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Diversity of crustaceans in the euphrates River/Najaf province-Iraq

Abdul Salam Hassan Hamza Al-Shamry
Master Student Department of Ecology and Pollution College of Science, University of Kufa, Najaf, Iraq.
Email: salamaliraqii14@gmail.com

Aliaa Hussain Mizhir
Professor, Department of Ecology and Pollution College of Science, University of Kufa, Najaf, Iraq

***Abstract*---**To study the biodiversity of crustaceans, five sites were taken with three replicates from each sample over a period of six months, from November 2021 to April 2022. Samples were also taken. Water is used to measure some chemical and physical properties. The density of crustaceans ranged from (4-773) individuals / liter, and the month of March recorded the highest density. The results of the isolation and identification of crustaceans showed the following species of *cyclops, Diaptomidae, Acroperus harpae, Daphnia sp, Bosmina sp, Ceriodaphnia quadrangula, Daphnia galeata, A amphipod Hyallela, Diaphanosoma brachyurum, Simocephalus vetulus and Bosmina sp*. According to the relative abundance index (Ra) of crustaceans, the first site throughout the research period had the highest density of cyclops, while the remaining sites had the highest density of *Bosmina sp*. It also showed The Crustacean Species constancy Index (S) also showed that among the species at the research sites, *Cyclops, Diaptomidae, Daphnia sp. and Bosmina sp. The Ceriodaphnia quadrangula* is the most persistent. The values of the species richness index (D*) ranged between 0.67-4.66. While the Shanon-Weiner index ranged between 0.346-2.76 bit/ind. While the values of the species homogeneity index (E) ranged between 0.499-1.256.

***Keywords*---**Biodiversity; Crustaceans; Species; Zooplanktons; Organisms.

Introduction

Zooplanktons are slow-moving flood organisms that are a significant biotic component of marine and freshwater ecosystems. Since zooplankton is larger and

easier to identify than phytoplankton, and because of its productivity and ability to adapt to changes brought on by unfavorable environmental factors, freshwater zooplankton can be considered a biological factor used as an indicator of the trophic status and health of water systems. Zooplanktons also act as a link between primary producers (phytoplankton) and secondary consumers, and they play a significant role in nutrient cycling (Abbas and Talib, 2018; Deibel et al.,2011).

The term "crustacean" refers to a large group of invertebrate animals, the majority of which are aquatic and can exist in both fresh and salt water. However, some species have evolved to coexist with wildlife and play a significant role in the food chain for both fish and other aquatic organisms (Rosa and Barracco, 2011; Kotpal, 1996).

A variety of physical and chemical characteristics, including biotic and abiotic substances like water temperature, salinity, dissolved oxygen, turbidity, and nutrients (TN, TP), influence and govern the spatial and seasonal growth and succession of crustacean in all habitats. For instance, a shortage of DO, nutrients comprising NH_4 + and PO_4^{3-}, and total suspended solids (TSS) and pH would all negatively affect crustacean development and survival. Total suspended solids (TSS) and pH are also crucial for crustacean variety and dispersion (Binsaidin, 2012; Ajeel 2016).

Despite their ecological relevance to marshes and wetlands and their scarcity in Iraqi rivers, studies of invertebrate biodiversity have mostly been ignored. This is evident from the previous review. So that, current study was conducted to diagnosing crustacean species , and applying biodiversity laws, incorporate Relative abundance index (Ra), Constancy index (S), species richness index (D), Shannon-Weiner diversity index (H), and uniformity index (E) The species uniformity index (E) in the Euphrates River / Najaf province.

2 Materials and Methods

Five sites on the Kufa River in the Najaf province were selected for the purpose of the study. There are orchards, farms, tourist attractions, and public rest spots on both sides of the river. The global positioning system (GPS) was used to identify the many pollution sources that discharge into the Kufa River, including the drainage area and the pollutants that people's homes and riverboat owners discard (See figure 1).

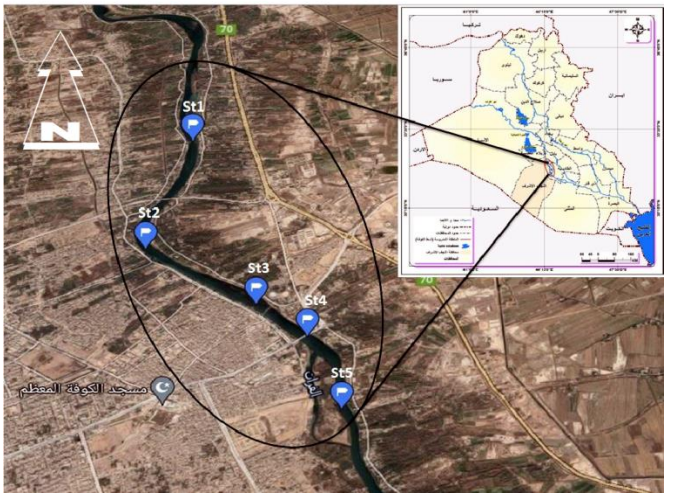


Figure 1. Study area on Al-kufa River by GPS (Google earth).

The first site is located 1 km to the north of the Imam Ali Bridge in the Albu Hadari area, the second site is located 1 km to the south of the Imam Ali Bridge and near the site of the drainage of sewage coming from the city to the river, and the third site is located near the Iron Bridge , the fourth site is located in the villages of the old Kufa bridge, and finally the fifth site is located in the Albu Numan area (Table 1).

Table 1
Geographical positions of the studied stations in Euphrates river.

GPS coordinates						
Station	Longitude(East)			Latitude (North)		
	°	'	"	°	'	"
1-St1	44	39	30	32	06	40
2-St2	44	39	27	32	04	83
3-St3	44	40	64	32	04	08
4-St4	44	41	28	32	03	64
5-St5	44	41	73	32	02	97

3. Results

3.1 Physical and chemical features of water in study areas

The water's temperature ranged between (14.5°C - 34.3°C) Figure(1), its salinity ranged between (0.236 - 0.889) ppt Figure(2), its electrical conductivity ranged

between (515 - 1933) µs/cm Figure(3), its pH ranged between (6.9 - 8.3) Figure(4), its total dissolved solids recorded ranged between (512 - 1773) µg /L Figure(5), its dissolved oxygen value ranged between (5 - 12.8) µg /L Figure(6), and its vital oxygen requirement ranged between (0.6-7.6) Figure(7). In terms of nutrients, nitrate concentrations varied from (0.26 to 3.146) µg /L Figure(8), phosphorus concentrations from (0.00031 to 0.04) µg /L Figure(9), and chlorophyll concentrations from (5.566 to 10.824) µg /L Figure(10).

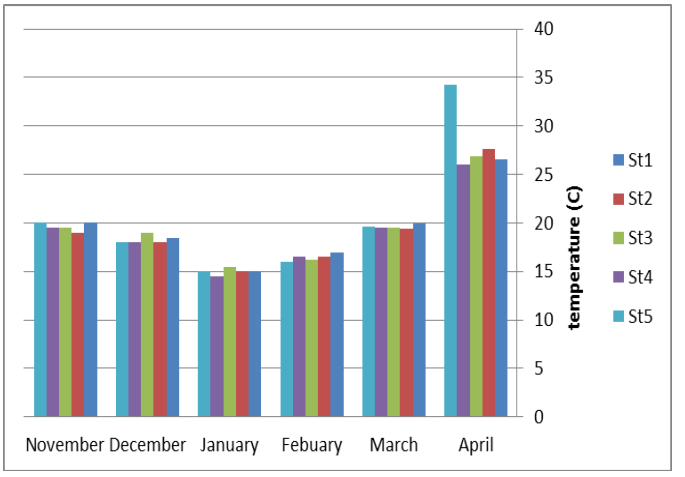


Figure 1. Monthly changes in water temperature (C) in the study sites in the Euphrates River during the study period.

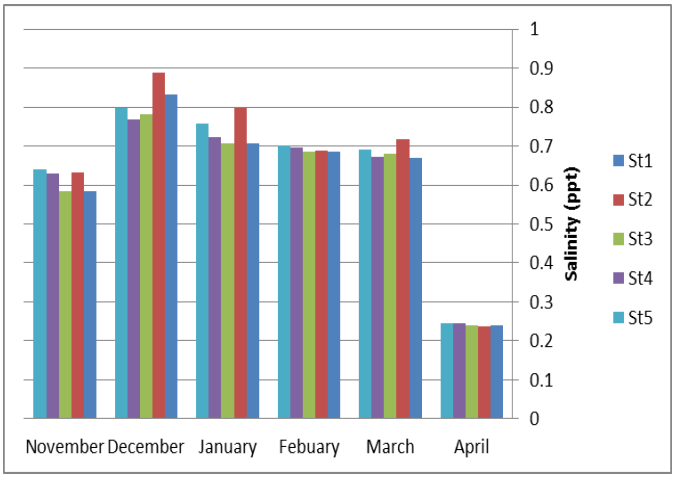


Figure 2. Monthly changes in Salinity (ppt) in the study sites in the Euphrates River during the study period.

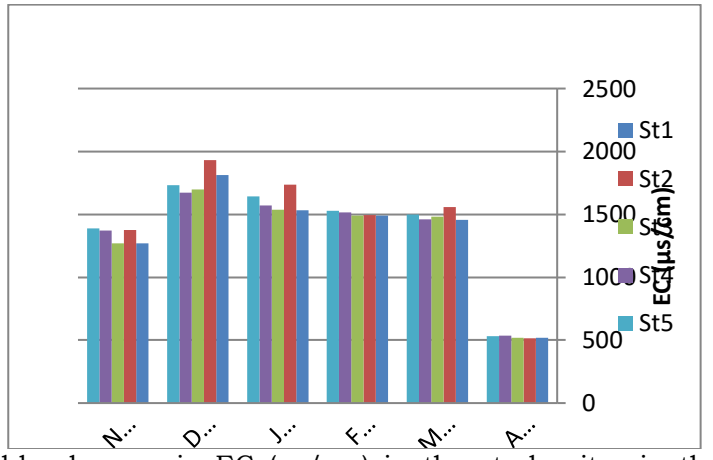


Figure 3. Monthly changes in EC (µs/cm) in the study sites in the Euphrates River during the study period.

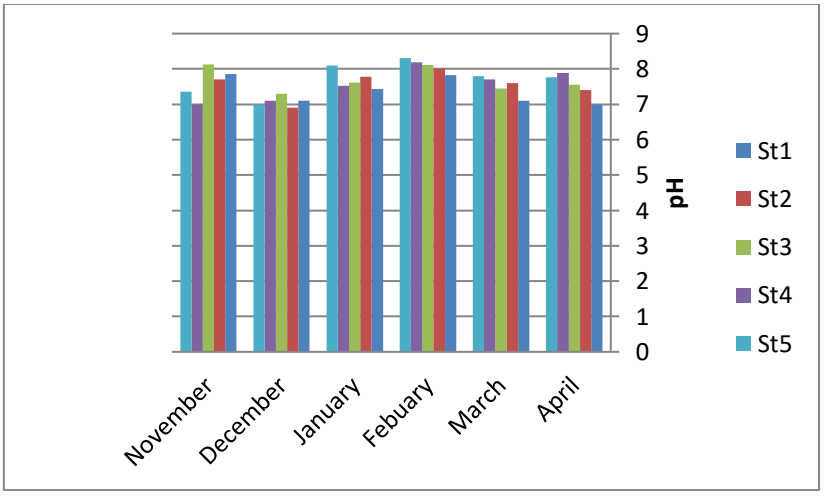


Figure 4. Monthly changes in pH in the study sites in the Euphrates River during the study period.

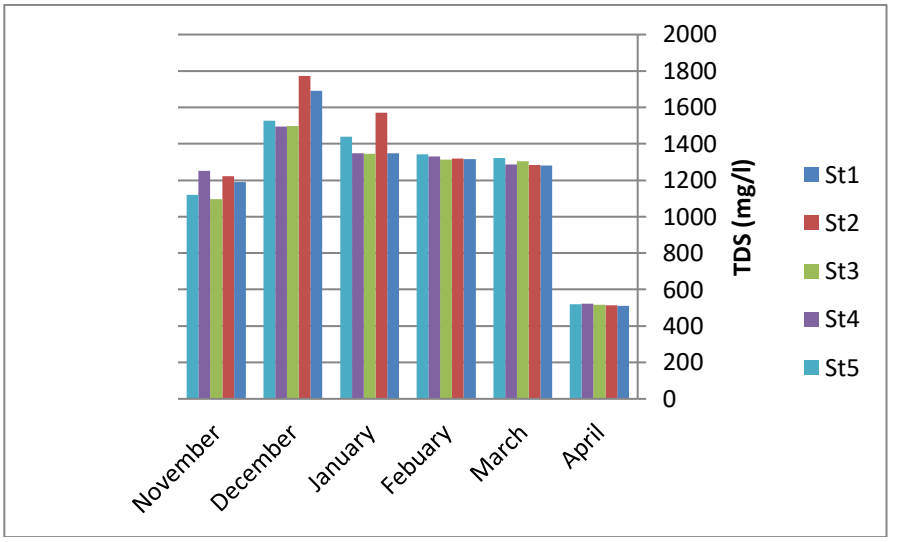


Figure 5. Monthly changes in TDS (mg/l) in the study sites in the Euphrates River during the study period.

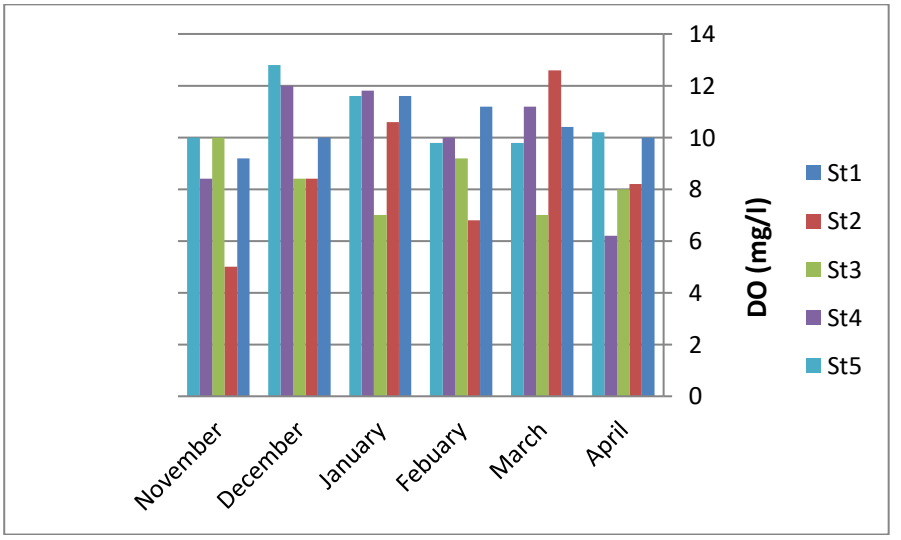


Figure 6. Monthly changes of DO (mg/l) in the study sites in the Euphrates River during the study period.

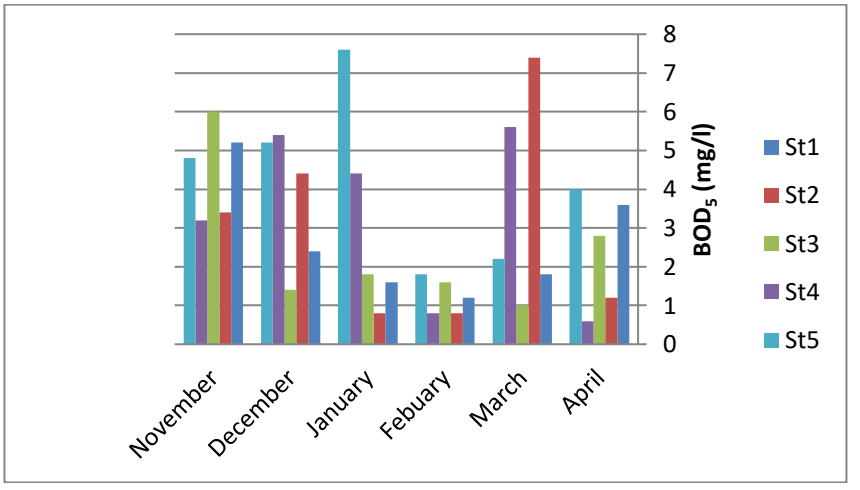


Figure 7. Monthly changes of BOD5 (mg/l) in the study sites in the Euphrates River during the study period.

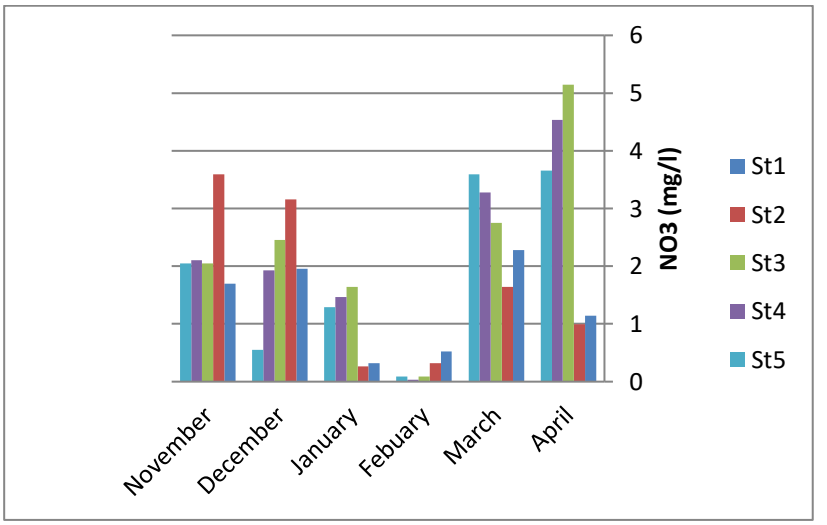


Figure 8. Monthly changes of NO3 (mg/l) in the study sites in the Euphrates River during the study period.

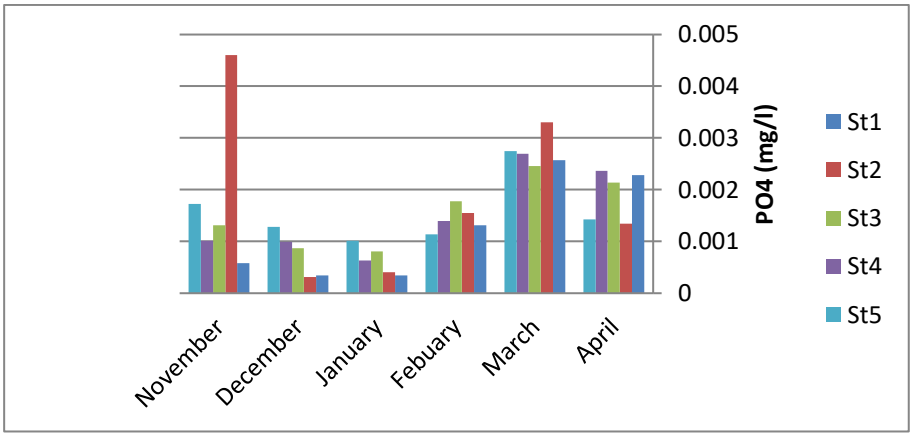


Figure 9. Monthly changes of PO_4 (mg/l) in the study sites in the Euphrates River during the study period.

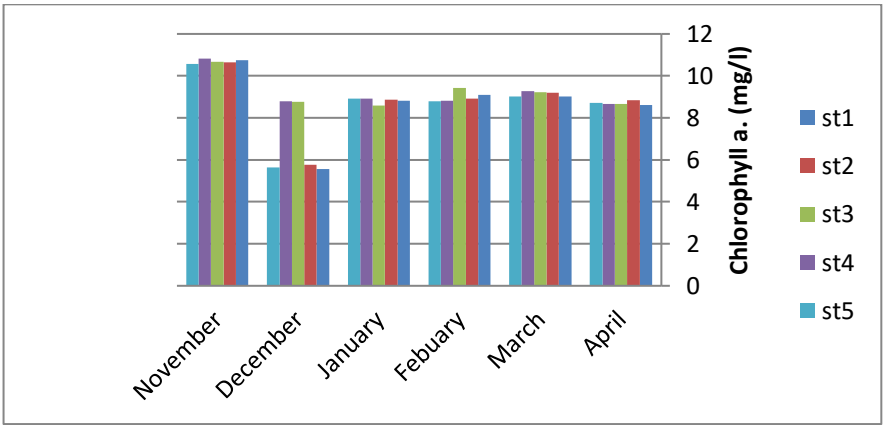


Figure 10. Monthly changes of Chlorophyll a. (mg/l) in the study sites in the Euphrates River during the study period.

3.2 Density and biomarkers:

Ten species of crustaceans were identified as a consequence of the present research, six of which are members of the Cladocera order, two of which are Copepoda, one of which is Ctenopoda, and one of which is also a member of the Amphipoda order, The total density of the crustacean group ranged between (4-773) ind./l, with the highest density recorded in March 2022 (Figure 11) .

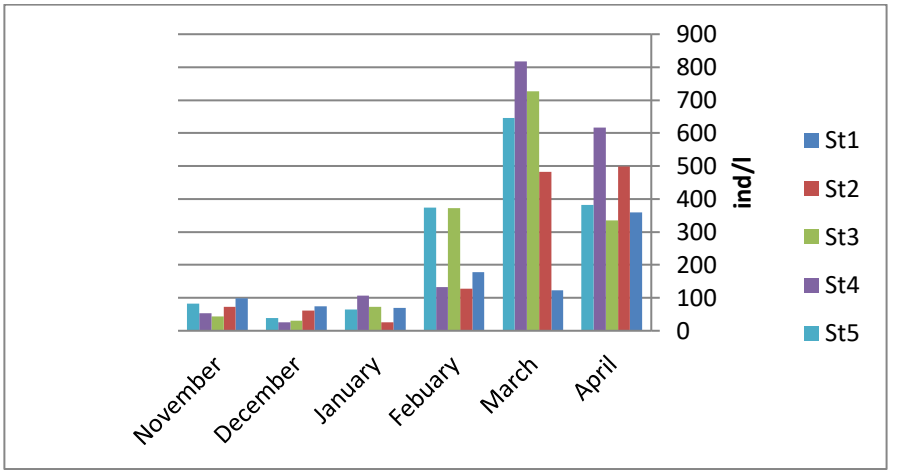


Figure 11. The total density of Crustaceans and Aquatic Insects (ind/l) in the study sites in the Euphrates River during the study period.

the species *Bosmina sp*. It is the most abundant at 36%, followed by Daphnia sp. at 22%. *Bosmina sp*. was also the most abundant with 46%, followed by Daphnia sp. at 15%. Also at the fifth site was the species *Bosmina sp*. It is the most abundant at 41%, followed by Daphnia sp. at 17% (Figure 12).

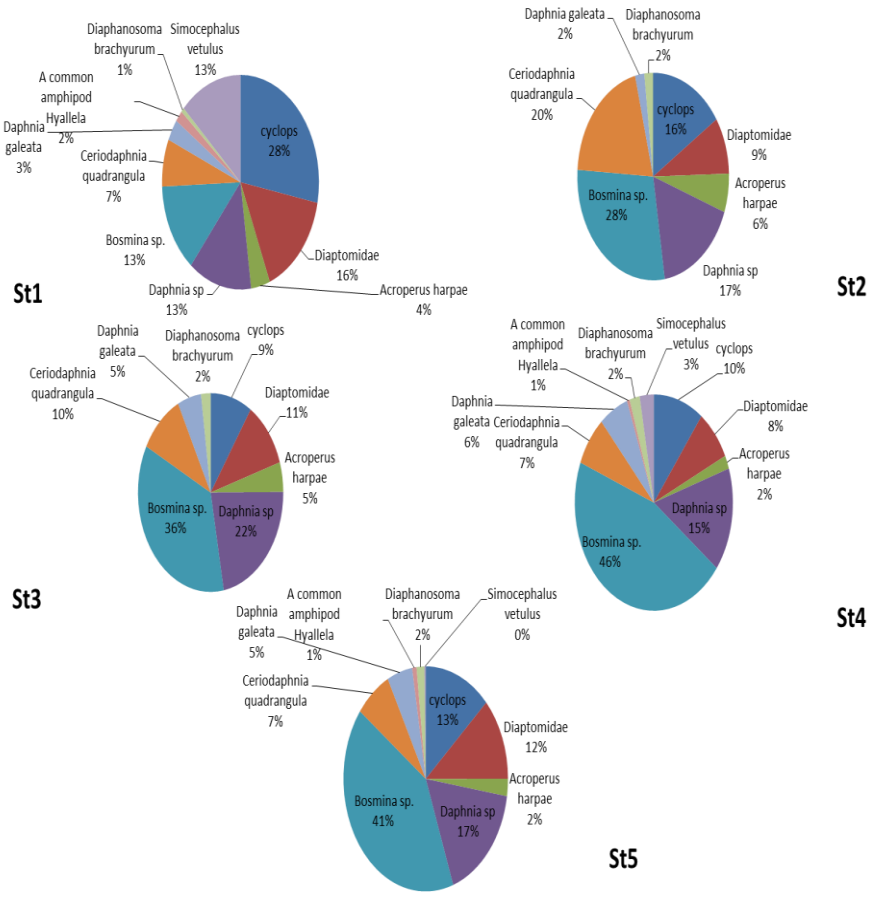
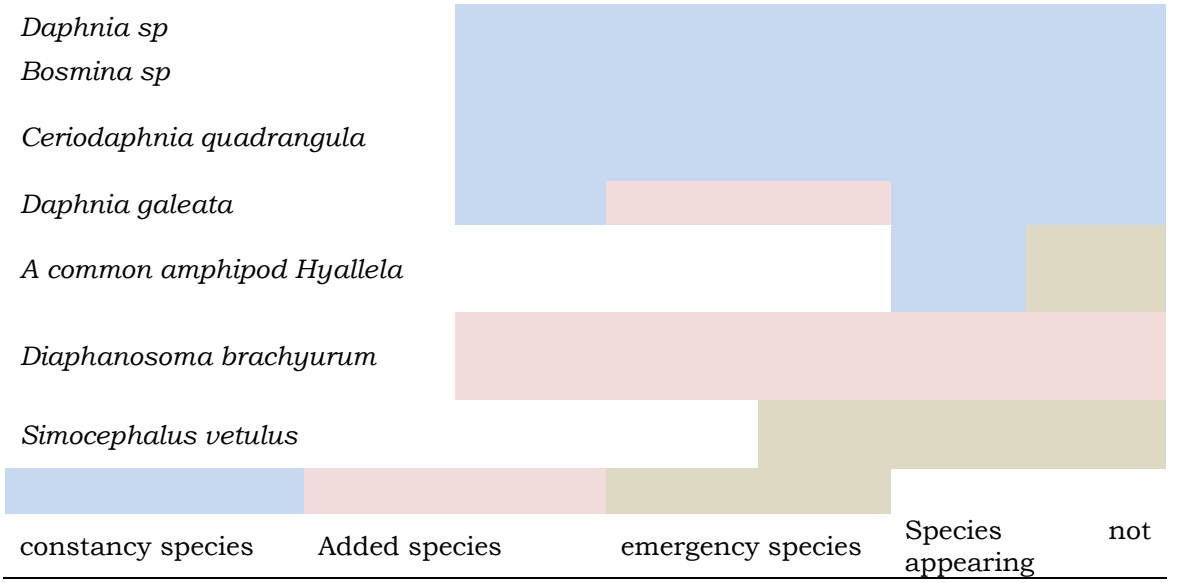


Figure 12. The Relative abundance index (Ra) of Crustaceans groups in the study sites in the Euphrates River during the study period.

In the table (2) the constancy index showed that the number of species diagnosed in this study that belong to the crustacean group is 10 species were *cyclops, Diaptomidae, Daphnia sp, Bosmina sp. Ceriodaphnia and quadrangula* are the most stable.

Table 2. constancy index of crustacean and the frequency of their presence in the study sites in the Euphrates River during the study period.

species	Locations				
Crustacean species	Site 1	Site 2	Site 3	Site 4	Site 5
cyclops					
Diaptomidae					
Acroperus harpae					



Where the values of the species richness index for crustaceans ranged from the lowest value (0.67), which was recorded in January 2022 in the third site, to the highest value (4.66) in the fourth site of February 2022 (Figure 13).And the results of the Shannon Wiener crustacean index also showed that its value ranged from the lowest value (0.346) in the second site of January 2022 to the highest value (2.76) in the fourth site of February 2022 (Figure 14). Finally, the value of the species uniformity index for crustaceans ranged between (1.256) in the fourth site of February 2022 and (0.499) in the second site of January 2022(Figure 15).

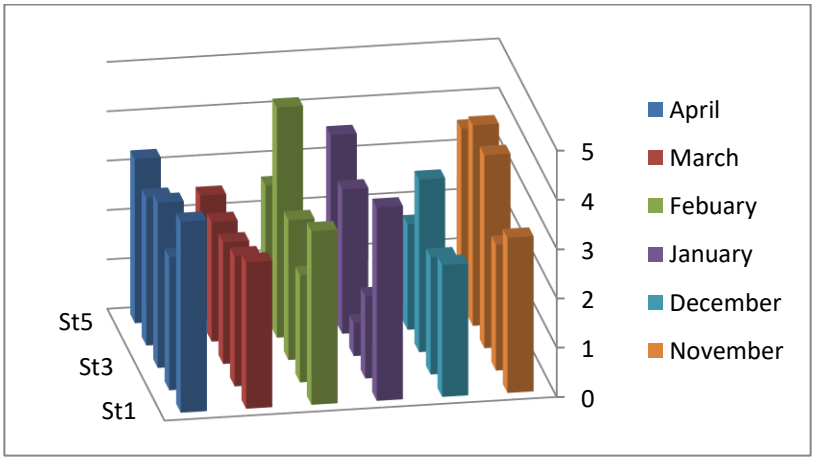


Figure 13. The species richness index (D*) of crustacean species and their frequency in the study sites in the Euphrates River during the study period.

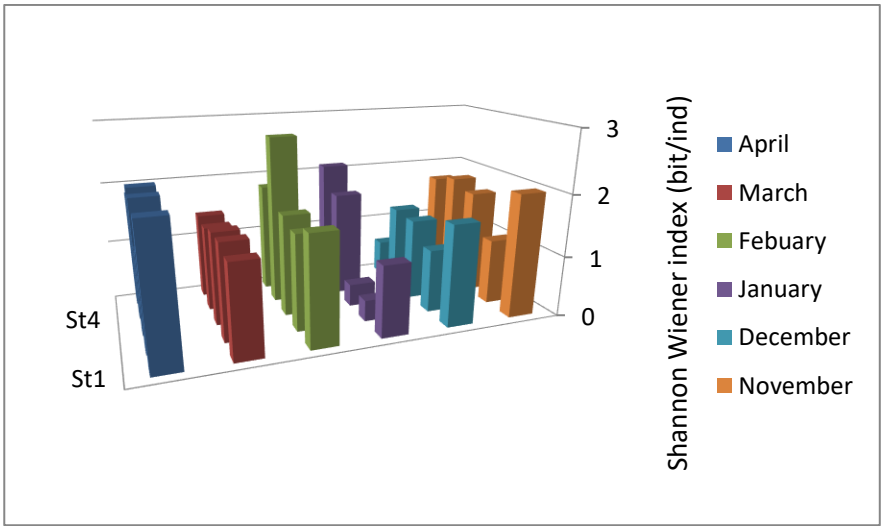


Figure 14. The Shannon Wiener index (H) of crustacean species and their frequency in the study sites in the Euphrates River during the study period.

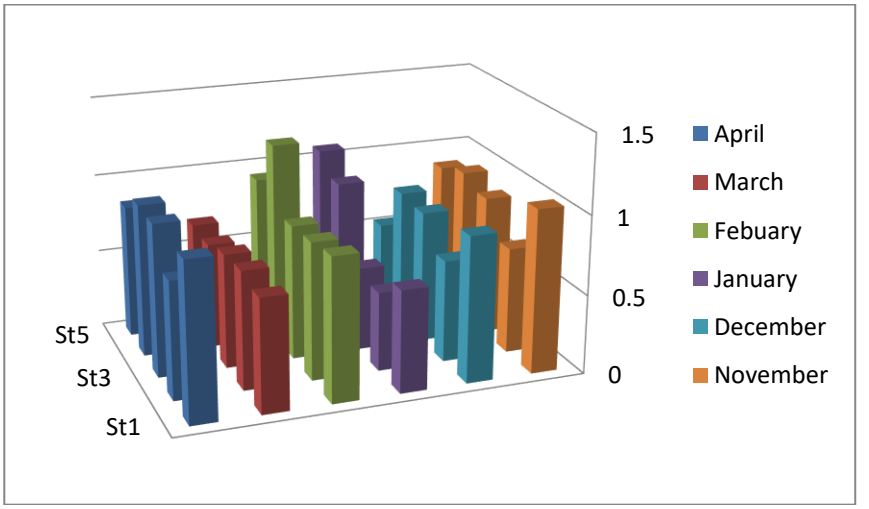


Figure 15. The species uniformity index (E) of crustacean species and their frequency in the study sites in the Euphrates River during the study period.

Discussion

The current study recorded the highest density of crustaceans in March, while the lowest density was recorded in January. Also, the species *Bosmina sp* of the order Cladocera is the most dense and the highest density of this species was in March when the temperature was moderate according to studies (Al-Shami, 2016; Sivakumar and Karuppasamy, 2008). The highest recording density at Site (4) for March of Cladocera is attributed to the availability of phytoplankton and aquatic plants with high levels of dissolved oxygen in addition to the presence of aquatic

plants that protect predators (Goel, 2008) as well as high levels of nutrients provided by household waste. As well as restaurants streamed from this site. There is a noticeable decrease in the density of cladocera throughout the low-temperature months compared to the temperate months. According to literature (Goel, 2008), temperature has a significant influence on the embryonic development and reproductive levels of cladocera. It is also possible that Cladocera in waters with higher concentrations of nutrients increases nutrients, which is supported by the results of most studies, which show a significant relationship between nutrients. These differences in density can be attributed to seasonal changes in water temperature.

The results of this study showed that copepod density was high in the March-April group, and the dominant genus was *Bosmina sp*. This may be attributed to the abundance of phytoplankton, the main food of this group, and its density is related to the time of algal abundance and the appropriate temperature (Al-Sudani et al., 2007).

According to the results of the current study, no dominant crustacean species was recorded at all sites, and Bosmina sp was the most abundant at site (4,5) according to (Omori & Ikeda, 1984). The Constance Index reveals the stability of taxonomic groups in their environments and the nature of their recurrence (Serafim et al., 2003), According to the Constansy index, these species can be considered *cyclops, Diaptomidae, Daphnia sp. , Bosmina sp. , Ceriodaphnia quadrangula* are stability species (table 1).Record high of the species richness index (D*) values due to the density and diversity of phytoplankton and high values indicate an environment suitable for the development and success of specific species (Badsi et al., 2010). The results (H) index of the current study of crustaceans showed that the highest values of diversity were during February in the fourth place (2.7) as shown in Figure (4-11). Biodiversity is influenced by environmental factors, with reduced water flow velocity and increased species abundance (Pliuraite, 1999) as well as food intake and predation (Saadallah and group, 2000). While the lowest value for diversity was in the 2nd of January station (0.34) due to the water pollution caused by the direct discharge of sewage, domestic and industrial water at that site. The result of the E index showed high values for crustaceans in most of the study sites (Fig. 4-22) its agree with (Al-Jizani, 2005).The results of this study showed that high values of the E index indicate that there is no environmental stress on crustaceans in the study area (Basavarajappa, 2010).

Conclusion

From the results obtained and the environmental measurements that were examined, we conclude that crustaceans live in a fresh water environment with little alkalinity, despite its low relative density. The reason may be the decline of phytoplankton as a result of low nutrient values in river water, as well as the presence of added types of crustaceans. For river water, which is indicated in the stability index.

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Biography of Authors

Abdul Salam Hassan Hamza
Bachelor of Ecology Sciences and Pollution 2019 / University of Kufa
Master Student, Department of Ecology and Pollution, College of Science, University of Kufa, Najaf, Iraq.
Email: salamaliraqii14@gmail.com

Professor. Dr. Aliaa Hussain Mizhir
Bachelor of Life Sciences 2000 / University of Kufa
Master's degree in Parasitology 2003/ University of Kufa
Ph.D. in invertebrate environment 2013/ University of Basra
Affiliation: Department of Ecology and Pollution, College of Science, University of Kufa, Najaf, Iraq.
Email: aliah.alamary@uokufa.edu.iq