



Abundance and Diversity of Mollusks and Related to Some Physicochemical Properties in Euphrates River in Al-Muthanna Province

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Abstract: Study was conducted to identify the composition of mollusks in relation to some physical-chemical parameters of the Euphrates river during the period from November 2019 to October 2020. The water temperature ranged between 11.33-38.67 °C. The highest mean of electrical conductivity was 3026.6 μS/cm, whereas the lowest was 1203.3 μS/cm. The maximum TDS was 2766.6 mg/l. The water flow was ranged from 0.133 to 0.426 m/sec. The turbidity ranged between 11.59 and 134.63 NTU. TSS recorded the highest mean of 36.66 mg/l and lowest of 21 mg/l. The pH values ranged between 6.63-8.60 and the concentrations of DO and BOD₅ between 5.15-10.10 and 1-12.33 mg/l, respectively. TA, TH, Ca²⁺, and Mg²⁺ were within 131.33-181.66, 423.33-1386.6, 125-320 mg. The NO₂⁻, NO₃⁻ and PO₄³⁻ varied between (0.03-3.05, 0.053-6.890 and 0.06-0.77 μg l⁻¹, respectively). The TOC ranged between 0.055-3.12 % and type of texture was silty in all stations. The study revealed the occurrence of 6 species of Mollusks with total density of 242.84 Ind./m². The relative abundance index, showed that the species *M. nodosa* was dominant and *C. fluminalis* less abundant. The Shannon-Weiner and Simson diversity indices ranged between 0.39-2.95 and 0.1-0.93, respectively.

Keywords: Physicochemical properties, Biodiversity, Euphrates river, Mollusks, Samawa.

Freshwater constitutes 3% of the total water on earth and the rivers as a freshwater source are complex systems containing rich diversity of living species which are in close interdependence with their surrounding physical environment (Brachet 2015). Among the organisms in the rivers, mollusks are the major grazers and playing a pivotal role in aquatic food webs, significantly influence algal primary productivity, nutrient cycling, water purification, and provide valuable information by their presence, absence, and abundance regarding their surrounding habitat and can be used to assess the local environmental impact. Freshwater mollusks are perfect organisms for rapid biological survey due to their sensitivity to changes in the environment and water quality and capacity for water filtering (Cummings 2016). The deterioration of physical and chemical water quality is often caused by human influences gradually, and the invisible adaptations of aquatic ecosystems to these changes may not always be discovered until a major transformation in the state of the ecosystem occurs (Stark et al 2000). These systems should be continuously monitored by assessing the species of organisms or measuring some physical and chemical properties. The current study was designed to study monthly variation in physicochemical parameters, which affect the abundance and diversity of Mollusk in the study area.

MATERIAL AND METHODS

Study area: The study area included three sampling sites located on a Euphrates river at Al-Muthanna province. Al-Muthanna province is located about 270 km south of Baghdad, the capital of Iraq. The first site located in Al-Hilal area (31°42'40.34"N- 45°45'11.16"E), while the second site about 34 km south of the first site (31°31'49.46"N- 45°29'72.79"E), in the city center of Samawa near Al-Shuhada Bridge, and the third site located about 16 km south of the second site (31°29'31.17"N - 45°45'63.35"E) (Fig. 1).

Sampling procedures: The study was conducted monthly from November 2019 to October 2020. Water samples were taken for physical and chemical parameter analysis. Water temperature (°C) was measured and water flow (m /sec) directly using the float method mentioned (US EPA (1997)). Electrical conductivity (μS/cm) and pH were estimated by using a portable Multimeter (SM801). Alkalinity was measured by the titration method (Estefan et al 2013) and reactive phosphate, nitrate, and nitrite were estimated according to Nollet (2014). Total dissolved solids were measured by an evaporation method, total dissolved solids were measured by gravimetric method (APHA (2017)). The total hardness, Ca hardness, Mg and dissolved oxygen were measured by using a titrimetric method (APHA 2017). Biological oxygen demand (BOD₅) measured by sensor method (Al-Fanharawi et al 2019). The turbidity was

measured in the field by turbidity meter, type Hanna (WTW-Turb-550). Sediment samples were collected for analysis the total organic carbon (Estefan et al 2013) and grain size analysis was carried out by using the standard sieving and pipet techniques (Folk 1974).

Mollusks were also sampled monthly using Vanveen Grab Sampler monthly (Al-Fanharawi 2010). Mollusks have been identified according to Plaziat and Younis, (2005) and Damborenea et al (2020). Mollusks were grouped by species and density determined (Ottensmann 2018) and expressed as individual/m². Relative abundance was calculated (Baderan et al 2019). Shannon-Wiener diversity (H') counted according to Baderan et al (2019) and Simpson's diversity as mentioned by Vajravelu et al (2018).

RESULTS AND DISCUSSION

Physical parameters: The highest water temperature was 38.67 °C at St.3 in July and the lowest 1.33°C at St.1 in February (Table 1). The monthly fluctuation in the water temperature was due to a long day period in the summer and the short day period in winter. The spatial variations in water temperatures may be due to the difference in the time of collection of the sample at each station. The highest value of electrical conductivity (EC) was 3026.6 μS/cm recorded in July at St.3, while lowest mean value 1203.3 (μS/cm) was in November at St.1 (Table 1). The highest values of electrical conductivity may be due to higher temperatures, which lead

to an increase in the solubility of the salts in addition to an increase in evaporation and an increase in the concentration of salts. Najafpoor et al (2007) indicated that highest electrical conductivity depends on the amount of total dissolved solids in water, which have the highest value of 2766.6 mg/l during July in St.2, while the lowest value 833.3 mg/l during November in St.1. The high concentrations of TDS may be due to higher temperature leads to high rates of evaporation that an increase of salt concentrations (Al-Fanharawi 2010). The highest mean water flow was 0.426 m/sec recorded in June at St.2, whereas the lowest value

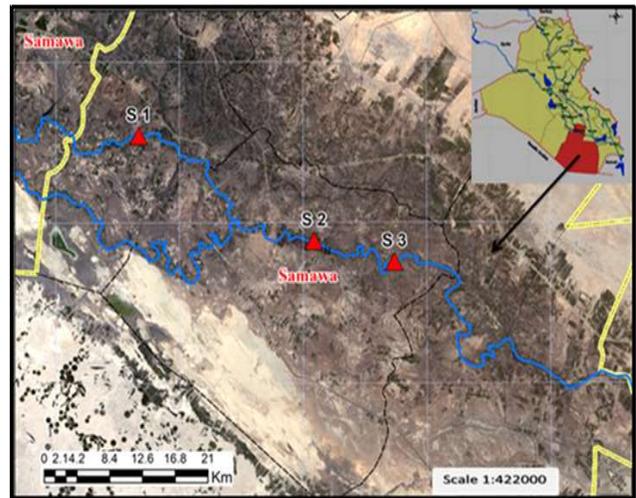


Fig. 1. Sampling site on Euphrates River

Table 1. Physical and chemical parameters in Euphrates river (Mean ± standard deviation)

Stations/Parameters	St.1	St.2	St.3
Water temperature (C°)	25.06±8.88A	23.44±8.74A	21.92±8.53A
Electrical conductivity (μS/cm)	2032.7±548.7A	1988.8±492.8A	1810.5±486.2B
Total dissolved solids (mg/l)	1794±512.4A	1753.0±517.3A	1541.9±512.5B
water flow (m/sec)	0.236±0.065C	0.340±0.084A	0.266±0.073B
Turbidity (NTU)	40.17±29.33A	42.40±31.43A	29.74±19.27B
Total suspended solids (mg/l)	83.80±26.13A	8.16±25.63B	43.50±19.14C
pH	7.73±0.05A	7.76±0.05A	7.66±0.15A
dissolved oxygen (mg/l)	6.70±0.90B	7.23±0.99B	7.85±1.24A
biochemical oxygen demand (mg/l)	7.11±2.98A	6.19±2.93B	4.66±2.48C
Total alkalinity (mgCaCO ₃ /L)	153.63±12.57	153.00±14.72	154.47±16.59
Total hardness (mgCaCO ₃ /L)	869.44±241.1A	815.83±208.4AB	761.94±175.2B
Calcium hardness (mgCaCO ₃ /L)	185.58±50.99	175.02±37.04	162.13±30.95
Magnesium (mg/l)	165.77±46.91A	156.85±42.77AB	145.76±35.76B
Nitrite (μg/l)	1.136±0.889A	1.121±0.883A	0.993±0.7A
Nitrate (μg/l)	4.152±2.226A	3.481±0.184B	3.017±1.816C
Reactive phosphate (μg/l)	0.340±0.211A	0.295±0.178B	0.238±0.142C

Different capital letters in row indicate significant difference in parameters between stations

0.133 m/sec recorded at St.1 (Table 1). The highest mean water flow in St.2 may be due to narrowing of the river at this station, and that the velocity of the river can change at various stations along the course of a river due to the shape, the lowest mean value in St.3 attributed to the presence of aquatic plants that delayed water flow. The highest turbidity and total suspended solids values were in October were 134.63 NTU and 136.66 mg/l, respectively. This may be due to the increased discharge of water into the Euphrates River, which flows with a high suspended matter content (Rabee et al 2011) and the lowest values were recorded in November at St.1 was 11.59 NTU and 21 mg/l respectively and may be due to the presence of aquatic plants (Noaman 2008).

Chemical parameters: The pH of water in the current ecosystem can be classified as slightly alkaline, the higher pH was in February at St.2 (6.63-8.6). This may be due to reduced microbial activity, improved algal productivity and the decreased decomposition (Sisodia and Chaturbhuj 2006). The low pH in July may be due to an increased rate of decomposition, leading to acidification (Ahipathy and Puttaiah 2006). The minimum of dissolved oxygen (5.15 mg/l) and higher levels of biological oxygen demand (12.33 mg/l) was in July (Table 1). The high BOD₅ may be due to the high decomposition processes of microbial organisms due to the height of the temperature Arimoro et al (2006) and these processes require the consumption of high concentrations of dissolved oxygen that lead to low DO. The highest alkalinity, total hardness, calcium hardness, and magnesium were in July (181.66, 1386.6, 320 mg CaCO₃/L and 259.2 mg/l) respectively. The high alkalinity attributed to the relationship between total alkalinity and total hardness, through common ions formed in aquatic systems, carbonate, and bicarbonate are the principal cations responsible for hardness are ions associated with alkalinity (Burton Jr and Pitt 2002). The higher total hardness, calcium hardness, and magnesium, maybe due to low water level and high rate of evaporation and decomposition that concentrating the salts (Mossa 2006).

The highest mean nitrite 3.05 µg/l was at St.2 in December, while the lowest 0.03 µg/l was at St.3 in July. Low levels of nitrite concentration may be related to a complex of biological processes, including the oxidation of nitrite as an unstable form of nitrogen to nitrate by nitrifying bacteria (Abdo and El-Nasharty, 2010). The highest mean nitrate was 6.890 µg/l in July and this may be due to deep ground waters with high nitrate concentrations which is important source of nitrate in surface waters (Tesoriero et al 2013). The lowest mean was 0.053 µg/l in January due to the high water level of the river and the dilution factor that effect on concentrations (Al-Fanharawi 2010). The highest reactive phosphate was

0.77 µg/l in July at St.3 due to the increasing water temperature, which causing increasing the degradation of organic matter containing phosphate compounds, including algal cells, or may be due to phosphate fertilizers used to fertilize agricultural land and discharged to the river and this agree with Mokaya et al (2004), while lowest mean of reactive phosphate was at St.1 (0.060 µg/l) and may be due to location of station more distant from the effluent discharge point.

Sediment samples: Sediment analysis in the present study showed that the lowest value of TOC % in sediments (0.055 %) was in June, while the highest (3.12 %) was at St. 3 in October (Fig. 2). The highest value may be due to contamination of this station with organic pollutants due to the direct discharge of domestic wastewater to the river (Zhibo et al 2009). Grain size analysis of sediment showed that the sediment texture of the three indicates silt, clay and sand as 90, 5 and 5%. According to the soil textural triangle, the sediments of the Euphrates River on sites can be considered as silty.

Identification and population mollusks: In the current study, from 577 individuals of Mollusks, identified 6 taxa belonging to 5 families, 3 orders, and 2 classes (Gastropoda and Bivalvia) in three sites on Euphrates river. Bivalvia class (3 species) comprised the orders Unionida (*U. tigridis*), and Veneroidea (*C. fluminea*, and *C. fluminalis*), whereas the class Gastropoda (3 species) comprised one order Mesogastropoda were *M. tuberculata*, *M. nodosa*, and *V. bengalensis*.

Density of Mollusks: The highest mean of mollusks density was in St.2 was 390.4 Ind./m² and this may be due to the

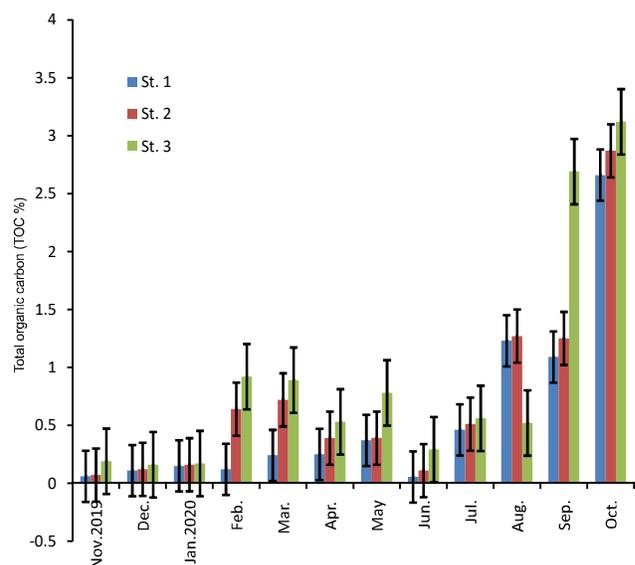


Fig. 2. Monthly variation in total organic carbon values in Euphrates river during study periods

effect of Al- Shuhada Bridge. Blettler and Marchese (2005) also showed the effect of bridges on the benthic invertebrates. The mollusks and found that the species density was highest under the bridges than upstream and downstream, while the lowest mean recorded in St.1was 127.52 Ind./m²(Table 2).

Ecological indices: The relative abundance of species varied between study stations, St.2 was the most abundant among while St.1 was less abundant (Fig 3-A). The species *M. nodosa* was the most abundant species (75.79%), followed by *C. fluminea* (8.07%), *V. bengalensis* (6.81%), and *M. tuberculata* (6.37%), *U. tigridis* (2.59%), whereas *C. fluminalis* (0.37%) was the less abundant species. Shannon-Wiener diversity index indicate lowest monthly diversity of

mollusks was 0.39 in August (Fig. 3A). This may be due to a combination of abiotic factors, including, low water flows and temperature increase, while the highest value of 2.95 was in October, may be due to the rapid migration of these organisms. Bishop et al (2009) reported that the rapid migration of mollusks reflects the behavioral response from them or may be due to the effect of temperature, the presence of vegetation cover nutrition as key factors for the success and the development of certain species. Badsı et al (2010) observed that highest organic carbon in sediment was in October. Sharmin et al (2019) reported that the lowest species diversity associated with low sediment organic carbon and low sediment organic matter. The highest value of Simpson index was 0.93 in October and may be due to the higher TOC recorded in this month, or may be due to the appropriate temperature and present the plant cover, while the lowest value was 0.1 in April (Fig. 3A).Two indices (Shannon-Wiener diversity and Simpson diversity)agreed on recording the same highest and lowest in the same stations St.1 and St.2 respectively (Fig. 3B).The lowest diversity in St.2 may be due to lack of evenness of species and decreases in the species richness, this due to the dominance of a few species with high densities, while that the opposite of what was onthe St.1 was have the highest richness of species. Kimbro (2006) reported that diversity depended on two major components, richness, and evenness of species.

Table 2. Total density of mollusk species in Euphrates river (Ind./m²)

Stations/ Months	St.1	St.2	St.3
Nov. 2019	30.3	75.75	75.75
Dec.	30.3	45.45	60.6
Jan.2020	45.45	30.3	45.45
Feb.	75.75	15.15	121.21
Mar.	90.9	60.6	75.75
Apr.	90.9	136.36	121.21
May	151.5	121.21	121.21
Jun.	90.9	212.12	136.36
Jul.	90.9	1015.15	454.54
Aug.	106.06	1045.45	45.45
Sep.	345.45	1163.63	651.51
Oct.	381.81	763.63	618.18
Means	127.52	390.4	210.6

CONCLUSION

1. The highest mean of most physicochemical parameters (electrical conductivity, total suspended solids, biological oxygen demand, total alkalinity, total hardness, calcium hardness, nutrients, and total organic carbon) was recorded at outside city center St.3.

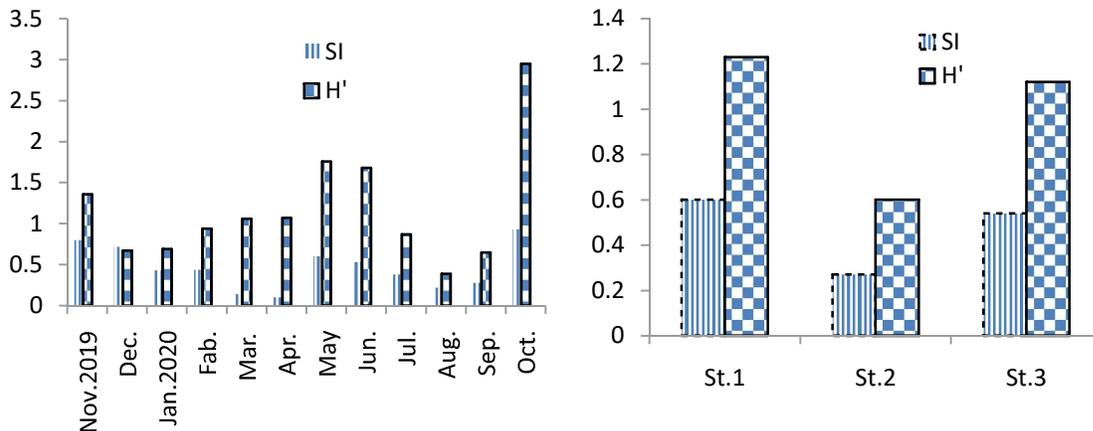


Fig. 3. Simpson and Shannon-Weiner diversity indices values of Mollusks species in stations in Euphrates river A- Monthly variation; B: Variations between stations

2. The values of density, relative abundance, and diversity (Shannon-Weiner and Simpson diversity indices) of mollusks, were impacted by total organic carbon, water flow, and temperatures.
3. The current study showed the species *M. nodosa* was the most abundant species in all stations during the study periods, while the species *C. fluminalis* was the less abundant species.
4. When more indices are used to assess the diversity, which gives a more accurate and clear picture, the two diversity indices (Shannon-Weiner and Simpson indices) agreed that the highest and lowest values were recorded in the same stations.
5. Biological diversity index showed that Euphrates river in the study area was low diversity, according to the Shannon-Weiner diversity index <1.

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