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Diversity of Mollusca in the Southern Part of the Euphrates River

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Abstract

This research paper aims at studying the diversity of Mollusca available in aquatic plants for three stations in the southern part of the Euphrates River; Abu Subatt, Abu Choolana, and al-Khinziri from September 2019 to August 2020. The study has included the calculation of some physiochemical variables at these stations. The results of ANOVA statistical analysis have shown that there were significant differences among stations ($p<0.05$) as to turbidity, transparency, and nitrates, while no differences between stations were registered as to temperature, pH, salinity, dissolved oxygen, and phosphates.

During this study, nine species of Mollusca, of Class Gastropoda in the Euphrates River were recorded. The species *Radix auricularia* has registered the highest monthly and annual numerical abundance 66.34 – 87.39 %, respectively. The highest population density was recorded on the *Ceratophyllum demersum* plant, 3.94 ind/m^2. As for the environmental indices, it recorded the highest value of diversity in Abu Subatt station was 1.481 during August 2020, the highest value of the richness index was 1.412 during August 2020, and the highest value of the evenness index was 0.971 during September 2019, while the dominance index recorded the highest value of 0.777 during February 2020.

Keywords: Euphrates River, Mollusca, aquatic plants, water quality

Introduction

Iraq is famous for its plenty of surface water resources represented by the Tigris and Euphrates rivers and their tributaries (Hussein, 2008). The waters of the Euphrates River are of great importance to central and southern Iraq due to the prevailing dry climate and the scarcity of traditional water sources (Nomas and Hushem,2017). Water plays a significant role in the formation and composition of living organisms represented by fish, phytoplankton, and zooplankton, and the bottom is represented by aquatic plants and benthic invertebrates (Schmid-Araya, 2000). Plants are of tremendous importance to natural ecosystem animals. They are a necessary component for the continuation of life on earth, as they work to make organic food from water, air, and soil (Siracusa and La Rosa, 2006). Aquatic plants represent the important and basic components of the natural ecosystem, and there are many species of them found in various water bodies such as rivers, ponds, and marshes (lzzati, 2015). Physical and chemical factors affect the distribution and spread and diversity of aquatic plants (Almayah,1994).

Aquatic plants as defined by Reid (1961), who confirmed that the plants in the water must spend their lifecycle or part of it in the water either emergent, floating, or submerged, as their seeds grow in a water medium or a place on a waterbody or defined as plants that live in areas covered by permanent or seasonal water and in different forms, such as being emergent, floating or submerged (Hutchinson, 1975).

Aquatic plants are divided based on the location of their vegetative organs from the surface of the water into Emergent, Submergent and floating plants

Mollusca phylum is considered one of the most important phyla of invertebrates, where its animals generally are of undivided bodies, usually having a shell, coelom, a unique internal shell. In general, these animals (Mollusca) have a head and visceral peritoneum (Raven and Johnson, 1986; Leftwich, 2004).

This phylum contains large groups of invertebrates that live in different environments, including terrestrial and aquatic animals. This phylum includes many animals, such as ketones, oysters, mussels, oysters, snails, slugs, octopuses, and some other forms (Subba Rao, 1993). One of these phylum classes is the class Gastropoda is deemed one of the most widespread species among the phyla classes. It comprises about 80% of its species, and it lives in marine and freshwater habitats. And some of them live in moist terrestrial habitats (Ponder and Lindberg, 2008).

Materials and methods

Description of Study area

The study area covered three stations from the southern part of the Euphrates River. The first station is called Abu Subatt, the second is Abu Choolana and the third is called al-Khinziri (Figure 1&Table1). The area was characterized by a distinctive vegetation cover of emergent, floating, and submerged plants and edge plants (Table2).

Table (1): Geographical coordinates of study stations using GPS.

The stations	Coordinates	
Abu-Soobat	N 30.57 43	E 47.02 56
Abu-Chulana	N 30.56 48	E 47.05 50
Al-Khnezeri	N 30.57 07	E 47.08 53

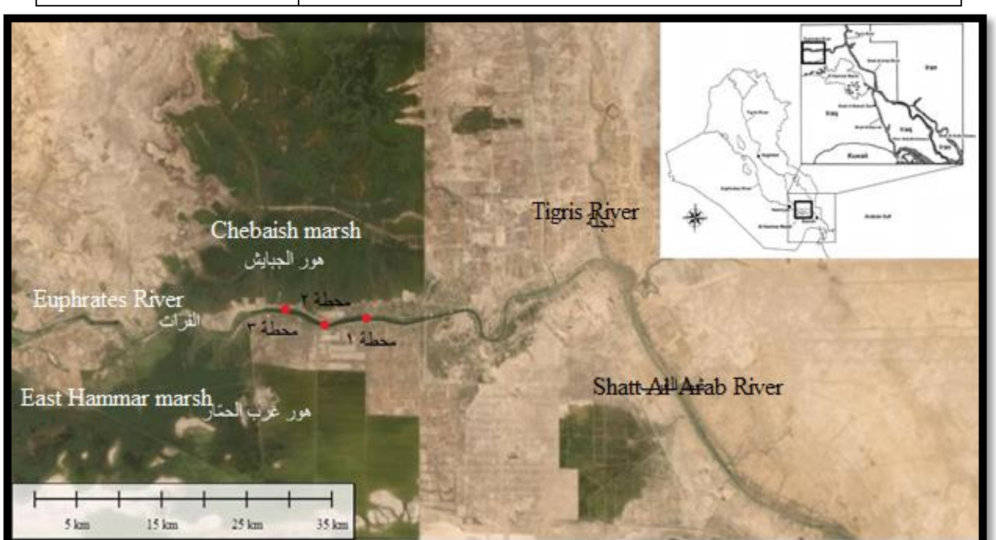

Figure (1): The study stations.

Table (2): Aquatic plants present in the study stations.

Aquatic plant	Season	The station		
Scientific name		Abu-Sobat	Abu-Chulana	Al-Khanziri
Phragmites australis	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Typha domingensis	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Ceratophyllum demersum	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Najas marina	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Vallisneria spiralis	Winter	-	-	-
	Spring	-	+	+
	Summer	+	+	+
	Autumn	-	-	+
Scirpus lacustris	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Bacopa monniear	Winter	+	+	+
	Spring	+	+	+
	Summer	+	+	+
	Autumn	+	+	+
Potamogeton perfelatu	Winter	-	-	-
	Spring	-	-	-
	Summer	-	-	-
	Autumn	+	+	+
Lemna minor	Winter	-	-	-
	Spring	-	-	-
	Summer	-	-	-
	Autumn	+	+	+
Azula sp.	Winter	-	-	-
	Spring	--	-	-
	Summer	-	-	-
	Autumn	+	+	+
Salvinia natans	Winter	-	-	-
	Spring	-	-	-
	Summer	-	-	-
	Autumn	+	+	+

Sample Collection:

Samples were collected from the study stations monthly during day hours from September 2019 to August 2020. The method of collection was characterized by being non-random and optional, to get to know all species of Mollusca available on plants. Also, the collection method was aimed at getting known the species of plants in the area by using quadrate and box mothed.

Laboratory Isolation:

In the laboratory plant bags collected in the field would be unloaded into basins and divided according to each species of plant, after which snails were isolated from the plants and diagnosed using the anatomical microscope type "Wild MB3" and classified according to (Ahmed, 1975; Frandsen, 1983).

Measurement of Environmental Factors:

Environmental measurements were conducted every month for the period from September 2019 to August 2020, during which some environmental factors were measured in the field containing some physicochemical factors such as air and water temperature, pH, electrical conductivity, and turbidity. In the laboratory, dissolved oxygen, calcium ion, and nutrients (nitrates & phosphates) were also measured.

Composition of the Mollusca Community Available on Aquatic Plants:

The study consisted of the qualitative composition, in which the Mollusca in the study stations were classified according to the mentioned keys with their presence on aquatic plants, and the quantitative structure represented by the density, which was calculated according to the equation (Mohan *et al*., 2013), which is as follows: -

individual / m^2 = 1000*N/A. S

Whereas

N-= Total number of Mollusca available on aquatic plants.

A= an area of collection tool.

S= Total number of plants collected.

Relative abundance was calculated according to an equation used in Omori and Ikeda (1984), read as follows:

Ra (%) = N/Ns x 100.

Whereas

N= number of individuals of one species per sample

NS= Total number of individuals per sample

Ecological Indices:

The ecological indices (diversity, richness, evenness, dominance & Simpson's index) were calculated according to the PAST Version 1.34 program as follows:

Diversity Index (H):

The diversity index is deduced according to the following equation adopted by Shanon and Wiener (1949) and Romos *et al.* (2006):

$H = - \sum pi \ In \ Pi$

Whereas

H: stands for the value of diversity

Pi stands for the ratio of the number of individuals per species to the total number.

Evenness Index (J):

It was calculated in line with the equation used by Pielou (1977), as follows:

J= H / In S

whereas

J: stands for evenness value. H: stands for diversity index. S: stands for a number of species.

Values which are greater than 0.5 are homogeneous or even in appearance (Porto Neto, 2003).

Richness Index (D):

To calculate the richness index, the following equation, adopted by Margalefe (1968), was used:

D = S-1/In N

Whereas

D stands for the value of the richness index.

S: stands for a number of species.

N: stands for the total number of individuals per sample.

Dominance Index (D):

It was calculated in line with an equation created by Berger and Parker (1970) as follows:

D= Nmax/N

Whereas

D stands for the value of dominance.

Nmax: Stands for the number of individuals for prominent species.

N: stands for the total number of individuals per species.

Results:

Environmental Factors:

The environmental factors were measured in the study stations monthly from September 2019 to August 2020 (Table 3).

Table (3): Minimum and Maximus values of environmental factors

Variables / The station	Abu-Sobat	Abu-Chulana	Al-Khanzirii
Air temperature	(16.9-39.3) c°	(17-38) c°	(17-37) c°
Water temperature	(13-36.4) c°	(14.5-31.3) c°	(16.2-33) c°
pH	(6.2-8.7)	(6-8.5)	(6.2-8.7)
Turbidity	(1.07-4.87) NTU	(0.8-2.64) NTU	(0.89-2.305) NTU
Salinity	(0.2-0.269) ppt	(0.163-0.282) ppt	(0.14-0.291) ppt
Transparency	(100-200) cm	(110-250) cm	(130-190) cm
Dissolved oxygen	(6.2-10.5) mg/ L	(6.45-10.7) mg /L	(4.75-10.85) mg/L
Calcium ion	(51.302-121.843) mg/L	(57.715-126-652) mg/L	(51.302-112.224) mg/L
Nitrates	(0.005313-2.43457) mg/L	(0.00826-0.42505) mg/L	(0.020649-1.01304) mg/L
Phosphate	(0.24437-1.57464) mg/L	(0.3333-1.41174) mg/L	(0.24806-1.46456 mg/L

Community Structure of Mollusca:

The number of Mollusca species available on aquatic plants was recorded it was nine species belonging to eight families (Table4).

Quantitative Structure of Mollusca:

Monthly Density:

First Station, Abu Subatt: The highest density of Mollusca was recorded on *Bacopa monnieri* plant during February 2020 at (0.89 ind/m^2), reaching (0.87 ind/m^2) on *Ceratophyllum* plant during September 2019 and (0.85 ind/m^2) on *Vallisneria spiralis* plant during December 2019. On the contrary, the lowest density on the *Schoenoplectus* plant was (0.01 ind/m^2) during September 2019, and (0.01 ind/m^2) on the *Typha domingensis* plant during July and August 2020 (Figure 2).

Second Station (Abu Choolana): The highest density value was recorded on the *Bacopa monnieri* plant (1.41 ind/m^2) during February 2020, and was (1.24 ind/m^2) on the *Ceratophyllum* plant during February 2020. Whereas the lowest value was recorded on the *Najas marina* plant (0.01 ind/m^2) during May and June 2020 and (0.01 ind/m^2) on the *Typha domingensis* plant during August 2020 (Figure 3).

Table (4): The Mollusca species occurence on aquatic plants

Classification ranks	**Stations**		
Class:Gastropoda Phlum:Mollusca Family1:Thiaridae	**Abu-Sobat**	**Abu-Chulana**	**Al-Khanzirii**
Melanoides tuberculate	+	+	+
Family2:Melanopsidae			
Melanopsis nodosa	+	+	+
Melanopsis costata	+	+	-
Family3:Vivaparidae			
Bellamya bengalensis	+	+	+
Family4: Bithyniidae			
Bithynia badiella	-	-	-
Family5: Neritidae			
Theodoxus jordani	+	+	+
Family6: Lymnaeidae			
Rabix auricularia	+	+	+
Family7:Physidae			
Physeila acuta	+	+	+
Family8:Planorbidae			
Gyraulus convexiusculus	+	+	+

Whereas: + exists, - Does not exist

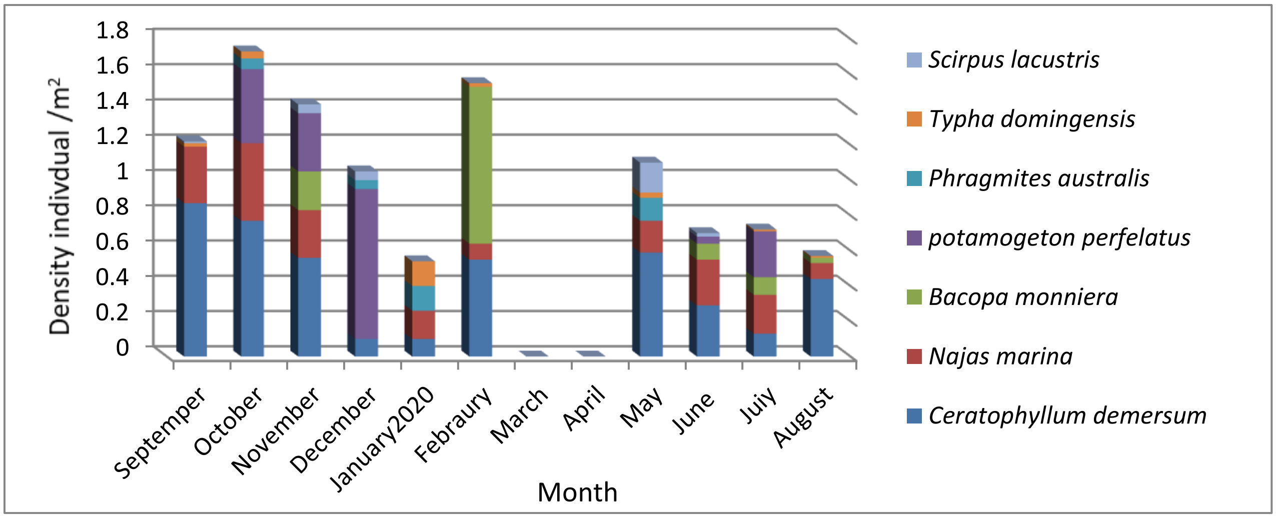

Figure (2): Density values recorded in Abu-Sobat station during the study period.

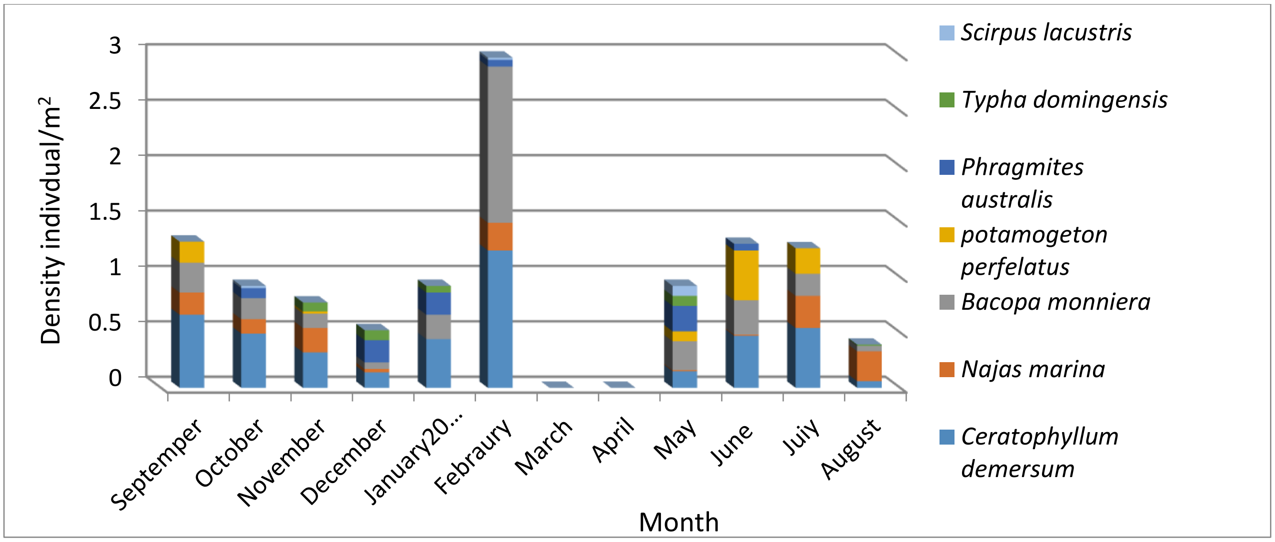

Figure (3): Density values recorded in Abu-Chulana station during the study period.

Third Station (al-Khanziri): The highest density value was (3.94 ind/m^2) on *Ceratophyllum* during February 2020, and (1.03 ind/m^2) on *Bacopa monnieri* plant during January 2020. Also, it reached (0.95 ind/m^2) on the *Ceratophyllum* plant in June 2020. The lowest recorded value was on the *Schoenoplectus* plant (0.01 ind/ m^2) during July and August 2020, and on the *Typha domingensis* plant (0.01 ind/ m^2) during June and August 2020 (Figure 4).

Monthly Relative Abundance:

The first station, Abu Subatt: The highest relative abundance was recorded on Mollusca *R. auricularia* during November 2019 reaching (82.89%) and the lowest on Mollusca *P. acuta*, *M. tuberculate* during February 2020 **(**1.68**%) (**figure,5).

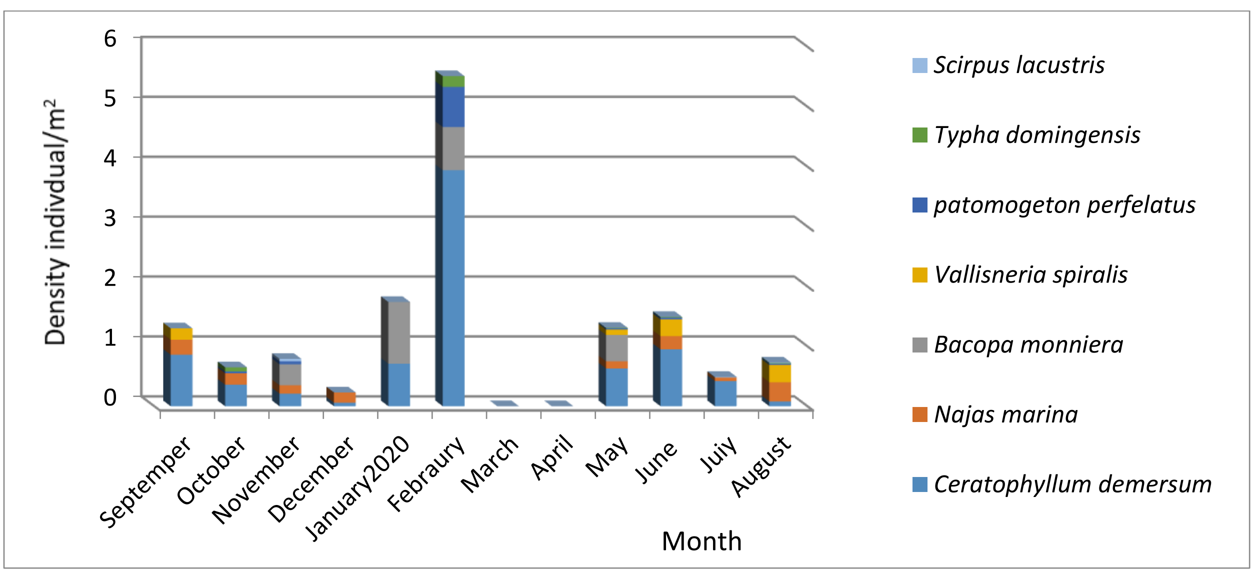

Figure (4): Density values recorded in al- Khanziri station during the study period.

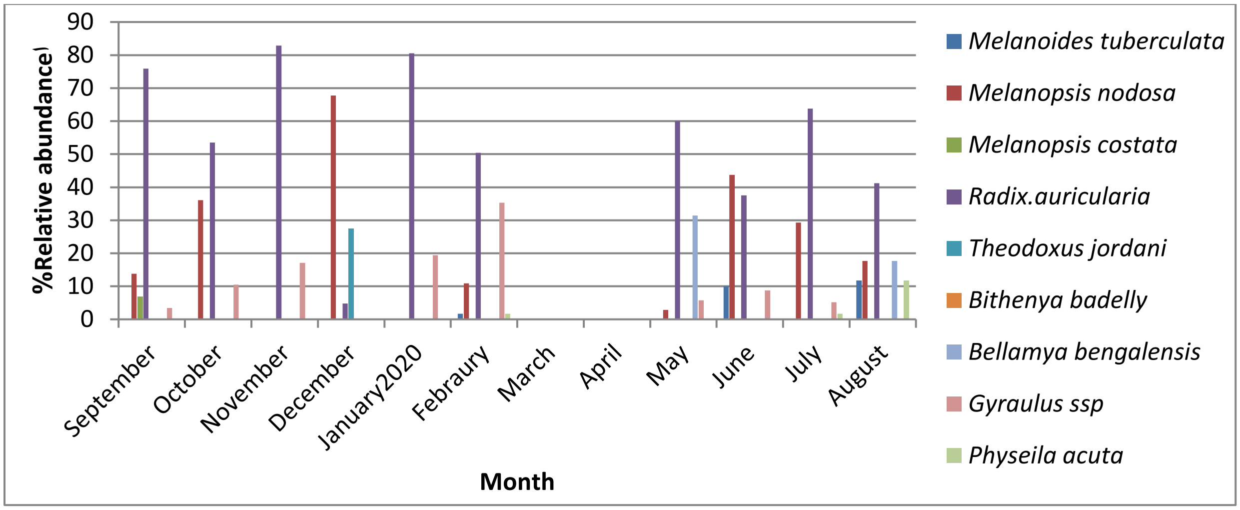

Figure 5: Monthly relative abundance values recorded in Abu Subatt station during the study period.

The second station, Abu Choolana: The highest relative abundance was recorded on Mollusca *R. auricularia* during January 2020 reaching (87.39%) and the lowest on Mollusca *M. tubercutata* during February 2020 (0.29) (figure,6).

The third station, al-khanzir: The highest relative abundance was recorded on Mollusca *R. auricularia* during February 2020 reaching (79.91%) and the lowest on mollsca *T. jordani* during February 2020 (0.41%) (figure,7)

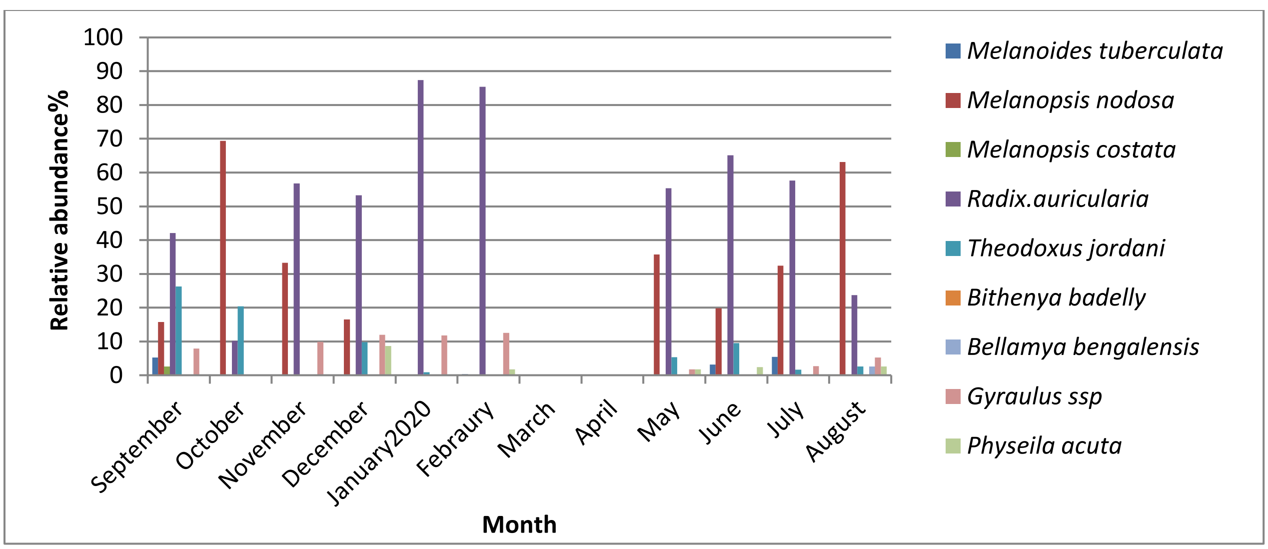

Figure (6): Monthly relative abundance values recorded in Abu Choolana station during the study period.

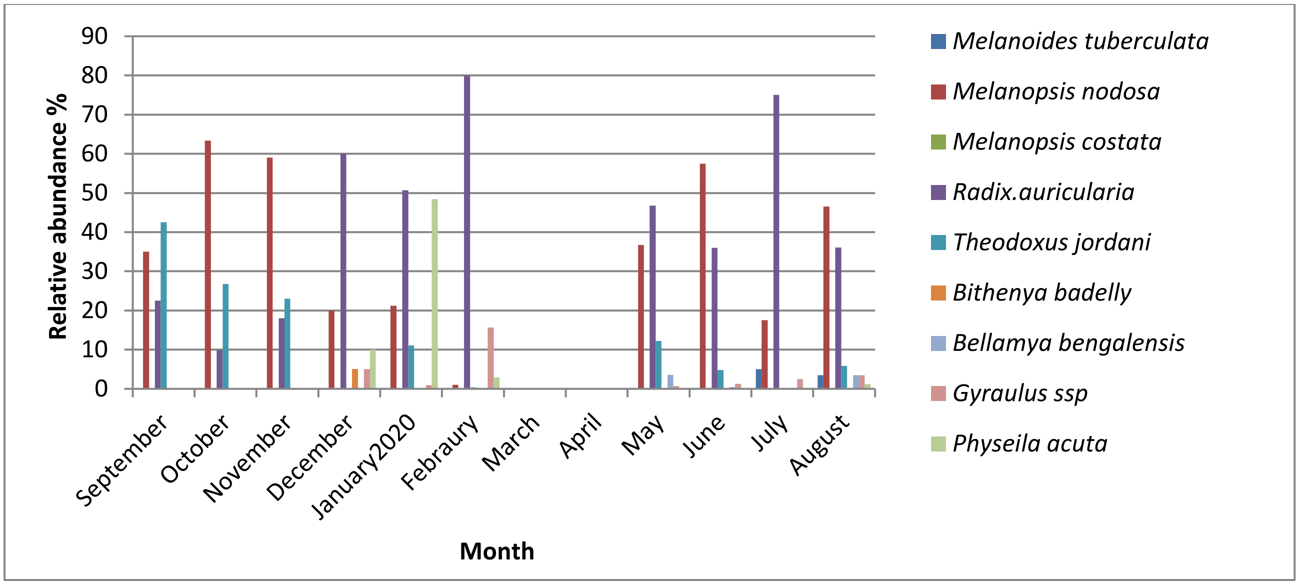

Figure (7): Monthly relative abundance values recorded in al-Khinziri station during the study period.

Ecological Indices:

Diversity Index (H): The monthly changes of the diversity index for studied species in the study stations were studied. The lowest value registered for this index was 0.4097 at Abu Choolana station in February 2020, and the

the highest value was 1.481 at Abu Subatt station in August 2020 (Figure 8).

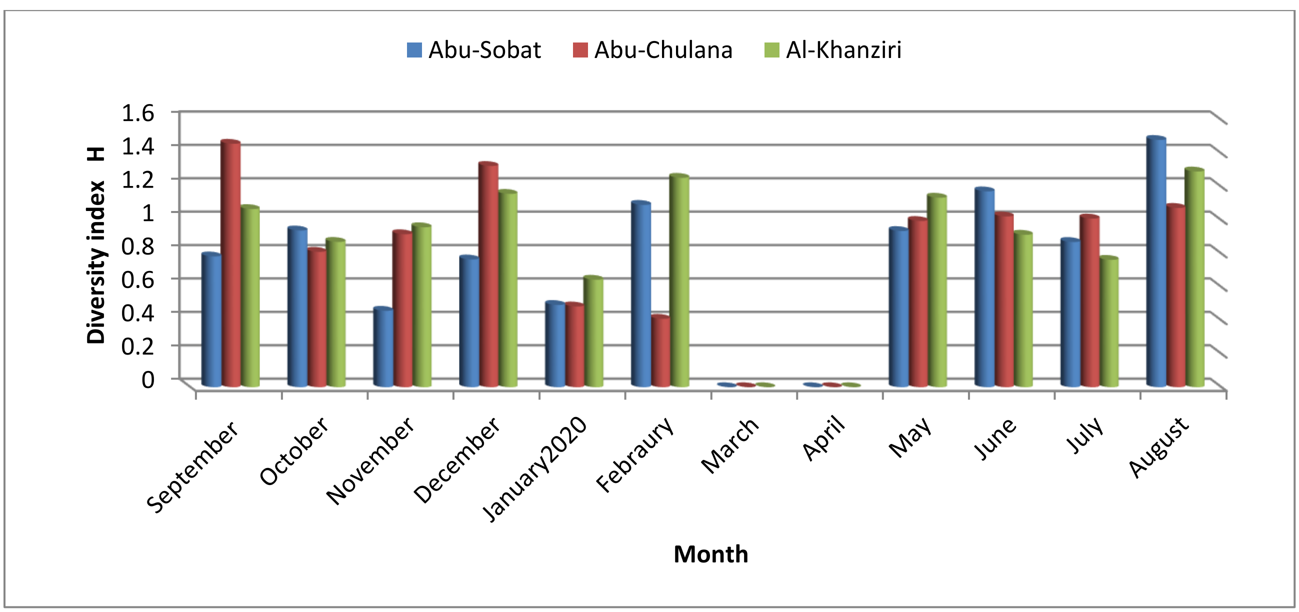

Figure (8): Monthly changes in the diversity index values for the three study stations.

Evenness Index:

Monthly changes occurred to the values of the evenness index of the studied species were measured in the three stations. The lowest value registered was 0.3489 at Abu Choolana station in January, while the highest value of this index was 0.971 at al-Khinziri station in September 2019 (Figure 9).

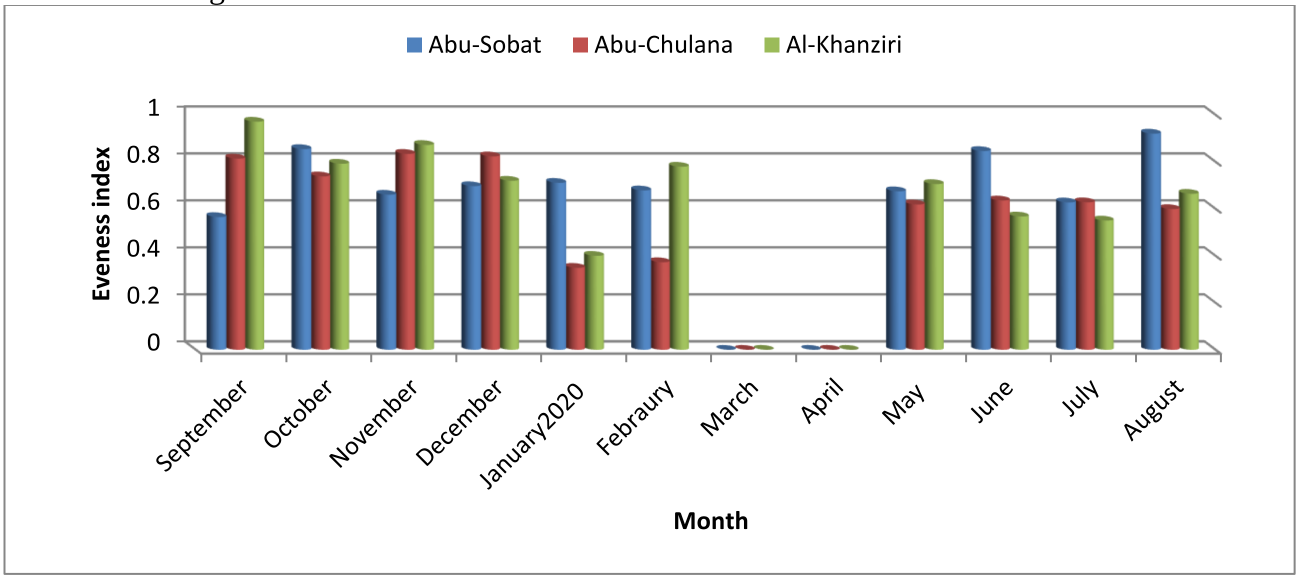

Figure (9): Monthly changes occurred to the evenness index for the three studied stations.

Richness Index (D):

The lowest value in the richness index was recorded at Abu Subatt station, was 0.2309 in November 2019, and the highest value was 1.412 at Abu Sobatt station in August 2020 (Figure 10).

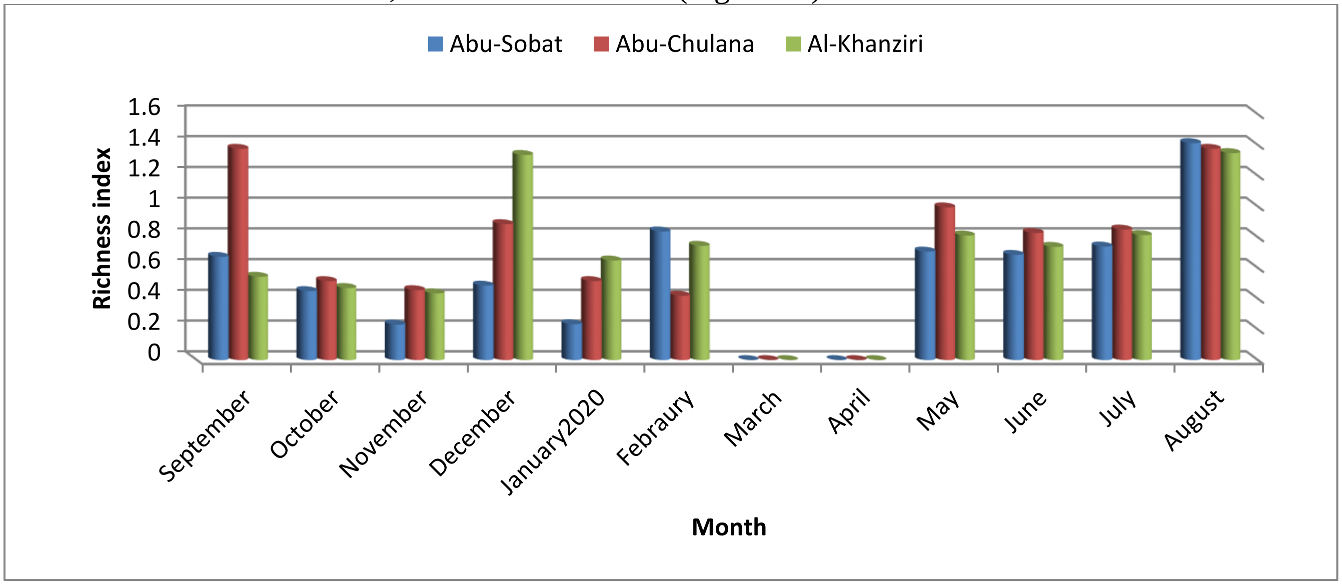

Figure (10): Monthly changes occurred to values of richness index for the three studied stations.

Dominance Index:

The lowest value of the dominance index registered was 0.2595 at Abu Subatt station in August 2020, and the highest value was 0.7777 at Abu Choolana station in February 2020 (Figure 11).

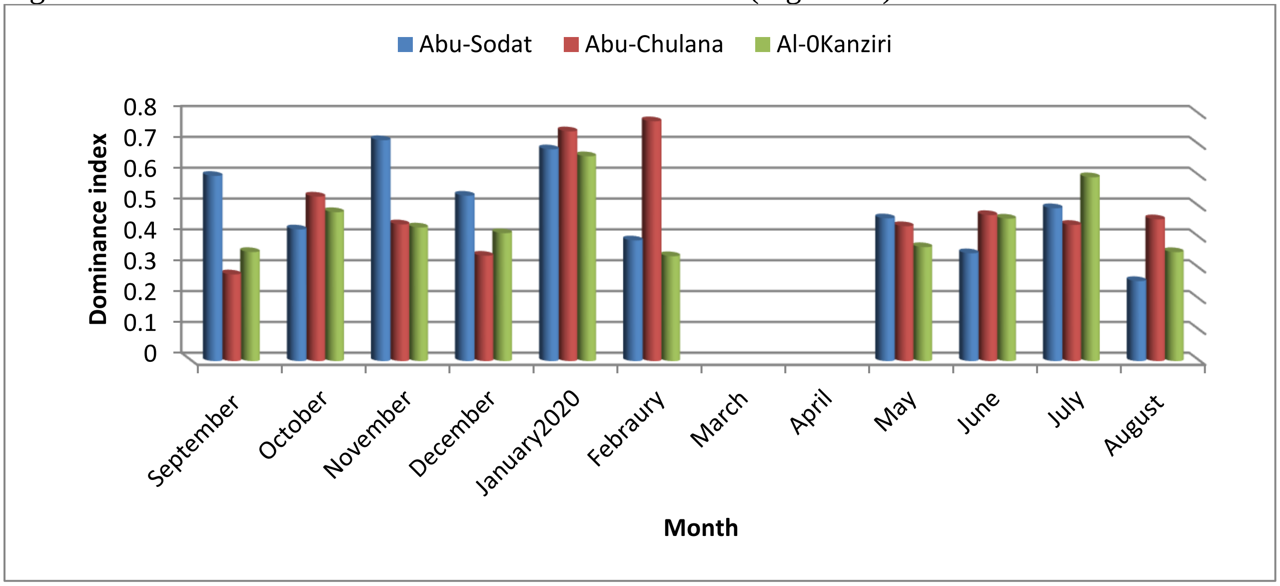

Figure (11): Monthly changes occurred to values of dominance index for the three studied stations

Discussion:

First of all, this group of species has received the interest of a big number of researchers in various fields. The seasonal changes in the dominance and biological diversity of the Mollusca community are associated with variations in the physicochemical properties of water.

It is worth mentioning that the study has made it clear that Mollusca plants are available in a high density on the submerged plants, unlike emergent plants. It is so because Mollusca prefers plants with complex leaves, and considers them as the best shelters to protect them from being preyed on by low-leaved plants (Irvine *et al*., 1990).and this shows on in this study.

Second, abundance represents the number of members of each taxonomic unit compared to the total number of individuals, where abundance gives information about the extent of the contribution of the number of individuals to the total living community. The second station recorded the highest numerical abundance, followed by the first station and then the third station. This has come in this way due to the different environmental factors affecting the abundance of Mollusca.

The fact that numerical abundance rises in winter and decreases in summer, it accounts for an inverse relationship between temperature and numerical abundance. The reason behind this lies in the fact heat is one of the most important factors in the aquatic environment. Once decreased, it leads to the inhibition of many vital activities of aquatic organisms such as growth, reproduction, movement, and nutrition. (Stewart and Garcia, 2002). As far as the fall of the abundance of Mollusca in summer is concerned, it is ascribed to the fact that Mollusca often appears in regions with a calm current and the nature of living through their climbing to aquatic plants (Nashat, 2009). It accounts for the fact that the current and high winds in summer may be the reason for the fall in the numerical abundance of the Class Gastropoda.

As for the environmental indices, it was found that Mollusca prefers regions with high densities of plants more than weak currents. This may explain what was come up with in this study, as the highest diversity was found in the Abu Subatt station, which was characterized by the high productivity of aquatic plants. The values of the indices varied, as the highest value was recorded during summer, and the lowest value was detected during winter. This result is inconsistent with findings achieved in a study carried out by Khalaf (2016). The reason is due to the different environments and the influence of environmental factors such as temperature, dissolved oxygen concentration, and the biological demand for oxygen (Wastson and Omerod, 2004).

Moreover, the study at hand recorded the highest value of evenness during September 2019 at al-Khinziri station, due to the presence of only three species, and their spread was equal. Whereas, the lowest value was made during January 2020 at Abu Choolana station, due to the presence of one species of Mollusca during this month as well as clear seasonal changes. This gives a clue to the balance between the number of different species and their individuals. Besides, the study brought to light results disclosing that the lowest value of the richness index was at Abu Subatt station in November 2019. This is due to the fall in the number of species in this month, as only two species were recorded as well as individuals being closely distributed. The highest value was recorded in August 2020 at Abu Subatt station. This may be attributed to the close distribution of individuals to species in this month's sample as well as the dominance of some species over other species in the sample.

In addition to the diversity of aquatic plants (floating, emergent, and submerged) that provide food and protection for Mollusca (Lana and Guiss, 1991), the values of this index went up during August due to the presence of a clear superiority of one species over the rest of the species. As for the low values of this index, they were recorded during February due to roughly the presence of all species with the same numerical abundance and dominance detected.

Conclusion

This research showed the diversity of Mollusca available in aquatic plants for three stations in the southern part of the Euphrates River. Nine species of Mollusca, of Class Gastropoda in the Euphrates River were recorded. The species *Radix auricularia* has registered the highest abundance. The highest population density was recorded on the *Ceratophyllum demersum* plant.

References

Ahmed, M.M. (1975). Systematic study on Mollusca from Arabian Gulf and Shatt al-Arab, Iraq, Basrah University. Iraq. 78 p.

Al-Mayah, A. A. (1994). Aquatic plants in the marshes of southern Iraq. The marshes of Iraq. Environmental Studies, Marine Science Publications, No. 18, 299 pages.

Berger, W. H., and Parker, F. L. (1979) Diversity of planktonic Foraminifera in deep-sea sediments. Science. 168: 1345 – 1347.

Frandsen, F. (1983). A field guide to freshwater snails in countries of the WHO

Eastern Mediterranean region. Danish Bilharziasis laboratory. 45pp.

Hussein, S. A. and Fahd, K. K. (2008). Seasonal changes in the concentration of nutrients and chlorine in the Garraf River, one of the main branches of the Tigris River in southern Iraq. Basra Journal of Science and Agriculture, 21 (special): 25-19.

Hutchinson, G. E. (1975). A treatise on limnology, Vol. 3. Limnological botany. Wiley, New York.

Irvine, K; Balls, H., and Moss, B. (1990). The entomostracan and rotifer communities associated with submerged plants in the Norfolk Broadland – effects of plant biomass and species composition. Internationale Revue der Gesamten Hydrobiologie and Hydrographie. 75 (2): 121 – 141.

Izzati, M. (2015). Salt Tolerance of Several Aquatic Plants. In Proceeding International Conference on Global Resource Conservation. (6); 1-10.

Khalaf, R. Z. (2016). Study of large benthic invertebrate communities in three different aquatic environments in southern Iraq, Ph.D. thesis, University of Basrah/College of Science/Department of Biology. 243 p.

Lana, P. and Guiss, C. (1991). Influence of *Spartina altrniflora* on the structure and temporal variability of macrobenthic associations in a tidal flat of Paranagua Bay (Southern Brazil). Ecol. Prog. Ser. 73:231-244.

Leftwich, A. W. (2004). Dictionary of Zoology. Asia Print Ograph, Shahdara Delhi .478 pp.

Margalefe, R. (1968). Perspectives in ecology theory. University of Chicago Press Chicago,111pp. Cited by Fausch, K. D.; Lyons, J.; Karr, R. and Angermeier. P.L (1990).

Mohan, D., Elumalai, V., Subbulakshmi, G., Jayalakshmi, S., & Srinivasan, M. (2013). Biodiversity of cultivable molluscan resources from Pulicat Lake, southeast coast of India. Arthropods, 2(2), 53.

Nashat, M. R., Al-Lami, A. and Radi, A. G. (2009). Biological diversity of benthic invertebrates' community in Yusufiya drainage basin - Iraq. The Third International Conference of the College of Science - University of Baghdad. 1198-1189.

Nomas, H. B. and A. A. H. (2017). Qualitative changes in the water of the Euphrates River between Nasiriyah and Qurna and its effects on development and the environment. Basra Studies Journal, Basrah University. Issue (16): 123-154 p.

Omori, M. and Ikeda, T. (1984). Methods in marine zooplankton ecology. Wily and Sons. New York. 103 pp.

Pielou, E.C. (1977). Mathematical ecology. John Wiley New York .385 pp.

Ponder, W. F. and D. R. Lindberg (Eds.) (2008). Phylogeny and Evolution of the Mollusca. Berkeley: University of California Press .481 pp.

Porto Neto, F. D. F. (2003). Zooplankton as Bioindicator of Environmental Quality in the Tamandare Reef System, Pernambuco, Brazil: Anthropogenic Influences and Interaction with Mangroves. ZMT. Bremen, Univertitat Bremen.

Raven, P. H. and G. B. Johnson (1986). Biology. Times Mirror / Mosby College Publishing, United States of America, 755-759 pp.

Reid, G. K . (1961). Ecology of inland water and estuaries. Rhiem hold crop New york. 375 pp.

Romos, S.; Cowen,R .K .; Re, P. and Bordalo, A.A. (2006) Temporal and Spatial distribution of Larval fish assemblages in the Lima estuary (Portugal). Estuarine, Coastal and Shelf Science .66:303 -314. Aquat.Sci. 52:2229-2237.

Schmid-Araya, J. M. (2000). Invertebrate recolonization patterns in the hyporheic zone of a gravel stream. Limnology and Oceanography, 45(4), 1000–1005. https://doi.org/10.4319/lo.2000.45.4.1000

Shannon, C. E. and Wiener, W (1949). The Mathematical Theory of Communication Urbana University of Illinois Press, Chicago, USA: 117pp.

Siracusa , G. and La Rosa , A.D. (2006) . Design of a constructed wetland for wastewater treatment in a Sicilian town and environmental evaluation using the emergy analysis. Ecological modeling, 197(4); 490-497.

Stewart, T. W., and Garcia, J. E. (2002). Environmental factors causing local variation in density and biomass of the snail *Leptoxis carinata* in Fishpond Creek, Virginia. American Naturalist. 148: 172-180.

Subba Rao, N.V. (1993). Freshwater Molluscs of India. In: Rao K.S. (Ed). Recent Advances in Freshwater Biology. New Delhi. Anmol Publication .2: 187 – 202.

Watson, A. M .and Omerod, S. J. (2004). The micro-distribution of three uncommon freshwater Gastropoda in the drainage ditches of British grazing marshes. Aquatic Conservation. Marine and Freshwater Ecosystems. 14(3): 221-236.

تنوع النواعم في الجزء الجنوبي من نـهر الفرات

هدى حليم جاسب و رغد زيدان خلف

جامعة البصرة ، كلية العلوم ، قسم البيئة

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المستخلص

تم دراسة تنوع النواعم المتوفرة مع النباتات المائية لثلاث محطات في الجزء الجنوبي من نهر الفرات شملت أبو سوباط وأبو جولانة والخنزيري من سبتمبر 2019 إلى أغسطس 2020. تضمنت الدراسة حساب بعض المتغيرات الفيزيوكيميائية في هذه المحطات. أظهرت نتائج التحليل الإحصائي ANOVA وجود فروق إحصائية بين المحطات ($p < 0.05$) فيما يتعلق بالعكارة والشفافية والنترات ، بينما لم تسجل أي فروق بين المحطات فيما يتعلق بدرجة الحرارة ، والاس الهيدروجيني ، والملوحة ، والأكسجين المذاب ، و الفوسفات.

تم تسجيل تسعة أنواع من النواعم من صنف Gastropoda في نهر الفرات. سجل *Radix auricularia* أعلى وفرة عددية شهرية وسنوية 66.34 - 87.39٪ على التوالي. سجلت أعلى كثافة في نبات *Ceratophyllum demersum* ، 3.94 فرد / م ^{2}. أما بالنسبة للمؤشرات البيئية ، فقد سجلت أعلى قيمة تنوع في محطة أبو سباط بلغت 1.481 خلال شهر أغسطس 2020 ، وأعلى قيمة لمؤشر الغنى كانت 1.412 خلال شهر أغسطس 2020 ، وأعلى قيمة لمؤشر التكافؤ كانت 0.971 خلال شهر سبتمبر 2019 ، بينما سجل مؤشر السيادة أعلى قيمة بلغت 0.777 خلال شهر فبراير 2020.