Impact of Al-Najebiya thermal energy power plant on aquatic ecosystem of Garmat Ali canal.
II. Monthly differences in abundance and distribution of algae

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Summary

Heated effluents, discharged from Al-Najebia electrical power station imposed tremendous impact on availability, abundance and distribution of algae in the Garmat Ali canal was investigated on monthly basis from November 1997 to October 1998. Area affected by discharge of wastewater was determined and extended to 750 m. A total of 79 algal species belong to 45 genera were identified. Diatoms (Bacillariophyta) consist of 59 species, green algae (chlorophyta) 13 species and blue green algae (cyanophyta) 12 species, but only one species was appeared of Euglenophyta and xanthophyta. Discharge points of cooling water possessed the highest number of species (60 species). Also, peak abundance in total counts of algal cells was encountered closer to discharge points (5998 cell/cm^2) in January. Diatoms dominated samples followed by blue green algae, green algae. However, blue green algae dominated others near discharging points particularly during summer months.

1- Introduction

Thermal discharge is another form of physical pollution comes from the discharge of cooling water and mainly caused by the release of heated effluents from electricity generating stations. For most purposes, it is necessary to consider water resources in terms of quality as well as quantity. Since the output of both domestic and industrial effluent is increasing in relation to the growing abstraction demand, the pollution load becomes progressively harder for water resources to absorb However, in order to protect aquatic environments from deterioration, sources of pollution, quality and quantity of released substances, limits of their dispersions and impact must be determined and avoided (Oslen and Burgess, 1976). Water temperature is one of the vital physical environmental factors that play substantial role in water ecosystem through affecting several components including solubility of gases on which life is depend (Mellanby, 1972). Bader *et al.* (1972) studied the effect of electric power generation station in California where the highest summer water temperature achieving 40ºC. The study revealed those effluent discharges that cause increasing ambient water temperature cause notable mortalities in some macro-algal components. Yi (1987) deduced that heated effluents also have an impact on marine organisms. Yi (1987 a) also found that heated effluents badly affect biodiversity of bottom fauna. Simn (1988) found that biomass of phytoplankton suffers notable reduction during spring blooming due to discharge of cooling waters, but blue-green algae were dominant.

During the last three decades, several industrial enterprises were constructed in Basrah province. We mainly concerned with those established on water courses, namely electric power generating stations. Impacts of these plants on both biotic and abiotic components of aquatic ecosystems are serious due to untreated discharges that disturb ecological balance. (Awad (1977); Kell and Saad (1975); Hameed (1977) and Huq *et al*. (1978) were among the formers who studied phytoplankton populations in the Iraqi inland waters but, unfortunately, no one has taken in consideration impacts of heated effluents on abundance and distribution. The present work, therefore, was designed and implemented to work out impact of heated effluents of Al-Najebiya electrical power station on composition of algae components.

2-Materials and Methods

Al-Najebiya electric generating power station is established in 1959. The station consist of two units to produce electricity (200 mW/h). It requires 34000m^3/h of raw water for cooling purposes. Three sites were selected in Garmat Ali canal to execute the work. The former designated by the symbol N1 is situated near inlet point westward the station, the second site N2 lie closer to initial discharging point of heated effluents eastward station about 500m apart from inlet and, the latter site designated by N3 is 500 m apart from N2 Fig.(1). However, detailed description to the study area and sampling locations are provided in Hussein *et al*. (2001).

Algal samples were collected, at low tide, on monthly basis from November 1997 to October 1998. Slides preparations, fixation in locality, qualitative and quantitative analysis, clearing, counting of specimens and examining were given in Hussein *et al*. (sent for publications).

3-Results

Table (1) reveals composition of algae and the dominant species, identified from samples collected from the selected sites of Al-Najebiya station. The study reveals that 79 species belong to 45 genera was isolated and identified. Diatoms ranked first comprising 52 species (23 genera) out of the total identified. Two of which belong to centric diatoms. Green algae (chlorophyta) dominated others and were represented by 13 species (11 genera). Identifications also recognized 12 species (8 genera) of blue-green algae (cyanophyta).This is unfavorable sign for natural habitat. Just one species of euglenoid and yellow algae were collected during the whole study period.

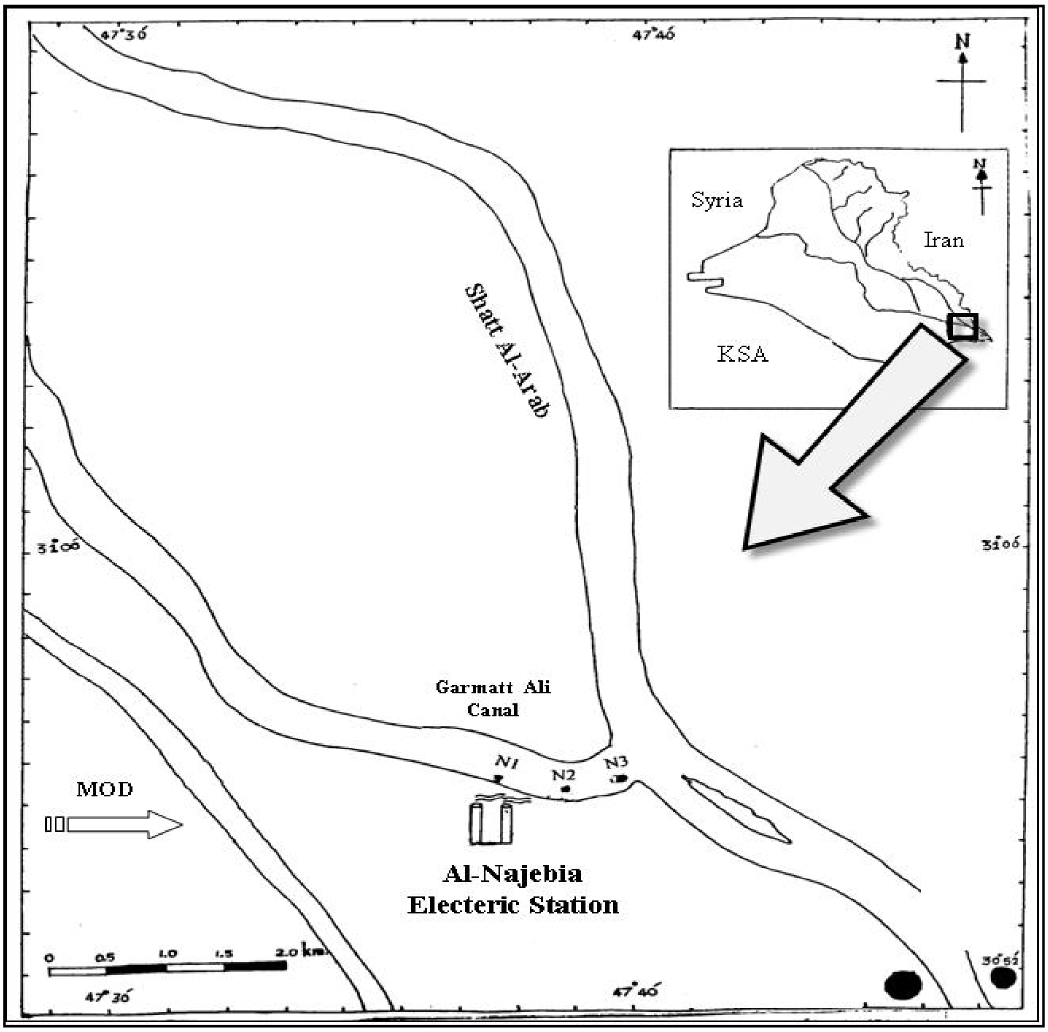

Fig.(1).Al-Najebiya electric power plant and three selected stations.

Figure (2) shows monthly and localized variations in total count of algal cells at Al-Najebiya power station, in one cm^2, during the investigation period. It is obvious that site N2 exceeding the other two sites and exhibited the highest numbers of cells all over the year, followed by sit N1, whereas N3 showed the lowest counts except in winter months when it revealed relatively less numbers than site N3.The highest increase in total count (2835 cell/ cm^2) in site N1 (water inlet) was shown during June and the lowest (1067 cell/ cm^2) in January. In N2, representing the initial spot of discharging heated effluents, the highest number of algae (5998 cell/ cm^2) was recorded in January and the minimum (2278 cell/ cm^2) in September. In site three the highest increase in algal count (1943 cell/ cm$^{2)}$ was in May and the lowest (1180 cell/ cm^2) in December.

Percentage composition of main algal groups at each selected sites are illustrated in Figure(3).Diatoms dominated other groups during the study period at all sites.It forms the proportions 66.2, 56.2 and 63.6% in N1, N2 and N3 respectively, followed by blue green algae that reflecting the percentage composition 20.1, 30.7 and 26.5% in the above sites in the same order. Green algae ranked third accounting for 10.1, 6.6 and 7.1% of the three sites in the same order. Yellow algae (xanthophytes), however, were meager and of very little importance in percentage composition forming 1.1, 3.3, 2.4% in the three sites respectively.

A sum of 53 (33 genera) algal species was identified in site N1. Diatoms formed 30 species, green algae 13, blue green algae 8 and one of each of euglenoids and yellow algae. Whereas in site N2 representing the position where heated effluent discharging first, the number of identified species accounted for 60 (30 genera). Diatoms were consisting the majority (43 species), green algae 5, blue green algae 11 and one yellow alga. In site N3, however, assigning the end of affected area with Al-Najebiya effluents. 59 species (33 genera) were recognized. They were dominated by diatoms (39 species), followed by blue green algae (11 species), while green algae ranked third (7 species). Euglenoids and yellow algae were each represented by one species.

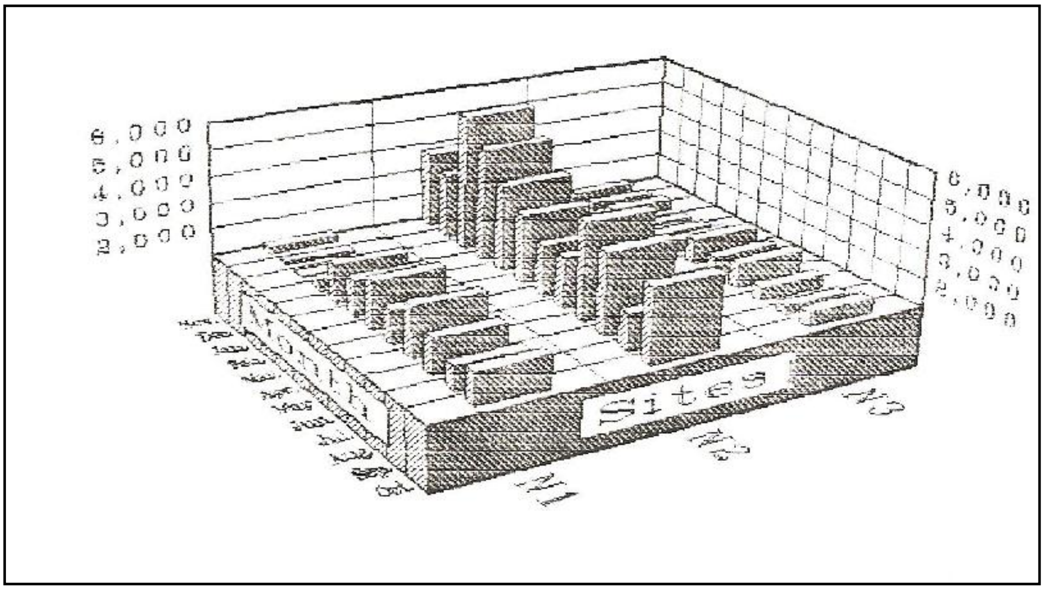

Fig.(2).Monthly and localized variation in total count of algal cells at Al-Najebiya power station, in one cm^2,during investigation period.

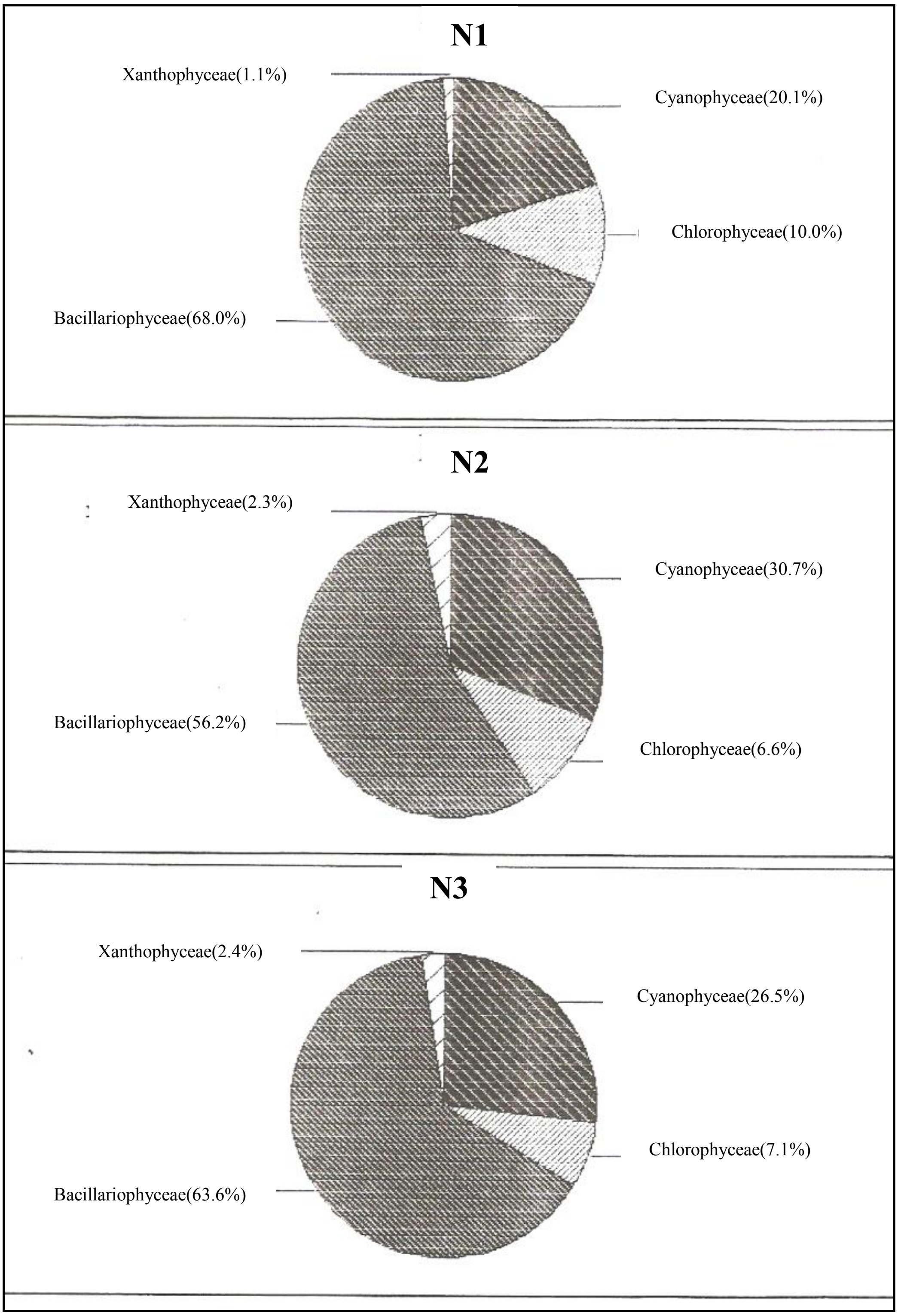

Fig.(3).Percentage composition of the main algal groups at the three selected site in Al-Najebiya thermal energy station.

Table(1).The dominate algal species of the main groups recovered from Al-Najebiya power station

Note: (-)absent; (+)present ; (++) common; (+++) very common

List of Taxa	**N_1**	**N_2**	**N_3**
Cynophyceae			
Anabaena sp.	-	+	+
Aphanocapsa sp.	-	+	-
Chroococus turgidus	-	+	+
Gleocapsa sp.	+	-	+
Lyngbya spp	++	+++	++
Oscillatoria amoena(Ktz)Gomont	++	+++	+++
O. formosa Bor.ex.Gom	+++	++	++
O. subbrevis Schmidle	++	+++	+++
O. tenuis Ag.ex.Gom	+++	+++	++
OScillatoria spp.	+	++	++
Phormidium spp	+	+++	+++
Spirulina princes West and West	-	+	+

Table(1).Continued.

Bacillariophyceae	***N_1***	***N_2***	***N_3***
Achnanthes affinis Grum	+++	+	+
A. saxonica Krasske	+	-	+
Amphora ovalis	-	+	-
Amphora sp.	+	-	+
Bacillaria paradoxa Gmelin	-	+	+
Caloneis sp.	-	+	+
Cocconeis placentula var euglypta Ktz.	++	+++	+++
C. placentula var lineate(Her.)Cleve	++	+++	+++
Cyclotella sp	-	-	+
Cymbella affinis Ktz	+	++	++
C. aspera(Her.)H.Pera.	-	++	++
C. cistula Kirch.	+++	+++	++
C. cymbeliformis(Ktz.)Van Heurck	+	++	+
C. tumida(Bereb.)Van Heurck	+	+++	++

Diatoma sp.	+	+++	++
Diploneis sp.	+	-	-
Fragillaria capucina Decm.	+	+++	+++
Fragillaria sp.	+++	+	+
Gomphoneis sp.	-	+	+
Gomphonema spp.	+	-	-
Gyrosigma attemuatum Rabenh	+++	++	+
G. exeimium(Thwaites)Bayar	+	+	-
G. scalpriodes(Rabenh)Cleve	-	-	+
Gyrosigma sp.	-	+	-
Licomphora sp.	-	+	+
Mastigloia smithii W.Smith	-	+	+
Melosira sp.	-	+	+
Navicula atomus Ktz.Grun	+++	+	+
N. crptocephala Ktz.	+	+++	+
N. mutica Ktz.	-	+	-
N. parva(Menegh)Cl.	+++	+	+
N. rodiosa Ktz.	+++	+	+
N. rhynchocephala Ktz.	+	+++	-
Navicula sp.	-	+++	-
Nitzschia acicularis(Ktz)W.Sm.	+	+	++
N. apiculata(Gerg)Grun.	++	+++	++
N. disspata(Ktz)Grun.	++	+++	++
N. faciculata(Grun)Grun.	+	+	++
N. filiformis(W.Smith)Van. Heur.	+	+	++
N. obtosa W.Smith	-	+++	++
N. palae(Ktz)W.Smith	+	+	++
N. punictata(W.Smith)Grun.	+	+	+
N. sigma(Ktz)W.Smith	+	+++	+
Nitzschia spp.	+	-	+

Table(1).Continued.

List of Taxa	N_1	N_2	N_3
Pleurosigma sp.	-	+	-
Rhiocosphenia curvata(Ktz)Grun.	+	+++	+
R. fossilis(Ktz)	+	++	+
Satauroneis sp.	-	-	+
Surirella ovata Ktz.	-	+	+
Surirella sp.	-	+	+
Syndra ulna(Nitz)Her.	-	+++	-
Syndra sp.	+	-	-
Chlorophyceae			
Cladophora sp.	+++	++	+
Chlorococcum sp.	+	-	+
Microcoleus sp.	+	-	-
Mougeotia sp.	+	-	-
Rhizoclonium sp.	+	-	-
Scenedesmus opliensis p.Rich	+	+++	+++
S. quadricauda(Turp.)de Bre.	+	+++	+++
Scenedesmus sp.	+	+++	+++
Spirogyra sp.	+	-	-
Stigeoclonium sp.	+	-	-
Ulothrix zonata(Webes&Mohr)Ktz	+	-	+
Uronema sp.	+++	+++	+++
Zygnema sp.	+	-	-
Euglenophyceae			
Euglena sp.	+	-	+
Xanthophyceae			
Vaucheria sp.	+	+++	+++
Total No. of genera	30	31	30
Total No. of taxa	53	60	59
Cynophyceae	8	11	11
Bacillariophyceae	30	43	39
Chlorophyceae	13	5	7
Euglenophyceae	1	0	1
Xanthophyceae	1	1	1

4-Discussion

The present work showed that heated effluents of Al-Najebiya electricity generating station may provide, during the colder season, suitable conditions for occurrence of aquatic organisms slightly apart from the point of discharging heated effluents. Thermal pollution may also have direct consequences for aquatic life, since fish die if their thermal environment rises beyond a certain threshold. In other period, in particular during the summer months, availability of aquatic organisms, including algae, declined sharply. It is therefore, the depletion in algal genera closer to discharging effluents may be related to the considerable rise in water temperature. Heated effluents lead to eliminating weak resistance species and replaced with more tolerable, but nuisance ones (i.e. blue green algae). The blue green algae exhibited notable rise in number of their species. Green algae were slightly occurred (5 species) closer to heated effluents. This is in agreement with Bader *et al.* (1972) who achieved similar conclusion in California. They detected heavy mortalities with the majority of chlorophyta, in particular during the summer months. The notable increase in number of species adjusted to both sites (N2 & N3) of heated effluents is due to considerable abundance of blue green algae which accounted for 11 species. This coincided with Carnis (1970) and Simn (1988) findings. The latter investigate impact of power generating plants on phytoplankton in Poland, who also deduced that blue green algae dominating other groups. However, the present work revealed that some genera of diatoms were abundant (Table1), namely, *Cymbella* spp., *Fragillaria* spp., *Rhiocosphenia* spp., *Cocconeis placentula*, *Achanthes* spp. and *Nitschia* spp. This may be attributed to their ability to tolerate fluctuating environmental conditions mainly elevated temperature (Hickman and Kalrer, 1974). On the other hand, an apparent abundance in cyanophyta's genera (i.e. *Phormdium* spp, *Lyngbia* spp. ,*Oscillatoria* spp.) was detected. This is in agreement with Round (1973) who also deduced dominance of the blue green algae with rise in temperature. Al-Mousawi and Whitton (1983) achieved similar conclusion as well. Zhong (1989) and Moor (1972) were of the opinion that temperature and nutrients are the two vital factors playing a substantial role in abundance and blooming of algae, but the reduced solubility of oxygen at higher temperatures causes deoxygenetion and may lead to mass mortalities among inhabitants.

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تأثير محطة النجيبية للطاقة الحرارية على النظام البيئي المائي لقناة كرمة علي
II. الاختلافات الفصلية في وفرة وتوزيع الطحالب

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الخلاصة

درست المتدفقات الحارة المصرفة من محطة توليد كهرباء النجيبية، والتي تظفي تأثيرات كبيرة على تواجد ووفرة وتوزيع الطحالب في قناة كرمة علي، على أساس شهري من تشرين الثاني 1997 إلى تشرين الأول 1998 . وحددت المنطقة المتأثرة بمياه الفضلات الحارة والتي تمتد إلى 750 م . وصنف ما مجموعه 79 نوع من الطحالب تعود إلى 45 جنسا. وشكلت الدايوتومات (Bacillariophyta) 59 نوعا منها والطحالب الخضراء (chlorophyta)13 نوعا والطحالب الخضراء المزرقة (cyanophyta) 12 نوعا. وسجل نوع واحد فقط من الطحالب اليوغلينية Euglenophyta و xanthophyta .وامتلكت نقطة تصريف مياه التبريد أعلى عدد من الطحالب (5998 خلية/سم2) في كانون الثاني. وسادت صف الدايوتومات في العينات، تلتها الطحالب الخضراء المزرقة والتي سادت على الأنواع الأخرى قرب نقطة التصريف وبا لأخص خلال أشهر الصيف.