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NUTRIENTS STATUS IN LAKE NASSER AND RIVER NILE AT ASWAN, EGYPT.

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ABSTRACT

The vertical and regional variations of nutrient salts (nitrite, nitrate, phosphate and silicate) were studied during the period of February 1987 to October 1987. The vertical distribution of these nutrient salts along the different regions shows remarkably irregular trend. In Lake Nasser, the average nitrite content fluctuated between a minimum value of 1.8 μgl^{-1} measured at 3 km upstream of High Dam during February and a maximum of 120 μgl^{-1} measured at 10 km from the High Dam in JUly. In Aswan Reservoir and Nile water, the ranges of nitrite content were 8.33 - 100 and 23.33 - 671.67 μgl^{-1} respectively. Also, the average nitrate concentration varied between 159 - 378, 138 - 447 and 540 - 5167 μgl^{-1} calculated for Lake Nasser, Aswan Reservoir and Nile water respectively. The higher concentration of nitrite and nitrate salts in the Nile water with respect to other regions is mainly attributed to sewage, industrial wastes and human activities.

INTRODUCTION

The Nile is the creator of the fertile land of Egypt, and it has sustained its existence and supported man's early civilization. The Nile yield has been subjected to dramatic changes from one year to another which depend on the amount of flood water. The extreme variations in the Nile flow have made it difficult to maintain sufficient agricultural production. The high floods inundated the land and caused property damage, and low floods were below agricultural and electricity requirements (Mancy, 1978). At the present time, the Nile in Egypt is totally controlled and fully utilized by the construction of High Dam. Since the damming of the river, Lake Nasser started its appearance and generally increasing in level along the

successive years. The level in Lake Nasser was 141m above mean sea level (MSL) in 1966, and through the increase from one year to another to reach a maximum of 177.3m in 1978. After this time, the water level in Lake Nasser decreased due to no flood water coming from south to reach a minimum value of 155m in 1987 by comparison to 106-111 and 83.3-84.8m above MSL in Aswan Reservoir and Nile River at Aswan respectively. In the other hand, the gross capacity of Lake Nasser and Aswan Reservoir amounted to 164 and 5.2 milliard m^3, respectively.

Again, after the construction of the High Dam on the Nile at Aswan all the excess water has been stored in the impounded lake. The volume of the accumulated water increased from 13.4 milliard m^3 in 1968 to 131.3 milliard m^3 by the end of 1978. At the same time, the water discharged through the Dam increased from 60 to 62 milliard m^3 respectively. In the recent years, due to the regulation of water used from the High Dam Reservoir, the amount of water discharged decreased to only 6.8 milliard m^3 during July 1987 (cf. Table 1).

TABLE (1)

Water levels in Lake Nasser, ASwan Reservoir and River Nileat Aswan, (meter) above sea level and the volume or water released from the Dam during 1987.

Items	Water Levels			volume of water released
Months	Lake Nasser	Aswan Reservoir	River Nile	from Dam (milliard m^3).
February	161.2	106 - 111	83.3	3,745
April	159.3		83.5	4,050
July	155.6		84.8	6,815
October	158.2		83.3	3,785

Again, prior to the construction of Aswan High Dam the Nile used to discharge from 60 to 180 million tone of silt annually into the Mediterranean. The main concerns have been the effect of siltation on the capacity of Lake Nasser, riverbed erosion and erosion of the Mediterranean coast. Since 1968, siltation has been confined to the southern third of the Aswan High Dam Reservoir. Another concern has been scouring of the riverbed due to modification of water velocity and the absence of silt and relatively high levels of dissolved salts.

The seasonal and regional variations of some physical and chemical conditions in Lake Nasser were studied by several authors (Elewa, 1980 and El-Din, 1985). Recently, concerning the Egyptian part of the River Nile much information on the chemical conditions has become available (Shehata 1976; Ramadan 1978; Saad 1980 and El-Gohary 1981). In the present study, the sequence of the seasonal and regional changes in the nutrient salts in Lake Nasser, Aswan Reservoir and Nile water Aswan-Egypt is investigated. The study involved measuring the concentration of nitrite, nitrate, phosphate and silicate salts during February, April, July and October 1987.

MATERIAL AND METHODS

Water samples were collected from different localities at different depths by means of a Van Dorn bottle. The sampling program carried out during February, April, July and October 1987 involved ten sampling sites to determine regional variation. Six sites were at upstream in the main channel of Lake Nasser (L_1, L_2, L_3 and L_4 0.5 Km, L_5 Khor Manam in the east side and L_6 Khor El-Ramla in the west side, 10 Km upstream). One sampling site was situated in the Aswan Reservoir (ASW_1) between the High Dam and Old Aswan Dam. Three sampling sites were chosen in the Nile at Aswan (ASW_2, ASW_3 and ASW_4), in front of Cataract Hotel, El-Sail drain canal and El-Kobanyi respectively (cf. Fig. 1).

Nitrite

The nitrite content was measured according to standard method (Anon., 1975).

Nitrate

Nitrate (NO_3) was determined by sulfanilic acid and sodium salicylate according to standard methods (Anon., 1975).

Phosphate

Phosphate $(PO_4)^{3-}$ was determined by colorimetric technique using stannous chloride reagent according to standard method (Anon., 1975).

Silicate

The silicate content was measured by colorimetric molybdosilicate method according to standard methods (Anon., 1975).

RESULTS AND DISCUSSION

Nitrite (NO_2)

During February and April, the average nitrite concentration was less than 20 μgl^{-1} in Lake Nasser and Aswan Reservoir in comparison to 30-130 and 23.33145 μgl^{-1} in the Nile at Aswan during these two periods

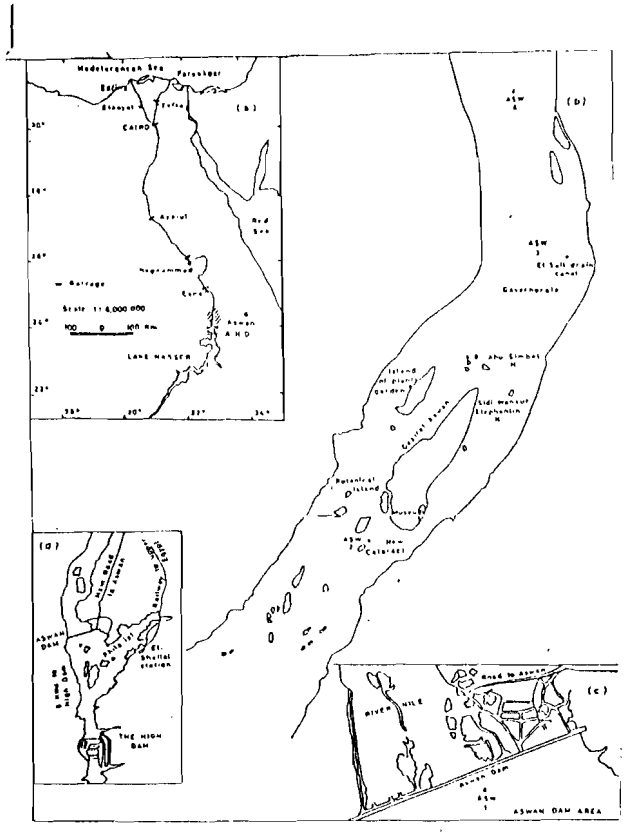

Fig. (1)
Map of the study area showing the sampling sites in Lake Nasser and River Nile at Aswan.
a) Monitoring segment. b) River Nile in Aswan.
c) Aswan Dam area. d) Area between Aswan Dam and the High Dam.

respectively (cf. Table 2). By rise of water temperature during July, nitrite content increased than the preceding periods in Lake Nasser and Nile water (cf. Fig. 2). During October, the values of February and April. Again, the sharp increase of nitrite in the Nile water may be attributed to the discharge of about 756 m^3/hour of industrial wastes through El-Sail drian canal with ammonia concentration of 104.2 mgl^{-1}, nitrite 4.1 mgl^{-1} and nitrate 30 mgl^{-1}.

TABLE (2)

Average values of nitrite content ($\mu g l^{-1}$) in Lake Nasser, Aswan Reservoir and Nile water at Aswan during 1987.

Sites / Months	L_1	L_2	L_3	L_4	L_5	L_6	ASW_1	ASW_2	ASW_3	ASW_4
February	1.8	3.2	3.2	5.66	5.0	15	16.7	30	130	101.67
April	7.6	6	11.8	10	7.5	3	8.33	23.33	145	76.67
July	21	84	28	120	50	43.33	81.67	271	671.67	363.33
October	40	14	30	9	2	2	100	233.33	525	433.33

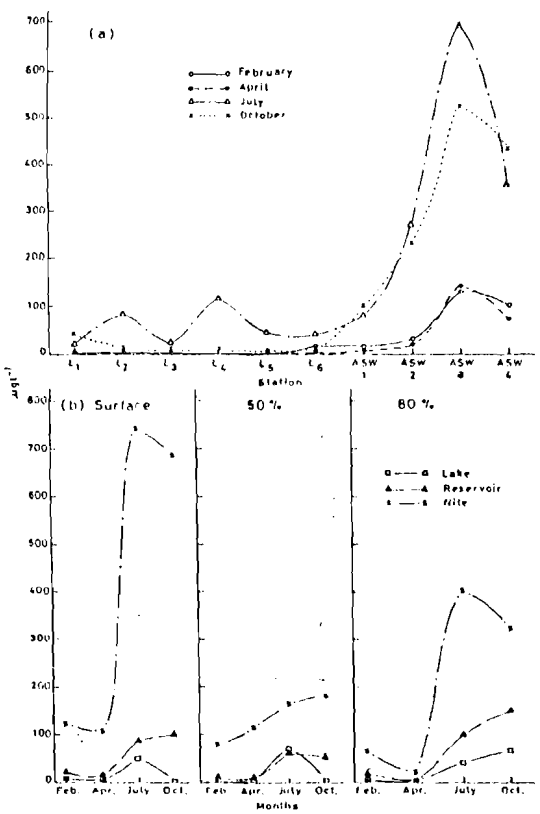

Fig. (2)
Average concentration of nitrite ($\mu g l^{-1}$)
a) at different sampled sites during different period of study.
b) on surface, 50% and 80% depth at different regions.

On one hand, the increase of nitrite content in the Nile water could be attributed mainly to the increase in nitrification of free ammonia into nitrite (Hutchinson 1957 & El-Wakeel and Wahby 1970), and denitrification of nitrate into nitrite. On the other hand the dissolved oxygen in Lake Nasser is lower in comparison with thoseAswan Reservoir or Nile water (cf. Table 3) which is consumed through the oxidation of nitrite to nitrate or its reduction to ammonia as well as its uptake by phytoplankton (Munawar 1970).

TABLE (3)

Seasonal variations of dissolved oxygen (mgl^{-1}) in Lake Nasser, Aswan Reservoir and Nile at Aswan.

Seasons	Winter		Spring		Summer		Autumn	
Depth	Surface	80%	Surface	80%	Surface	80%	Surface	80%
Lake Nasser	7	5.6	8.4	5.2	5.5	0.0	8.1	0.0
Aswan Reservoir	12.3	10.4	10.8	7.1	6.3	2.0	10.7	6.6
Nile	8.5	8.4	8.9	7.4	6.9	2.4	7.9	6.8

Nitrate

The seasonal and regional variations of the average nitrate content are given in Table 4 and represented graphically in Fig. 3. Thus, the variations of nitrate in Lake Nasser and Aswan reservoir are limited during the different periods of study in comparison with the distinct variations in the Nile.

The decrease of nitrate concentrations in Lake Nasser may be principally due to assimilation of nitrate by phytoplankton (cf. Table 5), in the eplimnion and its reduction in the hypolimnion by denitrifying bacteria during July and October (cf. Table 6). During these periods, it appears that stagnation period at the bottom layers in Lake Nasser (about 80-90 m. depth) are almost anaerobic and the bacterial densities are higher due to the presence of organic matter from sinking of dead plankton in comparison with the upper layer.

It was found that, the nitrate content in the Nile water at Aswan was higher than that in Lake Nasser water during the period of study. The increase of nitrate content in the Nile water at Aswan might be attributed to the anthropogenic activities in Aswan. The apparent nitrogen source is ElSail drain discharge into the River Nile. (Lakshminarayana 1965).

TABLE (4)

Average values of nitrate content (mgl^{-1})

Sites / Months	L_4	L_5	L_6	ASW_1	ASW_2	ASW_3	ASW_4
February	0.165	0.185	0.187	0.152	0.54	2.21	1.26
April	0.229	0.193	0.378	0.168	1.612	5.167	2.113
JUly	0.159	0.206	0.221	0.138	0.687	1.2	1.567
October	0.225	0.248	0.263	0.447	0.9	1.8	2.617

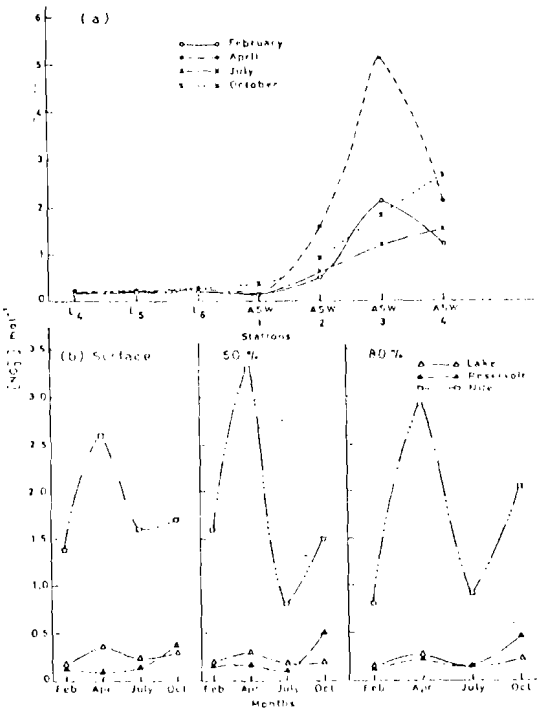

Fig. (3)
Regional average concentration of [$NO^{-}3$] at different
(a) sites and (b) depths.

TABLE (5)

Average values of total counts of green, blue green algae and diatoms (organisms/m) in Lake Nasser, Aswan Reservoir and Nile at Aswan.

Seasons	Spring			Summer			Autumn		
Sites	Lake	Reservoir	Nile	Lake	Reservoir	Nile	Lake	Reservoir	Nile
Green algae	333	213	217	106	80	100	140	347	220
Blue green algae	1067	1377	1197	313	572	572	1224	2102	1057
Diatoms	3253	2481	3081	497	293	528	38926	9058	3685

TABLE (6)

Seasonal variations of total plate counts of bacteria (counts/ml) (Saleh 1980).

Seasons	Winter				Spring				Summer			Autumn		
Sites / Depth	L_2	L_4	L_5	L_6	L_2	L_4	L_5	L_6	L_2	L_4	L_6	L_4	L_5	L_6
0	335	240	1000	1600	640	530	1565	1430	1200	2400	660	330	9.5×10^3	1[illegible]00
50%	120	270	1250	1500	310	500	1620	1235	760	800	610	480	4.7×10^3	$1.4\times$[illegible]0^3
80%	780	1.3×10^3	5.3×10^4	9.4×10^4	2.5×10^3	13.5×10^2	17.7×10^3	1.5×10^4	1.2×10^6	7×10^5	1.4×10^5	6.7×10^3	6.5×10^4	$1.5\times$[illegible]0^4

Phosphate

The phosphate content varried regionally and seasonally in the three regions as represented in Fig. 4. The increase of phosphate content in Lake Nasser during April in comparison to the other regions could be attributed to the increase of plankton decay (low suspended solids 1.2 mgl^{-1}) (Fayed 1980). It is noticed that, their is an pronounced increase of phosphate content in the bottom water of the River Nile and Lake Nasser during July and April due to the depletion of dissolved oxygen (cf. Table 3). As the oxygen in the hypolimnion is removed by active decompoisition of organic matter, which in turn release soluble phosphate from the decomposed sediments into the free water. Although, the high release of the water from the Dam during July (cf. Table 1), phosphate content had approximately the same value as in April but lower than phosphate content values during February and October in the Nile water.

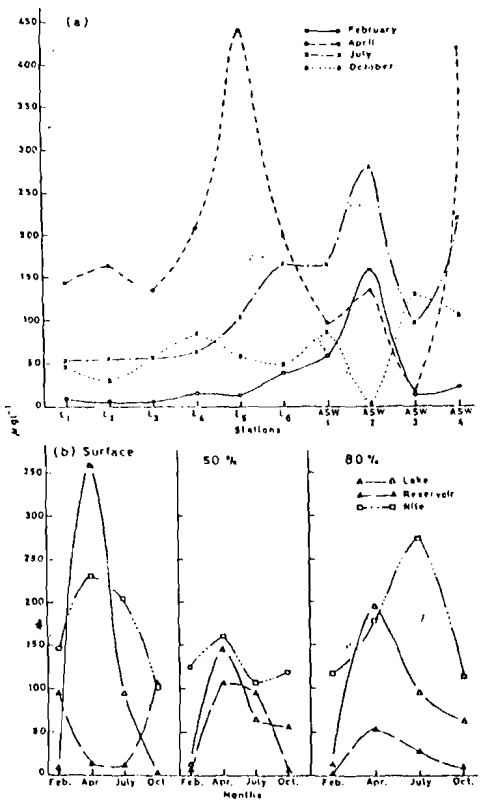

Fig. (4): Average $[PO_4^{3-}]$ at different (a) sites and (b) regions.

FIG. (4)
Average $[PO_4^{3-}]$ at different (a) sites and (b) regions.

On one hand, the higher phosphate content at ASW 1 in April is due to the discharge of domestic and phosphorus-carrier industrial wastes through Nile water (phosphate content of El-Sail drain 7 mgl^{-1}). On the other hand, the decrease pf phosphate in Lake Nasser and ASW during February is mainly due to the increase in its adsorption on the water (Kramer et al., 1972 and Saad, 1980).

Silicate

The silicate contents are varied regionally and seasonally as shown in the graph represented in Fig. 5 a & b. In Lake Nasser, the average values of silicate are varied between 2.35 and 13.38 mgl^{-1} measured in February and April respectively. The highest silicate content observed during April was associated by higher content of diatoms. The blue green algae are dominant in Lake Nasser during Summer which is more tolerent to relatively higher temperature than green algae. Again, the diatom population occurs in abundance in water containing large amount of silica and nitrate. Also in the case of rivers flood usually adds to increase in the number of diatoms.

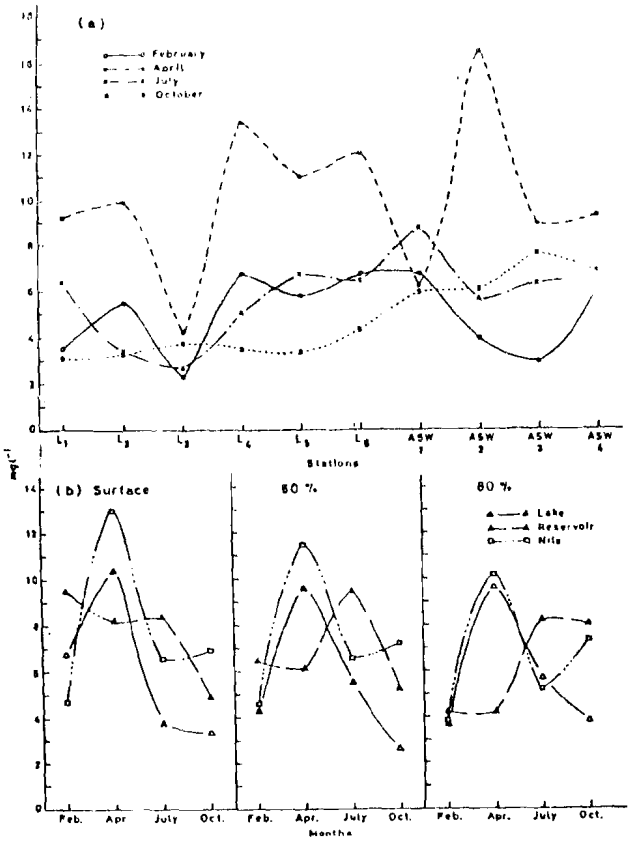

Fig. (5)
Silicate concentrations (mgl^{-1})
a- Regional average at different sites during different months.
b- Regional average at different depths.

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According to Abdin (1948 b&c) the phytoplankton population of the River Nile and behind Aswan Reservoir, showed that **Volvox** spp. occur in small numbers, while the blue green algae like **Microcystis** and **Anabaena** appeared in abundance in June-August, just before the flood period. The numerical distribution of phytoplankton in Lake Nasser shows the highest density in the southern sector due to the annual eutrophication with the flood rich in nutrient salts (Zaghloul, 1985).

Also Atkins (1932) and Rao (1955) observed that the peak of diatoms in general occurred after periods of high concentrations of nutrients.

In Aswan Reservoir, the minimum average silicate was 6.03 mgl^{-1} recorded during October. This reduction in the dissolved silicate was associated with an increase in the diatoms (cf. Table 5) especially the large size species BACILLARIA SYNEDRA and MOLOSIRA, Edwards (1974). The maximum value of the average silicate content in Aswan Reservoir was found to be 8.7 mgl^{-1} in July which is associated by minimum diatoms. In the Nile water, the minimum average values were 3.82 and 5.3 mgl^{-1} measured in February and July respectively with the peak in the diatoms population. The maximum silicate content measured in the Nile water was found to be 13.03 mgl^{-1} during April. This increase in silicate content during April is mainly attributed to be decline of diatoms.

On the other hand, the variation in silicate content is influenced mainly by the physical and chemical characteristics of the environment rather than by diatoms consumption (Aleem and Samaan, 1969).

CONCLUSION

In the surface layer (euphotic zone), biological processes will generally lead to a net utilization of the nutrients in Lake Nasser. This is the characteristic changes that occur during Spring and Summer. The reverse change takes place in the hypolimnion layer due to the consumption of oxygen content through the decomposition of organic matter and release of the nutrient elements from the sediments.

In general the Nile water at Aswan is rich by nutrient salts compared with Lake Nasser or Aswan Reservoir. This is mainly due to sewage wastes, human activities around the Nile and industrial effluents from El-Sail Canal. This study shows that, the released water from the Dam affected only silicate and nitrate contents especially during July.

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