvania* sp. and the barnacle *Balanus* sp.

The diversity and distribution of the benthic community is largely determined by alinity (Fig. 2). The relatively freshwater southern and western regions maintain the largest number of species (14 species) while the saline eastern and northern regions exhibit the lowest diversity (6 species). On the other hand, dominant species for low salinity areas and high ones are matually exclusive, while there is considerable species overlap across the nutrient loading gradient at low salinities (Fig. 2). The abundance of freshwater species i.e. *Pisidium* and *Melanoides* was negatively correlated with salinity while *Cerastoderma, Abra* and *Alvania* show positive correlation. The barnacle *Balanus* sp. appears to show a preference for brackish water areas.

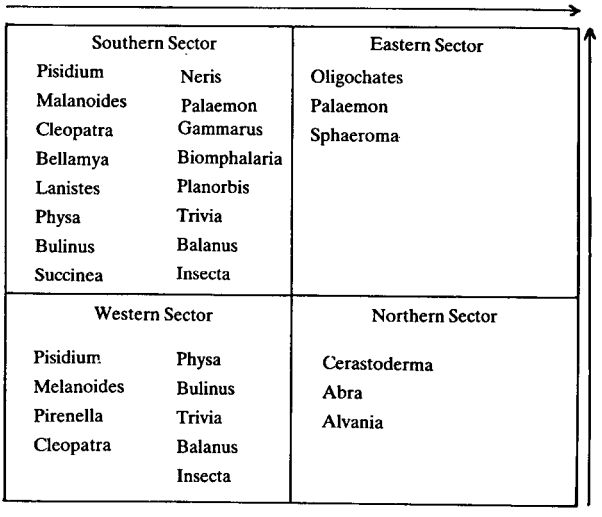

Fig. 2: Lake Areas Of Major Occurence Of Benthic Species Groups

The pelecypod *Pisidium* sp. dominates the low salinity southern region, and its maximun occurance was recorded at the middle of transect (A) where salinity was 1.5 %. The density was estimated to about 3800 organisms/m^2. At transects (B) and (D) there is a negative relationship between salinity and abundance of *Pisidium* sp.

Table 1

Abundance of benthic fauna in Lake Manzala during May, 1985 (mean number/m^2)

Species	Transect						
	A	B	C	D	E	F	Mean
PELECYPODA							
Pisidium sp.	1076	569		125	--	--	295
Cerastoderma glaucum	4	27	47	110	560	296	174
Abra ovata	--	56	76	--	1529	741	400
GASTROPODA							
Melanoides tuberculata	789	365	425	979	--	22	430
Pirenella conica	--	378	--	--	--	--	63
Cleopatra bulimoides	13	18	--	14	--	--	8
Bellamya Unicolor	33	--	--	2	--	--	6
Lanistes sp.	20	9	--	--	--	--	5
Physa acuta	29	4	--	29	--	--	10
Bulinus truncatus	31	2	--	17	--	--	8
Succinea cleopatra	2	--	--	--	--	--	1
Biomphalaria alexandrina	31	--	--	2	--	--	6
Planorbis sp.	13	--	--	--	--	--	2
Trivia sp.	29	18	--	4	--	--	9
Alvania sp.	--	--	191	--	712	372	213
ANNELIDA							
Nereis diversicolor	180	--	9	--	--	19	35
Oligochaete	4	--	1526	--	--	--	255
ARTHROPODA							
Gammarus sp.	111	33	20	--	--	--	27
Palaemon elegans	11	--	11	--	--	--	4
Sphaeroma sp.	--	--	25	--	--	--	4
Balanus sp.	218	11	73	210	19	44	96
Insect larvae	4	4	--	2	--	--	2
Total	2598	1494	2405	1492	2820	1494	2050
Number of Samples	20	20	20	26	24	12	
Mean Salinity (mg/L)	1700	3200	3500	1000	25900	3700	
Range of Salinity	1000	2100	1250	400	17000	2500	
	4000	5000	22000	1300	36000	14000	

(Fig. 3). At the high salinity regions (transects C, E and F), *Pisidium* sp. disappeared completely. Generally, its distribution in the lake is restricted to regions having salinities of less than 8000 mg/l.

The gastropod *Melanoides tuberculata* has the same distribution pattern as *Pisidium*, but it can tolerate salinity up to 22%. Therefore, it is abundant in stations of transect (C). The most abundant density of *M. tuberculata* was 2069 organisms/m², recorded at station 10 in transect D (Fig. 4).

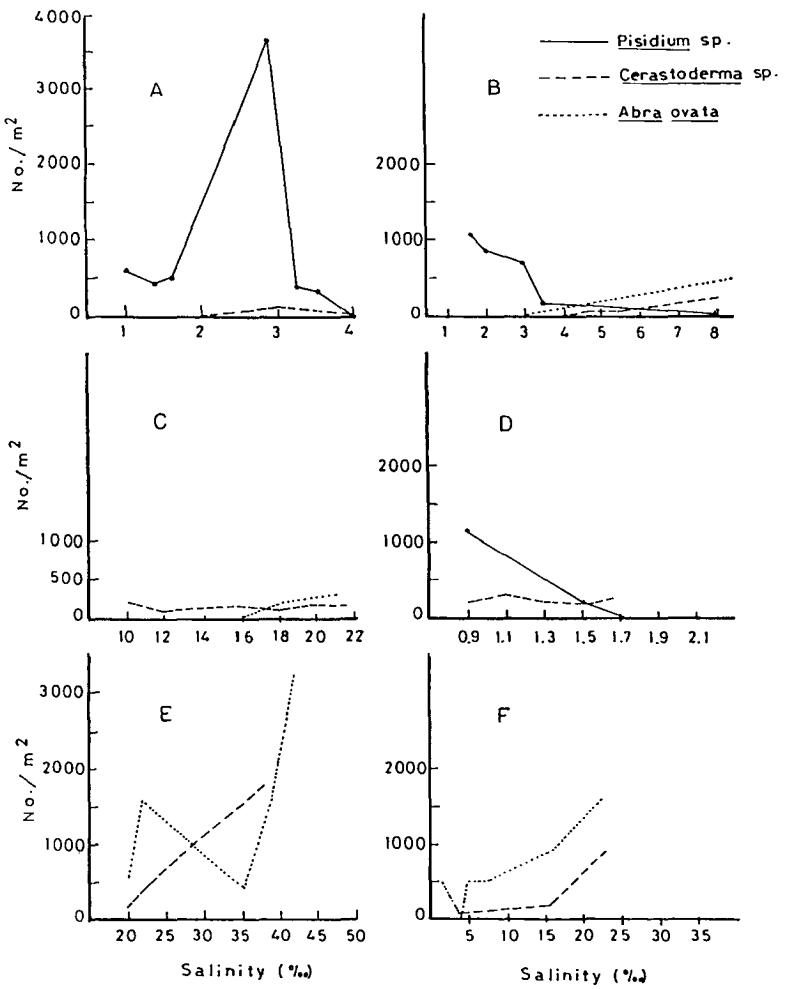

Fig. 3: Mean abundance of the pelecypods *Pisidium* sp., *Cerastoderma glaucum* and *Abra ovata* /m² and their relations to water salinity at six transects in lake Manzala

On the other hand, the pelecypod *Abra ovata* and the gastropod *Alvania* sp.were never found at the stations of transects A and D, where salinity is very low but they flourished well at transects E and F, where salinity reaches, in some regions, to more than 40,000 mg/l. The highest abundance of *Abra ovata* was 3293 organisms/m^2, recorded at station 7 of transect D, where salinity was about 42%. The highest density of *Alvania* sp. was about 1800 organisms/m^2 at station 5 of the same transect. These two molluscan species are common Mediterranean Sea inhabitants (Steuer, 1935), therefore they flourished well only in the high salinity northern stations.

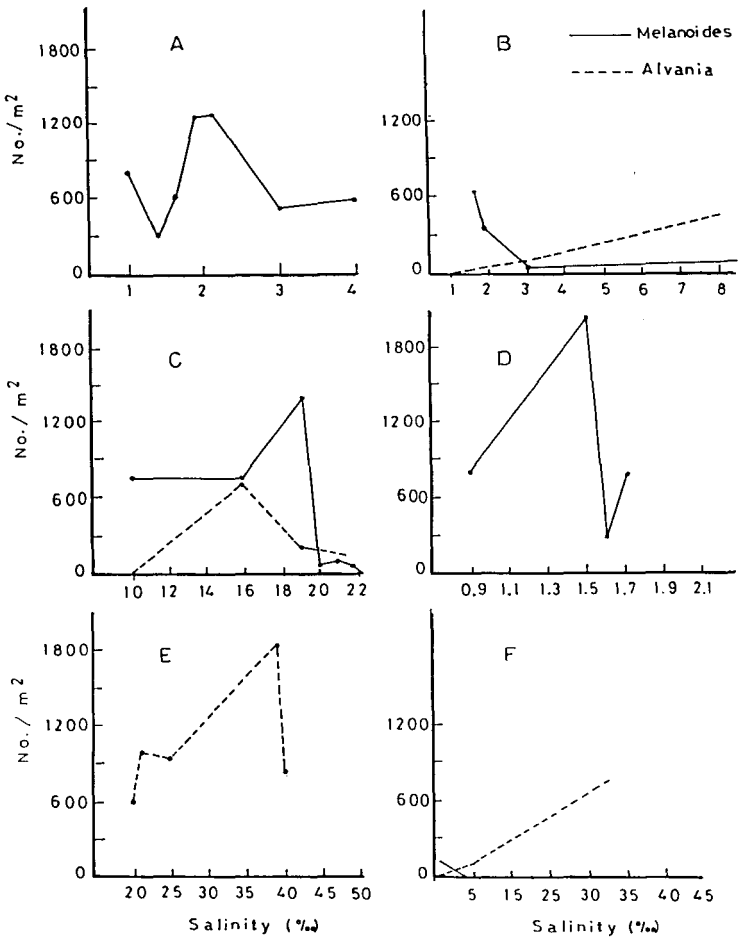

Fig. 4: Mean abundance of the gastropods *Melanoides* sp. and *Alvania* sp./m^2 and their relations to water salinity at six transects in lake Manzala

Two other speciesof considerable importance are the gastropods *Bulinus truncatus* and *Biomphalaria alexandrina* which function as bilharzia (schistosomiasis) disease vectors. The data indicate that both salinity and nutrient loading are significant factors in the distribution of these snails. The two species were only recorded in the southern sector (transect A), and the western region of the western sector (Transect D), with the exception of the last station on transect B, which is near Mataryia on the northern edge of the southern sector (Fig. 1). Transect A had the highest incidence of occurrence for both species (six out of ten stations) with a mean abundance of 31 organisms/m^2. The highest density of both snails was recorded at station 8 of this transect, and it was 156/m^2 for *Biomphalaria* and 111/m^2 for *Bulinus*. This lake region has a mean salinity of approximately 1700 mg/l and is heavily impacted by nutrients and waste loading from three large agricultural drains (Fig. 1). In the western subsector (transect D) *Bulinus* and *Biomphalaria* had a mean abundance of 17 and 2 organisms/m^2, respectively. This area has the lowest lake salinities (1000 mg/l) and is moderately influenced by drainwater. Schistosomiasis snails were not recorded in transect C which is moderately impacted by drainwater domestic waste effluents from Port Said. Mean salinities were 3500 mg/l with extensive seasonal variations of 2100-22000 mg/l. The failure of these snails and *Schistosoma* worm stages to survive in the high-salinity water has been well documented (Upatham, 1972 and 1973; Sturrock and Upatham, 1973).

Generally, it appears that southern areas of the highest incidence of the disease in humans (Maclaren, 1982) correspond with lake areas characterized by the presence of bilharzia snails. Furthermore, the distribution of such snails in Lake Manzala is restricted to regions having salinities of less than 2000 mg/l and which are impacted by moderate to high nutrient and waste loading.

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دراسات بيئية على كائنات القاع
في بحيرة المنزلة ، مصر

مجدي توفيق خليل

هذا البحث يشمل دراسة بيئية على عشائر كائنات القاع في بحيرة المنزلة وقد تم خلال عام ١٩٨٥ . دلت هذه الدراسة أن تنوع وتوزيع هذه الكائنات يتأثر كثيراً بمدى درجة ملوحة المياه . قدر المتوسط العددي لكائنات القاع بحوالي ١٤٩٤ إلى ٢٨٢٠ كائناً في المتر المربع . سادت الرخويات من نوع **بيسادیام وميلانويدز** منطقة المياه العذبة الجنوبية بينما سادت أنواع **سيراستودرما أبرا والفانيا** المناطق المالحة .

أثبت البحث وجود نوعين آخرين من الرخويات يعتبرا ذو أهمية خاصة من الناحية الاقتصادية والصحية وهما **بوليناس ترانكاتس وبيومفلاريا الاكساندرينا** وهما يعملان كعائل وسيط للديدان المسببة لمرض البلهارسيا في مصر . إتضح كذلك أن المناطق الموبوءة بهذا المرض تميز بوجود هذه الرخويات . وهذه الكائنات منتشرة في المناطق القليلة الملوحة ذات التلوث العالي في الجزء الجنوبي من البحيرة .