Journal of Education for Pure Science- University of Thi-Qar
Vol.9, No.2 (June, 2019)
Website: jceps.utq.edu.iq Email: jceps@eps.utq.edu.iq

DOI: http://doi.org/10.32792/utq.jceps.09.02.06

Assessment of Water quality for Euphrates River in AL-Nasiriyah City by Using Organic Pollution Index

Sarah Awad Turki, Afrah Abid Maktoof[1]

[1] Biology Department, College of Science, University of Thi-Qar, Thi-Qar, Iraq.

Received 08/11/2018, Accepted 27/12/2018, Published 02/06/2019

Abstract:

The present study was conducted to demonstrate the effect of organic matter on characteristics of the Euphrates river at the center of Al-Nasiriyah city and its feasibility for domestic, industrial and agricultural uses. [This index is an efficient and successful method for descriptive and quantitative assessment of organic pollution in different aquatic systems]. Four stations were selected, the first station near Al-Sharif, the second station near the thermal of electric power, the third station near the Zaytoon Bridge at the city center and the fourth station near the waste water treatment station, the samples were collected from water monthly starting October 2017 Until September 2018. Some physical and chemical properties were measured: Biological oxygen demand (BOD_5), Nitrate (NO_3), phosphate (PO_4), Ammonium (NH_4). The results of variables of water in the studied stations showed that the values of Biological Oxygen Demand ranged between (1.3-24.6) mg/L, nitrates between (9.24-61.98) mg /L, phosphate recorded values ranged between (0.10 – 1.30) mg /L, and ammonium (0.10 – 1.4) mg /L.

Keywords: Euphrates River, Water Quality, Organic Pollution Index (OPI).

1- Introduction:

Water resources play a vital role in various sectors of economy such as agriculture, livestock production, industrial activities, hydropower generation, fisheries and other creative activities has been put under tremendous pressure, and have been deteriorated due to some important factors, (Tyagi *et al.* ,2013). There was number of indices used for the assessment of water quality based on physical, chemical or biological parameters, the history of these indices is discussed by many authors (Rosenberg and Resh 1993, Chapman 1996, AQEM 2002). Often, it is difficult to interpret the results when numerous parameters are used for the evaluation of water quality, especially considering that single parameters reflect the influence of diverse pressures and could show different quality classes. On the other hand, the use of one or few metrics reduces the confidence of the assessment system. In practice, in multimetric assessment systems, usually the parameter of the poorest quality is used as determinant of the quality class (Simonović *et al* ., 2007). The Water Pollution Index represents an arithmetical way of integrating parameters for assessing the chemical and ecological status of inland waters (Filatov *et al.*, 2005) .Water

Pollution Index (WPI) , based on physical and chemical parameters for any rivers or any aquatic system. WPI has been used to study my river such as Latvia (Lyulko et al., 2001), Greece (Nikolaidis *et al.,* 2008), and Serbia (Milijašević *et al.,* 2011, Brankov *et al.,* 2012), as well as for the White Sea (Filatov *et al.,* 2005). These studies show that the use of this index simplifies the evaluation of the status and that it is suitable for application for different water body types. The most advantage of the WPI is that it allows combination of different parameters; in addition, there is no limitation in the number or types of the used parameters. In our case, we included parameters derived from the biological quality elements (BQE).

Over the last few decades, in order to assess the water quality in a water body, researchers from different parts of the world have developed a number of methodologies like NSFWQI (Kumar et al.,2014), Water Quality Index of Central Pollution Control Board (Sarkar and Abbasi., 2006), comprehensive pollution index (CPI) (Guo,2006), Overall Index of Pollution (Sargaonkar and Deshpande ., 2003), Eutrophication index (EI) (Liu *et al.*,2011), organic pollution index (OPI) (Quan *et al.*,2005) … etc. based on the water quality parameters. OPI is a model which has been previously proposed to assess the temporal and seasonal contamination with the organic pollutants.

Few studies were performed in south parts of Iraq to assess contamination with organic pollutants, like Al-Saboonchi (1998) that used benthic algae as indicator for organic pollution in the Shatt al-Arab and some of its branches, While Saleem (2013) and Majeed (2014) using OPI to assess the organic pollution status at six channels that connected with Shatt al-Arab river , and Al- Hejuje (2014) using OPI to assessment the water quality of Shatt Al-Arab river. Ahmed (2015) studied organic pollution in Ashar canal used OPI and benthic filamentous algae and found that the region is classified under the category (Deteriorated), and the dominant algae belong to blue green algae.

The objective of this study is to determine some of physical and chemical properties , which clearly affect the evidence of organic pollution, descriptive and quantitative assessment of the levels of organic pollution for Euphrates river in southern Iraq, using the organic pollution index to give a clear picture of the organic pollution in the Euphrates river.

2- Materials And Methods

2-1 Description of the study area

The Euphrates river is one of the most important sources of water for human use, such as the irrigation of crops, human consumption and other industrial purposes. Several important dams, beside several irrigation channels to irrigate the agricultural areas (Asaad *et al*., 1986).

Four stations were selected in Euphrates river. (Fig .1) shows the Euphartes river . The geographic position of four studied stations between alitude (East) and latitude (North) are : E22˚ 56" 646˚ N 45˚ 56" 431˚, E 44˚ 59" 946˚ N 22˚ 00" 231˚ , E 40˚ 89" 462˚ N 9˚ 36" 231˚ and E 46˚ 67" 461˚ N 31˚ 84" 231˚ . The first station , It is located in the south western part of the city of Al- Nasiriyah on the Euphrates river near Al-Sharif , where there are populated villages and agricultural lands where the vegetation is spread on both sides of the river. The second station , Located in the south west part of the city of Al-Nasiriyah on the Euphrates river near the electrical thermal power plant , this station 8 km far away from the first station . The third station , Located at the center of Al- Nasiriyah near Al-ziton bridge and a few meters from the drainage pipes that presents to the river without any treatment many kind of aquatic plants species were observed in this area . The fourth Station , Located at the center of Al- Nasiriyah, on the Euphrates river near the main sewage treatment station.

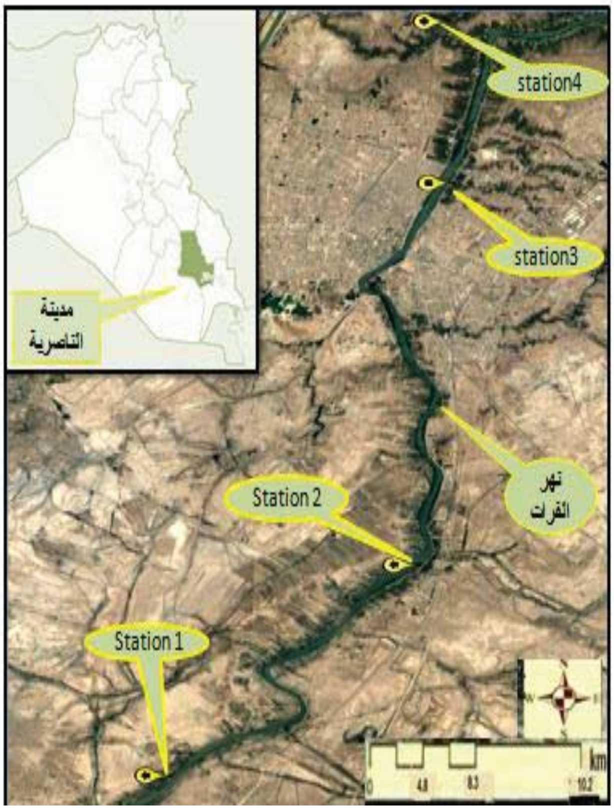

Figure (1): Map of the study area Showed the study stations.

2-2 Samples Collection

Water samples were collected per month starting from October 2017 until the September 2018 at a depth in particular under water starting from the first station and even fourth station, where plastic bottles are used 5 liters to collect water samples in three replicates randomly from each station for physical and chemical tests.

2-3- Physical and chemical properties:

1- Biological oxygen demand(BOD_5)

Measure the bio-oxygen requirement using the Tento meter device manufactured by HANNA by placing 157 ml of the sample in a dark vial and incubated in a 20 ° C incubator for 5 days. The value of BOD5 was then calculated by taking the difference between the oxygen values before and after incubation In units (mg/l).

BOD5 (mg / l) = [dissolved oxygen quantity – [dissolved oxygen quantity
(Mg / l) before incubation] (mg / l) after incubation]

2- Reactive Nitrate (NO 3)

Nitrates were measured by ultraviolet methods (APHA, 1998) using the EMC.LAB UV-spectrophotometer. 25 milliliters were taken from the candidate sample and 1 mL of hydrochloric acid was added. The absorbance was read by the device above and at a wavelength of 220 nm and re-measured at a wavelength of 275 nm and based on the difference between the two extracts to extract the effective nitrate value and expressed the results in (mg / L).

3- phosphate Reactive (PO4)

Ascorbic Acid Method (APHA, 1998) was measured by using a spectrophotometer and a wavelength of 885 nm and expressed in mg / L.

4- Ammonium Ion (NH3)

According to the ammonium ion according to the method described by (Lee et al. , 1999) by taking 500 ml of each sample in a glass flask with 25 mL of pre-prepared solution. The pH of the medium was then adjusted to 9.5 (NaOH) at a 6-point concentration, And then the contents of the beaker were heated after the water was delivered to the device and a 400 mL conical flask containing 25 mL Boric acid was placed below the condenser to receive the ammonium ion from the distillation. After reaching 350 mL, the heating process was stopped and the contents of the conical flask were transferred to a volume vial Complete the volume with distilled water to 500 ml, take 50 ml of the sample and wipe against acid Sulfuric concentration of 0.02 mm using Methelene Blue Guide through the results (mg / L).

According to the ammonium ion according to the following equation:

V2 / V1 * 14 * 0.02 * 1000 = (Mg / L) NH3 Since:

V1: Volume of the output of the wiper, V2: Form size, 14 :Atomic weight of nitrogen.

0.02 = Standard concentrated sulfuric acid.

2-4- Organic Pollution Index (Opi):

Organic pollution index calculated as the average number of four physical and chemical factors includes (BOD5, Ammonium , Nitrates and Phosphates) (Boluda *et al.*,2002) according to the following equation:

$$OPI = \left[\frac{(\sum Ci/Cmi)}{n}\right] * 10$$

Where :

Ci : are the monitored pollution concentrations .

Cmi : are the guidelines that stand for the maximal amount of permitted pollution content.

N: is the Number of variables.

Table(1): Grid evaluation of organic pollution types (Boluda *et al.*,2002).

Limits	Organic pollution level	Degree Index
9≥	None	1
10-29	Weak	2
30-39	Moderate (Medium)	3
31-49	Strong	4
50-59	Very Strong (Deteriorated)	5
60-69	Bad	6
70≤	Very Bad	7

3- Results :

3-1 physical and chemical properties

1- Biological Oxygen Demand (BOD_5)

Fig .(2), Showed monthly variations of the BOD_5 value in all station of the study, the highest value was (24.6) mg/ L in February at station 4, whereas the lowest value was (1.3) mg/ L was recorded at station 1 in August . Results of the statistical analysis showed that there were no significant differences between the stations except the station1 and the station 4 compared to the 2 and 4 stations with significant difference at ($P <0.05$), while there were no significant differences between the months except for October compared to February and June, At the same level.

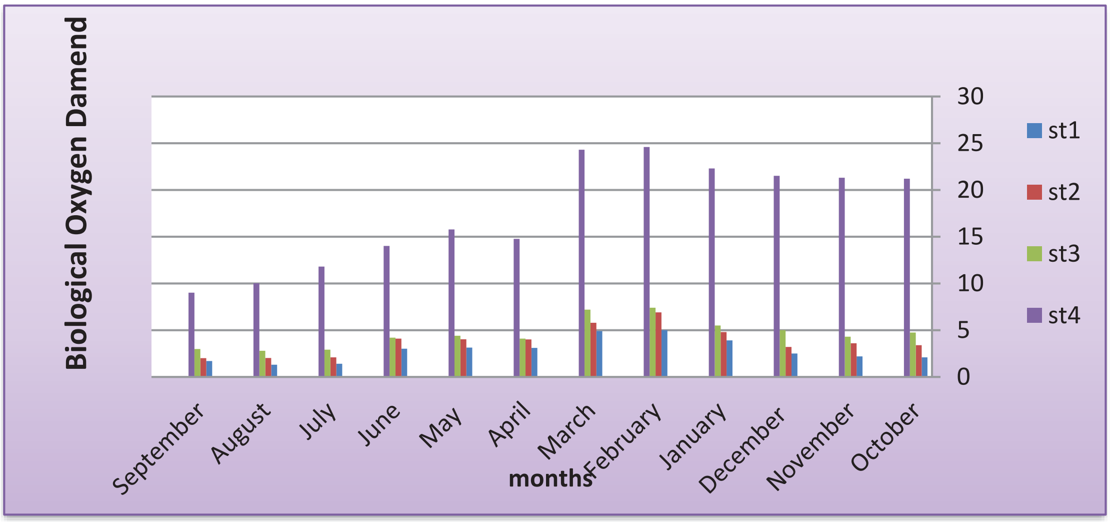

Fig (2): Monthly changes in the values of BOD_5 in all study stations.

2- Nitrate

The highest values of nitrate was (61.98) mg/L at station 4 in December and the lowest value was 9.24 mg/L in station 1 in August (Fig .4). The results of the statistical analysis showed that there were significant differences between the stations except the 1 and 4 stations. No significant difference was found at P (0.05), while significant differences were recorded in all months of the study except for the month of October compared to June and September at the same level.

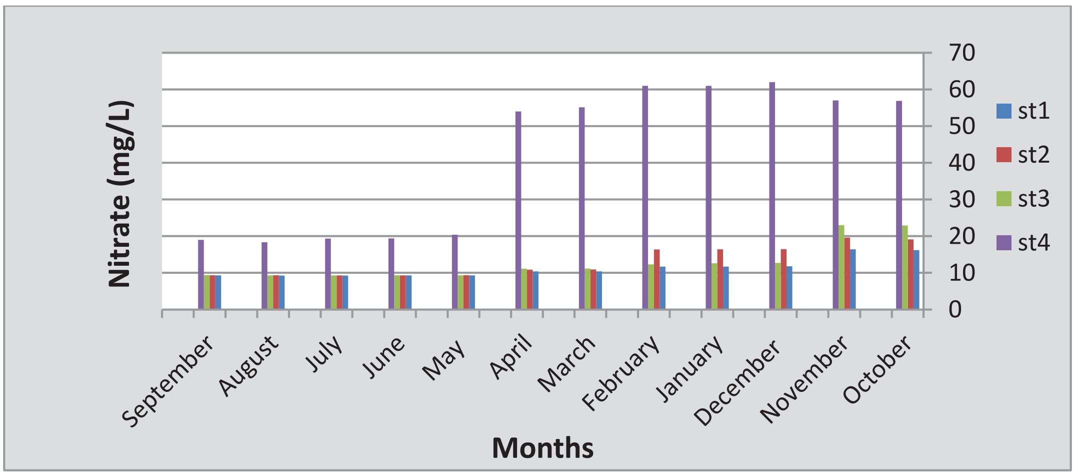

Fig (4): Monthly changes in the values of NO_3 in all study stations.

3- Phosphate (PO4)

It was found that the value of PO4 throughout the study period in all stations ranged between 1.30 mg/ L in December at station 4 to 0.10 mg/ L in March at station 1 (Fig .3). The results of the statistical analysis showed no significant differences between all study stations at (P <0.05). No significant differences were recorded between all study months at the same level.

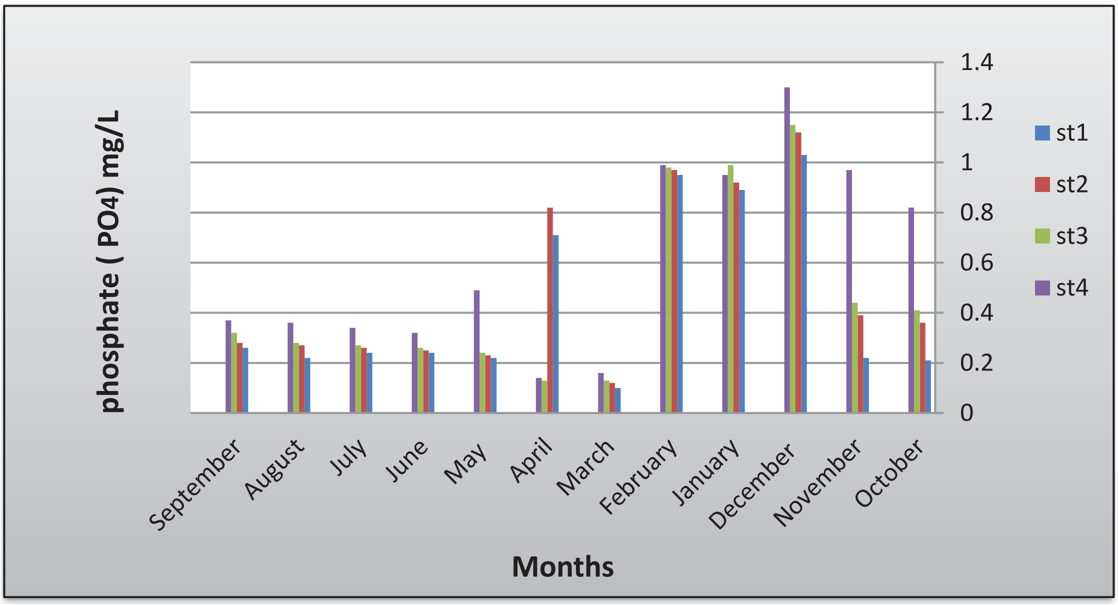

Fig (3): Monthly changes in the values of PO_4 in all study stations.

4 -Ammonium

The value of Ammonium in water at all location of the study area , showed that the highest value (4.1 mg/L) was at station 4 in march 2018 , while the lowest value (0.10 mg/L) was in August at station 1 (Fig . 5). The results of the statistical analysis showed no significant differences between the stations except for the 2 and 4 stations with significant difference at P (0.05). No significant difference was recorded between the months except for October and June.

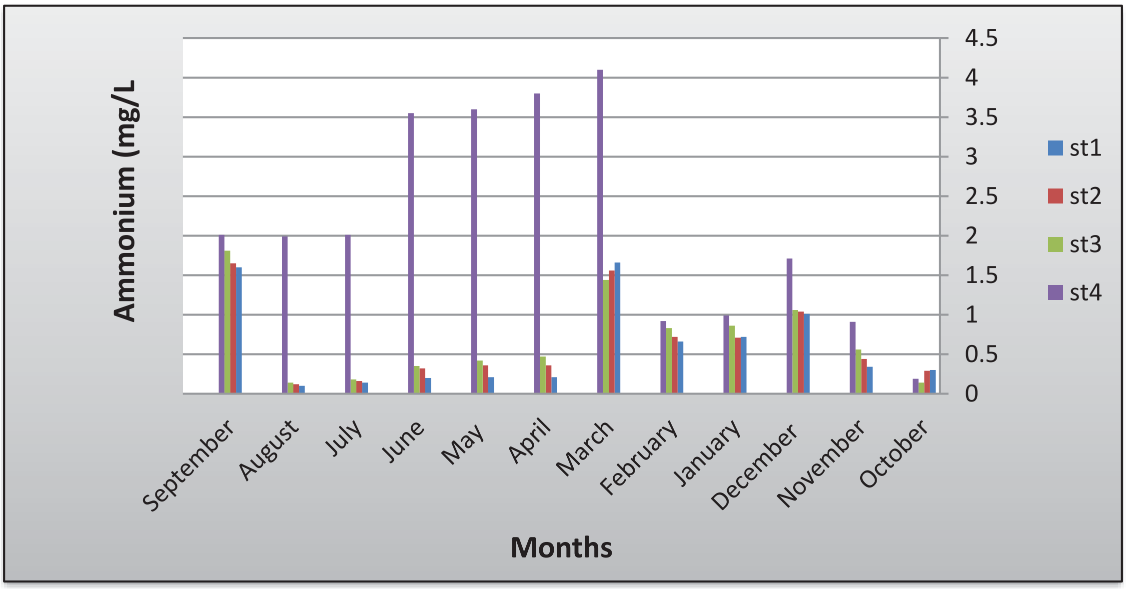

Fig (5): Monthly changes in the values of NH4 in all study stations.

3-2 Organic Pollution Index (OPI)

Fig . (6) showed monthly changes of organic pollution throughout the duration of the study, the higfest value was recorded at station 4 of (110) in December, while the lowest value was (13) on station 3 in April. The order of OPI values were recorded in all study stations as follows, (16 -70) during December and August at station 1 , (16-77) in March and December at station 2 , (13-79) during April and December and (33-110) during April and December at station 4 respectively .

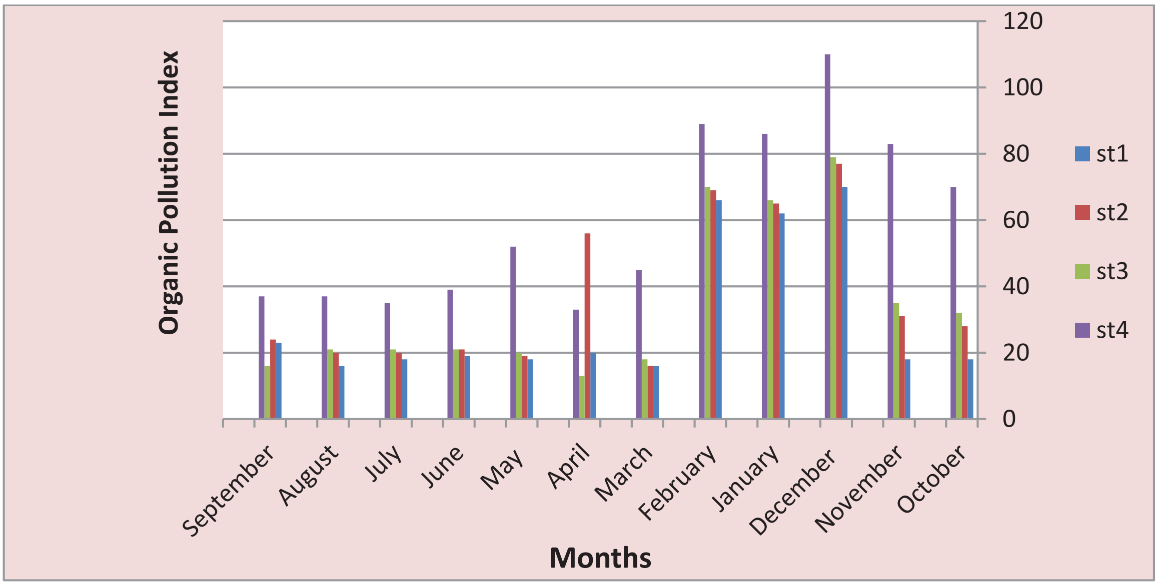

Figure (6) : Monthly changes in the values of organic pollution index in the study stations.

Seasonaly fluctuation similar in stations 1,2,3, but in station 4 with different for them . The value of OPI was recorded at station 4 (87) during Autumn and classified under category 7 (Very Bad), while in the station 3 recorded (18) during Spring (Fig . 7) and classified under category (Good).

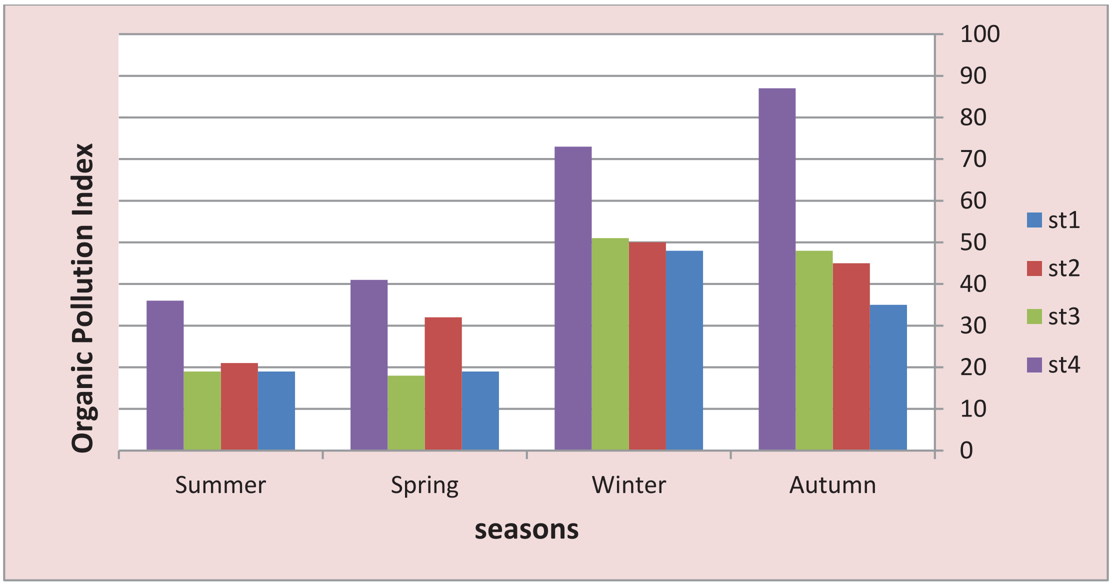

Figure (7):Seasonal changes in the values of organic pollution index during study stations.

4-Discussion:

4-1 Physical and chemical properties:

BOD_5 is the amount of oxygen consumed by microbial decomposition of organic matter include plant and aquatic animals decay and leaf fall consumer like fish and other aquatic.

Animals eat some of producers , and the nutrients move to for high food chain , when these organisms die , bacteria decompose the organic compounds and realse into the water inorganic and nutrients such as nitrate , phosphate , calcium and others , some of these nutrients end up down river or in sediment , but most of them recycle again and again most of the bacteria in the aquatic water column are aerobic . That mean they use oxygen to perform their metabolic activities of decomposition (Jawad , 2008). The results of the present study showed that BOD_5 , in station 1 were high compared with other stations and this caused by adding different quantities from domeotic and sewage wase , agriculture runoff , urban runoff and near the station from the center city.

Phosphate PO4 is the necessary nutrients needed by plants in cellular growth and increased efficiency (Turner *et al* . , 2005), Decreasing of PO4 leads to disturbances in photosynthesis and growth inhibition and leads to cell death **(Lee ,2000)**, There are many sources that provide aquatic environment with phosphate in different concentrations, However, these factors enter into river; lakes and oceans through discharge of industrial, agricultural , domestic waste; and mineral weathering and biodegradation **(UNEP/ GEMS ,2006**). Results in the current study showed the highest phosphate was recorded at station 4 compared with the lowest values in station 1 , due to an increase in phosphate compounds in sewage waste, agricultural discharge which plays major role in adding phosphate to the aqueous environment (Mokaya *et al*., 2004) . This can be explained by the exposure of station 4 to a high level of phosphate , as it is near the sewage waste water treatment that discharge theim waste to the Euphrates river . Nitrate NO3 are found in many places in the environment. They are introduced through the application of fertilizer containing nitrogen compounds, human and animal waste play an important role in increasing the content of nitrate in water . The results of the current study showed the highest value of nitrate was recorded when compared in station 4 with 1,2,3 stations . This was due to the exposures of station 4 to the various types of pollution . such as sewage , animal waste , chemicals used in agriculture and degradable of plant bodies (Johnson, 2004).

Ammonium is the preferred nitrogen-containing nutrient for plant growth. Ammonia can be converted to nitrite (NO2) and nitrate (NO3) by bacteria, and then used by plants. Nitrate and ammonia are the most common forms of nitrogen in aquatic systems. Nitrogen can be an important factor controlling algal growth when other nutrients, such as phosphate, are abundant. If phosphate is not abundant it may limit algal growth rather than nitrogen. Ammonia is excreted by animals and produced during decomposition of plants and animals, thus returning nitrogen to the aquatic system. The results of the current study recorded that the high concentration of ammonia in station 4, due to the large quantity of nitrogen compounds which contain sewage including ammonia (Wielgosinski, 2012). The presence of ammonia in the effluent put indicates high in large quantities in sewage (Ibrahim, 2004), containing large amounts of detergents and organic fertilizers from agricultural land and sources of nitrogen compounds in the aquatic environment (Agarwal, 2009).

4-2 Organic Pollution Index :

Organic pollution directory record monthly changes the results of the current study showed that the 1, 2 and 3 station similar in highest and lowest value expect in Desember similarity at all stations. The highest values on December in the forth stations this releated to several physical and chemical factors, sewage waste also input directly in rivers, this wastes increased the organic pollution and high pollution parameters higher than permitted Iraqi river maintenance system determinants of pollution. Organic pollution index values decline in station 3 during the month of April due to stop waste throw to the river this month and divert these wastes thrown into another path and lack of contaminants to the river compared with other months.

Marked seasonal changes in the values of organic pollution index for 1, 2 and 3 stations, but with different values, in station 4 . High values was recorded in the autumn and winter but declined in spring and summer for all study stations. Also , there were higher value in winter , increasing rains in the winter washed the farmland include chemical fertilizers , as well as the low consumption of plankton and water plants for nutrients . Lower values were found in spring season this due to increase phytoplankton or increase plant density in the river played an important role in increasing the nutrient consumption this leads to the low of organic pollution index (Twomey and Jhon, 2001).

Conclusions:

1 .This study found that station 4 was higher physical and chemical factors compared with 1,2,3 stations.

2. Euphrates river were classified under category 4 (Poor) for the duration of the study.

References:

- Agarwel , S. K. (2009) Water pollution. APH Publishing Corporation. New Delhi.
- Ahmed R.Abdul Zahra.(2015). Evaluation of organic pollution level and its effect on diversity of the filamentous benthic algae and fishes infected with copepods from three stations in Basrah province, Iraq. . M.Sc.Thesis.Basra Univ.College of Agri. Iraq.
- Al-Hejuje, M.M. Kallaf (2014). Application of Water Quality and Pollution Indices to Evaluate the Water and Sediments Status of Shatt Al-Arab River. Ph.D. thesis, Basra Univ. IRAQ.
- Al-Saboonchi A. A. (1998). Biological indicator of water pollution. Ph.D. thesis, Univ. of Basra. Iraq.
- AQEM (2002). Manual for the application of the AQEM system. A comprehensive method to assess European streams using benthic macroinvertebrates, developed for the purpose of the Water Framework Directive.
- Asaad, N.M. ; Hassan, S. and Noury, N. (1986). Detailed study on thewater Quality of Iraq. 11. Water Quality of Euphrates River.Sci.Bull. No. 123.179. .1986Ministry of Irrigation . Wat. & So. Res.Inst.
- Boluda, R.; Quintainilla, J. F.; Bonilla, J. A.; Seaz, E. and Goman, M. (2002). Application of the Microtox test and pollution Indices to the study of water toxity in the Albufera Natural park (Valencia, Spain). Cheomsphere, 46:355-369.
- Brenkov, J. Milijasevic, D. Milanovic, A.(2012) . The Assessment of the Surface Water Quality Using the Water pollution Index : ACase study of the Timok River (The Danube River Basin) , Serbia:pp.49-61.
- Chapman D. (1996). Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring. Second Edition. Chapman and Hall, London.
- Filatov N., D. Pozdnyakov, O. Johannessen, L. Pettersson, L. Bodylev

(2005). White Sea: Its Marine Environment and Ecosystem Dynamics Influenced by Global Change. Springer and Praxis Publishing, UK.

- Guo M.M.(2006).Application Of Mark Index Method in Water quality Assessment of river. Environmental science and management., 31 (7). 175–178.
- Ibrahim, S. A. H. (2004) Determination and distribution of total hydrocarbons, total organic carbon and nickel and fenadium elements in the waters and sediments of the southern part of the Shatt al - Arab. PhD thesis, Faculty of Education, University of Basra, Iraq.
- Jawad, S. S.(2008). Some Environmental and Bacteriological Characteristics of Marshlands of Dhi Qar Governorate, Southern Iraq, Dhi Qar Science Journal, 1 (1): 11-18.
- Johnson, G.B. (2004). Capacity of fresh water marsh to process nutrients in directed Mississippi river water. MSc. Thesis , louisiana state university and Agricultural and mechanical college in the department of agronomy and environmental management , 85.
- Kumar A.; Sharma M.P.; and Yadav N. S.(2014).Assessment of Water Quality Changes at Two Locations of Chambal River:, , J. Mater. Environ. Sci. 5 (6) 1781-1785.
- Lee, R. E. (2000). Phycology. Cambridge University Press. New York , 614.
- Liu S.; Lou S.; Kuang C.; Huang W.; Chen W.; Zhang J.; and Zhong G (2011). Water quality assessment by pollution-index method in the coastal waters of Hebei Province in western Bohai Sea, China. Mar. Pollut.Bull. 62(10):2220–2229.
- Lyulko I., T. Ambalova, T. Vasiljeva (2001). To Integrated Water Quality Assessment in Latvia. MTM (Monitoring Tailor-Made) III, Proceedings of International Workshop on information for Sustainable Water Management. Netherlands.
- Majeed, E. Sh.(2014) . Environmental assessment of aquatic channels in Basrah city. M.Sc. Thesis, Geography Department ,Arts College , Uni. Basra ,IRAQ , 199pp.(In Arabic).
- Mokaya, S. K.; Mathook, J. M. and Leichtfried, M. (2004). Influence of anthro -pogenic activities on water quality of atropical stream ecosystem, African J. Eco., 42: 281-288.
- Milijašević D., A. Milanović, J. Brankov, M. Radovanović (2011). Water quality assessment of the Borska reka river using the WPI (Water Pollution Index) method. – *Archive of Biological Science*, 63: 819-824.
- Nikolaidis, C., P. Mandalos, A. Vantarakis. (2008). Impact of intensive agricultural practices on drinking water quality in the EVROS Region (NE Greece) by GIS analysis. – *Environmental Monitoring and Assessment*, 143: 43-50.
- Quan, W.; M. X. Q. Shen; J. D. Han and Y. Q. Chen.(2005). Analysis and assessment on eutrophication status and developing trend in Changjiang estuary and adjacent East China Sea. Mar. Environ. Sci. 24:13–16..
- Rosenberg D. M., V. H. Resh (1993). Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman and Hall, New York.
- Saleem , F. M.(2013). Using organic pollution Index (OPI) to evaluate water quality and quantity of Shatt Al-Arab River,Iraq . M.Sc. Thesis. University of Basra, college of Science , IRAQ: 97pp. (In Arabic).

- Salim , B.J. ; Bidhendi ,G.N. ; Salemi , A. ; Taheryioun, M. &Ardestani , M. (2009). Water QualityAssessment of Gheshlagh River Using Water Quality Indices. Environmental Sciences, Vol.6 (4) , pp: 19 – 27.
- Sargaonkar A. and Deshpande V., (2003) "Development of an overall index of pollution for surface water based on a general classification scheme in Indian context", Environ. Monit. Assess., Vol.89, pp43-67.
- Sarkar, C. and S. A. Abbasi.(2006). Qualidex-A new Software for generating water quality Indice. Environ. Monit. and Assess.119(1),201-231.
- Simonović P., M. Paunović, A. Atanack ović, B. Vasiljević, S. Simić, A. Petrović, V. Simić (2007). Water Quality and Assessment of the chemical and ecological status of the Danube river and its tributaries after records from the JDS2 survey. – In: Simonović, P., Simić, V., Simić, S., Paunović, M. (Eds): The Danube in Serbia. Republic of Serbia Ministry of Agriculture, Forestry and Water Management, Republic Directorate of Water, 303-320.
- Tyagi S. ; Sharma B. ; Singh P ; and Dobhal , R.(2013). Water Quality Assessment in Terms of Water Quality Index . Ameri. J. Wat. Reso. , 1(3):34-38.
- Turner, B.L. ; Frossard, E. and Baldwin, D.S. (2005). Organic phosphrous in the environment. CAPI publ., London , UK, PP: 165-184.
- Twomey, L. John, J. (2001). Effect of rainfull and saltwedge movement on phytoplankton succession in the swan-canning estuary, wastern Australian. Hydrology Process, 15: 2655-2669.
- UNEP/GEMS, United Nations Environment Programme Global Environment Monitoring System/Water Programme (2006). Water Quality for Ecosystem and Human Health. UN GEMS/Water Programme Office c/o National Water Research Institute 867 Lakeshore Road Burlington, Ontario, L7R 4A6 CANADAavailableon-Line. .http://www.gemswater.org/.
- Wielgosinski, G. (2012) Pollutant formation in combustion Processes. In: Zeeshan Nawaz, Shahid Naveed, editors.Advances in chemical engineering. In tech. 20: 295-324.