

THE EFFECT OF SOME DISSOLVED NUTRIENTS
ON THE DISTRIBUTION AND PERIODICITY
OF CHLOROPHYCEAE AND CYANOPHYCEAE IN
EL-ZOMOR AND EL-MANSORIYA CANALS, GIZA, EGYPT.

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SUMMARY

The effect of dissolved nutrients and pH on the distribution and periodicity of chlorophyceae and cyanophyceae in El-Zomor and El-Mansoriya canals for a period of six months is given. In the two canals the rich development of chlorophyceae seemed to be limited by the interaction of various chemical and physical factors, while concerning cyanophyceae oxygen concentration and salinity seemed to be important but not the only factors. The diatoms form more than 90% of the algal population. Comparison of the algal flora of El-Zomor, El-Mansoriya and El-Khashab (Nosseir and Abou El-Kheir 1970, 1972) canals showed that there is a slight variation between them.

INTRODUCTION

The aim of the present work is to investigate the distribution and periodicity of Chlorophyceae and Cyanophyceae found in two main canals (El-Zomor and El-Mansoriya) at Giza during six months starting from August 1972 until January 1973. Dissolved oxygen, Ca, Mg, Cl, and the pH value were all estimated at every collection in order to find out their probable effect on the distribution and periodicity of the studied algae.

El-Zomor is an irrigation canal which receives water from El-Giza canal. The latter receives its water directly from the Nile and runs for about 104 Km. before it joins El-Zomor canal. This latter is about 26.5 Km. long with an average width of 10 meters and

depth of 3 meters. It starts at El-Wali farm and extends Northwards through cultivated land until El-Manash town where it drains its water and ends. The samples were collected at several points covering a distance of 1.1 Km. which represents part of the canal's course through El-Omraniya district near Giza.

El-Mansoriya canal is similar to El-Zomor in many respects. It receives its water from El-Giza canal at Anistas-Kagorian town and extends Northwards through cultivated land, West of El-Zomor canal, until it ends by draining its water in El-Moheet drain, at Manshiyet Radwan. It is of more or less the same width and depth of El-Zomor canal but it is much longer being about 37 Km. long. We collected our samples from the part of the canal which runs through El-Giza Province, and at the position where the canal crosses the main road to the Pyramids, about 5 Km. to the west of El-Zomor canal. The collection covered a distance of 1 Km. of the canal's length. The two canals are bounded in some places by trees that shadowed the water surface part of the day.

The distribution, growth, and periodicity of algal flora in a wide variety of ecological situations in Egypt (Red Sea Shore, Mediterranean Cost, The Nile, canals, drains, pools, ditches, lakes, etc.) have received comparatively little attention by a few workers.

Nayal (1931, 1935b) and Täckholm (1932) referred in detail to the earliest records on Egyptian freshwater, brackish, and marine algae. It is not our intention here to make full reference to all previous work dealing with the algae of Egypt. However, we may mention that work on the marine algae of Egypt is quite poor and is mainly that done on the algal flora of the Red Sea by Zanardini (1858), Piccone (1889, 1900), Muschler (1908), and Nasr (1939, 1944, 1947). More recent work on the Red Sea algae is that done by Mohsen 1972a, b,c), however, this is concerned with the algal flora of the Eastern Shore in Saudi Arabian Territory.

Work on the algal flora of the Mediterranean cost of Egypt is even poorer. We may mention as an example, Areschoug (1870).

Concerning mixed marine, brackish, and freshwater algal forms we may mention the work done on Lake Qarun by West (1909) and Nosseir and Abou El-Kheir (1970) and that done on Lake Edku by Nasr et al. (1961).

Literature dealing with Egyptian freshwater algae is comparatively more extensive. We may mention here ; Kaufmann (1897),

Müller (1899), Kneucker (1904), Hume (1906), Brunthaler (1914), Simpson (1930), and Abdin (1947a, b). The most important contribution to our knowledge of the Egyptian freshwater algae is, undoubtedly, that done by Nayal (1931, 1933, 1935a, b, 1937). He collected, identified, and enumerated hundreds of forms belonging to different algal groups. He described also several algal that were new to science. More recent work on Egyptian freshwater algae is mainly represented by a number of joint publications of the senior author of the present paper. The main concern of these joint publications (Nosseir and Abou El-Kheir 1970a, b, c, 1972) was to study the influence of dissolved nutrients on the distribution, growth, and periodicity of the algal flora in some Egyptian lakes and canals. Results obtained from these previous investigations will be compared here with those of the present work.

The importance of dissolved nutrients to algae has been the subject of a great many investigators. In this concern the findings of Pearsall (1930, 1932), Gran (1929), and Chu (1942, 1943) may be cited as examples.

MATERIAL AND METHODS

Regular monthly visits were made to the localities (El-Zomor and El-Mansoriya canals) of collection for a period of six months. Eleven sites were chosen, and two samples were taken from every site (surface and bottom : $1\frac{1}{2}$ meters deep) for each canal. At the time of sampling, notes were taken of the temperature of air and water, clarity of water and whether flowing or still, weather conditions ((sunshine, rainfall), degree of shade over sampling points, nature and quantity of macroscopic vegetation in awter.

The pH of all the sites was determined directly after sampling. Dissolved oxygen and other nutrients ; Ca, Mg, and Cl were all determined. Methods used for their determination will be referred to in detail in the M.Sc. thesis of the second author.

Fresh samples were examined microscopically for identification of the green and the blue-green forms. Further samples were treated with a mixture of conc.HNO₃ and H₂SO₄ acids for clearing diatoms prior to their identification.

The data recorded in table (1) represent the average concentration of estimated nutrients and the average pH determined for the 22 samples taken monthly from the 11 sites for each canal.

TABLE 1

pH and dissolved nutrients of El-Zomor and El-Mansoriya canals throughout six months (Aug. 1972 — Jan. 1973), average of 22 samples. mgm./L for O₂ & Cl. meq./L for Ca & Mg.

Dissolved nutrients	El-Zomor						El-Mansoriya					
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
O ₂	6.17	7.39	5.76	9.87	11.4	8.26	7.23	8.4	6.79	9.69	6.24	6.53
Cl	57.9	99.1	45.8	39.4	67.2	52.5	57.4	107.3	81.7	52.5	172.9	37.7
Ca	3.24	4.34	4.23	3.94	4.81	7.69	4.63	3.29	3.97	4.63	5.51	4.64
Mg	2.21	1.34	2.59	2.67	3.08	3.16	2.11	1.50	2.49	3.56	3.56	1.95
pH	7.2	7.2	7.1	7.0	7.6	7.4	7.01	7.1	7.05	7.01	7.3	6.9

A full list of the Chlorophyceae (20 genera) and the Cyanophyceae (6 genera) recorded in the two canals is compiled in table (2). The latter also indicates the state of occurrence of these algal taxa.

RESULTS AND DISCUSSION

The investigation of the samples of the two canals showed that the algae present belong to the Bacillariophyceae, Chlorophyceae, and Cyanophyceae. The Bacillariophyceae formed more than 90% of the algal population in the two canals, followed by the Chlorophyceae then comes the Cyanophyceae. This same result was found in earlier work by Nosseir and Abou El-Kheir (1970a,b,c, and 1972). It was found also that the numerous and more tolerant species were of the freshwater type which is expected in irrigation canals.

Both El-Zomor and El-Mansoriya are irrigation canals receiving their water from one source and running through more or less similar cultivated land. Thus it is expected that both canals will have more or less the same kind of water (see table 1) and subsequently also a similar algal flora (see table 2). The latter table also shows that the two canals have the same number of algal taxa. The number recorded in El-Zomor was 22 genera (16 greens and 6 blue-greens) and in El-Mansoriya also 22 genera (17 greens and 5 blue-greens). The total number recorded in the two localities being 26 genera.

There is, however, some variation in the concentration of dissolved nutrients in the two canals especially salinity which seems to be an important determining factor, since the majority of algal forms recorded in El-Zomor canal in August disappeared with the rise of salinity in September. However, the rise of salinity in El-Mansoriya canal during September and December appears to have affected the kind of algal forms present rather than their number. This agrees with Braarud's (1935) observations. Rich (1933) also noticed that blue-greens were plentiful where the salinity was high as well as where it was low. This statement agrees in part with the results obtained here. Thus blue-green forms were found in copious masses in El-Zomor canal in November when the salinity was at its lowest level and in El-Mansoriya canal in August, September, and November when the salinity was relatively high.

Factors other than salinity are also effective. Rao (1955) found that oxygen concentration affects the periodicity of blue-green algae. This is in agreement with the presence of copious masses of blue-greens in El-Zomor canal in November and in El-Mansoriya canal in

TABLE 2

The algal taxa and their state of occurrence in El-Zomor
& El-Mansoriya canals.

Taxa	State of occurrence	El-Zomor					El-Mansoriya						
		Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
<i>Chlorophyceae</i>													
1. Ankistrodesmus septatus		+	+	+	+	+	-	+	+	+	+	+	+
2. Chlorella spp.	R	-	-	-	+	-	-	-	+	-	-	-	-
3. Chlamydomonas spp.	P	+	-	-	+	-	-	-	+	+	+	-	-
4. Chlorella spp.	D	-	-	+	+	+	-	+	+	+	+	-	-
5. Chlorococcum spp.	PD	+	+	+	+	+	-	+	+	+	+	+	-
6. Closterium spp.	R	+	-	-	+	-	-	-	-	-	-	-	-
7. Coelestridium spp.	R	-	-	-	-	-	-	+	-	-	-	-	-
8. Cosmarium spp.	R	+	-	-	-	-	-	-	-	-	-	-	-
9. Euglena spp.	R	+	-	-	+	-	-	-	-	-	-	+	-
10. Meogoutia spp.	R	-	-	-	-	-	-	-	-	+	-	-	-
11. Merismopedia spp.	R	-	-	-	-	-	-	+	-	-	-	-	-
12. Oedogonium spp.	R	-	-	-	+	-	-	-	-	-	-	-	-
13. Pandorina spp.	D	+	-	+	+	+	-	-	+	+	+	-	-
14. Pediastrum spp.	P	+	-	-	-	-	-	-	+	-	-	+	+
15. Phacus spp.	R	-	-	-	+	-	-	-	+	-	-	-	-
16. Pleurococcus spp.	R	+	-	-	-	-	-	-	-	-	-	+	-
17. Scenedesmus spp.	PD	+	+	+	+	+	+	+	+	+	+	+	+
18. Selenastrum spp.	R	+	-	-	+	-	-	-	-	-	-	+	-
19. Spherella spp.	P	-	-	-	+	-	-	+	+	+	-	-	-
20. Spirogyra spp.	R	-	-	-	-	-	-	+	-	-	-	-	-
<i>Cyanophyceae</i>													
21. Anabaena spp.	P	+	+	-	+	-	-	+	+	+	+	-	-
22. Chroococcus spp.	R	-	-	-	+	-	-	+	+	-	+	-	-
23. Lyngbya spp.	R	+	-	+	-	-	-	-	+	-	-	-	-
24. Nostoc spp.	P	+	-	+	+	-	-	+	-	-	+	+	+
25. Oscillatoria spp.	PD	+	+	+	+	+	-	+	+	+	+	+	-
26. Spirolena spp.	R	+	-	-	-	-	-	-	-	-	-	-	+
<i>Chlorophyceae</i>													
Total No. of genera		11	3	6	13	5	1	8	9	9	7	7	3
<i>Cyanophyceae</i>													
Total No. of genera		5	2	3	4	1	-	4	4	2	4	2	2
<i>Bacillariophyceae</i> : dominant in all sites throughout.													

Note : PD = Predominant D = Dominant P = Present R = Rare

August, September, and November when the oxygen concentration was relatively high. However, the high oxygen concentration of El-Zomor canal in December does not agree with Rao's observation, since in this month the blue-greens were poorly developed.

The above results show that whatever the importance of salinity and oxygen concentration to blue-greens may be, the influence of other factors is also notable. Thus the low temperatures of December and January may be behind the poor development of both Chlorophyceae in these cold months especially in January where lowest temperature values were recorded. In the latter month Cynaophyceae disappeared entirely from El-Zomor canal. It is convenient to mention here that Nayal (1935) stated that Cyanophyceae as a whole are essentially summer forms.

Regarding the effect of pH, Durrell (1964) observed that Cyanophyceae are more characteristic of alkaline environments. This explains the generally poor representation and development of blue-green forms in the acidic waters of El-Khashab canal and lakes Qarun and Nasser. It also explains the much better development of this group of algae in El-Zomor and El-Mansoriya canals where the pH is generally in the alkaline side.

Another determining factor is the periodicity of the Nile. Nayal (1931) stated Nile periodicity might be expected to exert a notable influence on the time and place of occurrence of many Egyptian algae. It was noticed here that most of the greens and blue-greens that existed in lake Nasser were met with also in El-Khashab canal, El-Zomor canal, El-Mansoriya canal, and even in lake Qarun.

The foregoing discussion makes it clear and, as stated earlier by Lund and Talling (1957) that there is no ultimate factor responsible for algal mass productivity and periodicity. In other words the fluctuations and periodicity of the Chlorophyceae and Cyanophyceae in El-Zomor and El-Mansoriya canals throughout the six months of investigation might be due to the sums of the nutritional (Ca, Mg, Cl...) and environmental (temp., sunshine) conditions operating found by Fritsch (1906), Patrick (1945), Jørgensen (1957), and Nasseir and Abou El-Kheir (1970a,b,c).

Finally we may say that the list of diatoms of El-Zomor and El-Mansoriya canals for the period from August 1972 to January 1973 as well as the results of investigation of samples collected for the rest of the 12 months period (Feb. 1973 — Aug. 1973) is in preparation.

When completed this will allow for better comparisons and more comprehensive discussion than it was possible for us to give here. It will not be long before this work is published.

BIBLIOGRAPHY

1. Abdin, G. 1947a
Communities of sessile algae in Aswan Reservoir.
Palestine Journal of Botany, Jerusalem Series, Vol. IV :
105—106.
2. ———— 1947b
A few notes on little known algal species observed in Aswan
Reservoir.
The Egyptian Academy of Sciences. Proceedings Vol. III :
53—55.
3. Areschoug, J.E. 1870
Alger samlade vid Alexandria af framl. Dr. Hedenborg.
Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar,
27, Stockholm.
4. Braarud, T. 1935
The Ost. expedition to the Denmark Strait 1929.
II The phytoplankton and its condition of growth.
Hvalvadebs Skrifter 10 : 5—144.
5. Brunthaler, 1914
Beitrag zur Suswasser-Algenflora von Aegypten.
Hedwigia Band 54 Dresden.
6. Chu, S. P. 1942
The influence of the mineral composition of the medium on
the growth of planktonic algae. Part I : Methods and culture
media.
Jour. Ecol. 30 : 284—325.
7. ———— 1943
The influence of the mineral composition of the medium on
the growth of planktonic algae. II The influence of the con-
centration of inorganic nitrogen and phosphate phosphorus.
Jour. Ecol. 31 : 109—148.
8. Durrell, L. W. 1964
Algae in relation to soil fertility.
Bot. Ref. 30 (1) : 92—128.

9. Fritsch, F. E. 1906
Problems in aquatic biology with special reference to the study of algal periodicity.
New Phytol. 5 : 150—169.
10. Gran, H. H. 1929
Investigation of the production of plankton outside the Romsdalsfjord 1926—1927 cons.
Perm. Int. Explor. Mer. Rapp et Proc. Verb. 56 (6) : 1—12.
11. Hume, W. F. 1906
The Topography and Geology of the Peninsula of Sinai (Southeastern Portion), Cairo, pp. 231—233.
12. Jorgensen, E. G. 1957
Diatom periodicity and silicon assimilation.
Dansk. Bot. Ark. 18 : 1—54.
13. Kaufmann, P. 1897
Sur le pretendu Nil vert.
Revue d'Egypte, T. IV. p. 113.
14. Kneucker, A. 1904
Algen von Aegypten, Frankreich und Oberitalien, Allgemeine Botanische Zeitschrift, Karlsruhe.
15. Lund, J. W., and Talling, J. F. 1957
Botanical and Limnological methods with special reference to the algae.
Bot. Rev. 23 : 489—533.
16. Mohsen, A. F. 1972a
Contribution to the marine algal flora of the Red Sea shore bordering Jeddah zone (Saudi Arabia) Part I Cyanophytia and Rhodophytia.
Bull. Fac. Sci. Riyadh Univ. Vol. 4, 113—134.
17. Mohsen, A. F. 1972b
Contribution to the marine algal flora of the Red Sea shore bordering Jeddah zone (Saudi Arabia) Part II Phaeophytia.
Bull. Fac. Sci. Riyadh Univ. Vol. 4, 135—110.
18. ——— 1972c
Contribution to the marine algal flora of the Red Sea shore bordering Jeddah zone (Saudi Arabia) Part III Chlorophytia.
Bull. Fac. Sci. Riyadh Univ. Vol. 4, 151—169.

19. Müller, O. 1899
Bacillariaceen aus den Natrontbalern von ElKab (Ober-
Aegypten).
Hedwigia, Band 38, Dresden.
20. Muschler, R. 1908
Enumeration des algues marines et d'eau douce observees
jusqu'a ce jour en Egypte.
Mem. Inst. Egypte V ; Le Caire.
21. Nasr, A. H. 1939
Reports on the preliminary expedition to the Red Sea, algae.
Public. Mar. Biol. St., Ghardaqa, No. 1, Cairo.
22. ——— 1944
Some new algae from the Red Sea.
Bull. Inst. d'Egypte., T. XXVI.
23. ——— 1947
Synopsis of the marine algae of the Red Sea.
Bull. Fac. Sc. No. 26.
24. ———, Hashim, M. A., and Aleem, A. A. 1961
The flora of lake Edku, with particular reference to benthic
diatoms.
Bull. Fac. Sc., Alexandria Univ. U.A.R., 5 : 219—234.
25. Nayal, A. A. 1931
An enumeration of Egyptian Chlorophyceae and
Cyanophyceae.
Extrait de la Revue Algologique pp. 177—195
26. ——— 1933
A desert *Protosiphon*.
Ann. of Bot., Vol. XLVII.
27. Nayal, A. A. 1935a
Two new members of the Chaetophorales from Egypt.
Ann. of Bot., Vol. XLIX. No. CXCIV.
28. ——— 1935b
Egyptian freshwater algae.
Bull. Fac. Sc. No. 4, 1—106.

29. ——— 1937
On some new freshwater algae from Egypt.
Bull. Fac. Sc. No. 13, 5—15.
30. Nosseir, M. A. and Abou El-Kheir, W. S. 1970a
Effect of dissolved nutrients on the distribution of algal flora in selected lakes of U.A.R. I — Lake Qarun.
Ann. Rev. Univ. Coll. for Girl's, Ain Shams Univ. U.A.R. No. 6, 15—24.
31. ——— 1970b
Effect of dissolved nutrients on the distribution of algal flora in selected lakes of U.A.R. II — Lake Nasser.
Ann. Rev. Univ. Coll. for Girl's, Ain Shams Univ. U.A.R. No. 6, 33—47.
32. ——— 1970c
Distribution and periodicity of algal flora in El-Khashab canal during winter and spring months.
Ann. Rev. Univ. Coll. for Girl's, Ain Shams Univ. U.A.R. No. 6, 49—68.
33. ——— 1972
Fluctuations and periodicity of the algal flora found in El-Khashab canal throughout the year of 1968/1969.
Ann. Rev. Univ. Coll. for Girl's, Ain Shams Univ. U.A.R. No. 7, 59—66.
34. Patrick, R. 1945
A taxonomic and ecological study of some diatoms from the Pocono plateau and adjacent regions.
Farlowia 2 : 143—214.
35. Pearsall, W. H. 1930
Phytoplankton in the English lakes. I — The proportions in the waters of some dissolved substances of biological importance.
J. Ecol. 18 : 306—320.
36. Pearsall, W. H. 1932
Phytoplankton in the English lakes. II — The composition of the phytoplankton in relation to substances.
J. Ecol. 20 : 241—262.
37. Piccone, A. 1889
Manipole di Alghe Mar Rosso.
Reale Acad. Lincei, Cc LXXXVI ; Roma.

38. ————— 1900
Alge gallegianti raccolte del Dott. Vincenzo Ragazzi del Mar Rosso.
Anni Inst. Bot., IX ; Genova.
39. Rao, C. B. 1955
On the distribution of algae in a group of six small ponds
Part II.
J. Eco. 43 : 291—308.
40. Rich, F. 1933
Scientific results of the Cambridge Expedition to the East African lakes, 1930—1931. The algae.
J. Linn. Soc. (Zool.), 38 : 249—275.
41. Simpson, N. D. 1930
Some supplementary records to Muschler's Manual Flora of Egypt. Technical and Scientific Service Bull. No. 93, Cairo, pp. 55—56.
42. Täckholm, V. L. 1932
Bibliographical notes to the flora of Egypt.
Festschrift till Verner Söderberg den fjarde, pp. 193—210.
43. West, G. S. 1909
The algae of Birket Qaron, Egypt.
Journ. of Bot. Vol. 47.
44. Zanardini, G. 1858
Plantarum in Mari Rubro hucusque collectarum enumeratio.
Mem. R. Inst., 7, No. 2 ; Venezia.