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QUARTERLY VARIATION AND THEIR IMPACT ON PHYTOPLANKTON DYNAMICS IN THE GHARRAF RIVER ENVIRONMENT IN SOUTHERN IRAQ

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Abstract

The present study was conducted in the environment of Gharraf River in southern of Iraq during the spring 2018 and until the winter of 2019 to follow up the impact of climatic conditions such as drought, water shortage and high temperatures for the years from 2015 to 2017 and its effects on some physical, chemical factors of water characteristics and dynamic of the phytoplankton community in River environment, where heterogeneity rates of some factors were monitored including air-water temperature, flow speed, permeability, water depth, electrical conductivity EC, pH, total dissolved salts TDS, dissolved oxygen DO, BOD_5, total alkalinity, TH, Nitrate, NO_3 and nitrite NO_2. The results showed that the influence of climatic conditions of the seasons in addition to the effect of nature of sampling sites is evident on the studied characteristics, which was manifested on the phytoplankton community, where summer season recorded the highest average (15.43ºC), permeability recorded the highest average in the spring (33.60 cm), while autumn recorded the lowest average (26.60 cm), the highest average depth of water in winter (4.21 m) and the lowest average in summer (3.313 m), electrical conductivity EC recorded highest average in the spring (1050) which decreased in summer to give the lowest average (613Sμ/cm). In the meantime, the highest mean of TDS was recorded in spring (668 mg/L) and decreased in summer to give the lowest mean (532 mg/l), while the pH values ranged between (7.28-8.19) and were light bases. The highest concentration of (DO) and BOD_5 were recorded in winter with an average of (5.77 and 7.74 mg/l) which decreased in summer to give the lowest mean (3.07 and 2.84 mg/l) respectively. Nitrate NO_3 and nitrite NO_2 recorded the highest mean in spring (6.15 and 0.287 mg/l) and decreased in summer to give the lowest average (0.84 and 0.046 mg/l) respectively, when measured (TH) the highest average record in the winter (493.7 mg/l), while that the summer season record the lowest average (309.5 mg/l). Study and analysis of the phytoplankton community has reached the diagnosis of 274 species of algae belonging to 82 genera, the diatoms, Baciliariophyta constituted the largest proportion (52.9%) followed by blue-green algae, Cyanophyta (20.07%), green algae, Chlorophyta (18.61%) and Euglenophyta By the rate of (5.1%) while other divisions constituted (3.32%) of the total of community.

Key words: Algae, seasonal changes, phytoplankton, The Gharraf River.

Introduction

Water exists naturally in different forms and locations, including air, surface, underground and oceans. Despite this diversity of sources and large areas it occupies, only 2.5% of the Earth's water is freshwater, most of which is frozen in glaciers and ice sheets and about 96% of all liquid freshwater can be found underground and the small remaining part on the surface or in the air (Moss, 2010). The rivers drastically from season to season. The climatic zone to another. In the tropics, there are large flows throughout the year, while in drylands, which make up about 40% of the world's land area, they have only 2% of total water flow, so river flow data and water levels help predict annual or seasonal variations. It is difficult to make accurate long-term forecasts. For example, some records in industrialized countries date back 150 to 200 years. By contrast, many developing countries have only recently started record-keeping and these data are often inaccurate or poor. Therefore, his tendency to assess water quality and quality can be defined as an assessment of the physical, chemical and biological nature of water in relation to the state, physical characteristics, human activities and targeted uses (Fernández *et al*., 2011).

Several studies have discussed the effect of environmental factors on the dynamics of phytoplankton.

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These studies indicated that the level of influence of various factors on the seasonal presence and appearance of this group of algae differs substantially with the physical factors (temperature and light intensity) which are most important among them, as well as factors Chemical, such as DO, pH, salinity, total hardness, EC and nutrient level, although less important than previous workers (Smith, 2004, Reynolds, 1984) and based on the relationship between physiochemical different algal aggregates are sometimes unexpected within environmental contexts known (Hassan *et al*., 2004, Susanne *et al*., 2005).

Researchers refers Millie *et al*., (2009) indicates that the composition and abundance of phytoplankton and the environmental conditions that affect communities during late summer are distinct from the rest of the months and seasons of the year, where it represents a period in which the breeding of most species is usually greater, especially those that love warm water and average temperatures. Many researchers attribute the increase in freshwater biodiversity to the increase in plant nutrient concentrations. This fact has been observed in the results of several water studies. However, long-term studies on biodiversity changes due to altered nutrient intake and enrichment phenomenon Food and zooplankton growth and others are still not available for this water accurately (Dudgeon *et al*., 2006, Rashed *et al*., 2017). Therefore, biological control by understanding the relationship between the nature of environmental variables and physiochemical factors and studying the composition of aquatic communities and their biodiversity will help give a direct description of the state of any water body or any other ecosystem.

Materials and Methods

Location of the study

Five sites were selected to collect water and algae samples from Al-Gharaf River within Dhi Qar governorate from March 2018 to March 2019. The samples were collected monthly from each site and considered as quarterly replicates. The distance of the studied area was about 59 km. The first site was selected in the Alqaleah district and the second site was selected in Al-Rifai district, while the third site was chosen in Al-Nasr district. The fourth and fifth sites were selected in Al-Shatrah district. These locations were identified using the Geographic information system (GIS) and the codes were given ST1, ST2, ST3, ST4, ST5 respectively. Shown in fig. 1. The air and water temperature were measured using a mercury thermometer inserted, the depth was measured by a rope with a weighted weight marked by measurements and the results were expressed in meters, then the light transmittance in water was measured by the Sacchi Disk and the results were expressed in centimeters of the 500 ml polyethylene capacity filled in half with water and then thrown into the river and according to the time required to travel a length of (10) meters was measured using a tape measure on the edge of the river and then extracted the flow rate (m/min), measured pH values at the study site directly using the pH-meter

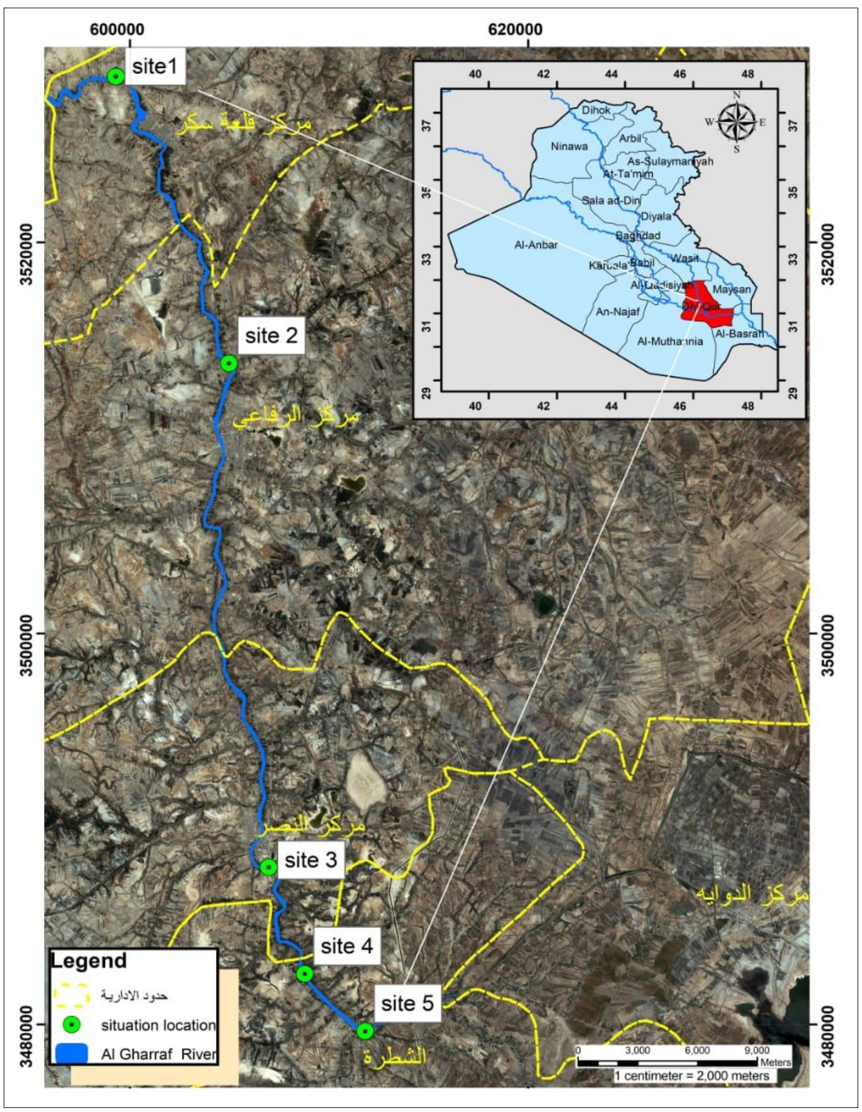

Fig. 1: A map showing the selected study sites on the Gharraf River.

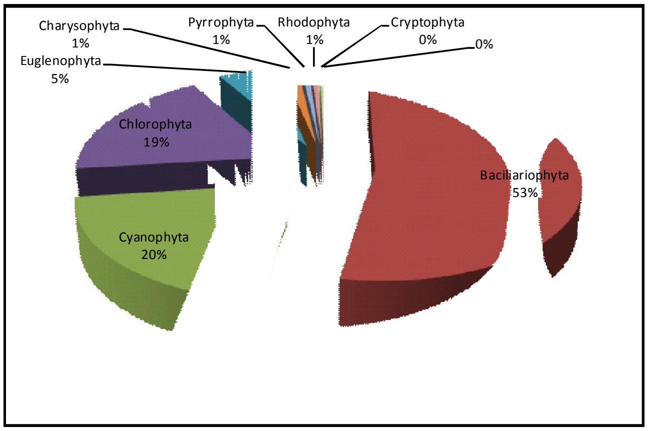

Fig. 2: Percentages of Algae Groups Diagnosed in the Gharraf River During the Study Period and in All Locations.

3320, electrical conductivity was measured using a pH meter. For the conductivity of EC-meter according to the method Rhoaeles (Sparks *et al*., 1996) and the results are expressed in micro Smens/cm, the concentration of sodium chloride salt (%) was measured using a Conductivity meter, the total dissolved substances were laboratory tested using TDS device and expressed in units.

The method described by APHA (2005) was followed to determine the amount of oxygen dissolved in water. The results were expressed in mg/l. Oxygen biomass was measured using Oxi direct method using Tento meter and the results expressed in units (mg/l). The total baseline was measured by the method described by the American Public Health Association (APHA, 2003), adopted. The method described above. Parsons *et al.,* 1984. To measure nitrite and express the results in mg/l, the method described in APHA (2005) was used to measure nitrates and the results were calculated in mg/l.

In the algae community, a qualitative study was conducted using the phytoplankton network with a diameter of 20m for collecting samples. The candidate models were developed in polyethylene bottles and preserved with the addition of a Louvel solution.

(Desikachary, 1959, Prescott, 1973, Hinton and Maulood, 1982 Wehr and Sheath, 2003, Patrick and Riemer, (1975, 1966), Benson and Rushforth, 1975, Germain, 1981, Hadi *et al*., 1984, Aboal *et al*., 2003, Hassan *et al*., 2012, Munir *et al*., 2012, Al-Hassany and Hassan, 2014.

Table 1: Average - First Line and Range - Second Line of Physiochemical Factors in the Gharraf River Water for the Study seasons.

Winter 2019	Autumn 2018	Summer 2018	Spring 2018	Seasons / Factor
15.87 15.00-16.67	22.93 20.33-25.33	29.47 23.67-34.67	22.67 19.67-24.67	Temp. air (C^o)
15.43 16.00-14.50	20.83 22.67-18.83	23.33 25.67-21.00	19.23 20.33-18.50	Temp. water (C^o)
20.87 25.00-16.0	21.94 26.00-18.00	19.85 28.6-12.4	21.56 30.33-13.0	Flow Rate (m)
27.40 31.33-24.00	26.60 31.67-19.67	28.53 34.33-23.67	33.60 37.67-29.33	Permeability (cm)
4.2 15.45-3.16	3.55 4.60-2.63	3.31 4.33-2.53	3.55 4.66-2.73	Depth (m)
914 974-877	641 668-619	613 619-610	1050 1127-888	E.C. (μs/cm)
8.19 8.46-7.93	7.54 7.61-7.38	7.53 7.55-7.49	7.55 7.93-7.28	pH
647 671-603	613 635-593	532 540-523	668 717-609	T.D.S. (mg/l)
5.77 6.10-5.54	3.88 4.16-3.67	3.07 3.19-2.98	4.58 4.94-4.11	D.O. (mg/l)
7.74 8.73-6.41	4.07 4.32-3.89	2.84 3.33-2.46	4.24 5.72-2.96	$(BOD)_5$ (mg/l)
1.64 1.92-1.34	1.04 1.09-0.98	0.84 0.89-0.72	6.15 6.00-4.72	NO_3 (mg/l)
0.106 0.119-0.092	0.051 0.060-0.031	0.046 0.052-0.037	0.287 0.357-0.199	No_2 (mg/l)
493.7 515.3-464.7	376.2 389.7-360.7	309.5 322.3-293.3	392.3 447.7-349.7	Total Alkalinity TH (mg/l)

The quantitative study prepared the slides to calculate the number of algae cells, where the concentration of 1 liter of water sample (after adding Lugol's solution) to 10 ml according to the method (Furet and Benson-Evan, 1982).

Results and Discussion

Aquatic systems are exposed to many different environmental factors depending on the geology and morphology of the body, climate changes and human activities. The pattern and distribution of algae is linked to the physical and chemical properties of river water and depend on each other and thus determine the stability of the aquatic food chain in any region (Baturina). (Basu *et al*., 2010, Prabhahar *et al*., 2011 and table 1) indicate the results of the factors studied.

In the table, there are variations in the measurement of the studied physicochemical characteristics resulting from the climate effects during the study seasons, where the highest average temperature in summer was 29.47^{o}C, while winter recorded the lowest quarterly average of 15.87^{o}C. Between the seasons explain the nature of Iraq's climate, which is characterized by high temperatures in summer and low in winter and the temperature variation between night and day (Al-Ghurairi, 2014), air temperature was positively correlated (r=0.4215) ($p<0.01$) total numbers of phytoplankton, this is confirmed by (Shehata and Bader, 2010), as we have shown that high temperatures affect the seasonal variability of the phytoplankton community is highly correlated with seasonal variations of temperature (Chalar, 2009), while water temperature recorded the highest average temperature in summer (23.33) while Winter is the lowest average seasonal 15.43 (m)^{o} and through the results shows the extent of water temperature affected by air temperature and variability as the relationship is direct between them and this explains the nature of the positive correlation (r=0.789) ($p<0.01$) between them. This is consistent with most studies in Iraqi inland waters (Qasim, 1986, Al-Fatlawi, 2005 and al-Hassani, 2010). There were no significant differences between the seasons, although the locations differed in the speed value. This is due to the fact that the supply of water from the river is controlled by the control systems located in most of the cities it passes in addition to the nature of the impact of human activity which varies from one location to another. Also, the speed depends on the amount of water coming from the river to the areas supplied by the river as needed and in this case the impact of climatic conditions less than the impact of human activities.

In the measurement of permeability recorded the highest average in the spring (33.60 cm), while the autumn recorded the lowest quarterly average (26.60 cm) that the high permeability values in the spring may be due to low flow speed and low wind at the time of sampling, which helped to settle a large part from the suspended material within the water column to the bottom. While the highest average depth of water in winter was 4.21m), while summer recorded the lowest quarterly average 3.313m). The increase in depth in winter is due to the increase in the quantity of water in the Tigris River and thus increase the amount of water coming to the river. The amount of water in the Tigris River for the winter is due to the nature of the circumstances surrounding the river, such as increased amount of rain and others. The lower depth in the summer is due to a decrease in the amount of water supplied to the river and to the increase in human consumption as well as the high temperature that leads to increased evaporation.

In the measurement of electrical conductivity, spring recorded the highest seasonal mean (1050/cm Sμ), which decreased in summer to give the lowest average quarterly (613/cm Sμ). Ionized water is due to the overlap between rain, rocks, soil and plants living in nearby areas (Leveque, 1997 and Saadi, 2013), as well as the presence of trocar, sewage and domestic water, which increases the concentrations of salts, dissolved solids and sedimentation processes (Hutchinson, 1957 Al-Lami, 2002). This resulted in an irregular pattern of seasonal and site variations. The reason for the decrease in the values of conductivity may be due to the decrease in sewage, domestic and trocar water due to evaporation operations before they reach the river, some of them travel relatively long distances before entering the riverbed in addition to the decrease in the level of human activities in the use of water for domestic and agricultural purposes in summer. This leads to lower concentrations of salts and dissolved solids and therefore a decrease in conductivity values. The highest mean of total soluble solids was recorded in spring (668 mg/l) and decreased in summer to give the lowest average seasonally (532 mg/l). The increase in mean total soluble solids and their convergence in spring and winter (668 mg/l) and (647 mg/l), respectively, may be due to the increase in the amount of rainfall in this period and the impact of the river water on the remnants of human activities and this conclusion is consistent with the findings (2000) Boyd (Janabi, 2011 and Makdmi, 2014). The pH values of the Garraf River were light bases, thus similar to the rest of the Iraqi rivers which have a narrow range for this factor. In the process of photosynthesis leading to higher pH values in water (Abowei and George, 2009), the results of our study agreed with other studies (Al-Fatlawi, 2005 and Janabi, 2011). The slight decrease in pH values during summer in addition to spring and autumn. In most locations it may be attributed to the decomposition of some aquatic and aerosol plants. The highest concentration of dissolved oxygen was recorded in winter with an average of 5.77 mg/l, which decreased in summer to give the

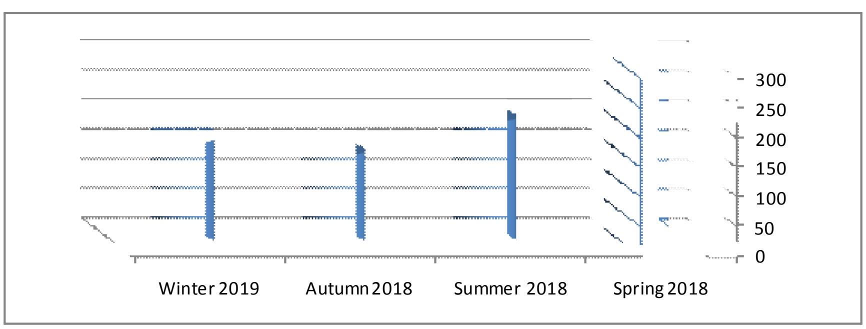

Fig. 3: Number of total species diagnosed during the four seasons.

lowest mean. The high concentration of dissolved oxygen in winter and low in summer is due to temperature difference as its high decreases or decreases dissolved oxygen concentration (Wetzel, 2001, while the highest average oxygen biomass in winter was 7.74). While summer recorded the lowest quarterly average of 2.84 (mg/l), the high value of the Oxygen in winter may be due to increased flow of organic materials with high water levels and the discharge of organic waste continuously to the river, as well as the presence of some types of bacteria such as E.coli be resistant to temperatures and active throughout the year and increase its activity when rainfall also increase the flow rate leads to increase the dissolved oxygen values at the same time as the oxygen biomass requirements increase (Douche, 2012 and Saadi, 2013). The highest average basal total was recorded in winter (493.7 mg/l), while summer recorded the lowest quarterly average (309.5 mg/l). The basal decrease in summer was due to CO_2 consumption by phytoplankton as well as carbonate deposition at higher temperatures. This is consistent with Al-Dulaimi (2013a) and the basal rise in winter as well as in spring is due to high water levels due to rainfall and low temperature which increase the solubility of CO_2 gas in water and then increase the basal because the main sources of ion Carbonate and bicarbonate in water is a CO_2 gas Dissolved (Smith, 2004). The nitrate factor recorded the highest mean in spring (6.15 mg/l) and decreased in summer to give the lowest average quarterly (0.84 mg/l) and did not differ significantly from autumn and winter. Nitrite was the highest in the spring (0.287 mg/l) and decreased in summer to give the lowest (0.046 mg/l) but not significantly different from autumn and winter. The high nitrate and nitrite values in the spring and in most of the sites may be due to the rise in river water levels, as a sudden rise in the level of river water for rainfall for a week during the time of sampling in the beginning of the spring months of 2017, which led to the erosion of some aspects of the river because of the speed of runoff. This is in line with Al-Fatlawi (2007), who explained that the high values of nitrite in winter and autumn is due to increased rainfall and high levels of the Tigris River and the sweeping of the edges of agricultural land rich in nitrogen compounds, which is a key component in the leakage of chemical fertilizers used by farmer. The marked decline in the summer due to the increase in the productivity of phytoplankton (league, 2005). This is consistent with what was said Jumaili (2011).

The qualitative and quantitative study of Phytoplankton algae. In the qualitative study, 274 species of algae belonging to 82 genera were recorded (fig. 2). Baciliariophyta accounted for the largest proportion (52.9%) followed by Cyanophyta (20.07%), Chlorophyta (18.61%) and Euglenophyta (5.1%). The rest of the other sections (3.32%) of the total total algae floating fig. 2.

The study recorded variations in the number of algal blooms in the different seasons in all study sites. fig. 3. Spring recorded the highest total number of species, 294 species belonging to 119 genera, while the lowest total number of species recorded in the autumn, where 151 species, 82 species. The increase in algae species in the spring is due to the increased nutrient concentration of phosphate, nitrate and silicate that reach the river with rainwater. Spring was characterized by increased rainfall and good temperatures, which is in line with Kasim (2011).

Environmental factors directly affect the diversity and density of the algae community. For example, the composition of the wandering Baciliariophyta in rivers is influenced by a number of chemical and physical factors such as temperature, pH, nutrients, lighting, current and predators. These factors, in turn, are influenced by the region's climate, geology, topographical composition and additions from neighboring areas and thus affect the diatomaceous community (Pan *et al.*, 1996). In the quantitative study, the highest mean was recorded in the spring (54.15×4^{10} cells/l), while the fall was the lowest quarterly average (14.11×4^{10} cells/l). (4). The presence of dissolved oxygen and nutrients, the intensity of the lighting suitable for growth, increasing

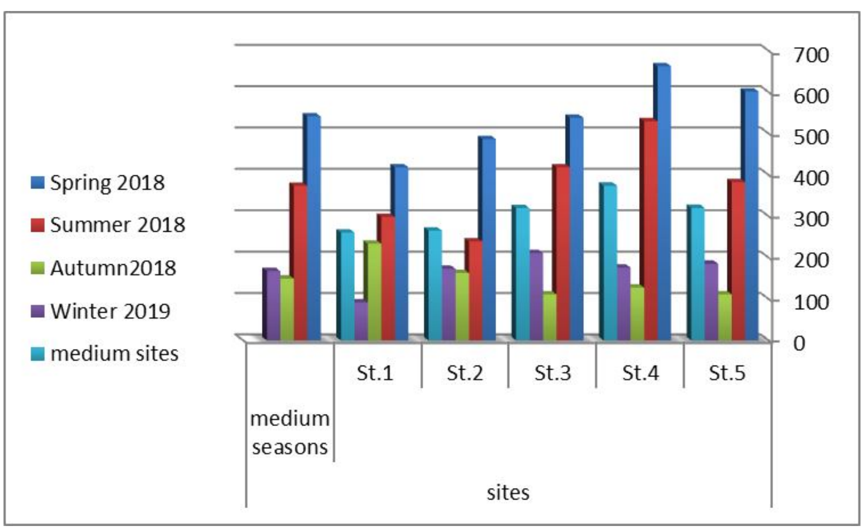

Fig. 4: Quarterly changes in the numbers and mean of algal blooms (cell × 4^{10}/ L) during the study period and for all sites.

the transparency of water, low flow rate and low water level (Shah *et al*., 2008). The other is summer and these results are consistent with that Researchers Ismail and Hassan (2007).

The fall in the fall may be due to some physical and chemical factors in this season, such as a lack of permeability, as the depth of light and temperature penetration facilitates algal blooms (Herath, 1997), or it may be due to the decrease in silica value between (Shehata and Bader, 2010). Soluble silicate is an important nutritional component of bacillary algae as it is involved in the formation of its silicate wall. The results are consistent with the decrease in total numbers of plant phytoplankton for the fall season (Al-Rikabi *et al*., 2012).

Conclusion

The qualitative study recorded clear differences in the number of algal species that in the different seasons in all study sites. Spring recorded the highest total number of species, 290 species belonging to 123 genera, while the lowest number was recorded in autumn 152 species, 79 genera. In the spring (54.15×4^{10} cells/l) while the autumn recorded the lowest average (14.11×4^{10} cells), it turned out the results of the study that there are two clear peaks of the total numbers of phytoplankton, one in spring and the other in summer, with a variation in the prevalence of dominance of non-diatoms algae, in most rivers and tributaries and branches which represented by the superiority of green algae over other groups, whereas in the current study was the superiority of blue-green algae, which shows that Climatic changes, water scarcity and increased pollutant levels have led to a qualitative change in the composition of the algae community, especially the phytoplankton.

The impact of severe weather conditions for the years 2015-2017 was reflected on the overall environmental factors of the study area and southern Iraq in particular, which withdrew in its effects on the phytoplankton community through its impact on the physical and chemical properties of the water column, the results also showed that the water environment of the river responds to these conditions depending on the nature. The location and interference caused by some human activities, as some of these activities limit or affect the natural climatic conditions surrounding the river water, which often have a negative impact, such as in controlling the speed of the water during the rise of the water level or increase and purification. The pollution levels.

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