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Monthly Changes of Some Nutrient and other Ecological Factors in the Shatt Al-Arab River South of Iraq

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Abstract - This study was conducted to find out the changes in the nutrient and other ecological factors in Shatt Al- Arab River's waters at three sites, which are Al-Hartha, Al-Ashar and Al-Seba. Samples were collected monthly starting from October 2020 to September 2021. It was noted through the study that there were spatial and temporal changes in the nutrient and other indicators in the three Sites. It was found that all the values were within normal standards. The results of measurements of the nutrients and other ecological factors were as follows: The reactive phosphate 0.01 - 1.19 µg/L, reactive nitrite 0.4-9.8 µg/L, reactive nitrate 0.1-14.65µg/L, while the reactive silicate fluctuated between 1.67-15.49 µg/L. Water temperature 14.7-31.4 C°, pH was 7.12-8.16, salinity between 0.1 and 22.1 mg/L, dissolved oxygen 3.4-11.1 mg/L.

التغيرات الشهرية لبعض المغذيات والمؤشرات البيئية الاخرى في نهر شط العرب جنوب العراق

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المستخلص - أجريت الدراسة لمعرفة التغيرات الشهرية في بعض الأملاح المغذية والمؤشرات الأخرى في مياه نهر شط العرب جنوب العراق في ثلاثة مواقع على طول امتداد النهر هي الهارثة والعشار والسيبة. تم جمع العينات شهرياً ابتداء من أكتوبر 2020 وحتى سبتمبر 2021، لوحظ من خلال الدراسة وجود تغيرات مكانية وزمانية في الأملاح المغذية والمؤشرات الاخرى في المواقع الثلاثة، وقد وجد أن جميع القيم كانت ضمن المعايير الطبيعية. وبينت النتائج ان الفوسفات الفعال تراوح بين 0.01 - 1.19 ميكروغرام/ لتر، النتريت الفعال تراوح بين 0.4 – 9.8 ميكروغرام/لتر، النترات الفعالة تراوحت بين 0.1 – 14.65 ميكروغرام/لتر، بينما تراوحت نسبة السليكا الفعالة بين 1.67 -15.49 ميكروغرام/لتر. وتراوحت درجة حرارة الماء بين 14.7- 31.4 درجة مئوية، وتراوح تركيز أيون الهيدروجين بين 7.1 – 8.16 والملوحة بين 0.1 – 22.1 ملغرام/لتر، وتراوح تركيز الأكسجين المذاب بين3.4 - 11.1ملغرام/لتر.

الكلمات المفتاحية: مؤشرات بيئية، مغذيات، نهر، شط العرب.

Introduction

The Shatt Al-Arab River has an economic and environmental importance, especially as it is the vital artery of the city of Basra. In the last two centuries, the city witnessed a wide renaissance in the economic and urban fields. This development must produce some impacts on the environment in general and pertaining to the Shatt Al-Arab in particular (Al-Waeli and Athib, 2021). Therefore, studies aimed to determine the basic concentrations of the chemical and physical indicators that are of particular importance at this stage, especially since the development in all the aforementioned fields are still continuing and accompanied by a noticeable increase in the population (Alhello *et al.*, 2019).

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The Shatt Al-Arab River is considered as one of the internal rivers in Iraq, as it is the main resource for many commercial, industrial and agricultural uses in Basra Governorate.

The river is directly affected by many factors, including the quality and quantity of the flowing water to it from the Tigris and Euphrates Rivers (Jawed, 1994). Water is the most important natural resource on the surface of the globe, and wherever there is water, civilization is found. Fresh water constitutes 2% of the land area and it is the most crucial natural resource to maintain life (Pesce and Wunderlin, 2000). Water pollution leads to severe damage with grave dangers to living organisms, and thus a disruption of the environmental balance occurs (Alhello *et al*., 2019). The process of preserving fresh water resources is one of the most significant issues facing the world, so monitoring programs are required to protect these sources from pollution (Al-Mahmood and Mahammad, 2019).

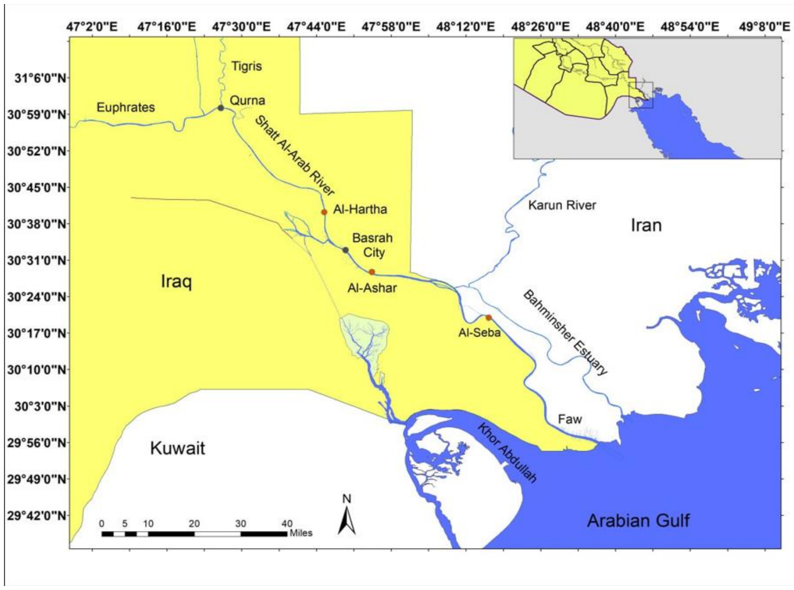
This study will provide information on the values of nutrient salts and other relevant indicators in the Shatt Al-Arab River's waters, and the extent to which it is affected by human activities.

Materials and Methods

Three sites were chosen to collect water samples monthly along the Shatt al-Arab River (Figure 1). The sites were determined using the Geographic Positioning System (GPS), and these are Al-Hartha, Al-Ashar and Al-Seba. Samples were collected from October 2020 until September 2021. The one-liter polyethylene bottles were used to collect samples of nutrient salts (phosphates, nitrites, nitrates and silicate) after washing them with water from the same site, then they were filled to their full capacity and one drop of chloroform was added to reduce its effectiveness. Then all of them were set in an ice box until they reach the laboratory. Laboratory analyses and measurements were implemented in accordance with the method outlined in APHA (2005). As for temperature, pH and salinity, they were measured by multi parameter model 340i). Winkler bottles at capacity of 125 ml, were used to take samples of water for measuring dissolved oxygen, three replicates from each site were taken.

(Table 1) shows the coordinates of the sample collection sites

Coordinates		Sites	
N	E		
30.6 49 62	47.7 60 43	Al-Hartha	St1
30.5 20 52	47.8 42 58	Al-Ashar	St2
30.3 38 81	48.2 59 01	Al- Seba	St3

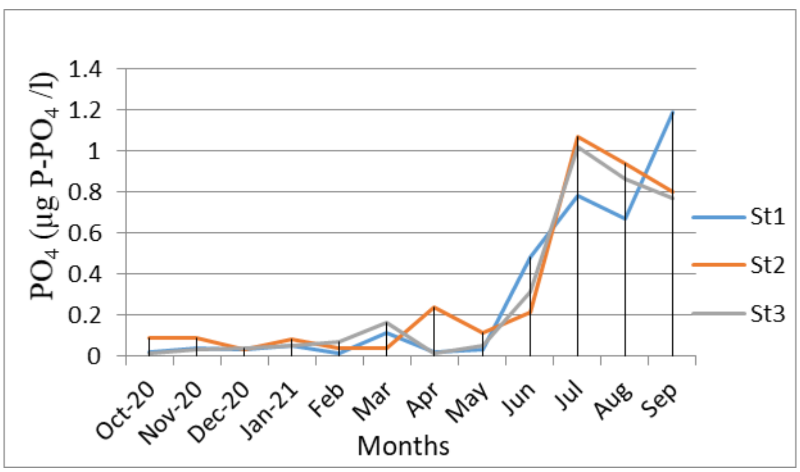


(Figure 1) A map showing samples collection Sites

Results

Reactive Phosphate

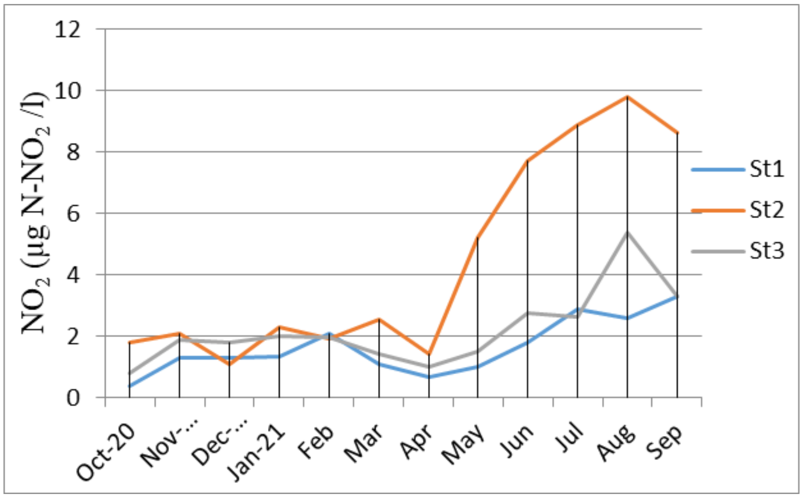
Results indicated that the lowest value of the reactive phosphates accurred in February at Al-Hartha site, and in October and April at Al-Seba site, amounted at 0.01 µg / L, for each of them, whereas the greatest value was recorded during September at Al-Hartha site, which reached 1.19µg/L. Figure 2.



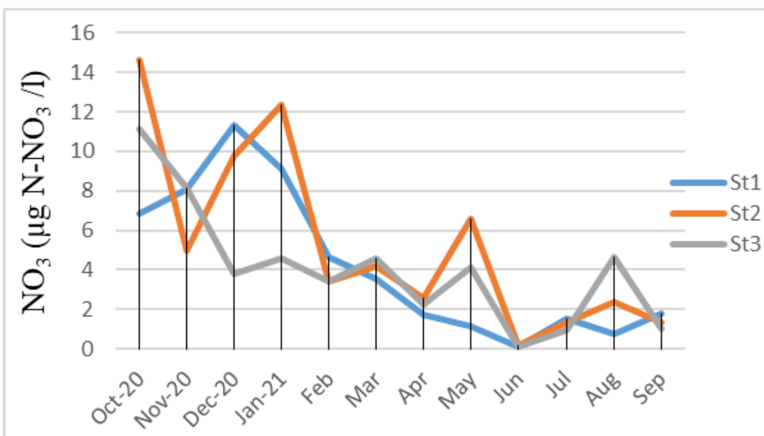
(Figure 2) Monthly variations in reactive phosphate at all sites in the Shatt Al-Arab River.

Reactive Nitrites and Reactive Nitrates

Findings showed the lowest value for reactive nitrites was recorded at Al-Hartha site during October 0.4 µg/L, While the highest value was recorded at Al-Ashar site during August 9.8 µg/L Figure 3. Also the study demonstrated the lowest values of reactive nitrate during June and for all sites, reach to 0.12 µg/L, 0.18 µg/L, and 0.1 µg/L, for Al- Hartha, Al- Ashar, and Al- Seba sites, respectively, while it the highest values for it Al-Ashar site, 14.65 µg/L was reported in October Figure 4.



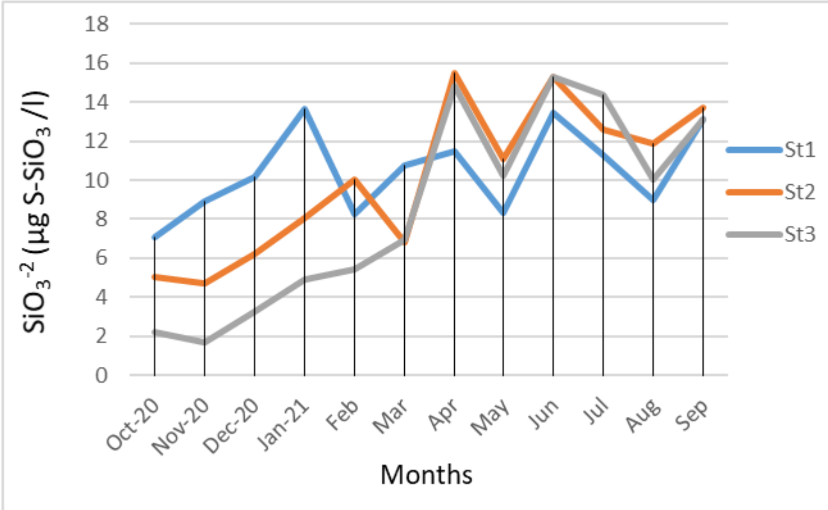
(Figure 3) Monthly variations in the reactive nitrite concentrations (NO_2) at all sites in the Shatt- Al-Arab River.



(Figure 4) Monthly variations in the reactive nitrate concentrations (NO_3) at all sites in the Shatt Al-Arab River.

Reactive Silicate

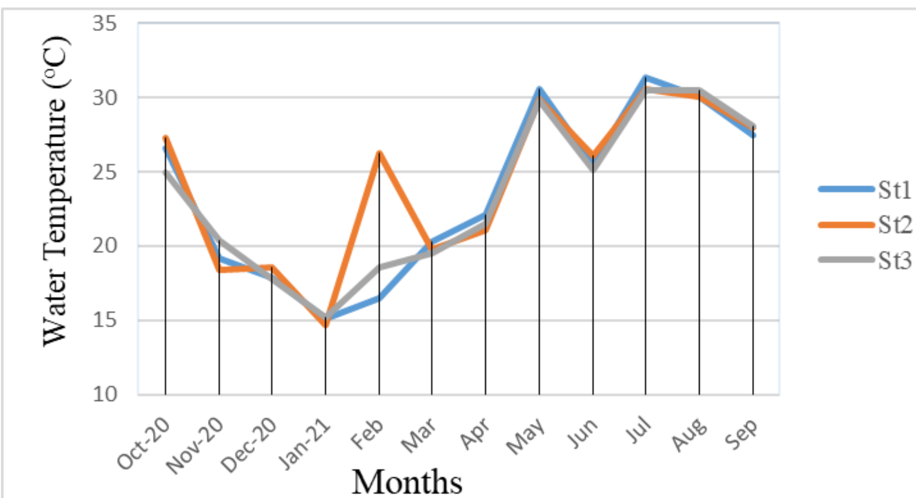
Figure 5 showed that the lowest value of reactive silicate during November and October at Al-Seba site, reach to 1.67 µg/L and 2.23 µg/L, respectively, while the highest values were observed at the Al-Ashar site during April and June, amounted at 15.49 µg/L and 15.31 µg. /L, respectively. However, Al-Seba site recorded a high value during the month of June, 15.32 µg /L.



(Figure 5) Monthly variations in the reactive Silicate concentrations (Sio3) at all sites in the Shatt Al-Arab River.

Water Temperature

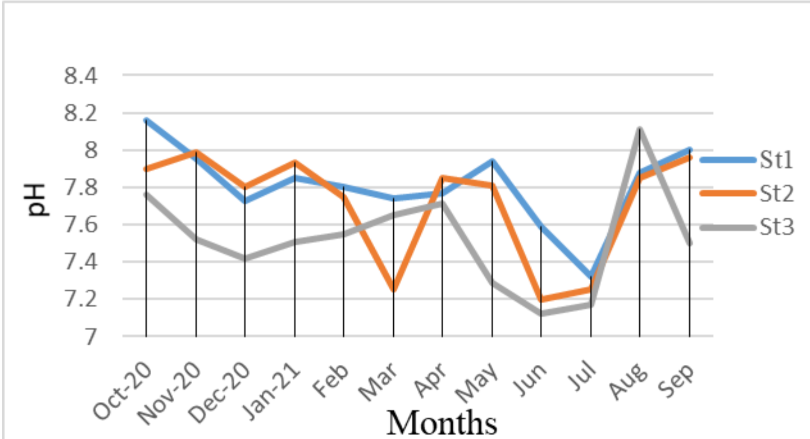
The minimum temperature for water in Al-Ashar site appeared in January at 14.7 C◦, while the highest temperature in July at Al-Hartha site, 31.4 C˚. Figure 6.



(Figure 6) Monthly variations in the Water temperature at all sites in the Shatt Al-Arab River.

Hydrogen Ion (pH)

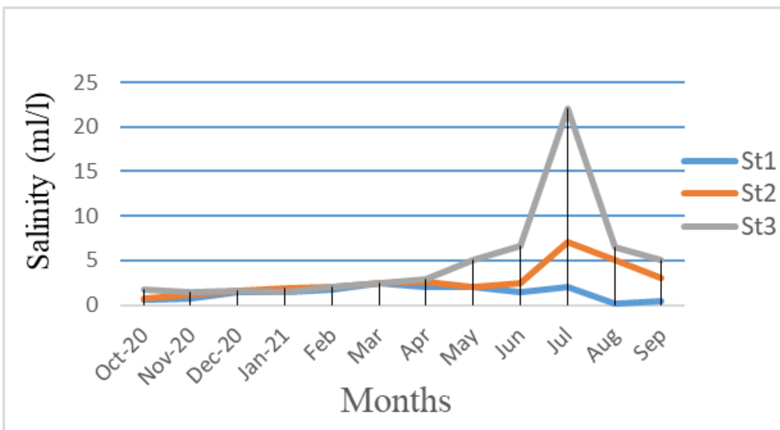
The pH levels ranged from 7.12 to 8.16 at Al- Seba and Al-Hartha, during June and October, respectively (Figure 7)



(Figure 7) Monthly variations in the Hydrogen ion concentration (pH) at all sites in the Shatt Al-Arab River.

Salinity

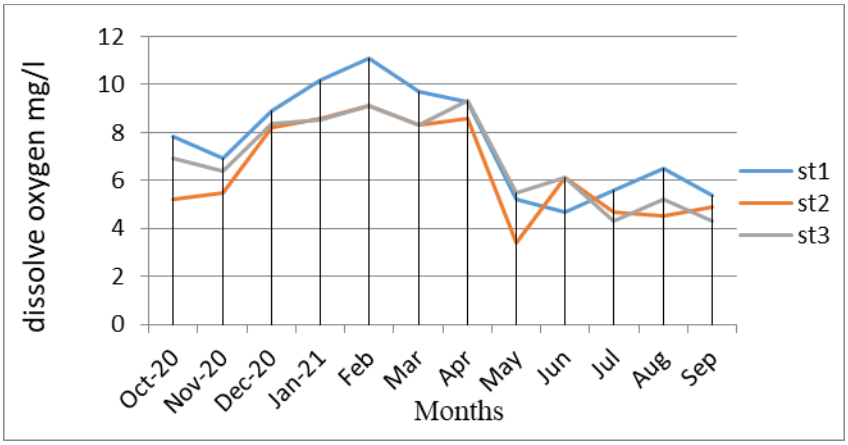
The results indicated in Figure 8 that the least worth of salinity noticed in Al- Hartha site during August 0.1 mg/L while the highest value was in the Al- seba site for July 22.1 mg/L.



(Figure 8) Monthly variations in the Salinity at all sites in the Shatt Al-Arab River

Dissolved Oxygen (DO)

According to the findings, the lowest value of dissolved oxygen was 3.4 mg/L at Al-Ashar site during May, and the highest value was recorded at Al-Hartha site in February 11.1 mg/L Figure 9.



(Figure 9) Monthly variations in the dissolve oxygen concentration at all sites in the Shatt Al-Arab River.

Discussion

The Nutrient Salts Sources of Nutrients in the Shatt Al-Arab River

The small rivers and irrigation canals linked to the River Shatt Al- Arab is natural or artificial sources of nutrients and pollutants along the course of the River, and these canals differ in the sources of their supply of nutrients. Some of their waters mixed with sewage water, and some of them mixed with water of agricultural lands. Eventually these waters reached the main course of the river and mixed with it. (Lateef *et al.*, 2020)

Excess phosphate may have accumulated in the water from the land as an organic and inorganic matters. It can also work with decomposing plants as internal water column sources of nutrients (Colon, 2017). However, any increase in the phosphate concentrations in the water could lead to the phenomenon of nutritional enrichment (Sharpley, 2001). The results indicated that the highest concentrations of reactive phosphates were in the hot months, June, July, August and September, and that their rise during these months may owing to the lack of discharges being transported by the Tigris River and the increase in the evaporation processes due to high temperatures, which led to an increase concentration (Al-waeli, 2021). as well as a lack of the activity of phytoplankton at this period and the liberation of quantities of phosphorus from the bottom due to the strong currents and the death of phytoplankton and their decomposition (Valdes and Real, 2004), or as a result of the escalation of human activity and their disposal of wastewater laden with many compounds rich in phosphates, such as washing powders, and water of draining agricultural lands rich in phosphate fertilizers (O' Hare *et al.*, 2018), While its low concentrations in the other months may be due to the increased activity of phytoplankton and aquatic plants that consume it during their growth and reproduction processes, as well as the increase in water levels in winter and spring, which decreased its concentrations.

Nitrite is formed as a by-product of the oxidation and reduction processes, and it is an unstable compound that results from the oxidation of ammonia or the reduction of nitrates (Eddy and Williams, 1986; Stiriling,1985). It is also one of the components of the nitrogen cycle in nature, and its high concentrations in water are toxic to living organisms (Kroupova *et al*., 2005). Nitrite and nitrate have an essential and important role in the abundance of phytoplankton (Pilkaityte and Razinkovas, 2007), and that one of their sources in the Shatt Al-Arab River may be the decomposition of dead organisms in the side branches of the Shatt al-Arab River (Al-Waeli, 2021) or melting atmospheric nitrogen gas directly into the water and convert it into another form (Dewald *et al*., 2020). It was observed through the results that most of the large quantities of nitrite were recorded during the summer and autumn, from June to September. On the other hand, it was observed that was during these months a decrease in the nitrate values was observed during these months, with an increase in its values during October to February Figures 3and 4. While, a clear reduction in the level of dissolved oxygen was observed in the summer months, which may explain the correlation between the values of nitrite, nitrate, and dissolved oxygen. This is due to the high water temperature during the summer months, which led to an increase in the process of reducing nitrates to nitrites (Hussein *et al*.,1991). The decrease in the oxygen concentration leds to an acceleration of the reduction process, as well as to an increase in the activity of microorganisms such as bacteria and fungi in the hot months, which decompose dead organic matter and release nitrite (Hassan, 2004). Also, the significant increase in the nitrite and nitrate values in the Al-Ashar site may be due to the large number of channels linked to the River Shatt Al-Arab in that region, like that Al-Khoura, Al-Ashar, and Al-Dakir, which flow into the Shatt Al-Arab River, carrying large quantities of household wastes and nutrient-rich sewage waters. The results showed differences in the nitrite values between seasons and Sites, as it was high in summer and low in winter and autumn for almost all sites. This may be due to the high water temperatures during this season, which causes nitrates to change into nitrites. Thus, these results are in agree meet with that of Al-Mahmoud (2008), in addition to the reduction in the values of dissolved oxygen in water at high temperatures, which also causes nitrates to become nitrites (Alhello *et al*., 2019)

Silica is one of the basic elements for the growth of many aquatic organisms that carry out the primary productivity process, especially diatoms, of which it is the main component, and the abundance of silica in the water is a determining factor for the growth of diatoms (Buesseler, 1998).

The current results showed a fluctuation in the of silica concentration as there was a decrease in it's values in some months, and a rise in others, due mainly to high temperatures that caused the dissolution of salts in that period (Al-Mahmood, 2008).

As well as the decomposition of dead diatoms and the lack of water levels, which led to increased concentration as well as the rise of the bottom materials containing dead algae residues and some silica-rich sediments to the surface, as well as the sand-laden monsoon activity, as for the decrease in silica concentrations, it may be due to an increase in its consumption rate by diatoms that bloom greatly in some months figure 5 (AL-Lami, 1986).

The study results showed changes in water temperature in all Sites, this is normal because the climate of the region has an effect on water temperature (Lou *et al.*, 2011). It is also directly proportional to the air temperature, and it is known that the Shatt Al-Arab River is located in the city of Basra, which is characterized by a hot, dry climate in summer and cold winter, so showed a clear difference in water temperature between the months. Shatt Al-Arab's River waters are also characterized by their large seasonal changes in temperature, as they begin with a rapid rise from May until they reach their highly peak in July and August (Sarker *et al*., 1980).

The results of the previous studies indicated that the waters of Shatt Al-Arab River are usually alkaline to neutral throughout the days of the year (Sabri, *et al*., 1989). The reason for the alkalinity of the Shatt al-Arab waters may be the intrusion of the salty waters of the Arabian Gulf into the River, it is known that the waters of the Gulf are usually alkaline (Hussein *et al*.,1991) also that marine waters have a pH of more than 8 (Hasen, 2002).

The results indicated in Figure 8 that the least of salinity noticed in Al-Hartha site during August (0.1 mg/L), while the highest value was in the Al- seba site for July (22.1 mg/L). This is normal for the Shatt Al-Arab where the salts increase as we go south, because of the mixing of fresh river water with the salty sea water, this is consistent with all studies conducted on that region (Al-Waeli and Athbi, 2021; Alhello *et al*.,2019; Al- Mahmood and Mahmmad,2019).

Dissolved oxygen plays an essential role in vital processes through the direct physiological influence on living organisms and indirectly through influence on nitrogen and the carbon cycle (Jingshui, *et al*., 2017).The measurement of dissolved oxygen can be used as an indicator of the degree of contamination with organic matter in rivers (Wahab, 2018) and one of the reasons that leads to a lack of dissolved oxygen in water is the high temperature of the water, which increases the evaporation of gases from the water, also the abundance of phytoplankton plays a major role in increasing the amount of dissolved oxygen.

Conclusions

The following conclusions can be drawn based on the study findings:

1-The nutrient and Other Ecological Factors was within the natural ranges, and no extremism was observed for any environmental factor during the study period.

2-There is no clear pattern in the distribution of nutrient, due to the influence of weather conditions and the waters of the Arabian Gulf and agricultural, industrial and household wastes that are thrown into the Shatt Al-Arab River, on the other hand.

3-There are spatial and temporal variations in the values of environmental factors due to changing climatic conditions.

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