Assessment of phytoplankton Biodiversity in Diwaniya River/Iraq

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ABSTRACT
Background and Aim: The present study was conducted to determine the biodiversity of the community of phytoplankton in AL- Diwaniya River.
Place and Duration of Study: Diwaniyah River in AL-Qadisiyah Province at three stations (The first station is located to the north of the city center, second station is located in the city center and the third station is located south of the city) during four season of 2015.
Methodology: The study included biological aspects using qualitative and quantitative studies of phytoplankton, Species richness index D, Shannon – Weiner index H, Species uniformity index E.
Statistical Analysis: A comparison of phytoplankton community in tow level 30cm and 60cm from the three stations was investigated.
Results: Current study recorded Total number of phytoplankton in depth 30 cm and 60 cm ranged from 2244.5 to 15104.7 cell x 10^3/l and 965.7 to 5610.4 cell x 10^3/l respectively. Also, two peaks of bloom, the first in spring and the other in autumn, and founded that the total density in depth 30 cm was higher than its in 60 cm. Richness Index values ranged from 16.61-6.22 ; 10.64-5.81, and the values of Shannon and Weaver Index ranged from 3.75-1.51 ; 3.39-2.35, while Evenness index mean values were 0.95-0.47 ; 0.96-0.70 for phytoplankton communities in depth 30cm and 60cm respectively,
Conclusion: Biodiversity indicator showed that Diwaniyah River moderate pollution and good diversity at the second station, while a poor diversity and contaminated at the station third due to expose to environmental stresses from of industrial and residential waste and wastewater effect.

Key word: *phytoplankton, biodiversity, AL-Diwaniya River, Shannon and Weaver Index.*

1.INTRODUCTION
The Primary Productivity is proceeded of photosynthesis and production of life, which has the primary role in the function of the ecosystem and the source for the manufacture of chemical energy and organic materials for various aquatic ecological communities by converting solar energy into chemical energy that benefits for all organisms [1,2].

Phytoplankton represented the basic rule of a food web in the aquatic environment, they represent the primary and basic products in these environments, as it turned solar energy presence of water and carbon dioxide into organic compounds by the photosynthesis process [3]. The advantage of phytoplankton being highly sensitive to changes in environmental conditions, as some of the biological factors affect on the presence and abundance of phytoplankton, which (temperature, pH, turbidity, and electrical conductivity and salinity, sodium, potassium, calcium, nitrate, and phosphate) The fact that phytoplankton are very sensitive to change the properties of water and nutrients in particular as well as the possibility of some of them used as indicators on water quality [4]. It can also be used to assess the biodiversity of water The biodiversity represents the variation in all forms of life, starting from the species through the geneses to the ecosystems where there are organisms, since all ecosystems depended on a balanced and accurate diversity system complements one another, else is losing species or

group of species in this ecosystem signal to a defect in the function of the system [5]. The biodiversity measuring guide for assessing water quality through the use of bio-monitoring in the aquatic environment, which includes the study of the quantity and quality to understand the complex relationships between organisms and their response and how Its resistance to environmental influences [6]. And this is done through the use of a set of biodiversity evidenced to describe the components and study of a community of organisms that live in the aquatic environment and characterized by undemanding and free of complexity and reveal environmental factors, biological and a biological factors that affecting on them [7].

Numerous studies on the diversity of phytoplankton were conducted and abundant in different regions of the world, as it was noted that some types of phytoplankton density and abundance, diversity and distribution, installation and appearance and disappearance is directly dependent on the living and non-living aquatic environment factors [8,9,10,11,12,13]

2.MATERIAL AND METHODS

It was selected three stations on Diwaniyah River for the purpose of the study and appreciation of the total numbers of phytoplankton. The first station is located to the north of the city center, second station is located in the city center and the third station is located south of the city(Figure 1). Phytoplankton samples collected from the middle of the river for the entire year by bottles of polyethylene (1 liter), the sample was preserved by added Logal solution and use method of deposition and concentration to 10 ml for the purpose of calculating the numbers of phytoplankton by following the method described by [14].

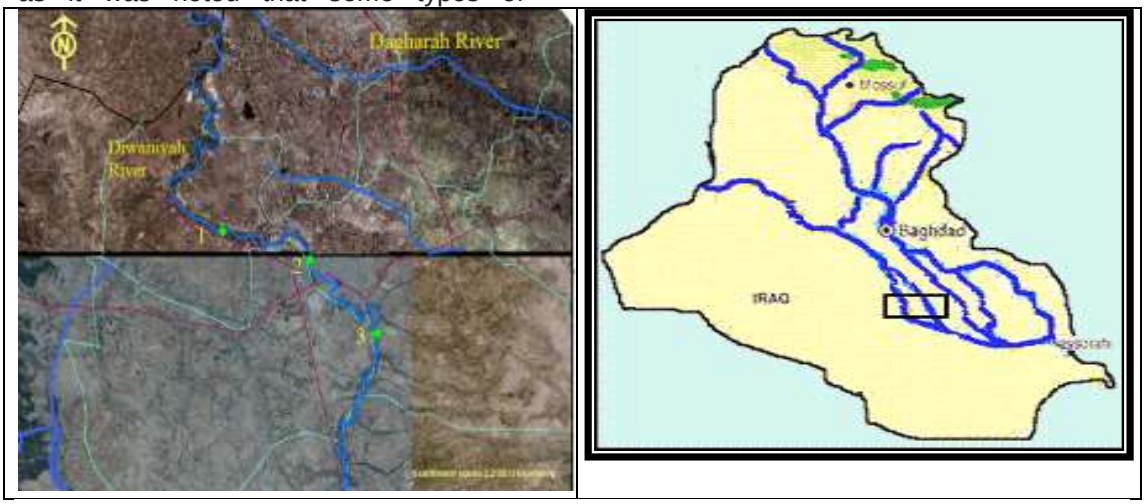


Figure (1): A map of the Diwaniyah River explaining the study stations.

Also in the present study was applying some of the bio - diversity evidence accordance with the calculation formulas below:-

1. Species Richness Index [15] according to the following formula: -

D = (S-1) / (Log N)

S = the number of species.

N = total number of individuals.

2. Shanon-Weiner Diversity Index [16] and according to the following formula

$$H = -\sum \frac{ni}{N} * Ln \frac{ni}{N}$$

ni = number of individuals of each type.

N = total number of individuals. And expressed of the results the unity bits / ind.

3. Species Uniformity Index (Evenness Index) [17], according to the following formula: -

$$E = \frac{H}{LnS}$$

LnS = greater theoretical value of diversity.

H = the value of the standard Shannon Weiner.

S = the number of species at the station.

3.RESULTS AND DISCUSSION

3.1 TOTAL DENSITY OF PHYTOPLANKTON

Total density refers to the total number of organisms in a specific area or a certain size [18]. Generally observed from the study that there are two peaks, one in spring and one in autumn in all study samples was also noted that phytoplankton are highest density have a surface over its presence in the depths specially when reached the peak of the day, the study also recorded a value of the total density of phytoplankton in the depth of 30 cm ranged from 15104.7 – 2244.5 cell × 10^3 / liter during the spring and winter for the second and third stations respectively, while the total density of phytoplankton in the depth 60 cm has ranged from 5610.4 – 963.7 cell × 10^3 /L. during the spring and winter, at the second and third stations respectively (Table 1, Figure 2).

Table: (1) Ranges of total number of phytoplankton and biodiversity index at Diwaniyah River in depth 30 cm and 60 cm during study period.

Third Station		Second Station		First Station		Stations	Parameter
60 cm	30 cm	60 cm	30 cm	60 cm	30 cm	Depth	
١٠٣٥,١-٣٥٠٧,١	-٩٤١٩,٩ ٢٢٤٤,٥	١١١٢,٩-٥٦١٠,٤	-١٥١٠٤,٧ ٣٠٩٤,٧	٩٦٥,٧-٣٦٦٩	١٣٥٦٩,٥-٢٧٠٧,٩	Total number of phytoplankton (cell*10^3/L)	
١٠,٦٤-٨,٣٧	١٢,٢٣-١٠,٢٣	٨,٥٣-٥,٨١	١٦,٦١-٦,٢٢	٩,٥٣-٦,٢٧	١٥,٢٢-١١,٣٦	Richness Index(D) of phytoplankton	
٣,٣٩-٢,٦٩	٣,٣٨-٢,٣٧	٢,٧٨-٢,٣٥	٣,٤٠-١,٥١	٢,٧٥-٢,٤٩	٣,٧٥-٢,٩٥	Shannon and Weaver Index (H) of phytoplankton(bit/Ind.)	
٠,٩٦-٠,٧٩	٠,٩٠-٠,٦٦	٠,٨١-٠,٧١	٠,٨٣-٠,٤٧	٠,٨٩-٠,٧٠	٠,٩٥-٠,٧١	Evenness Index (E) of phytoplankton	

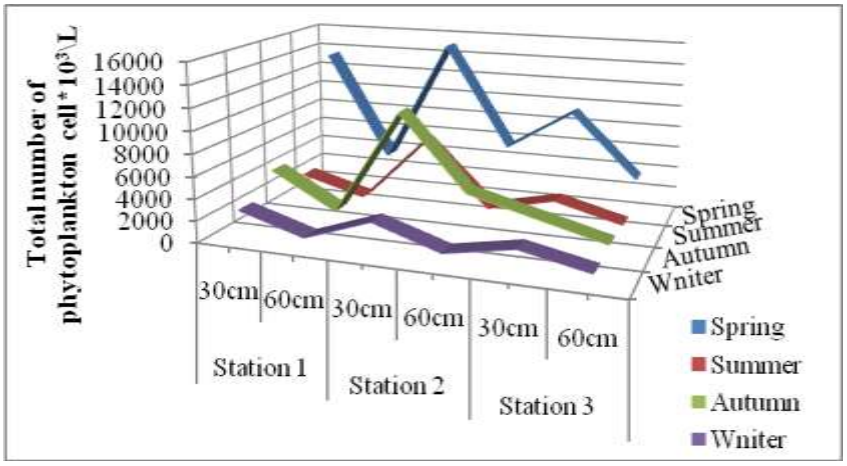


Figure (2): Seasonal changes of total number of phytoplankton during study period.

There are seasonal changes evident in the values of the total density of plant plankton, as the study recorded the lowest values during the winter followed by summer and this decline is attributable to the low temperatures in the winter and rise in the summer, which caused a slow algae growth rate [19,20]. While the reason for the rise in total numbers of phytoplankton in the spring and autumn back to the availability of suitable environmental conditions for the growth and reproduction of the mild temperatures and the availability of dissolved oxygen, nutrients and light intensity suitable for growth [19,21].

As for the location changes, second station recorded highest recorded values of the total density of phytoplankton, and this is due to the large number of aquatic plants at this station, which provides a favorable environment for the growth of

phytoplankton, as well as the shallowness of the water, increasing transparency and access sunlight into different depths of water [22]. While the decline in their numbers at the third station as a result of the large number of pollutants that pose in the river water from industrial and residential waste, which can be toxic for the phytoplankton, causing a lack of preparation [23,24].

The vertical distribution phytoplankton, the total numbers were at a depth of 30 cm higher than at the depth of 60 cm may be related with lacking of light penetration in the depths as the light intensity on the surface higher than up to different depths, and this may be e result of increase turbidity in surface, presence of solid particulate matter, the large number of microorganisms and the presence of some floating plants which are decreasing part of the light to reach the depths and thus lack phytoplankton get sufficient light quantity to do the photosynthesis process, which reduces the total numbers [25,26]. perhaps attributed the low total numbers of phytoplankton at depths to exposed to predation by zooplankton, which increases their density in the depths during the day [27].

3.2 BIODIVERSITY INDEXES

3.2.1 SPECIES RICHNESS INDEX (D)

The results of the study evidence of biodiversity that the highest value of species Richness at a depth of 30 cm was 16.62 in the second station during the spring and least 6.23 in the third station during the summer, while at the depth of 60 cm has ranged from 5.81-10.65 during the summer and autumn for the second and the third station respectively (Table 1, Figure 3). It was observed from the results there is a difference in the value of the index between stations and seasons and depths, but it was mostly just in the second station and the first during the spring, then autumn and summer and was at the surface higher than at depths, this is a result from the light effect [28].

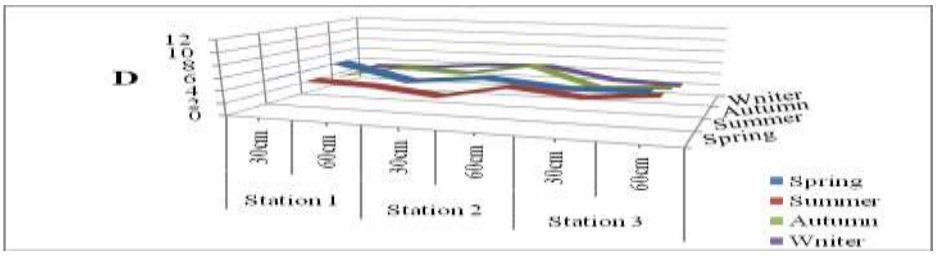


Figure (3): Seasonal changes of species richness index of phytoplankton during study period.

3.2.2 SHANNON-WIENER INDEX (H)

The Shannon – Weiner Index one of the environmental indicators that referred to the number of species in the sample and the distribution of individuals between these species, though the change in the values of this index expresses the change in the characteristics of the water [29] study results indicated that the highest value for biodiversity a depth of 30 cm was 3.75 bit/ Ind. at first station in the spring, whereas the lowest was 1.52 bit / Ind. at the second station during the summer, but in the depth of 60 cm ranged from 2.49 - 3.39 bit/ Ind. during spring and autumn at the first and third station, respectively (Table 1, Figure 4).

It was Observed from the study and the existence of a distinct seasonal changes, as most of the high values recorded was during the spring, and this is linked to the initial increase productivity as a result of blooming phytoplankton in this season [30], As for the location changes were higher values in the second station due to the presence of plants water and a lack of flow velocity, while the lowest values were in the third station this is a result of increased flow velocity, salinity and very low values of dissolved oxygen and increased organic pollution resulting from the discharge of sewage [31].

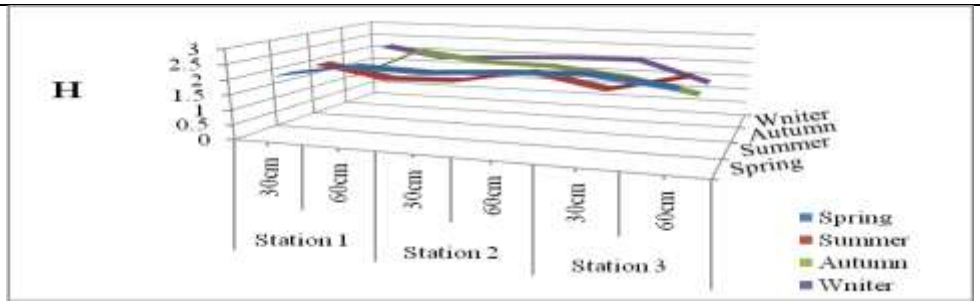


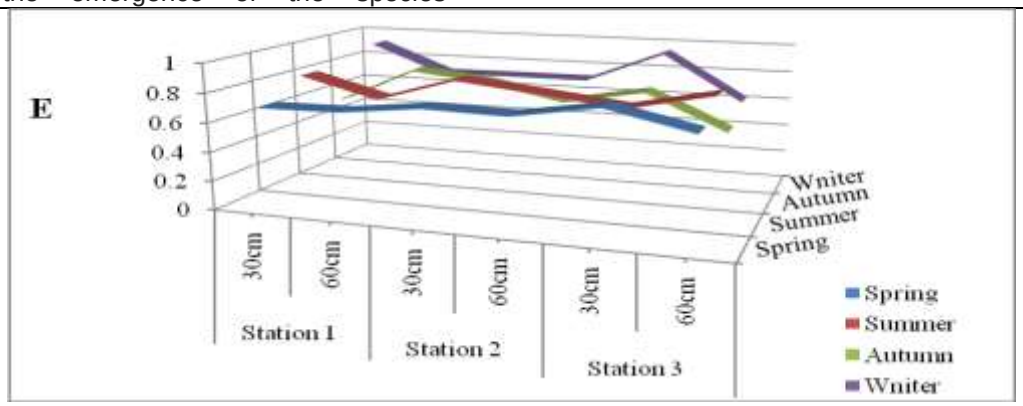
Figure (4): Seasonal changes of Shannon-Weiner index of phytoplankton during study period.

The biodiversity values ranging from 0-5, as the values that most of the show 3 bit/Ind. referred to a high diversity, while indicating at least 1 bit/Ind. to the presence of environmental pressures. Thus, this index is a measure of the quality of water and the extent of contamination [32], so, the water of AL- Diwaniyah River is considered a poor water to a moderate diversity, where the values of Shannon - Wiener ranges from 1-3 bit / Ind., can also be regarded as a moderate pollution.

3.2.3 SPECIES EVENNESS INDEX (E)

It represents homogeneity evidence for the emergence of the species distribution pattern of individuals between the sample types, since the density of individuals approaching each other to make some of the guide values closer to 1 [33].

The present study recorded the highest value to index of homogenization for species evenness at depth 30 cm was 0.95 during the winter for the first station and the lowest value was 0.47 during the summer for the second station. At a depth of 60 cm was the highest value was 0.96 recoded in the autumn for the third station and the least during the spring for the first station, as was 0.70 (Table 1, Figure 5).



Figure(5): Seasonally changes of Evenness index of phytoplankton during study period.

As the recorded differences in this study between stations and seasons and depths due to the differences in the nature of the environmental conditions that may be appropriate or inappropriate for the growth and the presence of phytoplankton [34]. As higher values recorded in the study indicate the availability of suitable environmental conditions for the stability of species, it has mostly exceeded 0.5, indicating that the species homogeneous to appear within a single sample. Low values of the index may be from an ecological pressure.

4.Conclusion

Biodiversity indicator showed that Diwaniyah River moderate pollution and good diversity at the second station, while a poor diversity and contaminated at the station third due to expose to

environmental stresses from of industrial and residential waste and wastewater effect.

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