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The Characteristic Algal Mats and Flora of El-Timsah Lake

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ABSTRACT

The study attempted to characterize the physicochemical limnology and the algal community of El-Timsah Lake during March 2004 to May 2005. The physicochemical limnology plays a key role in the blooming characteristic of benthic mats during spring season. Two mats were recognized visually of green and black colours. The green mat was constructed by the mechanical entanglement of filaments of *Cladophora* with four species of diatoms trapped within the filaments. In addition, the mat also bears fragments of *Ulva*, *Enteromorpha* and *Chaetomorpha*. The black mat was constructed primarily from filaments of *Oscillatoria nigroviridis* with two genera of coccoid cyanobacteria and some diatom species. Mat-forming algae grow initially on the bottom, but often "breaks away" to create numerous floating pads on the surface of the lake. Although, marine macroscopic algae were identified during this investigation, a brackish stratification was consistently confirmed by the appearance of some indicators of brackish type of diatoms such as *Melosira nummuloids*, *Achnanthes brevipes* var. *intermedia*, *Skeletonema subsalsum*, *Navicula capitata*, *Navicula digitoradiata* and *Surirella brebissonii*.
Key words: Algal mats, brackish stratification, El-Timsah Lake.

INTRODUCTION

Numerous of earlier floral studies of Suez Canal have been done, starting with the first record of seaweeds by Muschler (1908) in his "enumeration of the Egyptian Algae" and Lyle (1930), who added 23 seaweeds to Muschler`s list. The Great Bitter Lake (a part of Suez Canal) has been investigated by Lami (1932), Nasr (1947), Beets (1953), Lipkin (1972), Aleem, (1980, 1983), and Farghaly (1985). The middle part of Suez Canal, comprising El-Timsah Lake, was phycologically studied by El-Manawy (1987) who identified 80 species of the seaweeds from the lake and other sites of the Canal. Aleem (1980) also recorded 10 species of seaweeds from the lake.

Till now, no information about the seasonal algal bloom phenomenon comprising mat formation by some characteristic algae has been recorded, except masses of *Cheatomorpha* recorded in autumn by Aleem (1983). The objective of this work is the monitoring of algal mat formation during spring season relevant to some of physicochemical limnology which plays a key role in this phenomenon.

MATERIALS AND METHODS

The studied area covered the part of El-Timsah Lake which lies between 30º 33` and 30º 35` latitude and 32º 16` and 32º 19` longitude (Fig. 1). All limnological measurements were made from a designated area of the littoral zone of the lake. Surface measurements of average water temperature and pH were conducted by standard thermometer and digital pH-meter. One litre volume of water sample was collected during spring season of 2004 and 2005 in a clean dark bottle and preserved by few drops of toluene for chemical analyses according to methods of Dewis and Freites (1970).

The macrophytes were removed by hand and preserved in 4% formalin, while the phytoplankton samples were collected by a net of mesh 25 µm and concentrated in a 50 ml of Falcon plastic tube, followed by preservation in 4 % formalin.

Algal identification was performed using the keys of Smith (1969), and Aleem (1993) for the macrophytes. Cyanobacteria (blue-greens) were identified according to Desikachary (1959). For identification of diatoms, 10 ml of each plankton sample was cleaned and mounted according to Jouse *et al*., (1949), then Identified following to the keys of Jensen (1985) and Krammer and Lange-Bertalot (1986 and 1988).

RESULTS

The recorded water temperature ranged between 25ºC at early spring of 2004 and 30ºC at late spring of 2005 while the hydrogen ion concentration ranged was between 7.64 and 7.91. Chemically, the water salt type (the most hypothetical salt formed) was mainly sodium chloride, where sodium and chloride acquired the highest cationic and anionic concentrations, respectively (Table 1). Average salinity of water was 28.16‰. The dissolved oxygen content of water had a reasonable range of 5.8-6 mg/L. Total nitrogen raised from 15 ppm to 40 ppm during the period of investigation, while phosphate concentration had not magnificently changed.

Phycologically, this investigation revealed a floristic list of thirty one algal species belonging to five taxonomic algal divisions; 3 species from Cyanophyta (Cyanobacteria), 17 species from Bacillariophyta, 8 species from Chlorophyta, 2 species from Rhodophyta, and 1 species from Phaeophyta (Table 2).

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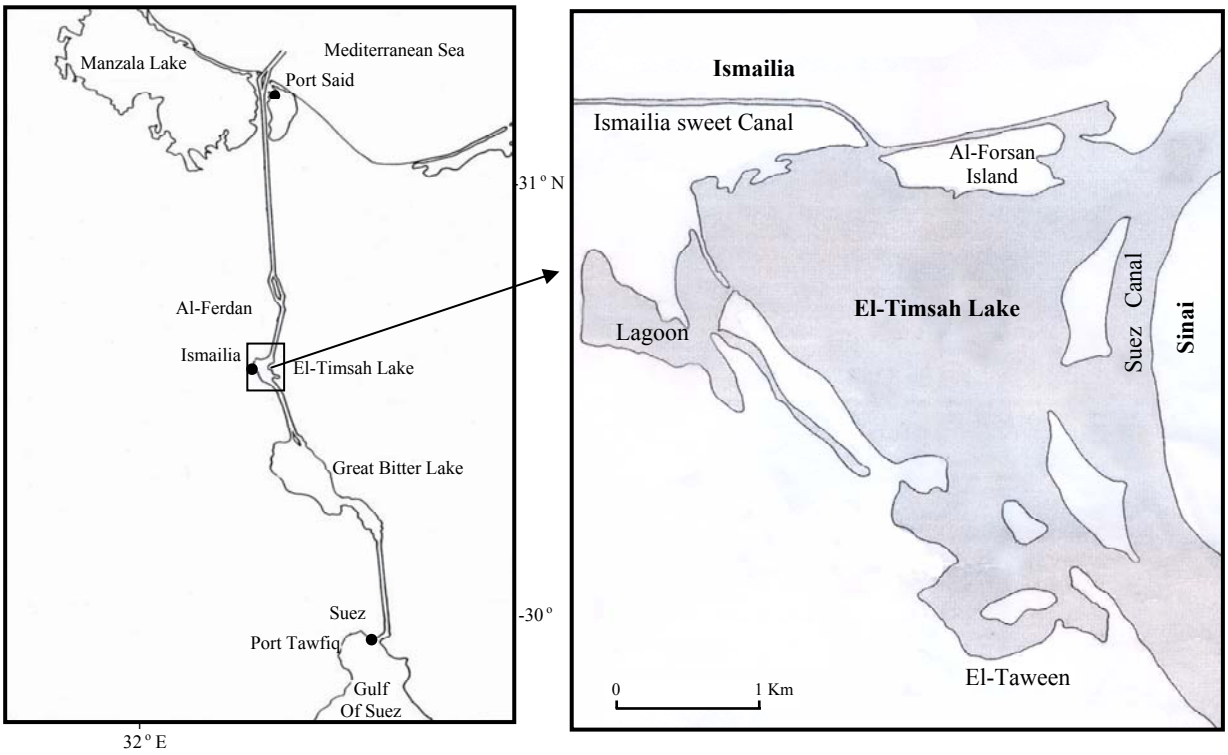

Figure (1): A map of the Suez Canal and El-Timsah Lake.

Table (1): Physico-chemical parameters of water in El-Timsah Lake during spring 2004 and spring 2005.

Parameters	Spring 2004	Spring 2005
Water Temperature (°C)	25	30
pH	7.64	7.91
Dissolved oxygen (mg/l)	6.0	5.8
E.C. Conductivity (dsm^{-1})	47.6	40.4
Salinity (‰)	30.46	25.86
Na^{+} (ppm)	13800	10000
K^{+} ppm	469.8	450
Cl^{-} ppm	24140	16152
Ca^{+2} ppm	340	360
Mg^{+2} (ppm)	1392	1365
CO_3^{-2} (ppm)	150	142
HCO_3^{-} (ppm)	244	701
SO_4^{-2} (ppm)	2680	2541
Total nitrogen (ppm)	15.2	40
Nitrate & nitrite (ppm)	11.3	23.5
Total phosphorus (ppm)	0.153	0.162

Some of the species identified in this study contributed in the formation of the characteristic algal mats during winter-spring period. Bottom mat-forming algae grow initially on the shallow bottom, but often breaks away to create numerous floating pads on the surface of the lake at the sunny spring days (Photo 1). The algal mats were recognized visually. This characteristic mats included the following algae:

(1) Filaments of *Cladophora rupestris* and other *Cladophora* species, constructed thin, green, fibrous, unlamented, cohesive mat formed on Lake floor in littoral zone from March 2004 to April 2005. The mat was constructed by the mechanical entanglement of filaments of *Cladophora* spp. (Chlorophyta genera), associated with Bacillariophytes (*Rhioicosphenia curvata, Martyana martyi*, *Skeletonema subsalsum* and *Synedra acus*). The previous identified diatoms were trapped within the filaments of *Cladophora* spp. In addition the mat also contained fragments of *Ulva* spp., *Enteromorpha* spp. and *Chaetomorpha* spp.

(2) Black cohesive, laminated, rubbery mat, formed on lake floor and margins throughout the period of investigation, constructed primarily from filaments of Cyanobacterium, *Oscillatoria nigroviridis* associated with two other coccoid species, *Myxosarcina burnmensis* and *Chroococcus minutes*. Diatom species; *Surirella brebissonii, Achnanthes brevipes* var. *intermedia* and *Skeletonema subsalsum* were also included. The physical entanglement of filamentous Cyanobacterium (*O. nigroviridis*) was coupled with the binding action of mucilage produced by the coccoid Cyanobacteria (*Myxosarcina burnmensis*, *Chroococcus minutus*). Bacillariophycean species were trapped inbetween the filaments and mucilage to construct the mat. This interwaved mat was collected from the littoral zone of the lake.

Discussion

Algal mat formation in El-Timsah Lake is a consistant phenomenon which usually happens during late winter-early spring period and drops significantly in late spring. Blooming of the most common algal

Photo (1): Algal mats floating on El-Timsah Lake.

species inhabiting the Lake is owing to their ability to survive under El-Timsah lake habitat. The habitat has unique limnological features, in which:

(1) The bottom sediments of the lake are mostly composed of mud or mud mixed with sand and it is occupied by a saline bottom layer (Miller and Munns, 1974), which favours the appearance of marine water species of green and red algae. Also our data are in agreement with Lipkin (1972) who mentioned that the muddy bottom is formed of very shallow patchy algal cover, nearly *Cladophora* sp. which in fact attaches to the protruding shells.

(2) The salinity of the lake is of a brackish stratification type (25.86 - 30.46‰) due to the fresh water inflow of Ismailia Canal reaching the lake (Por, 1978 and El-Manawy, 1987). Under this condition, some mesohalobien diatom species appeared as indicators of this type of salinity such as *Melosira nummuloides*, *Achnanthes brevipes* var. *intermedia, Skeletonema subsalsum*, *Navicula capitata*, *Navicula digitoradiata* and *Surirella brebissonii* (Hustedt, 1953; 1957; Simonsen, 1962; Ehrlich, 1975).

(3) Total nitrogen levels of the lake ranged between 15.12-40 mg/L, indicating the eutrophic character (Wetzel, 1983; Fujita *et al*., 1989; Thybo-Christensen *et al*., 1993; Peckol *et al.,* 1994), this leads to the appearance of some indicators of nitrogenous organic pollution of Cyanobacteria like *Oscillatoria nigroviridis*, *Chroococcus minutus* and meso-polysaprobien diatom *Synedra acus* (Zelinka and

Table (2): Algal taxa identified in El-Timsah Lake during spring season of 2004 and 2005.

Division Cyanophyta
Chroococcus minutus (Ehr.) Grun., S4.
Myxosarcina burmensis Skuja., S4.
Oscillatoria nigroviridis Thw. Ex Gomont., S5.
Division Bacillariophyta
Achnanthes brevipes var. *intermedia* Kütz., S4.
Campylodiscus clypeus (Ehr.) Ehr. ex Kütz., S4.
Cocconeis pediculus Ehr., S4.
Cyclotella meneghiniana Kütz., S4.
Martyana martyi (Heriband) Round., S5.
Melosira nummuloids (Dillwyn) C. A. Agardh., S5.
Navicula capitata Her., S5.
Navicula cincta (Ehr.) Ralfs., S5.
Navicula digitoradiata (Gregory) Ralfs., S5.
Navicula rhynchocephala var. *amphiceros* (Kütz.) Gurn., S4.
Nitzschia amphibia Grun., S4.
Nitzschia communis Kütz., S4.
Nitzschia valedstriata Aleem and Hustedt., S5.
Rhoicosphenia curvata (Kütz.) Grun., S4.
Skleletonema subsalsum (Cleve-Euler) Bethge., S4.
Surirella brebissonii Krammer and Lange-Bertalot., S5.
Synedra acus Kutz., S4.
Division Chlorophyta
Chaetomorpha indica Kütz., S4, S5.
Chaetomorpha linum (Mull.) Kütz., S4, S5.
Cladophora glomerata (L.) Kütz., S4.
Cladophora rupestris (L.) Kutz., S4, S5.
Enteromorpha clathrata (Roth) Greville., S5.
Enteromorpha compressa (L.) Greville., S5.
Enteromorpha flexuosa (Wulf.) J. Agard., S4, S5.
Ulva lactuca L., S4, S5.
Division Rhodophyta
Ceramium gracillimum Harv., S5.
Polysiphonia variegate (Ag.) Zanardini., S4.
Division Phaeophyta
Ectocarpus sp, S5.

S4: spring 2004 and **S5:** spring 2005

Marven, 1961; Sladeck, 1972; Villegas and de Giner, 1973), in addition to the most characteristic species of green mats including members of the closely related genera *Ulva* and *Enteromorpha* (Lowthion *et al.*, 1985; Brown *et al*., 1990; Lavery *et al*., 1991). This observation confirms the existence of sewage pollution pointed by Dewedar and Abdel-Monem (1990) who indicated the presence of coliform bacteria in water of El-Timsah Lake.

(4) Total phosphorus levels were of 0.153 to 0.162 mg/L, indicating the increasing of the algal growth rates and their quantities (Nisbet and Verneaux, 1970; Peckol *et al*., 1994).

REFERENCE

ALEEM, A.A. 1980. Contributions to the study of the marine algae of the Red Sea. IV-The algae and seagrasses inhabiting the Suez Canal (Systematic Part). Bulletin. Faculty of Science, King Abd-Elaziz University, Jeddah **4:** 31-89.

ALEEM, A.A. 1983. The Suez Canal as a habitat and pathway for marine algae and seagrasses. Proceeding of the Mabahith John Murray Institute Symposium, Egypt, 3-6 September, 907-918.

ALEEM, A.A. 1993. The marine algae of Alexandria, Egypt. University of Alexandria Bulletin 138-155.

BEETS, C. 1953. Notes on dredging in the Great Bitter Lake of the Suez Canal. Zoologische Mededeelinger. Leiden **32:** 97-106.

BROWN, V.B., S.A. DAVIES, AND R.N. SYNNOT. 1990. Long-term monitoring of the effects of sewage effluent on intertidal macroalgae. Botanica Marina **33:** 85-98.

DEWIS, F., AND M. FREITES. 1970. Physical and chemical methods of soil and water analysis. Food and Agricultural Organization of the United Nations. Rome.

DESIKACHARY, T.V. 1959. Cyanophyta, Indian council agricultural research, New Delhi.

DEWEDAR, A. AND M.H. ABDEL-MONEM. 1990. Effect of chemical pollutants on bacterial counts in El-Temsah Lake area, Ismailia, Egypt. Journal of Egyptian Public Health Association **65**(3-4): 305-318.

EHRLICH, A. 1975. The diatoms from the surface sediments of the Bardawil Lagoon (North Sinai)-Paleoecological significance. Nova Hedwigia Beihft **53:** 253-277.

EL-MANAWY, I.M. 1987. Ecological studies on the seaweeds of the Suez Canal. M.Sc. Thesis, Botany Department, Faculty of Science, Suez Canal University.

FARGHALY, M.S. 1985. Remarks on the marine vegetation of the Suez Canal. Proceedings. Egyptian Botany Society 4, Ismailia Conference.

FUJITA, R.M., P.A. WHEELER, AND R.L. EDWARDS. 1989. Assessment of macroalgal limitation in a seasonal upwelling region. Marine Ecology Progress series **53:** 292-303.

HUSTEDT, F. 1953. Die systematisk der diatomeen in ihen Beiziehungen zur geologie und okologie nebst einert revision des halobien-systems. Svensk Botanisk Tidskrift **47**(4): 509-519.

HUSTEDT, F. 1957. Die Diatomeenflora des Fluss-Systems der Weser in Gebiet der Hansestadt Bremen. Abh. Naturw. Ver. Bremen **34**: 181-440.

JENSEN, N. G. 1985. The pinnate diatoms. A translation of Hustedt "Die Keiselalgen, 2Teil" Koeltz Scientific Books, Koenigstein.

JOUSE, N.G., A.I. PROSCHKINA-LAVERENKO, AND V.C. SHESHYKOVA. 1949. Diatom Analysis. Volume I Publication "Geol Liter" Leningrad.

KRAMMER, K., H. LANGE-BERTALOT. 1986. Bacillariophyceae. Naviculaceae. Gustav Fisher Verlag. Stuttgart , New York.

KRAMMER, K., AND H. LANGE-BERTALOT. 1988. Bacillariophyceae. Nitzschiaceae. Gustav Fisher Verlag. Stuttgart, New York.

LAMI, R. 1932. Quelques algues du grand la Amer (Basse Egypte) recoltees per M. Le Professeur Gruvel , en Avril, 1932. Reverse Algol. **6:** 355-356.

LAVERY, P.S., R.J. LUKATELICH, AND A.J. MCCOLIN. 1991. Changes in the biomass and species composition of macroalgae in an eutrophic estuary, Estuarine Coastal and Shelf. Science **33:** 1-12.

LIPKIN, Y. 1972. Contributions to the knowledge of Suez Canal migration. Israel Journal of Zoology **21**(3-4): 405-445.

LOWTHION, D., R.G. SOULSBY, AND M. HOUSTON. 1985. Investigation of an eutrophic tidal basin. 1. Factors affecting the distribution and biomass of macroalgae. Marine Environmental Research **15:** 263-284.

LYLE, L. 1930. Flora of the Suez Canal and Lakes. Journal of Botany **68:** 327-333.

MILLER, A.R., AND R.G. MUNNS. 1974. The bitter Lakes salt barrier. In L'Oceanographe physique de la Mer Rouge, IAPSO symposium, Paris, 1970. CNEXO Sew: Actes Colloque No. **2:** 295-306.

MÜSCHLER, R. 1908. Enumeration des algues marines et d'eau douce observes jusqu'a ce jour en Egypte. Memoires de L' Institute d'Egypte **5:** 141-237.

NASR, A.H. 1947. Synopsis of the marine algae of the Egyptian Red Sea Coast. Bulletin Faculty of Science, Egyptian University **26:** 1-155.

NISBET, M., AND J. VERNEAUX. 1970. Discussion et proposition de classes entantique bases interpretation de analyses chimiques. Limnologie **6:** 161-190.

PECKOL, P., B. DEMEO-ANDERSON, J. RIVERS, I. VALIELA, M. MALDONADO, AND J. YATES. 1994. Growth, nutrient uptake capacities and tissue constituents of the macroalgae, *Cladophora vagabunda* and *Gracilaria tikvahiae*, related to site-

specific nitrogen loading rales. Marine Biology **121:** 179-185.

POR, F.D. 1978. Lessepsian Migration. Springer Verlag Berlin Heidelberg.

SIMONSEN, R. 1962. Untersauchungen zur systematic und okologie der boden diatomeen der weslichen Ostree. Syst. Beih. International Reverse Gesamt. Hydrobiology **1:** 1-144.

SLADECEK, V. 1972. The vector of saprobity and the system of water quality**.** Pol Arch Hydrobiology. **19**(2): 211- 213.

SMITH, G.M. 1969. Marine algae of the Moterey Peninsula California. Stanford, University Press, Stanford, California, second edition.

THYBO-CHRISTENSEN, M., M.B. RASMUSSEN, AND T.H. BLACKBURN. 1993. Nutrient fluxes and growth of *Cladophora sericea* in a shallow Danish bay. Marine Ecology Progress Series **100:** 273-281.

VILLEGAS, J., AND G. DE GINER. 1973. Phytoplankton as a biological indicator of water quality. Water Resources **7**(3)**:** 479-483.

WETZEL, R. G. 1983. Limnology. G. Michigan State University, Annual Arbor MI.

ZELINKA, M., AND P. MARVAN. 1961. Zur Prazisierung der biologischen klassifkation der Reinbeit fliessender Gewwasser. Arch. Hydrobiology **57:** 389-407.

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الحصائر الطحلبية والفلورا المميزة لبحيرة التمساح

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الملخص العربـــى

تهدف الدراسة إلى تقدير العوامل الفيزيقوكيميائية ووصف المجتمع الطحلبي في بحيرة التمساح في الفترة من مارس 2004 إلى مايو 2005 . وقد وُجد أن العوامل الفيزيقوكيميائية تلعب دوراً هاماً في نمو وإزدهار حصائر من طحالب القاع إلى سطح البحيرة خلال موسم الربيع. ويمكن بصريا تمييز لونين من الحصائر الطحلبية الطافية على سطح البحيرة وهما الأخضر والأسود. وقد وُجد إختلاف فى تركيب كل منهما، حيث تتكون الحصيرة الخضراء من خيوط متشابكة من *Cladophora* sp. مع أربع أنواع من الدياتومات متداخلة معها بالإضافة إلى أنواع أخرى من *Ulva* spp. و *Enteromorpha* spp. و *Chaetomorpha* spp. . أما الحصيرة السوداء فتتكون من خيوط من *Oscillatoria nigroviridis* متصاحبة مع جنسين من السيانوبكتيريا المستديرة وبعض الدياتومات. وقد وُجد أن الطحالب تنمو أولاً في قاع البحيرة ثم تنفصل وتندفع بعيداً بإتجاه السطح لتعطى حصائر طحلبية طافية على سطح البحيرة. كما وُجد أيضاً أنه على الرغم من التعرف على أنواع من الطحالب البحرية إلا أن البحيرة (وهى ذات تعدد طبقي بين العذب والمالح) تتميز بظهور بعض أنواع من الدياتومات كدلائل للملوحة بين العذب والمالح مثل:
Melosira nummuloids, *Achnanthes brevipes* var. *intermedia*, *Skeletonema subsalsum*, *Navicula capitata*, *Navicula digitoradiata* and *Surirella brebissonii*.