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SOME CHEMICAL FEATURES OF LAKE MARIUT

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ABSTRACT

The polluted basin in Lake Mariut (lake proper) receives most of its water from the Qalaa Drain. Sewage effluents and industrial wastes are also discarded constantly into the basin. Such water affected most of its chemical conditions.

The dissolved chlorides in the polluted basin decreased to 1063 mg Cl/L, while the total alkalinity increased to 370 mg Ca CO_3/L.

The pH values fluctuated between 7.0 and 9.6 with an average of 8.50. The amount of oxidized dissolved organic matter attained highest concentration infront of the industrial waste disposal pipe (average 41.8 mg O_2 consumed /L).

For the fish farm which is fed by Mariut - El Gedida Pumping Station, the dissolved chlorides remained higher than that of the lake proper, attaining an average 2212 mg Cl/L. The total alkalinity decreased to 238 mg Ca CO_3 /L and the oxidizable dissolved organic matter to 15.5 mg O_2 consumed /L.

The chlorosity, total alkalinity and oxidizable organic matter in the Qalaa Drain were also low with values of 874 mg Cl/L, 313 mg Ca CO_3 /L and 16.2 mg O_2 consumed / L, respectively.

INTRODUCTION

Lake Mariut is a small shallow lake that lies beside Alexandria at latitude 31° 10'N and longitude 29° 55'E. It has a total area of about 5500 hectars with an average water depth of 120 cm. The lake is divided by the Desert Road and the Umum Drain into four basins, namely; the lake proper, the fish farm and south east and south west basins (Fig. 1).

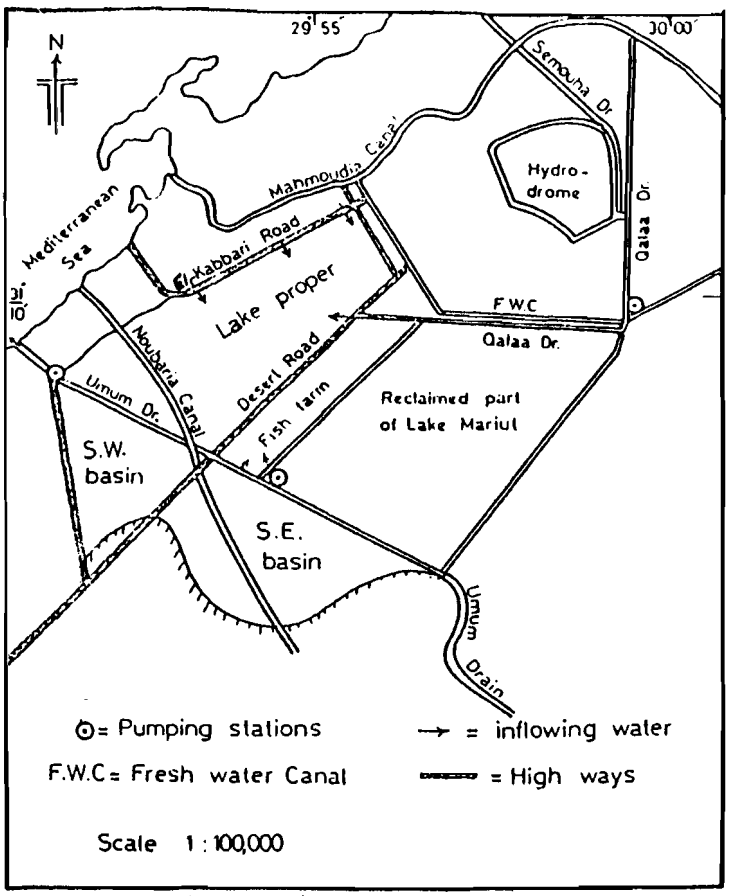

Fig. (1)
Morphometry of Lake Mariut.

The lake proper represents the main basin in the lake and has a total area of about 2500 hectars. It is bordered by highways from three sides and by the Noubaria Navigation Canal and the Umum Drain at the west. It receives most of its water from the polluted water of Qalaa Drain through Moharram Bey Bridge. Other sources of pollution include industrial waste effluents discharged at the north eastern corner, Gheit El-Enab drain receiving sewage from Karmous and El-Kabbari out-fall that discharges raw sewage at the north west side. The average water depth in the lake proper is about 120 cm. The excess water is constantly discharged into the sea through El-Max pumping Station via El-Umum drain.

The fish farm has a total area of about 420 hectare. It receives most of its water from Mariut-El Gedida hydraulic pumps and the Umum Drain. The fish farm is also connected with the Qalaa Drain through a movable gate which is usually closed. The average depth of water in the fish farm is about 130 cm.

The S.W. and S.E. Basins are totally separated from the lake by a dyke bordering the Umum Drain. They are extremely shallow and nearly free from pollution. Their total area is about 3500 hectare.

Choice of Stations :

This investigation was restricted to the lake proper and fish farm. Fourteen stations in the lake proper as well as three stations in the fish farm were selected as sampling stations. Water samples were also taken directly from the Qalaa Drain and Noubaria Canal. The position of these stations are shown in Fig. (2). The habitats represented by these stations are as follows:

1. Area Affected By Industrial Wastes, (Station 1):

This area is situated at the north eastern side of the lake proper infront of the industrial waste disposal pipe.

2. Area Subjected to Sewage Effluents, (Stations 4,7 and 10):

This area lies along the northern side of the lake proper. It receives sewage effluents from Karmous (St. 4) and El-Kabbari (St. 7) sewers.

3. Area Receiving the Influx of the Qalaa Drain Water, (Stations 3):

This area surrounds Moharram Bey Bridge through which the Qalaa Drain water pours into the lake proper.

4. The Middle Lake , (Stations 2,5 and 8):

This sector represents the middle of the lake proper and is less affected by contaminated waters. It is usually more productive than the other regions.

5. The South Western Part of the Lake , (Stations 6,9,11,12,13 and 14):

It represent the areas lying at the west parallel to the Noubaria Canal and at the south beside the Desert Road. This sector is located away from direct pollution.

6. The Fish Farm, (Station 15,16 and 17):

Stations 15,16 and 17 were chose to represent respectively north, middle and south parts of the lake proper.

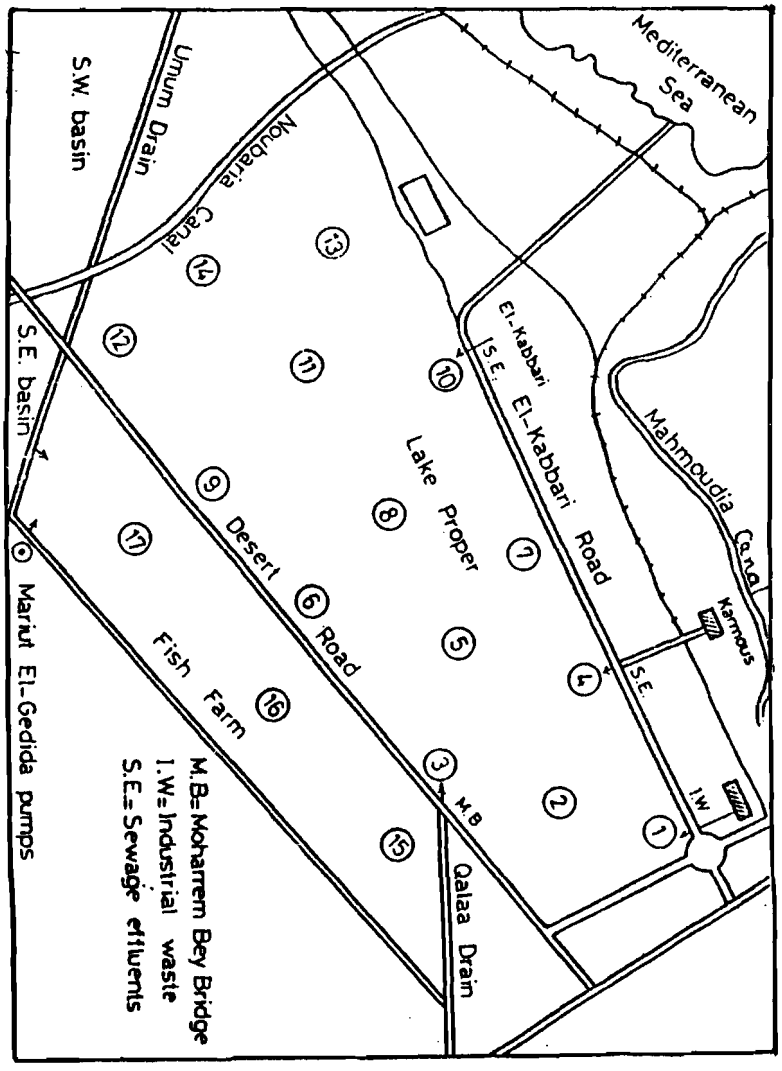

Fig. (2)
Position of stations.

MATERIAL AND METHODS

The water samples used for chemical analysis were collected monthly from the different stations during the period from August 1975 to July 1977 using a Ruttner water sampler. Samples were taken just below the surface and transferred directly to the laboratory for chemical analysis.

The total chlorides were determined according to Mohr's method by titrating 10 ml of the water against exactly 0.01N silver intrate, using potassium chromate as indicator.

The hydrogen ion concentration was measured electrometrically in the field with a portable pocket pll meter.

The total alkalinity was determined by titration of 10 ml of the water sample agains exactly 0.01N HCL, using methyl organe as indicator.

The oxidizable organic matter was determined according to Ellis, et al., 1946 where 100 ml water samples were boiled with 25 ml of 0.01N alkaline solution of potassium permanganate for 10 minutes. Subsequently 25 ml of 25% conc. sulphuric acid and 25 ml of 0.01N oxalic acid were added. The excess oxalic was then titrated against the standard permanganate solution while the sample was still hot to the end point.

RESULTS

a) Dissolved Chlorides :

Lake Mariut is considered as a slightly brackish water lake. The chlorosity in the lake proper ranged between 270 and 1760 mg Cl/L. The highest concentration appeared in the south western section beside the Umun Drain and Noubaria Canal as well as the north east corner as affected by the outfall of industrial wastes (Fig. 3). The lowest chlorosity values were observed at station 3 which was subjected to the direct flow of the Qalaa Drain water. The outfall of El-Kabbari sewer was also characterized by lower chlorosity.

The dissolved chlorides in the fish farm were higher than that of the lake proper and they fluctuated between 809 and 4490 mg Cl/L, showing a pronounced increase during the second year of investigation.

The dissolved chlorides of the Qalaa Drain water attained an annual average 962 and 784 mg Cl/L during the two successive years. Being indirectly connected with the sea, the chlorosity in the Noubaria Canal stretch crossing the take remained relatively high during most of the year and it fluctuated between 506 and 2751 mg Cl/L.

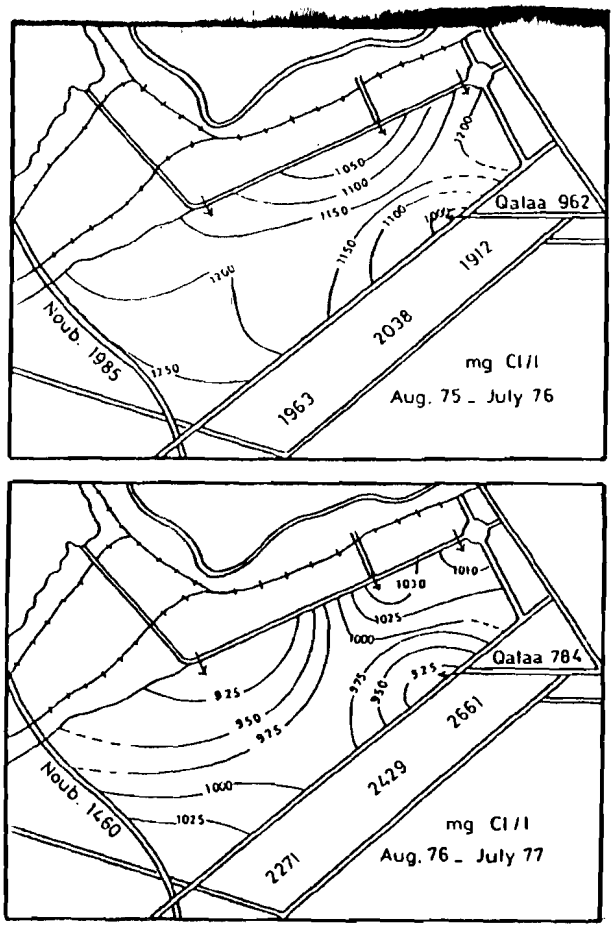

Fig. (3)
Distribution of dissolved chlorides in mg cl/l
during two successive years from August, 1975 to July, 1977.

As regards to the seasonal variations, the dissolved chlorides in the proper showed a pronounced increase during the period January-March, 1976. Otherwise, they remained more or less constant in the other months with the exception of a rapid decrease observed in March (Fig. 4). The dissolved chlorides in the fish farm tended to increase gradually during the successive months of 1976, reaching a peak in February 1977. This was followed by a sharp drop in March, coinciding with that recorded in the lake proper. It increased again gradually in April and May.

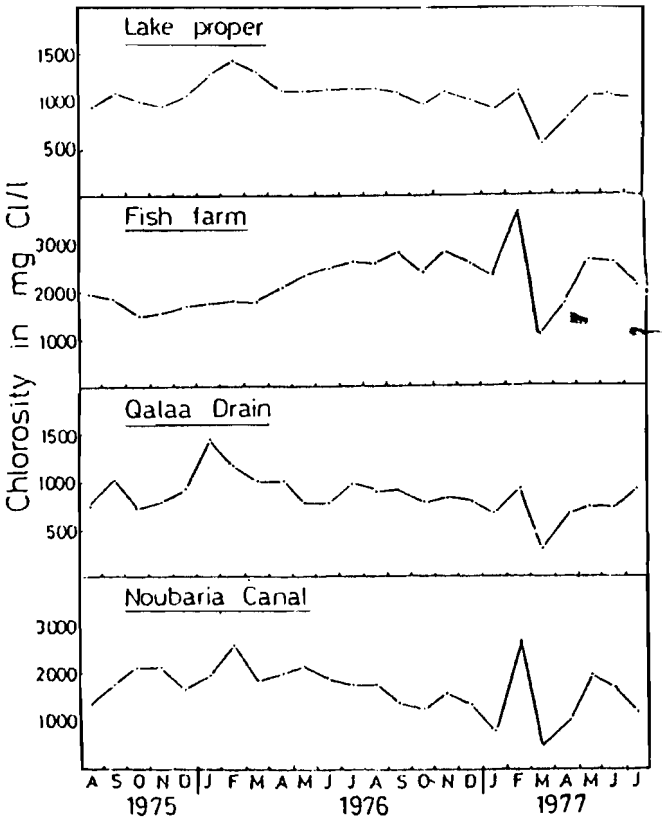

Fig. (4)
Seasonal variations of dissolved chlorides in mg cl/l.

The seasonal variations of the dissolved chlorides in the Qalaa Drain water nearly similar to that of the lake proper, but attaining lower values. The highest chlorosity was observed in the drain water during January, 1976 and this may be responsible for the increased chlorosity in the lake proper during the winter.

In general, the distribution of the dissolved chlorides showed a pronounced decrease in the lake proper and Qalaa Drain during the second year of investigation (Fig. 4), while it increased during the same period in the fish farm.

b) Total Alkalinity :

The total alkalinity in the lake proper fluctuated between 211 and 625 mg $CaCO_3/l$. The highest values were recorded in areas receiving industrial wastes and sewage effluents while the lowest were reached ar station 3 which is subjected to the influx of Qalaa Drain water. The total alkalinity tended to decrease gradually towards the south west, (Fig. 5).

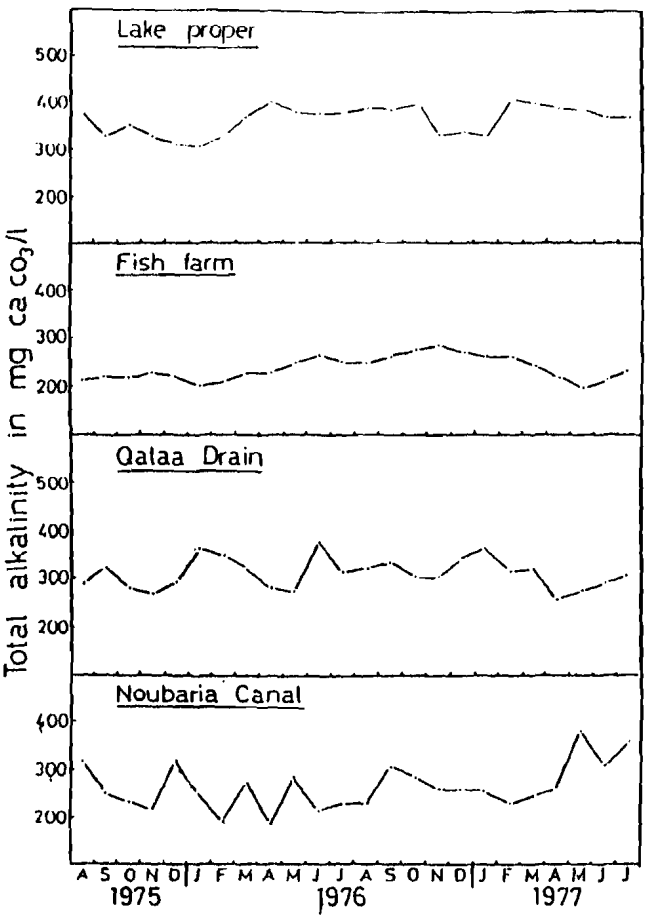

Fig. (5)
Seasonal variations of the total alkalinity in mg Ca CO_3/l.

The fish farm sustained lower alkalinity which ranged from 165 to 380 mg $CaCO_3$/L. It remained nearly of the same concentration at the three stations but tending to increase slightly in the south part.

The total alkalinity in the Qalaa Drain water was lower than that of the lake proper and it ranged between 260 and 465 mg $CaCO_3$/L. A further decrease in the total alkalinity was observed in the Noubaria Canal which fluctuated between 182 and 380 mg $CaCO_3$/L.

As shown in Fig. (6), the total alkalinity in the lake proper was subjected to small seasonal variations. It remained relatively low during the autumn

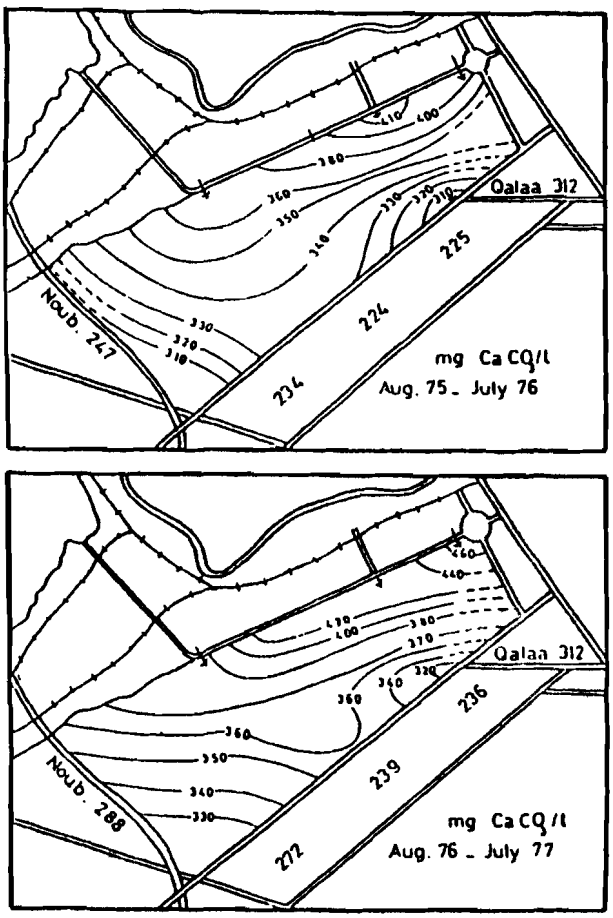

Fig. (6)
Distribution of the total alkalinity in mg Ca CO_3/l recorded during the two successive years from August, 1975 to July, 1977.

of 1975, followed by a gradual increase between February and May, 1976 and it persisted within this high level till October. Another drop was observed between November and January, 1977 and this was succeeded by a rapid increase in February.

The monthly variation of the total alkalinity in the fish farm were more smooth, showing a gradual small increase between January and November, 1976, but decreased again slowly till May, 1977.

The total alkalinity in the Qalaa Drain and Noubaria Canal waters showed irregular fluctuation from one month to the other. The highest values appeared in June, 1976 and May, 1977 in the Qalaa Drain and Noubaria Canal, respectively.

c) Hydrogen Ion Concentration :

The hydrogen ion concentration of the lake water lies on the alkaline side. The pH in the proper ranged between 7.0 and 9.6. The lowest pH values appeared in localities subjected to the outfall of industrial wastes and sewage effluents. The same phenomenon was also recorded at station 3 which received the influx of the Qalaa Drain water. The pH increased gradually towards the middle of the lake proper and at the south western parts, away of pollution as shown in Figure (7).

The pH in the fish farm fluctuated between 7.40 and 9.35, with a tendency to decrease slightly in the south part.

The Qalaa Drain water sustained lower pH which ranged between 6.95 and 8.20. The pH of the Noubaria Canal water fluctuated within a wider range between 7.10 and 8.65.

The seasonal changes of pH in the lake proper were irregular, with the highest value in August, 1976 and the lowest in October of the same year. The same irregular fluctuation of pH were also recorded in the fish farm, Qalaa Drain and Noubaria Canal, (Fig. 8). The pH remained relatively high in the fish farm during the period from September, 1975 to August, 1976 as compared with the rest of the investigation period.

The annual average pH values in the investigated areas showed a pronounced decrease during the second year of investigation.

d) Oxidizable Dissolved Organic Matter :

The oxidizable dissolved organic matter in the lake proper was subjected to wide fluctuations between 2.0 and 152.0 mg O_2 consumed/L, depending on the locality and period of sampling. The highest concentration appeared in areas receiving and industrial wastes and it decreased gradually towards the south west (Fig. 9). Station 3 sustained lower values of oxidizable organic matter similar to that of the Qalaa Drain water.

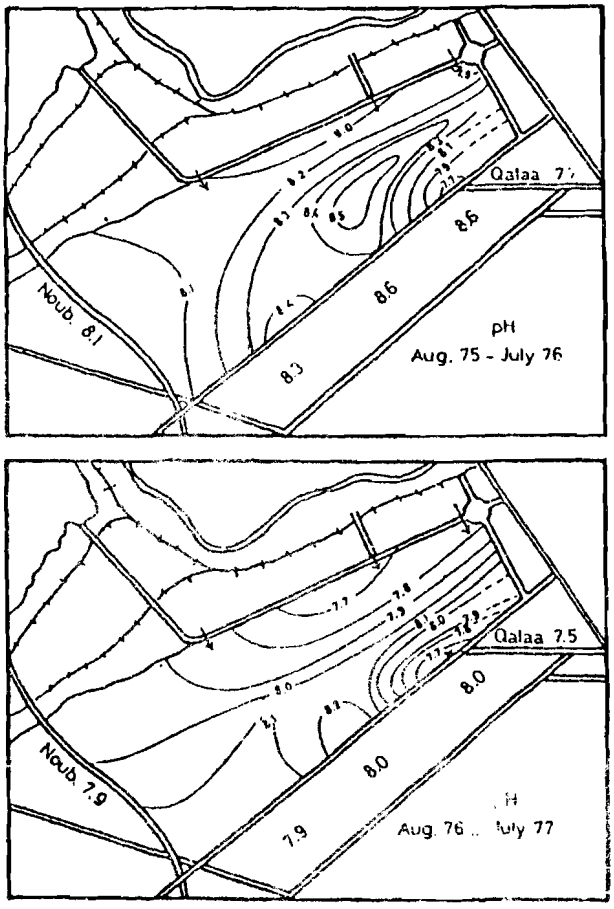

Fig. (7)
Distribution of pH values during the two successive years from August, 1975 to July, 1977.

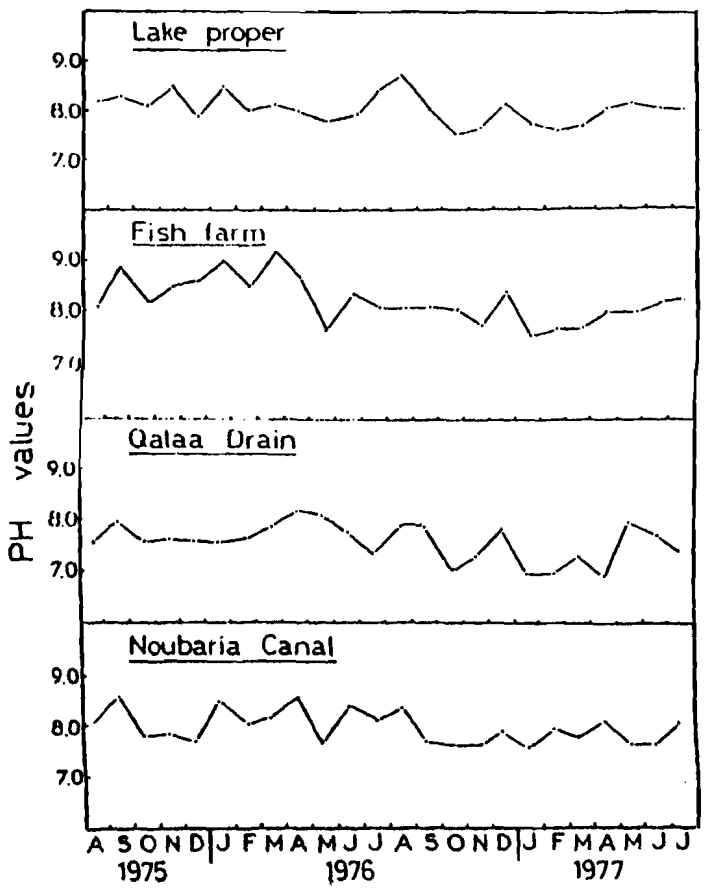

Fig. (8)
Seasonal variations of pH values.

The dissolved organic matter in the fish farm attained lower values which ranged between 1.0 and 39.6 mg O_2 consumed/L.

The dissolved organic matter in the Qalaa Drain remained relatively low during most of the year. It fluctuated between 7.0 and 22.6 mg O_2 consumed/L through out the investigation period with the exception of a high value of 76.2 mg O_2 consumed/L observed in September, 1976. The oxidizable dissolved organic matter in the Noubaria Canal ranged from 0.8 to 20.9 mg O_2 consumed/L.

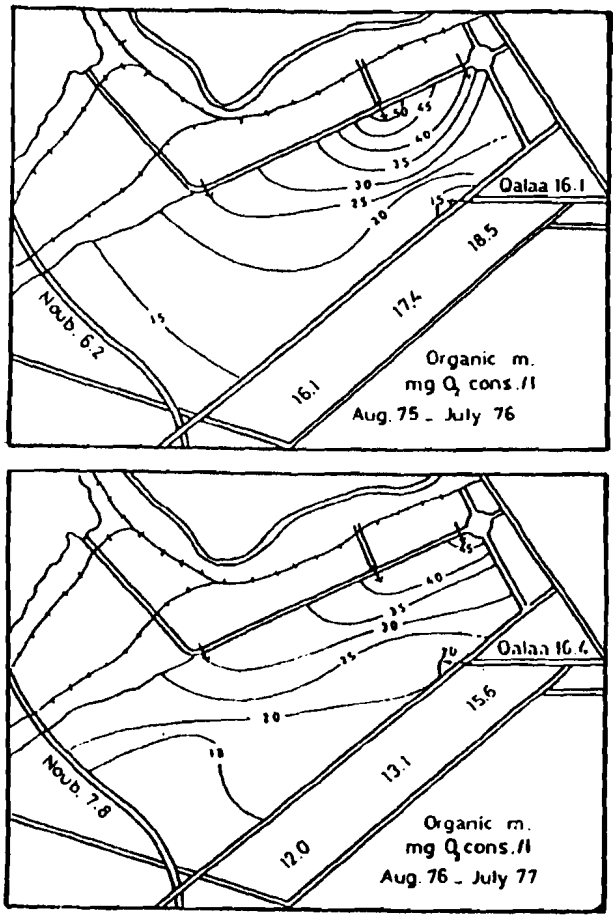

Fig. (9)
Distribution of dissolved organic matter in mg O_2 consumed/l during the two successive years from August, 1975 to July, 1977.

The seasonal variations of dissolved organic matter in the lake proper showed three peaks, namely, in October, 1975 (42.3 mg O_2 consumed/L), in September, 1976 (55.5 mg O_2 consumed/L) and in February, 1977 (37.8 mg O_2 consumed/L). The lowest value of 12.5 mg O_2 consumed/L was recorded in March, (Fig. 10). It is to be noted that such fluctuations are controlled by the quality of water discharged into the lake.

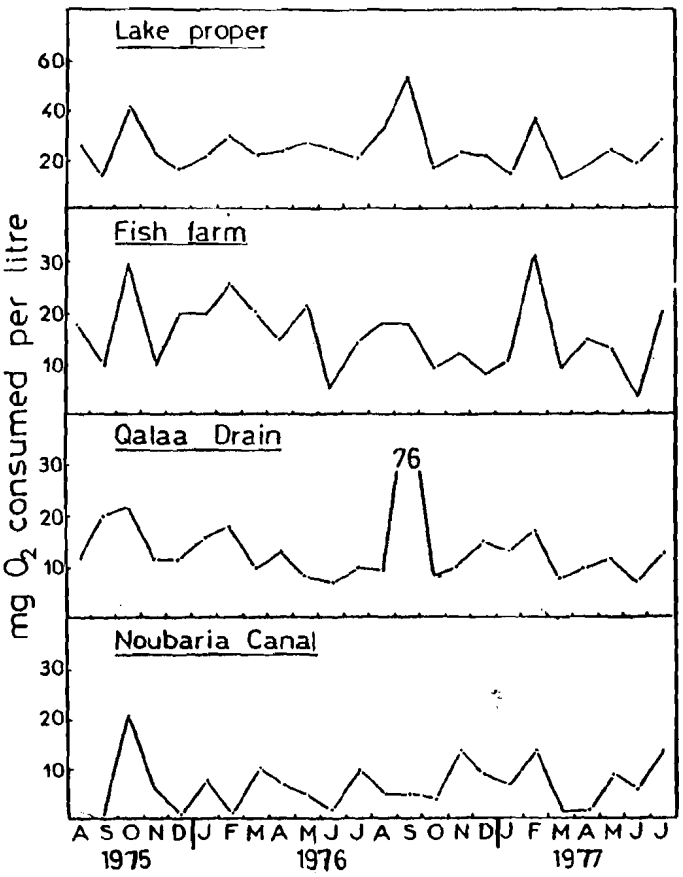

Fig. (10)
Seasonal variations of dissolved organic matter in mg O_2 consumed/l.

The seasonal variations of the dissolved organic matter in the fish farm showed peaks, namely; in October 1975 (29.6 mg O_2 consumed/L) and February, 1977 (31.2 mg O_2 consumed/L), coinciding with the death of the hydrophyte **Potamogeton pectinatus** which covered its major area. The lowest values appeared there during the summer and autumn of 1976.

The dissolved organic matter in the Qalaa Drain attained a small peak in October, 1975 (22.6 mg O_2 consumed/L) and a higher one in September, 1976 as mentioned previously, otherwise it remained at lower concentrations throughtout the rest of the investigation period. The dissolved organic matter in the Noubaria Canal showed also a pronouned increase in October, 1975 (20.9 mg O_2 consumed/L), and it remained relatively low with irregular fluctuations during the successive months.

DISCUSSION

The dissolved chlorides in the lake proper fluctuated between 270 and 1760 mg Cl/L with an annual average of 1063 mg Cl/L. The high concentration appeared in the western sector beside the Noubaria Canal as well as in areas subjected to the influx of industrial wastes. The dissolved chlorides in the fish farm remained higher than that of the lake proper and it averaged 2212 mg Cl/L.

Comparing the results obtained for dissolved chlorides in the lake proper during the present investigation with the previous records of 1960 (Aleem & Samaan, 1969a), it appears that the chlorosity was subjected to a sharp drop from an average of 3940 to 1063 mg Cl/L. This attributed to the change of the main source of water supply from the Umum Drain to the Qalaa Drain, beside other minor sources. Such decrease appears, however, to have no pronounced effect on the flora and fauna of the lake since most of the biota surviving there are euryhaline and can tolerate a wide range of salinity (Samaan & Aleem, 1972a, 1972b). These lower chlorosity values are also suitable for the growth and survival of **Tilapia** spp., which are the main fish inhabiting the lake.

The pH values in the lake proper ranged from 7.0 to 9.6. It remained low in areas subjected to the direct outfall of sewage and industrial wastes and that receiving the influx of the Qalaa Drain. It increased gradually towards the middle lake due to the increased growth of phytoplankton as well as at the south west parts away of pollution. A slight decrease of pH was observed in the lake proper during the second year of investigation from 8.14 to 7.95, while this was more pronounced in the fish farm from 8.50 to 7.95.

Previous estimation of pH in Lake Mariut during 1960 gave an annual average value of 8.50. Its pronounced decrease in the last years appears to result from increased pollution.

The total alkalinity in the lake proper fluctuated between 211 and 625 mg $CaCO_3$/L, being more high in areas receiving sewage and industrial wastes. The fish farm sustatined lower alkalinity than the lake proper which fluctuated between 165 and 380 mg $CaCO_3$/L.

The total alkalinity has increased during the last few years from an average 243 mg $CaCO_3$/L in 1960 to 370 mg CaCO/L in the present investigation. This is contrast to the dissolved chlorides which dropped sharply as mentioned previously. Such results indicate that the linear relation previously recorded by Mahlis, et al., (1970) between the total alkalinity and chlorinity is no more pronounced in Lake Mariut.

The lake water sustained a high content of oxidizable organic matter which ranges from 2 to 152 mg O_2 consumed/L. The highest concentration appeared in the contaminated areas particularly at station 4.

The annual average of dissolved organic matter in the lake proper showed a pronounced increase during the second year of investigation from 25 to 30 mg O_2 consumed/L, indicating increased pollution.

Results of the present investigation indicate that the Lake proper is heavily polluted with sewage and industrial wastes. Certain chemical changes have occurred in the lake water. These appeared as a decrease in the amount of dissolved chlorides and increase of the total alkalinity and oxidizable organic matter. The pH has also dropped.

Gross primary production measurements carried out during the present investigation gave lowest values of 1.01 g C/m^2/day in the area receiving industrial wastes and 1.07 g C/m^2/day at station 3 which is subjected to the influx of Qalaa Drain water. Primary production increased to 2.23 g C/m^2/day in areas affected by sewage effluents. The highest records of gross primary production appeared in the west and middle lake away from pollution, attaining respectively 3.50 and 3.90 g C/m^2/day. Comparing the annual average value of gross primary production recorded in the proper during the present investigation which amounted 2.24 g C/m^2/day with the previous results obtained for the same basin during 1961 which reached 6.84 g C/m^2/day (Aleem & Samaan, 1969b). It appears that the fertility of the lake proper has been reduced during the present investigation to about 1/3 records of 1961 as a result of pollution. Such a decrease can be recovered by improving the quality of water discharged into the lake.

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