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Study of dissolved and suspended heavy metals in four different sites of mid Euphrates River, Iraq

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Abstract

The Euphrates River is one of the most important sources of running water in Iraq. In this study, the dissolved and suspended heavy metals in the Euphrates River are measured by taking water samples from four different sites between three provinces Babylon, Al-Najaf, and Al-Diwaniyah. The results of the samples, which were taken between May 2013 and April 2014, showed that the values of cadmium (imperceptible -0.075) ppm for the dissolved and (0.0043 to 0.2705) ppm for the suspended, while the values of lead ranged between (imperceptible -0.0232) ppm for the dissolved and (0.0045-0.148) for the suspended and for zinc, recorded (imperceptible– 0.0168) ppm for the dissolved and recorded (0.0115 – 0.316) ppm for the suspended; for copper between (imperceptible – 0.0273) ppm for the dissolved and (0.0062 – 0.063) ppm for the suspended and for chromium between (imperceptible –0.0193) ppm for the dissolved and between (0.0043-0.0449) ppm for the suspended and manganese between (imperceptible -0.0256) ppm for the dissolved and between (0.0085-0.0739) ppm for the suspended manganese. All the above confirms the pollution of the river water with heavy metals.

Keywords: Heavy Metals, Euphrates River, Mid Euphrates, Iraq

Introduction

The largest freshwater in West Asia is the Euphrates. It starts in Turkey, flows through Syria, enters Iraq from the west, and empties into Shatt Al-Arab. The safety of surface water, including river water, depends greatly on natural and anthropogenic processes like mining and throwing domestic waste, agricultural and industrial waste, which serves as an ongoing source of pollution for this water [1]. Water pollution also results from other sources like untreated or inadequately treated waste and animal excrement, pollution may occur naturally as chemicals like arsenic and fluoride enter the waterway through these natural processes [2]. Due to the depletion of freshwater resources over the past few decades brought on by increasing population, economic progress, and social advancement, there has been an increase in demand for surface and groundwater sources to supply the varied needs resulting from this growth [3, 4].

Unpolluted water is a vital natural resource. It is important for drinking, irrigation, agriculture, industry, and animal husbandry, in addition to being a recreational source such as swimming and recreation. Many large rivers in the world suffer from pollution resulting from human activities, especially in recent centuries [5]. Heavy metals have a major influence on water quality, and numerous studies, including [6, 7], have supported this. Determining the concentrations of various dissolved and suspended heavy metals in the Euphrates River was the target of this work for determine the extent of river pollution with heavy metals.

Material and methods

Study area and water samples collection:

Four sites throughout the major Euphrates River basin were chosen to collect the samples of the current study (Table 1) and (Figure 1). Three-liter polyethylene bottles were used to collect water samples from 20-30 cm deep in the upper and middle streams every month from the study sits between May 2013 and April 2014. Following the collection of the water samples, the technique described in [8] was used to filter the samples using specialized filter papers (Millipore Filter paper 0.45 m) in order to determine the levels of the dissolved metals, while the method described in [9]. Least Significant Difference (LSD) use to find the least significant difference.

Table 1. Study Sites by GPS

Sites	East longitude	North latitude
Al Kifil	44°21'45.00"	32°13'10.20"
Al Kufa	44°24'38.80"	32°02'15.10"
Al Mishkhab	44°31'09.04"	31°45'33.01"
Al Shinafiyah	44°38'47.01"	31°34'49.05"

was used to determine the concentration of suspended heavy metals using filter papers. Flame Atomic Absorption Spectrophotometer (model Shimadzu AA-6300) was used to measure the concentration of dissolved and suspended heavy metals, and the results were presented in ppm.

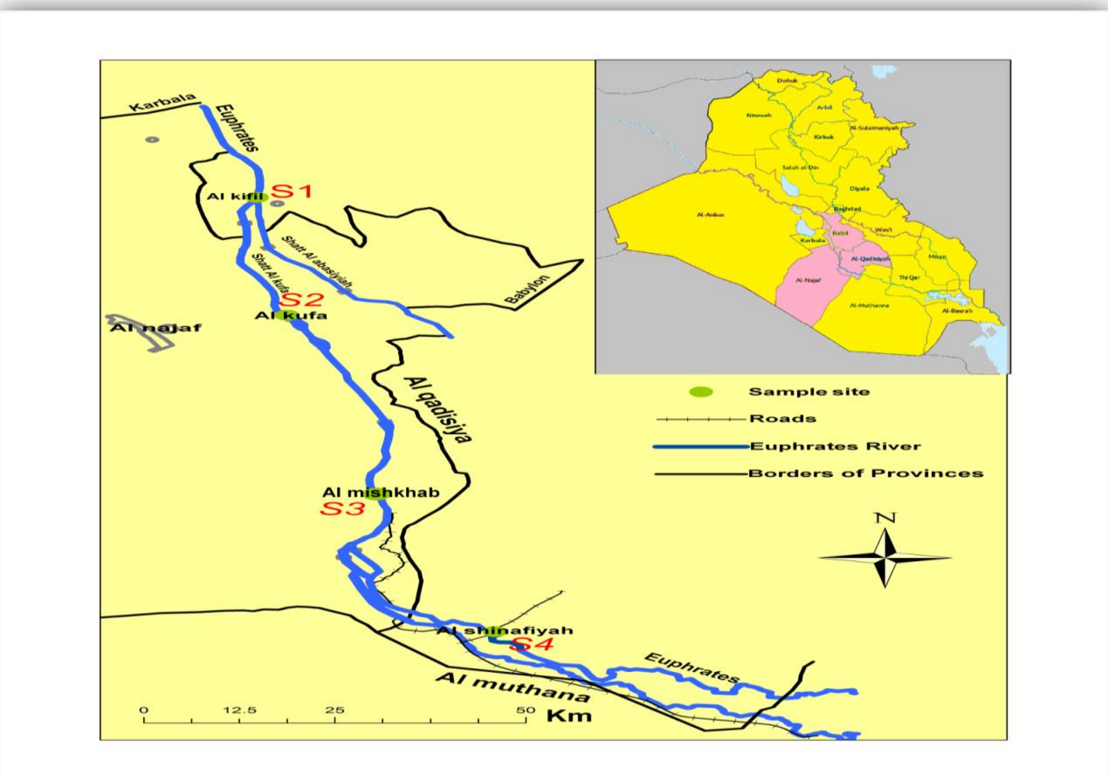

Figure (1) Map of the study places

Results

Dissolved cadmium values in the fourth and first sits varied between (0.075 ppm - undetectable) in May which is the highest value recorded in site 1, Figure (2. a) and the highest value for suspended cadmium was 0.2705 ppm in April at the second site, while the lowest value was 0.0043 ppm in May at the fourth site Figure (2. b). The statistical analysis's results indicated that there were clearly significantly different among the sites and the months for the two types of cadmium, suspended and dissolved ($p \leq 0.05$), (Table 2).

It is clear as in Figures (3. a) and (3. b) the highest value of dissolved lead is 0.0232 ppm recorded in December in the second site, and the lowest (imperceptible) value in the second site in October. As for suspended lead, the highest value was 0.148 ppm in December in the third site, and the lowest value was 0.0045 ppm in October in the second site. It is evident from the statistical analysis ($p \leq 0.05$) that there are distinct significant differences between the sites and significant differences between the months for both dissolved and suspended lead (Table 2).

The results show that the range of dissolved zinc levels was between (0.0186 ppm - imperceptible) at the second site in February and January, respectively Figure (4. a). As for suspended zinc, it fluctuated from 0.316 ppm in April in the third site and 0.0115 ppm in June at the fourth site Figure (4. b). There were significant variations between the months and the sites according to the statistical analysis ($p \leq 0.05$) for the two forms of dissolved and suspended zinc (Table 2).

The values of dissolved copper fluctuated between (0.0273 ppm - imperceptible), which is the highest value dated in February in the fourth site, and the least value recorded in September in the second site Figure (5. a). As for suspended copper, its highest value was recorded at 0.063 ppm in the first site in February, whereas its lowest value was attained 0.0062 ppm in July in the first site as well, Figure (5. b). It is evident from the statistical analysis's findings that there are different significant variations between the sites as well as between the months for each of the dissolved and suspended copper (Table 2).

The values of dissolved chromium ranged between (0.0193 ppm - imperceptible), which is the highest value observed in September at the second site, and the lowest value recorded in June in the first and third sites, in January in the third and fourth sites, and in May and September in the fourth site Figure (6. a) While the suspended chromium values ranged between (0.0043 ppm - 0.0449 ppm), the first site recording the highest value in March and the fourth site recording the lowest value in May, Figure (6. b). The statistical analysis findings that there are substantial variations between sites as well as between months for both dissolved and suspended chromium, ($p \leq 0.05$). (Table 2).

The outcomes further recorded that the greatest value of dissolved manganese was 0.0256 ppm in April in the third site, the lowest was imperceptible in December in the third site and in July in the fourth site Figure (7. a). As for suspended manganese, the highest value was 0.0739 ppm in the first site in November, and the least amount was 0.0085 ppm in July in the fourth site Figure (7. b). The statistical analysis showed that there were substantial variations between the months as well as the sites for both dissolved and suspended manganese ($p \leq 0.05$) (Table 2).

Discussion

One of the most significant types of pollution in the environment is heavy metals, which can come from either natural or human sources. [10-13]. Sediments are the source and final place for heavy metals in the water [14]. The results showed an increase in heavy metals in suspended as compared with dissolved form, and this may be due to the tendency of heavy metals to move from dissolved forms to suspended forms due to increased adsorption and bonding with clay, organic materials, and particle matter surfaces in the water column [15]. The release of trace elements in the water and sediment column and their movement depends on many factors including pH, manganese oxides, iron and reducing potential [14].

As the pH affects the solubility of metal ions, the weak acidic conditions limit the adsorption of heavy metals to solutions and increase their deposition[16], which restores the adsorption of insoluble mineral complexes on sediments including silica and clay reach the water column, and this affects the vital readiness of heavy metals. [12] and causes the release of heavy metals by dissolving unstable metal compounds or through the formation of insoluble mineral sulfates [17], while increasing the pH causes the transformation of heavy metals from the dissolved form to the suspended form [18].

The quantity of heavy metals is impacted by municipal garbage and waste put into water systems. The concentration of these metals in water is also impacted by rainfall and atmospheric decomposition processes. [16, 19]. Salinity plays a major role in the lack of toxicity of heavy metals in aquatic organisms, by forming complexes, which makes the metal unavailable biologically, and then its deposition [20]. The increase in water hardness causes an increase in the toxicity of many heavy metals in an aquatic environment due to the formation of a complex of elemental and calcium carbonates, and this depends on the exponent The increase in the pH increases the toxicity [21].

The high concentrations of heavy metals in the cold months during the current study may be due to the influx of eroded materials from the river shoulders containing the concentrations of heavy metals, in addition to the rates of discharge from farms and factories, sewage water, sediment dissolution, and an increase in bioaccumulation and chemical adsorption on the sediments [22] and The findings of the present investigation were consistent with those of [23] on the Euphrates River and [24] on the Nile River.

It is also apparent that during other high-temperature months, there is an increase in the concentration of heavy metals, which due to increase the rates of vaporization and breakdown of organic materials, particularly the dead parts of living organisms, and a reduce in the uptake of these metals by living organisms, In addition, the majority of these metals are reduced by anaerobic bacteria, such as sulfur-decomposing bacteria, which analyze organic materials mixed with heavy metals subsequently, increasing the amount of heavy metals in the water [25], and the concentration of these metals increases in the suspended phase at times when the sulfates in the water rise, to form sulfates of insoluble metals [26].

As for the positional differences, they are due to the different rates of discharge of industrial pollutants, household waste, and agricultural land waste [27], or to the difference in wind speed, as the increase in turbulence increases the rates of release of heavy metals from the sediments into the water column [28], and this agrees with what Accessed by [29].

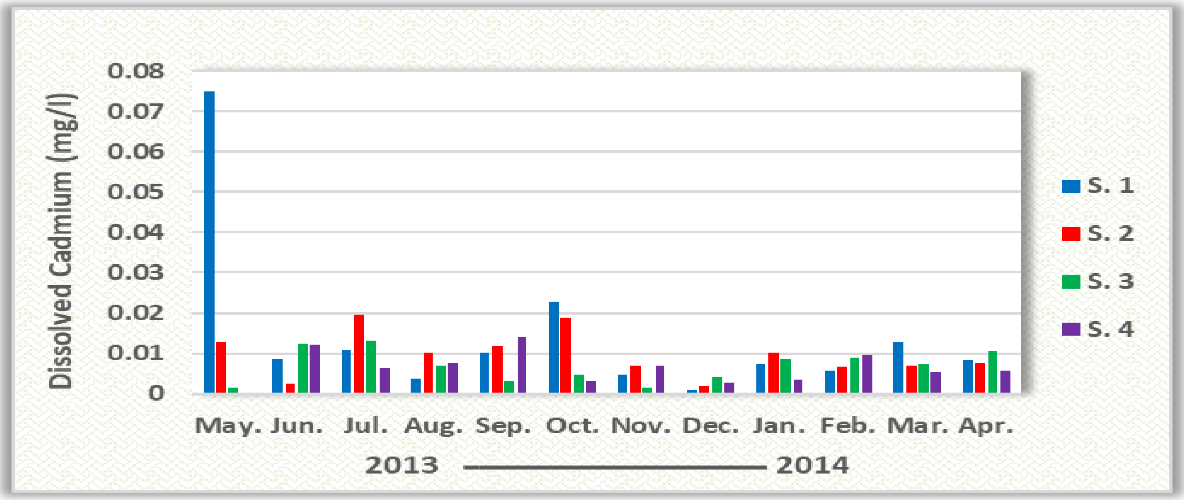

Figure (2.a) Variations in dissolved cadmium concentrations in the study sites

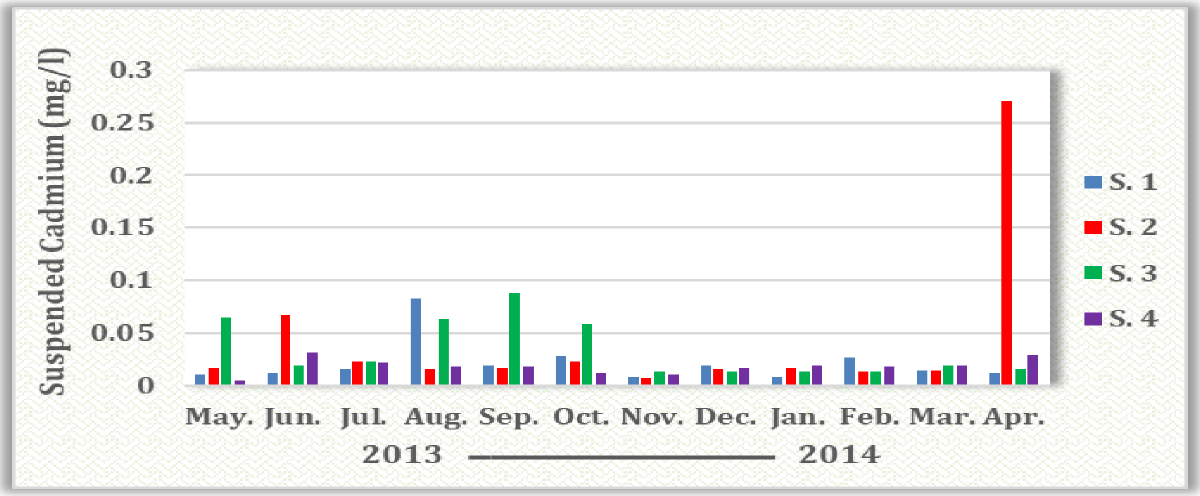

Figure (2.b) Variations in Suspended cadmium concentrations in the study sites

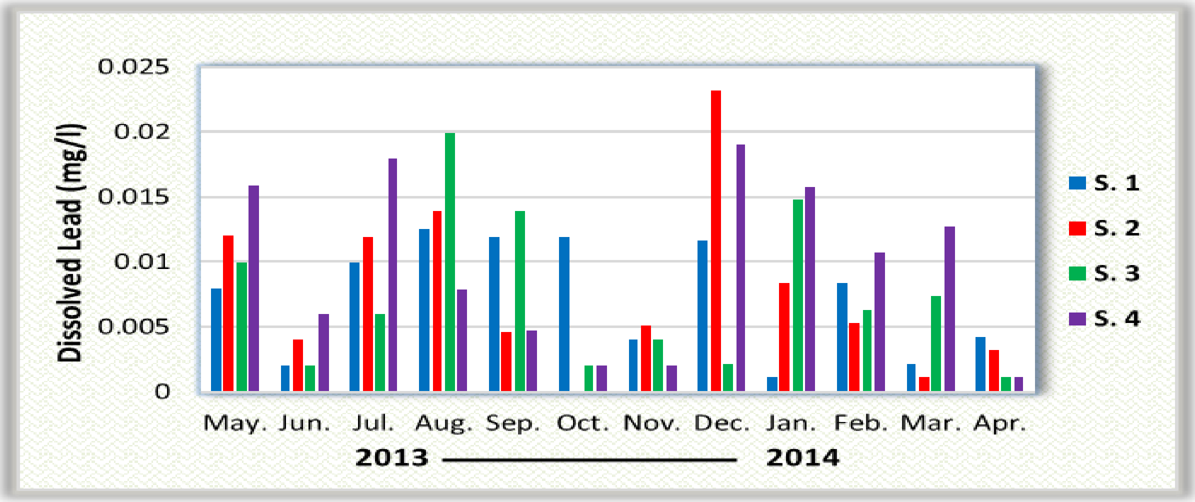

Figure (3.a) Variations of dissolved lead concentrations in the study sites

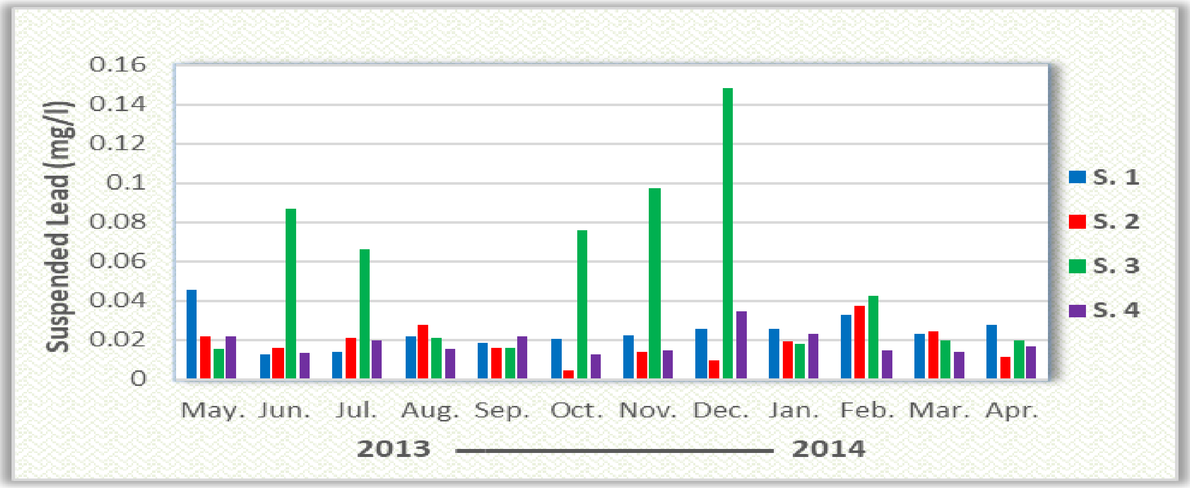

Figure (3.b) Variations of Suspended lead concentrations in the study sites

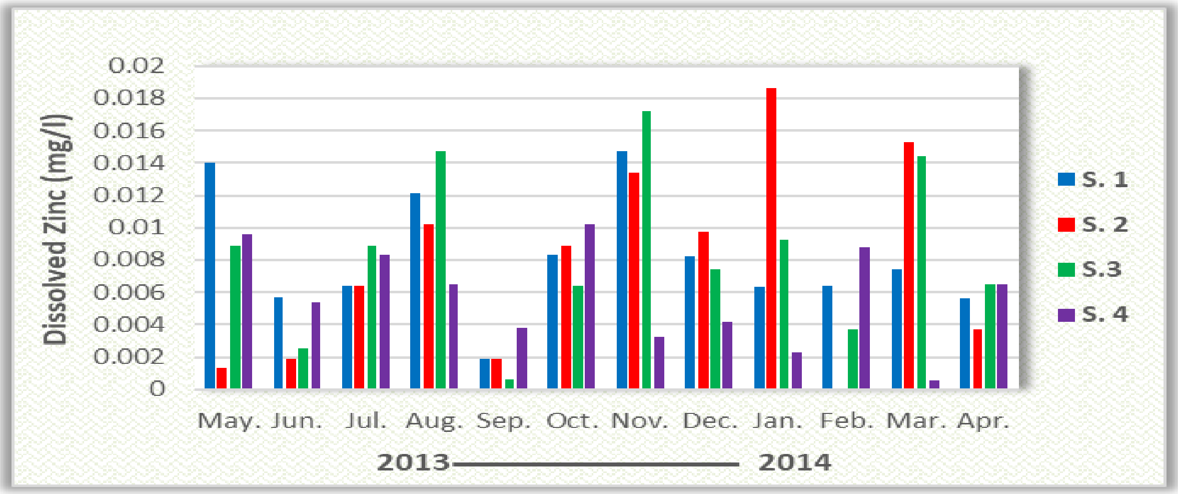

Figure (4.a) Variations of dissolved Zinc concentrations in the study sites

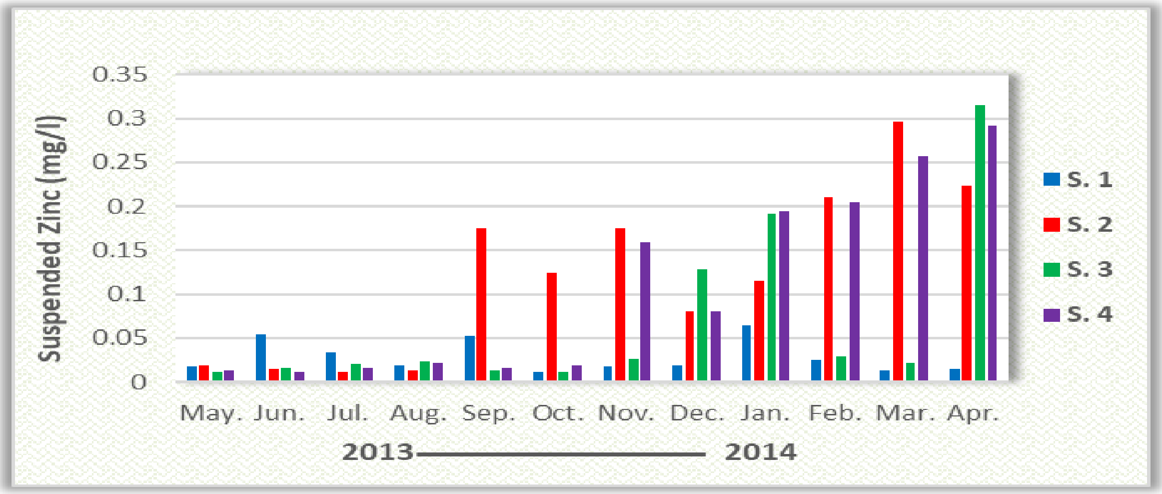

Figure (4.b) Variations of Suspended Zinc concentrations in the study sites

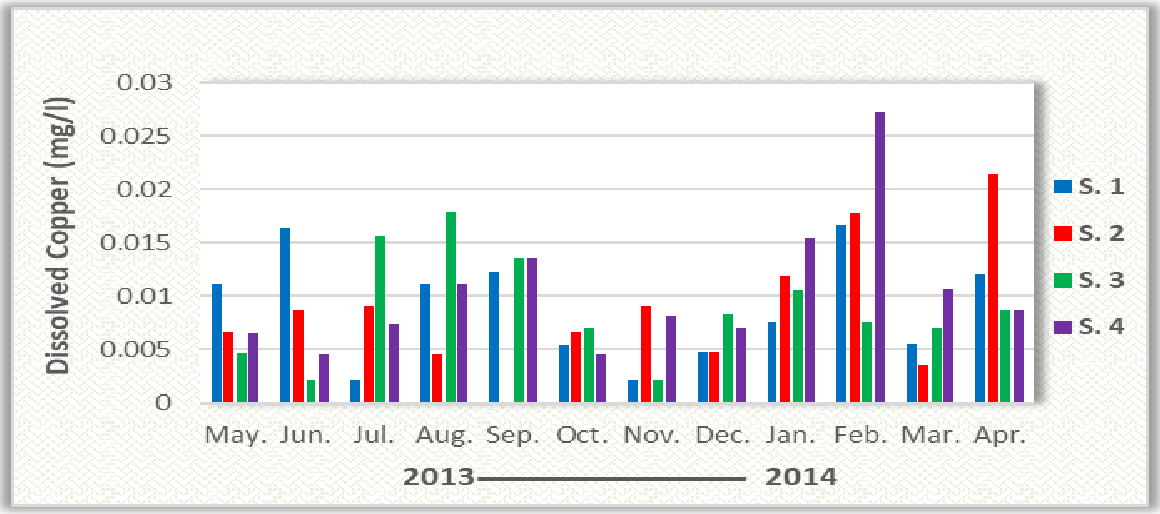

Figure (5.a) Variations of dissolved Copper concentrations in the study sites

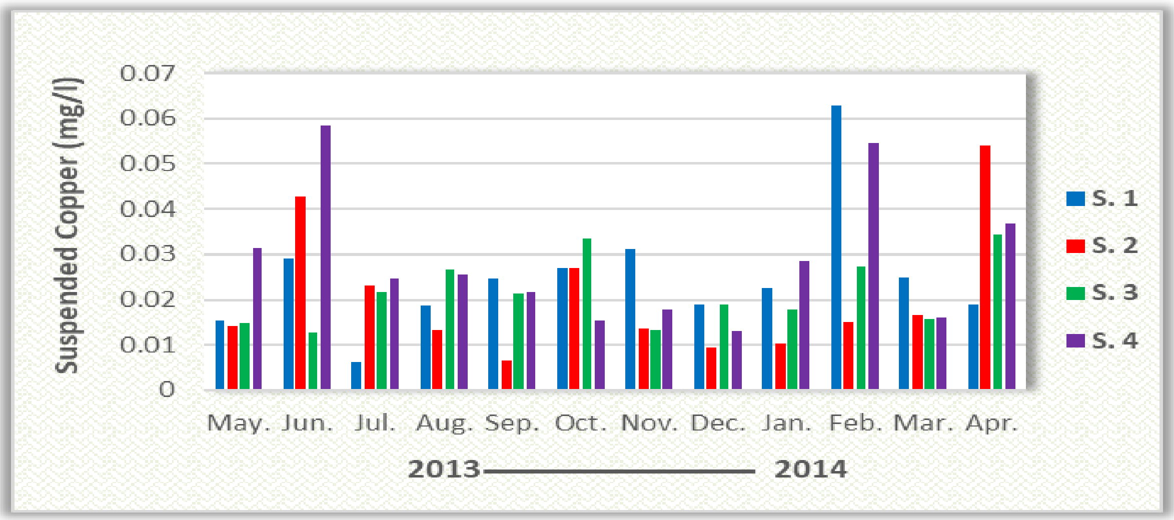

Figure (5.b) Variations of Suspended Copper concentrations in the study sites

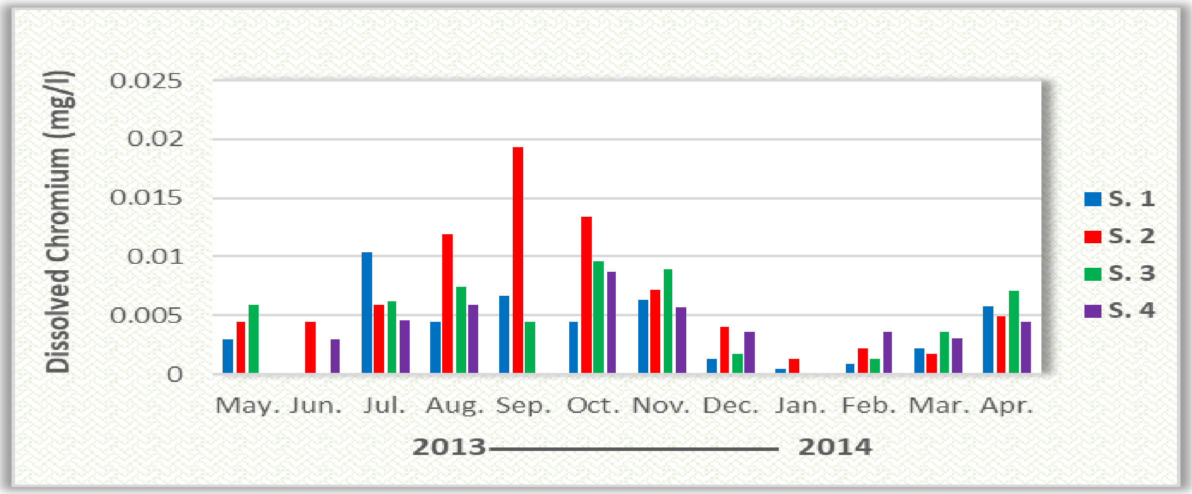

Figure (6.a) Variations of dissolved Chromium concentrations in the study sites

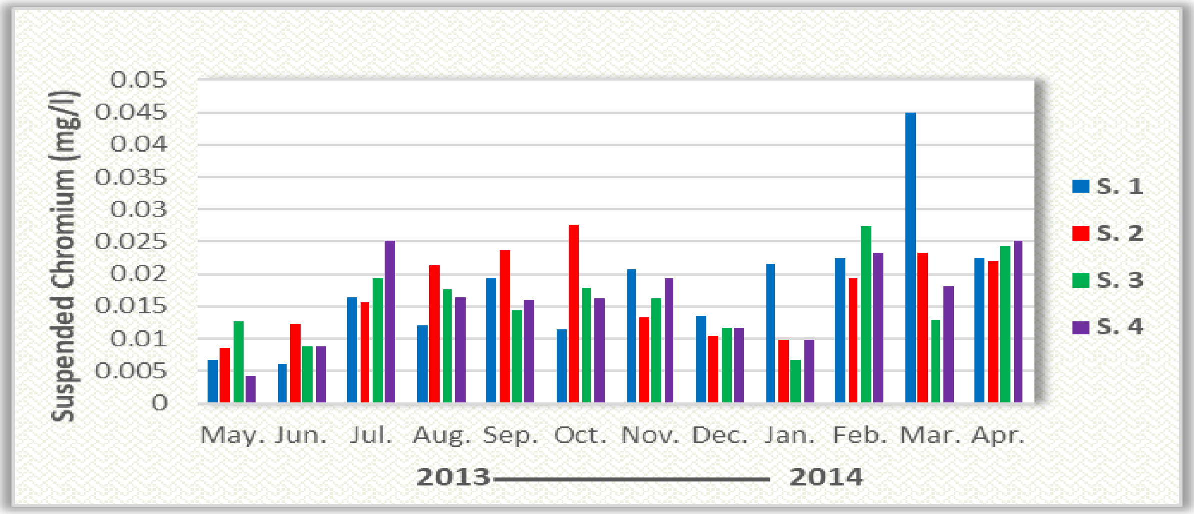

Figure (6.b) Variations of Suspended Chromium concentrations in the study sites

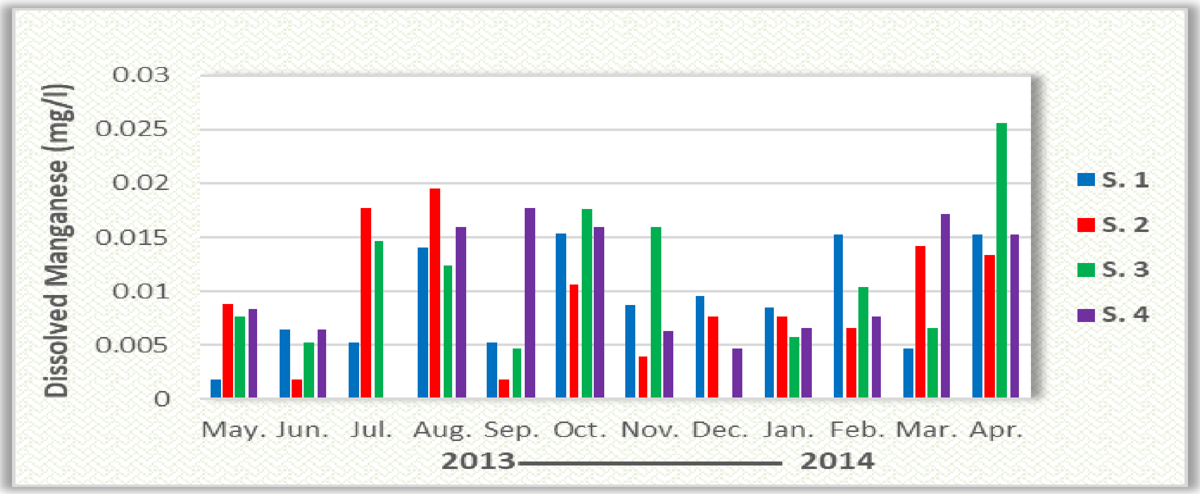

Figure (7.a) Variations of dissolved Manganese concentrations in the study sites

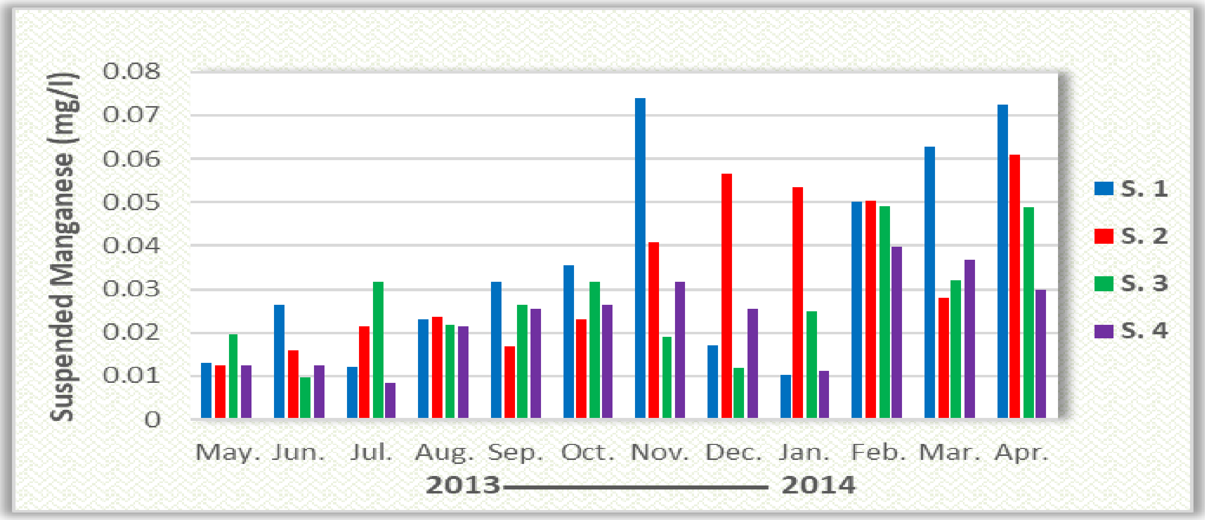

Figure (7.b) Variations of Suspended Manganese concentrations in the study sites

Table 2. The range (first line) and mean± standard deviation (second line) and of Heavy metals of the study sites.

- **= Not Detection (Imperceptible)**

Heavy Metals	S.1	S.2	S.3	S.4
Dissolved Cadmium (ppm)	0.077 – 0.001 0.008 ± 0.014	0.02 – 0.002 0.005 ± 0.01	0.013 – 0.001 0.004 ± 0.007	0.014 – N.D.* 0.004 ± 0.006
Suspended cadmium (ppm)	0.085 – 0.008 0.020 ± 0.021	0.271 – 0.007 0.002 ± 0.042	0.09 – 0.013 0.026 ± 0.034	0.032 – 0.004 0.007 ± 0.018
Dissolved lead (ppm)	0.013 –0.001 0.004 ± 0.007	0.023 – N.D. 0.006 ± 0.008	0.020 –0.01 0.006 ± 0.007	0.019 –0.001 0.006 – 0.010
Suspended lead (ppm)	0.046 – 0.013 0.009 ± 0.024	0.037 – 0.004 0.008 ± 0.019	0.150 – 0.015 0.042 ± 0.052	0.035 – 0.012 0.006 ± 0.019
Dissolved zinc (ppm)	0.015 – 0.002 0.004 ± 0.008	0.019 -N.D. 0.006 ± 0.008	0.017 – 0.001 0.005 ± 0.008	0.01 – 0.001 0.003 ± 0.006
Suspended zinc (ppm)	0.065 – 0.012 0.018 ± 0.029	0.299 – 0.012 0.095 ± 0.122	0.318 – 0.012 0.043± 0.068	0.29 – 0.011 0.104 ± 0.107

Dissolved copper (ppm)	0.017 – 0.002 0.005 ± 0.009	0.022 – N.D. 0.006 ± 0.009	0.018 – 0.001 0.005 ± 0.009	0.028 – 0.004 0.006 ± 0.01
Suspended copper (ppm)	0.065 – 0.006 0.013 ± 0.025	0.056 – 0.006 0.014 ± 0.02	0.035 – 0.012 0.007 ± 0.022	0.059 – 0.013 0.07 ± 0.029
Dissolved Chromium (ppm)	0.011 – N.D. 0.003 ± 0.004	0.019 – 0.001 0.005 ± 0.007	0.01 –N.D. 0.003 ± 0.005	0.009 – N.D. 0.003 ±0.004
Suspended chromium (ppm)	0.045 – 0.004 0.01 ± 0.018	0.028 – 0.008 0.006 ± 0.017	0.028 – 0.007 0.006 ± 0.016	0.025 – 0.004 0.006 ± 0.016
Dissolved manganese (ppm)	0.016 – 0.002 0.009 ± 0.005	0.02 – 0.002 0.009 ± 0.006	0.026 –N.D. 0.011 ± 0.007	0.018 -N.D. 0.004 ± 0.01
Suspended manganese (ppm)	0.074 – 0.01 0.036 ± 0.023	0.061 – 0.012 0.034 ± 0.017	0.051 – 0.009 0.027 ± 0.012	0.04 – 0.008 0.010 ± 0.024

Conclusion

The increases in heavy metal concentrations are affected by many physical and chemical properties of river water. There is an increase in heavy metals in the suspended form compared with dissolved and elevated concentrations of lead and cadmium, as their concentrations exceeded other metals.

References

1. Nasly, M., Hossain, M., and Islam, M.S. *Water quality index of Sungai Tunggak: an analytical study*. in *3rd International Conference on Chemical, Biological and Environment Sciences*. 2013.
2. O'Keefe, S., *A study of alternative microbial indicators for drinking water quality in Northern Ghana.* Unpublished master's thesis). Massachusetts Institute of Technology. Retrieved from http://web. mit. edu/watsan/docs_theses_ghana. html, 2009.
3. Ramakrishnaiah, C., Sadashivaiah, C., and Ranganna, G., *Assessment of water quality index for the groundwater in Tumkur Taluk, Karnataka State, India.* E-Journal of chemistry, 2009. **6**(2): p. 523-530.
4. Abbasi, S., *Water quality indices, state of the art report, National Institute of Hydrology, scientific contribution no.* incoh/sar-25/2002, Roorkee: INCOH, 2002: p. 73-200.
5. Ochir, A. and Davaa, G., *Application of index analysis to evaluate the water quality of the Tuul River in Mongolia.* Journal of Water Resource and Protection, 2011.
6. Kulmatov, R., Opp, C., Groll, M., and Kulmatova, D., *Assessment of water quality of the trans-boundary Zarafshan River in the territory of Uzbekistan.* 2013.
7. Al-Yasiri, A.A., *Studing chemical and physical properties for different water positionals in Suq Al-Shyukh and Cheapish regions in Thi-Qar government, Univesity of Thi-Qar Journal, 2007. 3(1): p. 123-129.*
8. APHA, A., *WEF, Standard Methods For Examination Of water and Wastewater. Washington DC: USA.* American Public Health Association Publication, 2003: p. 321-30.
9. Sturgeon, R., Desaulniers, J., Berman, S., and Russell, D., *Determination of trace metals in estuarine sediments by graphite-furnace atomic absorption spectrometry.* Analytica Chimica Acta, 1982. **134**: p. 283-291.
10. Khethi, M.T., Al-Mosuli, B.B.Q., and Neama, A.-S., *Analysis of Heavy Metals in Water Samples of Euphrates River in Nasiriya City, Iraq.* Univesity of Thi-Qar Journal, 2013. **8**(2).
11. Ahaneku, E. and Animashaun, I.M., *Determination of water quality index of river Asa, Ilorin, Nigeria.* Pelagia Research Library, Advances in Applied Science Research, 2013. **4**: p. 277-284.
12. Tanimu, Y., Bako, S.P., and Adakole, J.A., *Effects of domestic waste water on water quality of three reservoirs supplying drinking water in kaduna state-Northern Nigeria.* Intech., Rijeka, Croatia, 2011: p. 269-282.
13. El-Bouraie, M., El-Barbary, A.A., Yehia, M.M., and Motawea, E.A., *Heavy metal concentrations in surface river water and bed sediments at Nile Delta in Egypt.* Suo, 2010. **61**(1): p. 1-12.
14. Environment., A., *Water for Life: Current and Future Use. Prepared by North/South Consultants Inc., Clearwater Environmental Consultants Inc. and Patricia Mitchell Environmental Consulting. Accessed at.* 2007.
15. Demina, L.L., Galkin, S.V., and Shumilin, E.N., *Bioaccumulation of some trace elements in the biota of hydrothermal fields of the Guaymas Basin (Gulf of California).* Boletín de la Sociedad Geológica Mexicana, 2009. **61**(1): p. 31-45.
16. Sekabira, K., Origa, H.O., Basamba, T., Mutumba, G., and Kakudidi, E., *Heavy metal assessment and water quality values in urban stream and rain water.* International Journal of Environmental Science & Technology, 2010. **7**(4): p. 759-770.
17. Mwashote, B.M., *Levels of cadmium and lead in water, sediments and selected fish species in Mombasa, Kenya.* Western Indian Ocean Journal of Marine Science, 2003. **2**(1): p. 25-34.
18. Faragallah, H., Askar, A., Okbah, M., and Moustafa, H., *Physico-chemical*

characteristics of the open Mediterranean sea water far about 60 Km from Damietta harbor, Egypt. Journal of Ecology and The Natural Environment, 2009. **1**(5): p. 106-119.

19. Abdul-Kareem, B.M., Rabee, A.M., and Al-Fatlawy, Y.F., *Monitoring heavy metals, cations and anions levels and its possible health risks in Tigris River at Baghdad region.* Iraqi journal of science, 2011. **52**(3): p. 306-316.
20. Salvadó, V., Quintana, X., and Hidalgo, M., *Monitoring of nutrients, pesticides, and metals in waters, sediments, and fish of a wetland.* Archives of environmental contamination and toxicology, 2006. **51**(3): p. 377-386.
21. Environment, C.C.o.M.o.t., *Guidance on the site-specific application of water quality guidelines in Canada: Procedures for deriving numerical water quality objectives*. 2003, CCME Quebec,, Canada.
22. Hassan, F.M., Saleh, M.M., and Salman, J.M., *A study of physicochemical parameters and nine heavy metals in the Euphrates River, Iraq.* E-Journal of Chemistry, 2010. **7**(3): p. 685-692.
23. Al-Fatlawy, H.J., *An environmental study of the Euphrates River between the Hindiya Dam and the Al-Kifl sub-district - Iraq*. 2005.
24. Moustafa, M., Ali, M., Abdel-Satar, A., Mohamed, T., and Madbouly, S., *Water Quality Assessment of Rosetta and Damietta Branches, River Nile, Egypt.* African J. Biol. Sci, 2010. **6**(2): p. 127-142.
25. Park, N., Kim, J.H., and Cho, J., *Organic matter, anion, and metal wastewater treatment in Damyang surface-flow constructed wetlands in Korea.* ecological engineering, 2008. **32**(1): p. 68-71.
26. Salman, J.M., *Studying the effects of some potential pollutants in the Euphrates River between Al Hindiya Dam and Kufa City - Iraq*. 2006: University of Babylon,Iraq.
27. Programme, U.N.E.P.G.E.M.S.W., *Water Quality for Ecosystem and Human Health.* 2nd edition, Canada., 2008.
28. Feza, K., Aslhan, K., Saadet, l., Sonay, S., and Nurcan, A., *Dissolved and particulate trace elementsâ€™ configuration: Case study from a shallow lake.* International Journal of Physical Sciences, 2013. **8**(24): p. 1319-1333.
29. Salman, J.M., Hassan, F.M., and Abdulameer, S.H., *A study on the fate of some heavy metals in water and sediments in lotic ecosystems.* Int. J. Chem. Phy. Sci, 2015. **4**(2): p. 36-45.