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EFFECT OF POLLUTION ON THE FISHERY GROUND ADJACENT TO ALEXANDRIA.

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ABSTRACT

The coastal water adjacent to Alexandria and in Abu-Kir Bay are influenced by restricting the Nile discharge after 1965. The hydrological and chemical characteristics changed significantly and the changes were associated with sharp decline in the productivity of the area and fish landings. The pollutants disposed in these localities added complex changes according to their chemical composition and field of distribution. Attempt to identify the kinds and localities of spreading of pollutants as well as their effect upon the living organisms, revealed local spreading and changes in the zooplankton community as well as the fish catch.

INTRODUCTION

The south and east Mediterranean regions were investigated by the Soviet-Egyptian Expeditions of the R/V "Ichthyolog" during 1964 - 1966 and 1971-1972. Special care was given to the fisheries investigations.

The area of interest extends in a west east-ward direction along the Egyptian coast from the Arab-Gulf to El-Mex, Alexandria and Rosetta branch of the Nile. It includes Abu-Qir Bay (Fig. 1). Each of the mentioned localities has its specific pollution conditions. The Arab-Gulf region could be considered up-till now unpolluted with any industrial or domestic wastes because it is located north to the desert extention along the western coasts.

Special concern was undertaken to the north eastwardly flowing current of water along the coast and which help the spreading of the pollutants to the east.

Data from the past expeditions were also used to compensate for the unfortunate lack of informations (AzcherNIRO, 1970).

Before 1965, these regions were prevailed every autumn season by the Nile flood waters which ranged from 30 to 60 Km^3 in volume. Seasonal changes in the chemical constitution and suspended matter of the sea waters were very significant. The salinity was recorded to fluctuate from 14 ‰ to 39.4 ‰ and the various nutrient salts concentrations varied

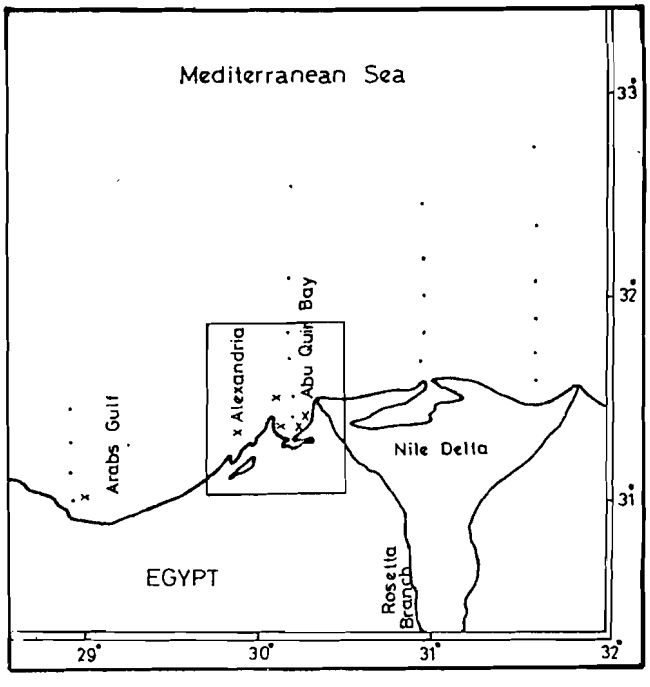

Fig. 1. The location of stations in the investigated regions along the Egyptian coast during 1970-1978.

from zero to highly productive concentrations as about 1.8 microgram at-P/L for the reactive phosphate.

The animal and plant communities were constituted of the euryhaline and highly tolerant species to the fluctuations of the environmental conditions (Halim et al. 1967; El-Zarka and Koura, 1965). After 1966, the Nile water was reserved before the recently constructed Aswan High Dam. The discharge of pollutants under the recent hydrological conditions exerted marked influence upon the shallow sea water characteristics and the living communities in the localities of their distribution.

MATERIAL and METHODS

During the period December 1976 - August 1978, it was possible to collect sea water,hyponeusten and some benthic samples. Seasonal trips were carried out to about 40 stations in the shallow water localities of El-Mex, Alexandria, Abu-Qir and Rosetta mouth of the Nile. Special care was given to the identification and the variations in the chemical characteristics of water as well as those in the animal aggregates in the hyponeusten.

The sea water was analysed according to Strickland and Parsons (1968), the zooplankton identification after Rose (1933) and the fish eggs and larvae after Marinaro (1971).

Geomorphology of the Coast

About 175 kilometers of the coastal line extends from the Arab Gulf in the west to Rosetta mouth in the east. Abu-Qir Bay is situated at about 50 kilometers east to Alexandria. It has an area of ca 650 km^2 and a depth not exceeding 15 m. Its coast extends in a semi-circle form, from Abu-Qir city to Rosetta mouth of the Nile. The influence of the sea upon the south western part of the bay is limited because of the existence of a ridge which extends several miles in a straight line from the western end of the coast to the east. Therefore, eddy currents are frequently noticed in the bay. El-Tabia pumps drain in the south-western part of the coast and other lake-sea connection at El-Maadia located in the southern part of the coast discharge the pulp-mill wastes and the brackish Lake Edku waters successively in the bay. The distance between these two outlets is about 8 kms.

The Variability of Source Regions

The surveys indicated that about two square kilometers of the coastal water surrounding Rosetta mouth of the Nile branch is constantly dominated with brackish water. This kind of water results from annual outflow of 2-5 km^3 of the Nile fresh water. Spreading in the north eastward direction is the general rule for the movements of this water, but there could be limited south westwardly anticurrent which influences the adjacent localities of Abu-Qir Bay.

Drain and lake water discharge from Lake Edku outlet in the south eastern part of Abu-Qir Bay spreads to the east.

Paper-mill wastes reaching about 18 x $10^6 m^3$/year is discharged from El-Tabia pumps outlet at the south western part of Abu-Qir Bay. This polluted water flows to the east from the outlet.

About 85 x $10^6 m^3$/year of domestic wastes and sewage water are discharged to 15 points located in the shallow coastal area north to Alexandria.

Metallurgical, petroleum and chemical industries plants dispose about 12 x $10^6 m^3$/year of wastes in the northern shallow water at El-Mex. About 3 x $10^6 m^6$/year of domestic wastes is also discharged in these localities.

The western coastal area to El-Mex regions is not influenced by any pollutants except from the ships passing by the route to Alexandria.

The Influence of Pollution Upon the Chemistry of Sea Water

The Salinity

During the winter season, the minimum salinity values 20.0 %° , 36.7 %° and 38.5 %° characterised the source localities north to Rosetta outlet of the Nile, the outlets in Abu-Qir Bay and those north to Alexandria respectively (Fig.2).. In the warm seasons, the water salinity decreased to about 19.5 %o, 35.0 %° and 37.5 %°.

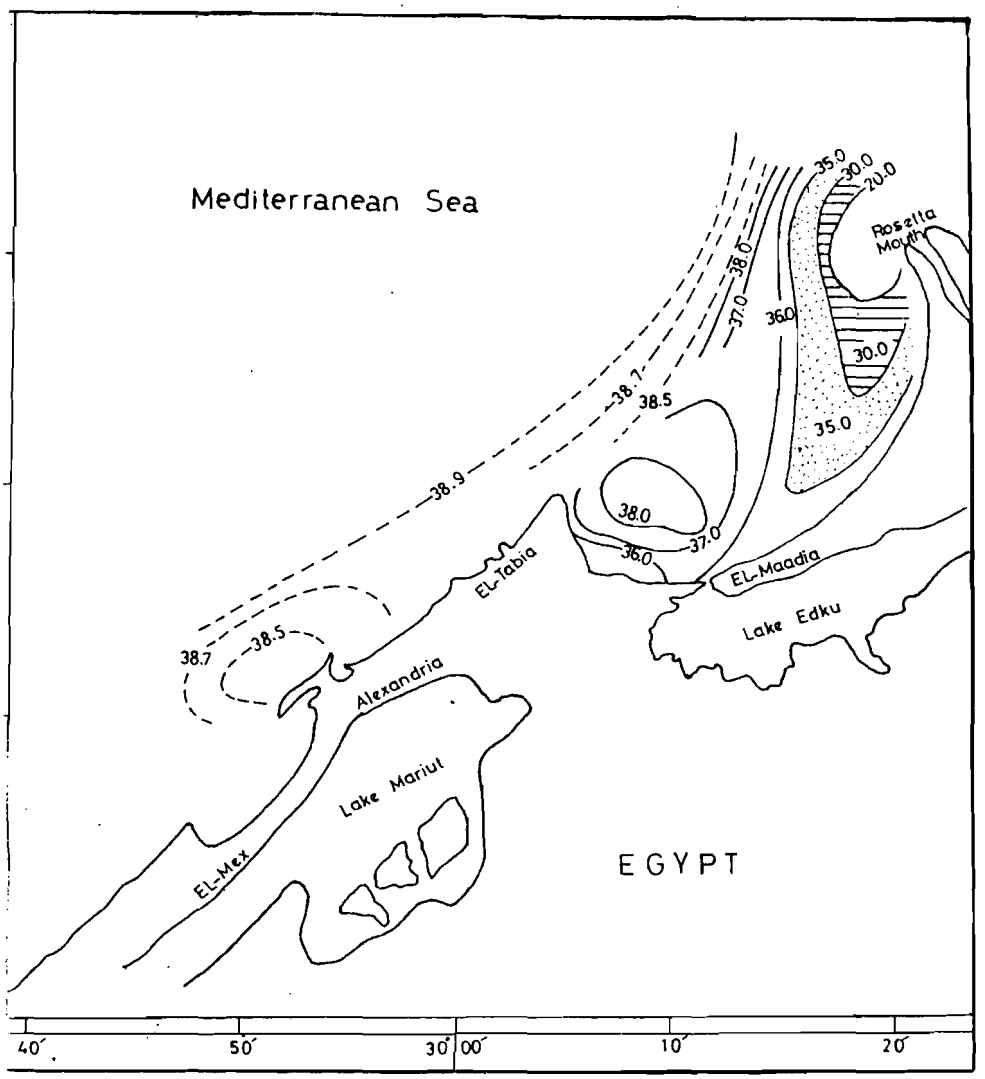

Fig. 2. The minimum salinity distribution in Alexandria and Abu-Kir Bay shallow water, dyring the cold season.

The pH Values

The proper Mediterranean Sea water attains pH values about 7.91-8.21. Changes between 6.57 and 8.38 were found seasonally in the most influenced zones by the Nile discharge from Rosetta outlet. The polluted water attained higher pH values ranging from 8.60 to 9.20 in Abu-Qir Bay as a result of the outflow of Lake Edku waters and the paper-mill wastes in the bay. The sea water north to Alexandria and El-Mex had pH 7.20-8.30, especially in the source localities.

The Oxygen Concentration

In the southern localities of Abu-Qir Bay the water had concentrations fluctuating from 2.90 to 5.10 ml/l which may be attributed to the influence of the lake and drain water mixing with sea water. The corresponding saturation values are 66 % and 88 %. The concentration in the polluted waters of the south western localities varied from 1.00 to 4.10 ml O_2/l with saturation values of 21 % to 71 % (Fig. 3).

The sea water in the localities about 0.5-1.5 kilometer north to Alexandria had between 3.25-4.34 ml O_2/l and its saturation ranged between 73 % and 98 %. This suggests higher biological activity than in the polluted localities of Abu-Qir Bay.

Westwardly and north to El-Mex the oxygen content increased nearly to the saturation 96-106 % which characterised the waters in Arab-Gulf.

Phosphate Variations

Seasonal variations of the phosphate-P in the mixed Nile-Sea water were found in between 0.35 and 1.98 ug-at p/l. It dropped to 0.04-0.05 ug-at/l in the zone surrounding Lake Edku outlet and to about 0.15-0.30 ug-at/l at the vicinity of El-Tabia pumps outlet. Apparently the disposal of domestic wastes north to Alexandria increases the phosphate-P content of the sea water to significant value in the range 0.05-0.60 ug-at/l. Concentrations which did not exceed 0.09 were found in the waters north and westwardly from El-Mex.

Nitrate-nitrogen

The Nile discharge was associated with significant seasonal fluctuations in the nitrates - N content (from 0.04 to 2.0 µg-at NO_3 - N/l). This range appeared much higher than that 0.10 - 0.20 µg-at NO_3 - N/l found in the vicinity of Lake Edku outlet and that of 0.30 - 0.50 µg-at NO_3-N/l in the water polluted with the pulp-mill wastes at El-Tabia pumps. Values as 0.07 - 4.50 µg-at NO_3-N/l were measured in the polluted shallow waters of Alexandria. The concentration decreased to 0.90 µg-at NO_3-N/l in ElMex waters.

Silicate

Fluctuating values between 6.0 and 250.0 ug-at/l were observed seasonally in the mixed river-sea water at Rosetta outlet. They dropped to 2.0-37.0 ug-at SiO_3-Si/l in the vicinity of Lake Edku outlet and to 3.0-16.0

ug-at/l in the mixed waters with the pumps discharge in Abu-Qir Bay. Alexandria polluted waters attained 8.0-15.0 ug-at/l and decreased to 3.0-6.0 ug-at/l in El-Mex waters.

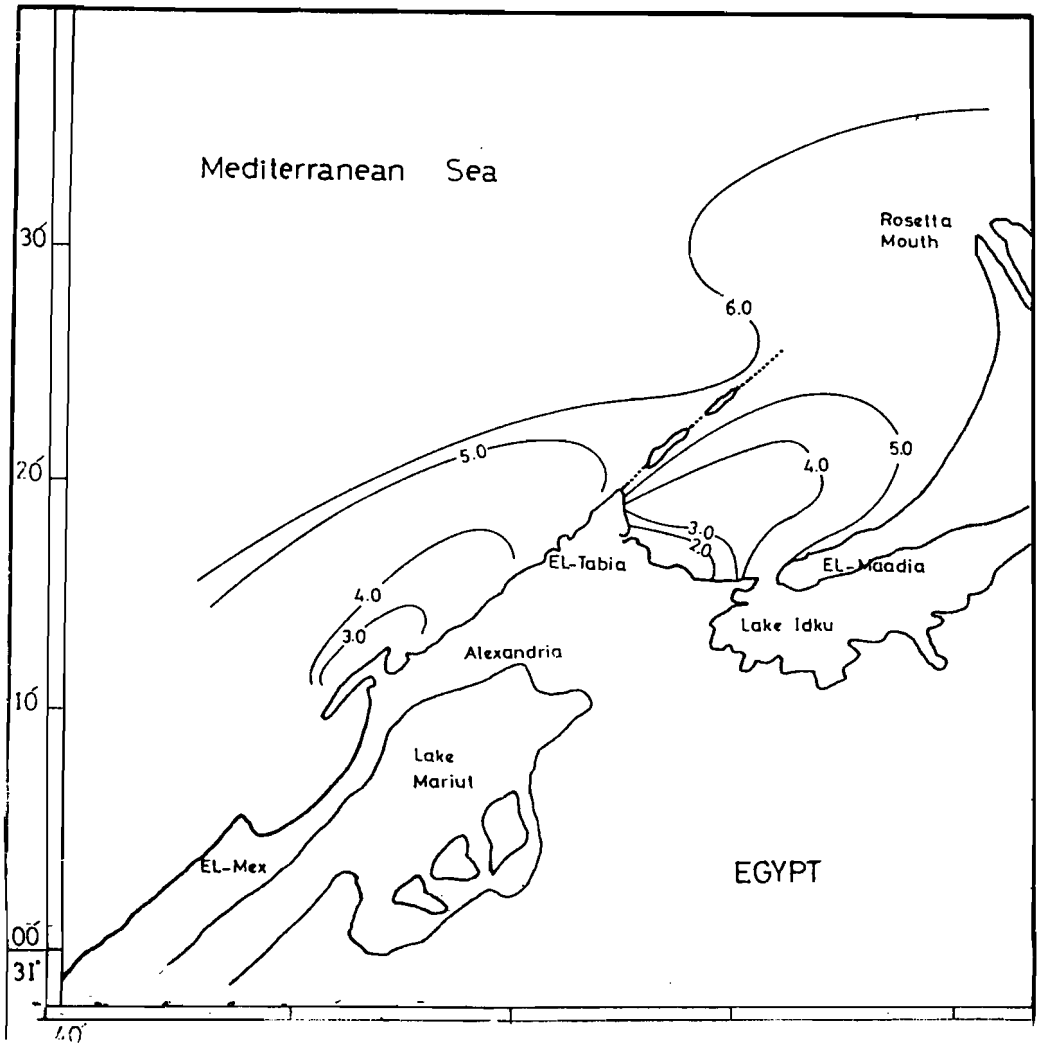

Fig. 3. The distribution of minimum oxygen concentration (ml/l) during the cold season.

The Influence of Pollution upon the Zooplankton

The collected samples contained common species of Copepoda including **Paracalanus sp., Isias spp., Clausocalanus sp., Centropagus spp., Acartia spp., Ctenocalanus sp., Oithona sp., Euterpina sp., Oncea sp., Cerycaeus sp.**

Other constituents as Medusae, Gastropoda veligers, **Oikopleura sp., Sagitta spp.,** Noctiluca, are frequently found. The forms from Cladocera, Tintinnides, Siphonophores, Amphipods, Foraminifera, Decapod larvae, **Salpa sp.,** Lamellibranch veligers, Zoae larvae of crabs, Polychaeta larvae were comparatively few. In addition to pollution they were influenced by the depth, season and locality.

During the spring season the zooplankton abundance varied from 25.0-40.0 organisim/m^2 to 2.0-8.0 counts/m^2 in the hyponeuston of Abu-Qir Bay. Values in between 523.0 and 17.0 organisms/m^2 were found north to Alexandria and in El-Mex waters. Some increase in the abundance could be detected in the localities influenced by the domestic wastes while it dropped sharply as direct effect of industrial wastes disposal. In addition there was high mercury content as 0.5-5.6 ug/gm dry weight of the body of the meroplanktonic forms and **Euterpina** sp., from Alexandria waters. The catch of eggs and larvae represented **Sardinella sp., Trigla sp., Mullus sp., Trachurus sp., Engraulis sp.** and other unknowns. The larvae of the family Mugilidae as well as the sardine eggs were frequently found during the winter season. The others appeared during the warm seasons. The abundance of the fish eggs were found to vary from 0.25 to 11.0 counts/m^2 in the unpolluted waters. They were absent in the source regions of pollution with pulp-mill wastes in Abu-Qir Bay.

The Influence upon Fishes

High catch of several species were found before the construction of Aswan High Dam and the following change in the hydrology of the water characteristics (Table 1).

Since 1965, a sharp decline in fish landings were observed. The catch of different species dropped during 1966-1972 to 5-25 times less than before 1965 (Table 2). This could be attributed to effective hydrological changes and pollution problems. The catches also indicate a decrease in the dominant species to about one-fifth of their amounts recorded before 1965.

Atherina and other small euryhaline fishes appeared as significant percentage in the recent years catch (Table 3). It may reflect the influence of an increase in the brackish water flow from the source points in the coastal regions and the aggregation of these fishes in the corresponding limited area.

Other species as **Sciaena aquilla, Trachurus trachurus, Pagrus vulgaris, Mullus barbatus and Solea vulgaris** appeared of significance in the last

TABLE 1
THE ANNUAL LANDINGS OF ECONOMIC FISHES FROM ABU-KIR BAY
DURING 1962 - 1976.

Species	Annual catch (ton)					
	1962	1966	1970	1974	1957	1976
Sardinella sp	680.3	17.7	0.3	0.0	0.1	0.0
Atherina sp	31.3	76.2	10.5	15.9	21.3	17.9
Sarda sarda	5.1	1.1	0.0	0.0	0.0	0.0
Muugil sp	100.2	27.2	2.6	6.4	9.2	6.2
Sauridia sp	52.4	45.3	17.3	4.5	10.8	11.6
Chrysophyrs sp	1.4	0.1	0.5	0.0	0.0	0.0
Solea vulgaris	9.4	0.9	7.1	7.2	7.6	3.3
Trichiurus sp	211.8	9.2	0.4	1.9	0.0	0.1
Lichia glaucus (L)	4.4	2.5	0.0	0.0	0.0	0.0
Trachurus sp	0.0	0.4	0.1	3.5	6.7	9.4
Trigla sp	0.0	0.0	5.3	0.0	0.0	0.0
Mullus barbatus	0.1	1.6	18.1	3.8	2.6	2.4
Sciaena aquilla	3.0	0.0	0.0	0.0	0.0	0.0
Pagrus & Pagellus sp.	0.0	0.0	0.3	3.7	2.3	2.3
Sphyraena sp	0.8	0.0	0.6	0.0	0.0	0.0
Box boops (L)	1.3	0.2	0.6	0.0	0.0	0.0
Temnodon sp	7.2	1.6	0.0	0.0	0.0	0.0
Epinephelus & Serranus sp	0.5	0.7	0.1	0.0	0.0	0.0
Morone punctata	18.3	0.8	0.0	1.0	2.2	2.6
Morone labrax	3.0	0.0	0.0	0.0	0.0	0.0

few years catch. Some of their eggs were found away from the heavy polluted zones in Abu-Qir Bay and Alexandria nearshore waters. The salinity and pollutants content in the regions of their distribution appeared to be within the range of the organisms tolerance. Chemical analyses of water in these regions indicate that these areas are polluted to slightly polluted. The main forms of crustacea in the catch were crabs and prawns as **Metapenaeus stebbingi** (Nobili), **Metapenaeus monoceros** (Fab.), **Penaeus trisulcatus** (Leach), **Penaeus japonicus** (Bate), **Penaeus semisulcatus** (De Haan).

CONCLUSION

About seven sources of pollution with different kinds of waters influence the shallow coastal water in the investigated regions. The flow of the polluted water was generally noticed in the eastward direction along the

THE ANNUAL LANDINGS OF CATCHABLE TAXONS FROM ABU-KIR BAY.

Year	Annualcatch (ton)			
	All forms	Bony fish	Cartilagenous fish	Crustacea
1966	460.1	196.6	0.6	189.8
1968	480.3	269.6	4.5	187.5
1970	123.3	65.8	0.7	40.4
1972	56.0	50.0	0.0	8.2
1974	76.0	55.4	2.5	15.1
1975	98.6	71.0	0.4	21.4
1976	83.0	61.0	1.1	15.3

TABLE 3

THE PERCENTAGE COMPOSITION OF THE DOMINANT SPECIES OF FISH LANDED IN EL-MAADIA CENTER.

Species	Annual percentage in catch						
	1966	1968	1970	1972	1974	1975	1976
Sardinella sp	3.8	7.2	0.2	0.0	0.0	0.1	0.0
Atherina & small fishes	16.7	16.4	2.2	25.0	20.9	21.6	21.6
Mugil sp	5.9	3.4	2.1	12.9	8.4	9.3	7.3
Saurus sp	9.8	11.8	14.0	4.8	5.9	11.0	14.0
Sciaena aquilla	2.5	3.2	1.6	9.2	9.9	8.1	6.3
Trachurus trachurus	0.1	0.3	0.1	0.0	4.6	6.8	11.3
Pagrus sp	0.0	0.0	0.2	0.0	4.9	2.3	2.8
Mullus barbatus	0.3	5.2	14.7		5.0	2.7	2.9
Solea sp	0.2	3.0	5.8	4.1	9.5	7.7	4.0

coast. This is in agreemrnt with the dominating water current pattern. Variable magnitude, distribution and location of pollutants suggested that the investigated area may be divided into three types of grounds according to the degree of mixing with sea water and the effect upon living organisms and communities.

The first was highly polluted zones. They include the points of industrial waste disposal which causes sharp drop in the abundance of all living organisms. This was noticed in the intensively polluted zones affected by paper-mill wastes in Abu-Qir Bay and the chemical industries discharge in El-Mex region. The area could be estimated to exceed five square kilometers. Other intensive pollution with domestic wastes from 15-17 points distributed at nearly equidistances north to Alexandria was noticed to elevate the nutrient content and the abundance of the organisms. The corresponding area could be estimated to vary from 5.0 to 8.o square kilometers. This area is open to the influence of annually dominating north westerly winds. Turbulance of water due to 95 days of strong storm surges per year is very effective in preventing any stagnation of these wastes. Drain and lake waters discharge in Abu-Qir Bay was difficult to be considered harmful. Lake Edku basin probably helped through physical, chemical and biological processes the degradation or adsorption of the pollutants. Noticable abundance of the euryhaline organisms was found in these localities.

The second was the polluted area. It includes the areas of spreading and mixing of pollutants with sea water beyond the highly polluted zone. Frontal line could clearly be detected between them as a sharp change in the colour of the sea surface. Its polluted water characteristics did not adversely influence the survival of the organisms. This area was estimated to be boardered by northern parallel line at about 5 miles to the coast. It extended from El-Mex to Rosetta outlet and enveloped the highly polluted zones. Clear indication was found as high abundance of some zooplankton species from Alexandria waters and distinguishable content of mercury in their body.

The third was the slightly polluted area. Its location was identified by the slightly deviated values of the chemical characteristics from those of the proper Mediterranean water. Modification of the communities structure of living organisms depend upon other seasonal or geographical changes rather than direct influence by the concentration of pollutants. This area was found located between 7-10 miles north to the shore. It was also clear that the limits of polluted shallow water areas were liable to change under disturbed climatic and sea water conditions as well as seasonally.

The stock of catchable fishes and prawns could not be considered at its healthiful level in the polluted and slightly polluted area.

REFERENCES

Al-Kholy,A.A. and S.K. El-Wakeel 1975. Fisheries of the South-Eastern Mediterranean Sea along the Egyptian coast. Soviet-Egyptian expedition, 1970-1971. **Bull. Inst. Ocean. and Fish.** 5: 1-279.

AzcherNIRO 1970. Fishery research of AzcherNIRO in the Red and Mediterranean Seas in 1964-1966 years. **Azov-Black Sea research institute of fishery and oceanography.** Transaction, 30.

El-Zarka, S. and R. Koura 1965. Seasonal fluctuations in the production of the important food fishes of the UAR waters of the Mediterranean Sea. **Notes and Memoirs Hydrobiol. Dep. UAR.** 74: 1-69.

Halim,Y. S.K. Guergues and H.H. Saleh 1967. Hydrographic conditions and plankton in the south east Mediterranean during the last normal Nile flood. **Int. Rev. ges. Hydrobiol.** 52, 3 : 401-425.

Marinaro, F.Y. 1971. Contribution a l' etude des Oeufs et larves pelagiques de poissons Mediterraneens. V- Oefus pelagiques de la baie d' Alger. Pelagos. **Bull. de l' Inst. Oceanogr. d' Alger.** 3, 1 : 1-118.

Rose,M. 1933. Copepodes pelagiques. **Faune de France.** 26: 1-374.

Strickland, J.D. and T.R. Parsons 1968. A practical hand book of sea water analysis. **Bull. Fish. Res. Bd. Canada. 167.**