



STUDY THE EFFECT OF PHYSICAL AND CHEMICAL FACTORS ON PHYTOPLANKTON IN THE EUPHRATES RIVER COMMUNITY WITHIN A OF ANBAR PROVINCE – IRAQ

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ABSTRACT

The study addressed the Bio indicators evidence of contamination mediated by phytoplankton (algae) through the selection of eight locations (1, 2, 3, 4, 5, 6, 7 and 8), respectively, of the Euphrates River within the province of Anbar, represented by (the village of a Zalah) north of the city of Rawah and in the city of Anh , Yellow hill and Al- Khasafa area and Haqlaniyah hand and hand-Baghdadi and al-Baghdadi, the South hand and 1 km south of hand-Baghdadi 2 km respectively. Amounted to results Electrical Conductivity (622 and 756, and 803 and 888 and 740 and in 1395 and 1214 and 879 $\mu\text{s}/\text{cm}$), respectively, and were the results of the requirement Biological Oxygen Demand (BOD_5) 1.77 and 1.82 and 1.94 and 2.21 and 1.45 and 8.10 and 6.18 and 3.94 mg / l, respectively, and the value of active nitrate to 281, 189, 139, 123, 260 and 491 and 414 and 338 mg / L , respectively, and the value of the phosphate to 17, 29, 37.5, 39, 27, 50, 39 and 25 mg / L , respectively, Suspended solids also Amounted to to 21.3 and 12.2 and 5.8, 4.7 and 8.6, 11, 10 and 8.3 mg / L , respectively, while the TDS Amounted to 506 and 582, and 604 and 653 and 695 and 1069, 824 and 669 mg /L respectively, as well as the overall top ten values Amounted to 314, 362 and 349, and 387 and 461 and 945 and 729 and 506 mg CaCO_3 / l, respectively, with the algae density amounting to 565 and 768 and 786, 851, 691, 1390 and 985 and 855 cell $\times 10^3$ / L respectively, water signatories 6 and 7 are bottom of the tank from the affected water and sanitation can be considered as evidence of the following types of biological pollution *Bacillaria paxillifer*, *Nitzschia acucularis*. *N. dissipata*, *N. hungarica* and *N. palea*, *Synedra ulna*, *Scenedesmus armatus*, *Oscillatoria angusts*, *O. limnetica* and *O. tenuis*.

KEYWORD: phytoplankton, Evidence of pollution, density of algae, nitrate and phosphate.

INTRODUCTION

Many organisms have been used to denote the pollution of water bodies such as bacteria, fungi, algae, giant plants as well as vertebrates and fish. However, most studies have used phytoplankton, as indicator of water quality in the initial assessment of any type of pollution, and that organic pollution and other types of pollution affect the ecosystem and it uses change in phytoplankton communities as a response to pollution^[1]. Plant phytoplankton have been used in many studies as biomarkers for pollution because they are beneficial in Eutrophication studies and are sensitive to pollution effects, availability of automatic counting also it is resisting of the contamination, the sampling is easy and inexpensive, in addition we can diagnosis in laboratory. In the past, chemical and physical evidence has been easier to evaluate and use than biomarkers that are believed to be still under consideration, and although chemical analyzes of water are a good indicator of the chemical status of aquatic ecosystems, but do not afford an idea of the environmental and productive factors of these systems^[2]. It is therefore necessary to have a biological assessment and knowledge of the biota for the information of the quality of aquatic ecosystems. Showed^[3] that the use of organisms as evidence of water quality is the important compared with the chemical analysis, which gives an idea of the state of water when collecting

samples, while the biological evidence shows the state of water for a long time, and it is a vital evidence of the numbers that describes structural and functional specifications in societies So it presents a measure that compares with the results of any environmental assessment. Several local studies have been conducted that use algae as an indicator of polluting water sources. These studies included a study of algal diversity and its relation to some physical and chemical properties of the Hilla River. It was concluded that the sewage and waste water in the river had a significant effect on the physical, chemical and phytoplankton factors. Diatoms were predominant, that is of the benthic, furthermore the appearance of blue-green algae in the warm seasons and the dominance of some species of plant phytoplankton with the elevated of tolerance to pollutants in the contaminated sites. Proved ^[4] that the untreated sewage effluents as well as agricultural effluents affected the quality of water in the Shatt al-Hillah and altered the structure of the phytoplankton community. Some of the pollution, species such as *Navicula*, *Nitzschia* and *Cymbella* have been observed in rivers contaminated by the sewage waste. Showed^[5] the introduction of industrial waste increased the percentage of blue - green algae to 41% in the Cauvery River, followed by green algae by 29% and Bacillariophyceae algae (diatoms) by 14%. The study aims to detect pollutants is using algae as biological evidence for detection.

MATERIALS & METHODS

The study region

The current study area was about 150 km from the northern part of the Euphrates River within Iraqi territory between the coordinates 34 ° 31'48.57 "north and 41 ° 46'44.03" east to 33 ° 53 '14.29 "north and 42 ° 32' 4.28". Eight sites were selected, divided by five sites in the riverbed and three others in Haditha reservoir, as shown in Figure 1. Photographs of the study sites were taken using an Italian Digital Camera. The coordinates of the sites were determined using GPS:

1. The site (1) :

The first site is located in the village of Zalah north of the city of Rawah before entering the river Euphrates reservoir at 29 km at coordinates 34 ° 31'48.57 "north and 41° 46'44.03" east, and the depth of water in this location 5-2 m. The area where this site is located is characterized by extensive agricultural activity, covering the banks of the river with a thick vegetation cover.

2-The site (2)

The second location is located in the north of Hditha reservoir in the city of Anh near the water project at coordinates 34 ° 24'16.32 "north and 42 ° 0'26.88" east. The depth of the water column in this site ranges from 5 to 15 m, as this area was flooded after the dam was established after it was villages and orchards of palms and agricultural land. This region is bordered by desert areas and small valleys. On the edge of the reservoir, abundant types of aquatic plants such as *Potamgeton crispus* and *P. Pectinatus* and *Shuijah Nagas armata* .

3-The site (3)

The third location in the center of the reservoir in the Yellow Hill area at coordinates 34 ° 20'13.17 "north and 42 ° 18'12.94" east, and the water depth is between 8-19 m. This site is characterized by the presence of small algae and other aquatic plants.

4-The site (4):

The fourth site south of the reservoir in Al- Khasafa area, which is 2 km from the body of the dam, at coordinates 34 ° 14'17.93 "north and 42 ° 21'57.83" east. The depth of the water in this site is about 24 m, the banks of the river are characterized by a vegetative cover is not dense.

5-The site (5):

The fifth site is located in the river stream below the reservoir in the direction of the reservoir near the water complex, which is about 8 km from the dam, at the events of 34 ° 5'40.51 "north and 42 ° 22'11.96" east, the depth of water is between 1 - 5 m, This area is characterized by agricultural fields on both sides of the river.

6-The site (6):

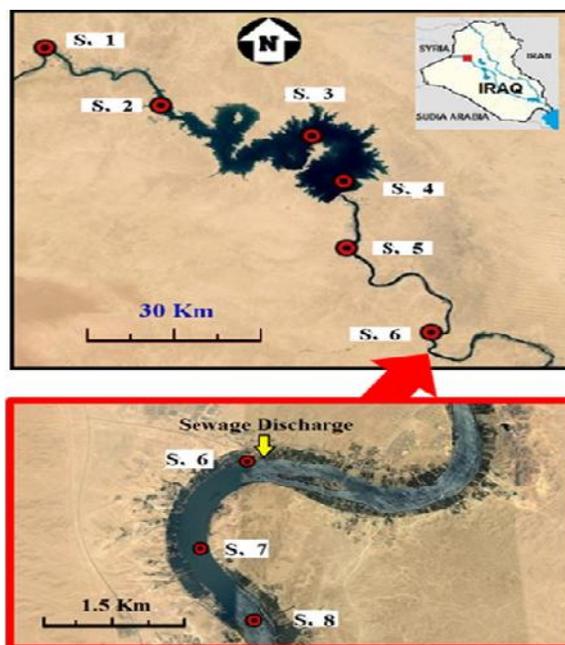
The sixth site is located in the city of Jabah in the area of Baghdadi, 50 km from the fifth location at coordinates 33 ° 54'39.08 "north and 42 ° 31'58.35" east. In this area, the sewage of the town of Jabah, as well as the agricultural land, is located. This site is characterized by the complete dominance of the *Phragmites australis* and the *Ceraophyllum demersum* in the stream of the river and its banks.

7-The site (7):

The seventh site is located at the south of the sixth site about 1 km at the events 33 ° 53'50.71 "north and 42 ° 31'38.54" east. The water of the river in this site is shallow where the depth of the water column is not more than 2 m, and is characterized by the presence of cane plant on the banks in addition to agricultural fields as well as high population density in the neighboring areas.

8-The site (8)

The seventh site is located at the south of the sixth site about 1 km at the events 33 ° 53'50.71 "north and 42° 31'38.54" east. The water of the river in this site is shallow where the depth of the water column is not more than 2 m, and is characterized by the presence of cane plant on the banks in addition to agricultural fields as well as high population density in the neighboring areas.



MAP 1: The sampling sites in this study

Physic and Chemical Parameters

Direct Field Measurements

The portable Instruments were used to measure some of the physical and chemical environmental factors directly in the field. The collection of samples and field measurements took about mid-day, as follows:

Temperature:

The temperature of air and water was measured by using mercurial thermometer with the gradients up to 1 °C.

Electrical Conductivity

The conductivity of water was measured by using the Conductivity Meter, which was manufactured by Hanna

HI 98301; the results were expressed in microsiemens / cm.

pH

The pH-meter was used (which was manufactured by Hanna modale HI 9321) it was calibrated by using the buffer solutions at values 4, 7 and 9pH, the temperature sets the compared to the readings of the thermometers.

Laboratory Analyses

Salinity

The salinity of water was calculated depended on the measurements of the electrical conductivity of the samples and then the readings were converted according to the following formula^[6].

$$\text{Salinity } \text{‰} = \frac{\text{Electrical Conductivity } (\mu\text{S/cm}) - 14.78}{1589.08}$$

Total Hardness:

The total hardness was measured by using the method described by^[7], where 5 ml of the sample water was titrated with the standard EDTA solution (0.01 M), after pH was regulated of the sample to 10 ± 0.1 by using the Buffer Solution. The detector (pure NaCl with T Eriochrom Black dye) was used and the results were expressed with mg CaCO₃ / L

Biological Oxygen Demand (BOD₅):

The method of American Public Health Association^[8] was adopted, the samples were kept in an incubator at 20 ° C for five days and the results expressed in mg / L according to the following equation:

$$\text{BOD}_5 (\text{mg/L}) = D - D_2$$

D1= the initial oxygen concentration of the diluted sample.
D2=the final oxygen concentration of the diluted sample.

Nitrate

Nitrate concentration was estimated in water samples. A series of standard nitrogen solutions were prepared with concentrations ranging from 350-0.0 µg / L by diluting the following volumes to 50 ml with distilled water of 0.1,2,4,7., 35 ml. 1 mL of hydrochloric acid HCl was added to 1N. The absorbance was measured using the Spectrophotometer CE1011 CECLL at 220 nm. The standard curve was drawn for these concentrations and the results were expressed in µg / L.

Phosphate

The ascorbic acid method according to^[9] was used to measure the total effective phosphate. 42mL of the sample was treated with 8 ml of the combined solution of which consists of sulfuric acid, Pottassium antimonyl tritrat, ammonium molybdate and acid Ascorbic. The solution was mixing and left for 30 minutes and then the absorption was measured by spectrophotometer at a wavelength of 860 nanometers, the standard solutions were made of KH₂PO₄ solution which was treated with the same sample treatment. The phosphorus was extracted using the straight line equation and the results were expressed in µg /L.

Total Suspended& Dissolved Solids

The total suspended solids (TSS) were estimated by according to^[9]. The filter paper was dehydrated in an electric oven at 150 ° C in 1hr to eliminate of the moisture, then the filter paper was weighed by the balance sensitive, 50ml of the sample was taken and passed through the

filter paper by using the filtration apparatus ,this filter paper placed in oven at 105 ° C and it re-weighed . The first weight was subtracted from the second after then the value was calculated. The Total TDS was calculated by filtering 50 ml of the water samples and dried in ceramic veneer desiccators at 105 ° C .The total concentration of dissolved solids calculated through the following equation:

$$\text{mg total dissolved solids /L} = \frac{(A-B) \times 1000}{\text{Sample volume (ml)}}$$

A= It is the weight of the desiccator with the remainder

B=the weight of the desiccator is empty

Phytoplankton:

Qualitative Study:

The non-diatomial algae were diagnosed by microscopic slides on 400X by using a compound microscope that is diagnosing by depending on^[10-12], The diatomate species were diagnosed after dissolving the organic material and clarifying its structures on 1000X^[13].

RESULTS & DISCUSSION

The results of the present study showed the effect sewage water for Al-Baghdadi area on the quantitative and qualitative composition of phytoplankton during the study period. Table (1) shows the significant differences in the values of the physical, chemical environmental factors studied at site 6 compared with the other sites. The results showed significant differences in all the factors which were studied between the site 6 and the sites. Salinity at site 6 elevated to 0.36, 0.32, 0.38, 0.40 and 0.48 g/L from the stations of (1,2,3,4,5) respectively, while electrical conductivity increased by 655, 507, 592 ,639 ,773 ms / cm respectively. This is due to the wastewater as well as the interactions that occur between the acidic compounds formed from oxidation and biodegradation processes with the alkaline compounds which found in the suspended substances and the surrounding soil such as calcium carbonate CaCO₃, which are subsequently converted to dissolved calcium bicarbonate, thus it is increasing salinity and electrical conductivity.

TABLE 1: Standard and standard deviation of physical, chemical and biological factors at the study sites

Parameter	The study site							
	1	2	3	4	5	6	7	8
The temperature of water (C ⁰)	6.07±20.4 A	5.86±21.3 A	5.30±22.4 A	5.62±22.08 A	5.26±20.75 A	5.26±23.75 A	5.81±22.58 A	5.65±21.67 A
The temperature of air (C ⁰)	6.63±23.8 A	6.36±24.58 A	6.7±24.25 A	6.31±25.0 A	7.52±24.33 A	7.27±25.69 A	7.72±24.75 A	7.03±24.58 A
Electrical Conductivity (Microsiemen/cm)	115±622 A	134±756 AB	177±803 C	184±888 D	129±740 AB	279±1395 E	283±1214 F	166±879 B
Salinity (Gram/Liter)	0.07±0.38 A	0.09±0.46 AB	0.11±0.48 AB	0.12±0.54 B	0.11±0.50 B	0.18±0.86 C	0.20±0.75 C	0.11±0.54 B
pH	0.37±7.62 CD	0.47 ± 7.76 CD	0.34±7.73 CD	0.27±7.92 D	0.40±7.59 CD	0.54±6.63 A	0.37±7.17 B	0.31±7.46 BC
Total Hardness (mg CaCO ₃ / L)	73 ±314 A	106±362 A	84±349 A	109±387 A	107±461 A	338±945 C	140±729 B	146±506 A
Total suspended solids (TSS)	5.9±21.3 C	8.8±12.2 B	2.2±5.8 A	1.6±4.7 A	4.2±8.6 AB	3.4±11.0 B	3.0±10.0 B	2.9±8.3 AB
Total solids dissolve(TDS)	81±506 A	110±582 AB	106±604 BC	109±653 BC	80±695 C	132±1069 E	122±824 D	140±669 BC

Note: The different letters horizontally means that there is a significant difference between the study sites at the probability level (P < 0.05) and the similar letters means that there is no significant difference between the study sites

While pH recorded a decrease in its rate at site 6 than its rate at sites (1,2,3,4,5), as a result for the decomposition of organic material that is leading to release the free carbon dioxide, which combines with water to be a carbonic acid, which works to reduce pH, when it is studying the impact of wastewater and industrial in the aquatic environment of the Shatt Al - Arab. The rise or decline in pH is due to the variation in the amount of polluted water which was discharged into the river. There were also significant differences in the total hardness of this site from all another sites due to the impact of the wastewater. It may be due to the fact that the wastewater contains an organic substance that is consisting of the sulfates such as methionine and lysine, which add the high concentrations of sulfur when it degrades by of the microorganisms.

As well as the concentrations of nutrients from phosphates and nitrates have risen significantly between the site 6 and the other sites, the fact that the wastewater contain of the ammonia compounds, show [14] these compounds are exposed to nitrification process, which converts it to nitrate, as well as the detergents and soaps are resulting from household uses that is a rich with the salts of phosphorus and nitrogen, which stimulates the growth of algae with the highly density this called (Eutrophication), which causes many damages such as it increased the organic content, as a result of the deposition of the remains of phytoplankton at the end of the blooms and the death of their cells, as well as block out light because of that thick growth which causes reduced rates of photosynthesis and then the lack of dissolved oxygen [15] (Figure 1).

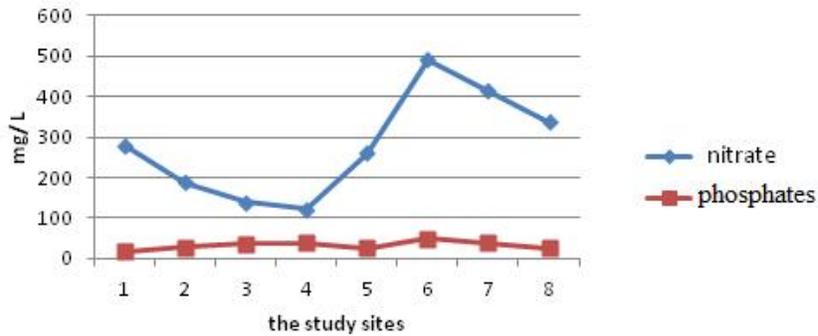


FIGURE 1: show the concentrations of nitrates and phosphates within the study sites

The concentration of Biological Oxygen Demand (BOD₅) was increased at the site 6, it recorded a difference of 6.06, 5.26, 4.85, 4.78, and 5.73 mg / L between the site 6 and the sites (1, 2, 3, 4, 5). The water in the site 6 has a high level of organic pollution means that the water is unclean. This may be due to the direct additions of the organic

waste to the river. Also, it may be due to the large quantities of the organic matter in the wastewater, which leads to the consumption of dissolved oxygen due to an increase in the Biological Oxygen Demand (BOD₅) by bacteria, organisms and the other microorganisms, which leads to deplete of the oxygen dissolving (Figure 2).

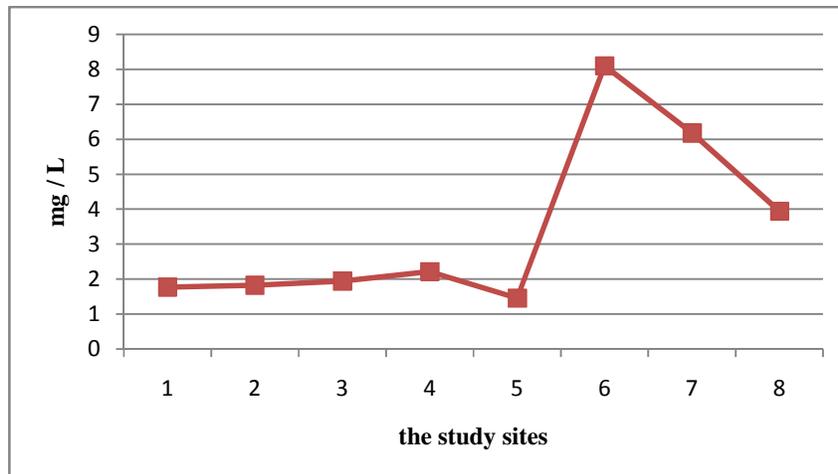


FIGURE 2: show the value of Biological Oxygen Demand within the study sites.

While the phytoplankton changed in the species and the quantity at site 6 from the other of the sites, as the

diversity in the site 6 was declining than in the other of the sites, as shown in figure (3).

Phytoplankton in the Euphrates River community within a of Anbar province

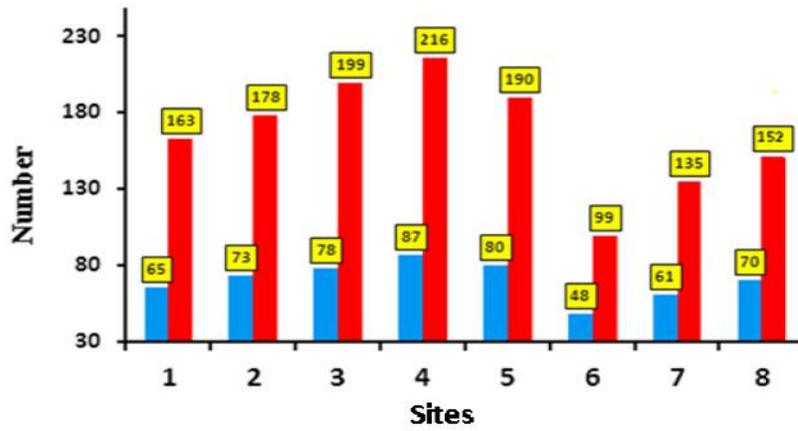


FIGURE 3: show the number of species and genus for the phytoplankton in the sites within the study period

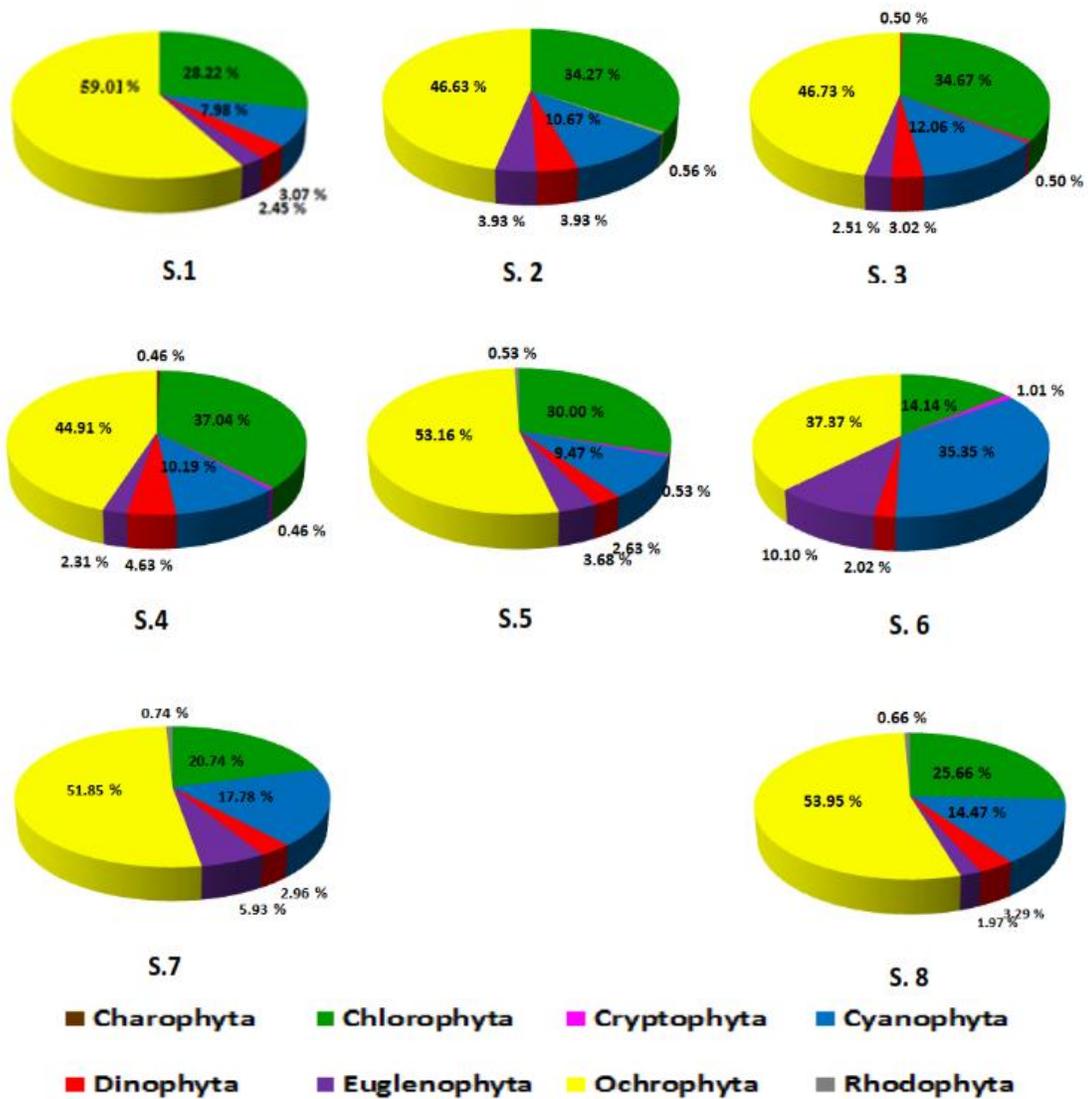


FIGURE 4: show the percentages of species belonging to phytoplankton groups at study sites

This decrease of the number species in the site 6 indicates to the pollution resulting from wastewater. This led to Eutrophication that associated with the lack of species and increased in the density of one species. The structure of the phytoplankton community has also changed markedly by the occurrence of pollution. Ditomes were appeared with high densities. These species include *Nitzschia amphibia*, *N. dissipata*, *N. hungraica* and *N. palea* and *N. acicularis*, that all these species are considered as indicator of the pollution^[16]. There was a decrease in the percentage of the green algae species at the site 6 by 16% compared to the site 5 with a difference of 23.26%, 20.53%, 20.13% and 14.0% for the sites (1,2,3,4). All the species of green algae that appeared at the site 6 are a species that are the resistance to the pollution such as *Chlamydomonas*, *Chorella*, *Pandorina* and *Scenedesmus*. The growth of these species of green algae in the polluted water as for, the blue-green algae, the percentage of species in the site 6 increased by 26% compared to the site 5. The presence genus of *Oscillatoria* with its species that is reaching 17 species at the site 6, which confirms water pollution showed^[17] the presence of *Oscillatoria lemnetica* and *O. tuis* is indicative of the high level organic contamination. *Spirulina* and *Lyngbya* are a species that can live in the pollution water with the wastewater, as they exploit the elevated of concentrations from nitrogen and the phosphate compounds in their growth. The presence of some species phytoplankton at a high density is indicating to the pollution. The pollution is one of the most important factors which is affecting the qualitative and the quantitative composition of algae in the aquatic environments^[18] proved it is some species of algae, such

as *Anabaena*, *Melosira*, *Oscillatoria*, and *Scenedesmus*, when they grow with a high density in the water, these are indicating to eutrophication. The results of the current study show a rise in the percentage of Euglenophyta species. The increased was reached 6.4% between site 6 and 5. These algae have the potential to grow in the conditions with a high water temperature and low acidity of water^[19]. Demonstrated^[20] that the Euglenophyta of algae can grow and reproduce in the polluted environments with the depressed dissolved oxygen levels, and the most of the Euglenophyta of algae are indicating to the pollution, it was founded seven Euglenophyta species at the site 6.^[21] Show the use of blue-green algae, the Euglenophyta of algae and the Bacillariophyceae of algae, which are as an indicator of pollution that became a common biological means in the regions of the world because these algae have the potential to the saprophytic in the extreme environmental conditions (Figure- 4).

This study indicates to a high significant difference in the total density of phytoplankton between the sites 6 and the other sites, since the total density of phytoplankton increased from 8286 cell $\times 10^3$ / liter in the site 5 to 16684 cell $\times 10^3$ / liter in the site 6, and that those density clearly indicate the level of pollution in this site, that is nearby from the densely populated as well as agricultural areas, that have made it highly eutrophication. As shown, the reduction of pH is usually accompanied by an increase in the nutrient concentrations and its enrichment, so it reduced in the site 6 due to these reasons. The limited availability of Microbial degradation also leads to reduced pH^[22] (Figure 5).

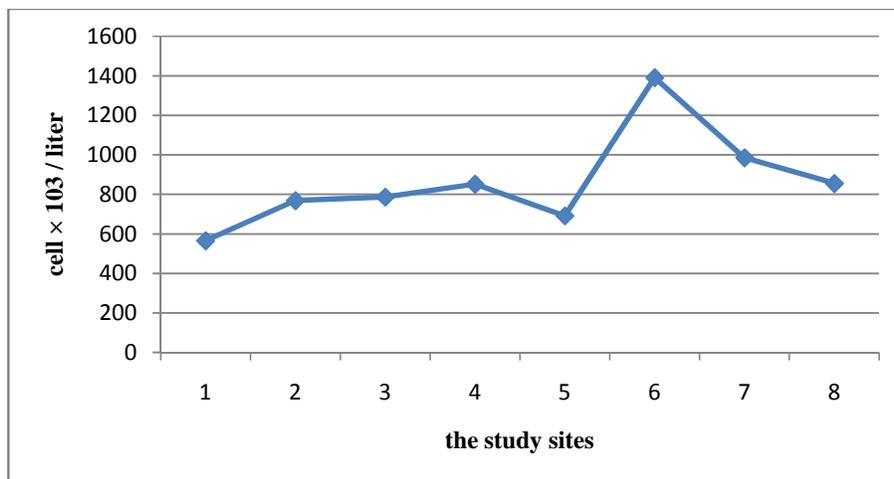


FIGURE 5: The cellular density for the phytoplankton in the study sites

It is clearly that the impact of the pollution extended to site 7, which is about 1 km from the site 6, the results shown in Table 1 show the effect of the pollution on that site. The concentration of biological oxygen demand of this site exceeded the permissible limits of 5 Mg / L). The BOD₅ concentration was 6.18 mg / L. Accordingly; the water was classified as a highly polluted, therefore considered to be within the critical limits for living of the aquatic organisms. The average elevation was 3.94 mg / L at the site 8. Therefore, the water at the last site is considered to be of average cleanliness for Al- Baghdadi area as well as

the agricultural drainage of the nearby agricultural areas have a clear effect on the composition of the phytoplankton community at the site 6 and the sites that followed^[8,7] compared to the sites (1, 2, 3, 4 and 5). As the Euphrates River is affected by the contaminants that introduced to the river in that area, that a case has been mentioned by^[23] in Al- wund River in the town of Khanaqin in the Diyala River. The frequency and abundance of phytoplankton species at the site 6 can be considered as a biological evidence of the pollution in the studied area: *Bacillaria paxillifer*, *Nitzschia acicularis*, *N.*

dissipata, *N. hungraga*, *N. palea*, *Sinedra ulna*, *Scenedesmus armatus*, *Oscillatoria angusta*, *O. limnetica* and *O. tenuis*.

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