Study Some Heavy Metal Concentrations in Al- Rumaytha River water-Iraq

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Abstract

Heavy metals are one of the most important inorganic contaminants in river water since they were non-biodegradable and accumulated at the trophic level, resulting in negative biological impacts. Concentrations of copper, cadmium, chromium, and lead were determined in water of Al- Rumayth River from November 2021 to October 2022. Samples were collected monthly from three sites (Al- Arthiat area, Al-Rumaytha center, Dyoalim village), The result of Heavy metal concentrations (dissolved phase) for cadmium, lead ,Copper and Chrome ranged (0.06-49 µg/L, 0.0-163.13 µg/L/l,0-1328.9 µg/L,0-28.33) respectively . As shown in the results, heavy metal levels in the water supply were too high. High yearly levels of Cu and pb in the dissolved phase suggest to continually input of anthropogenic pollutants to the river, which refers to ongoing supplementation of metals pollutants, as shown by the data.

Keywords: *Water pollution, Metal pollution, Al -Rumaytha River, Al-Muthanna.*

1. INTRODUCTION

Metals with a high atomic number, weight, and specific gravity of greater than 5 g/cm3[1] have become one of the most pervasive and harmful environmental contaminants in recent decades. Heavy metal levels in the aquatic environment have risen dramatically during the last 50 years [2]. There are two categories of heavy metals: those that are necessary for human survival and those that aren't.

Biological systems rely on a class of substances known as "essential elements" [3]. These elements are required in minute quantities, yet are crucial to life. Metals including chromium (Cr), cobalt (Co), zinc (Zn), copper (Cu), manganese (Mn), iron (Fe), and selenium (Se) may be harmful if present in amounts beyond what organisms need [4]. Elements like arsenic (Ar), barium (Ba), cadmium (Cd), lead (Pb), lithium (Li), mercury (Hg), and nickel (Ni) are examples of the non-essential elements that do not play any specific functions in living organisms and are thus seen as harmful (Ni) [4].

Pollution by heavy metals is the most important types of pollution [5]. In recent years, contamination of water environment with heavy metals has become a worldwide issue because they are non-degradable in nature and accumulate across tropical levels causng a deleterious biological effects [6]. The American Protection Agency [7] coined the name to describe the group of elements that sits between positions two and six on the periodic table. More emphasis has recently been dedicated to studying the impacts of heavy metals on the environment, human health, communities occurring in aquatic environments, and ecosystems because of their classification as pollutants with deadly and sub-lethal effects on living organisms. [8].

Heavy metal contamination in Iraq's aquatic environment has been studied extensively by a variety of international and local specialists. Researchers [9] looked examined Pb, Zn, Cd, Fe, and Mn levels in Bahr Al-water Najaf's and determined that they were too high. Mn > Pb > Zn > Cu > Fe > Cd was the order of elements found in the evaluation of heavy metal concentrations in the water of the Euphrates River in the city of Al-Nasiriya conducted by [10]. We also discovered that the river's pollution levels fluctuated greatly from place to place and season to season. On top of that, [11] heavy metals in the Euphrates river water and sediments compared at Al-Muthanna.A study results [12] indicated that the values of Heavy Metals Index (HPI) of the three stations were (238.8, 185.5, 230.2) High Polluted in the all sites. The Results WQI min ranged between (Bad to Good water. The result of Provincial water samples found elevated levels of heavy metals, over the range allowed by World Health Organization (WHO) guidelines for Iraqi water.

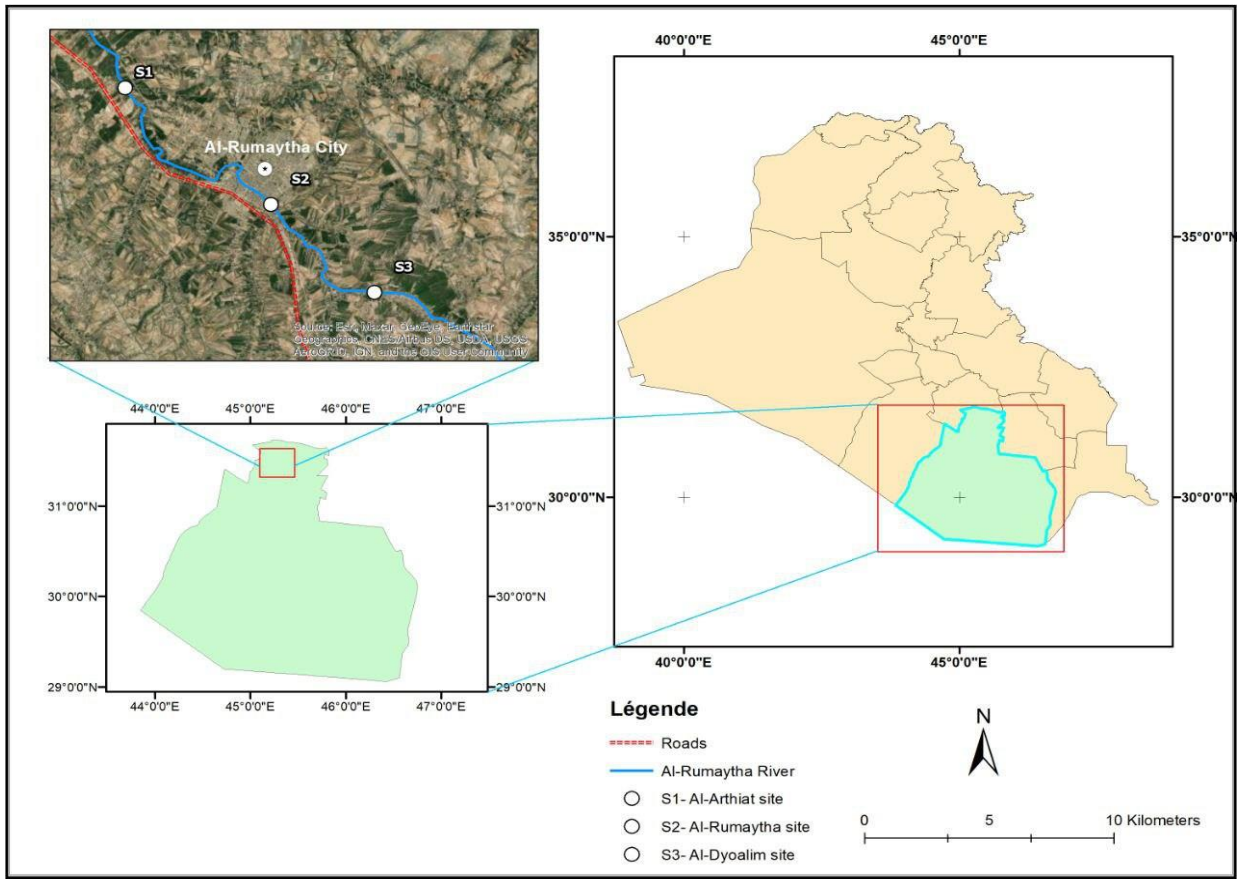
2. Materials and Method

2.1: The study area is described.

Al-Rumaytha River is a natural extension of the Al- Hilla River.Al- Hilla River is generally branches from the left side upstream of the New Hindiya barrage on the Euphrates River. As a result, Al- Hilla River water flows through Al- Hilla City before turning south and continuing up to Al- Diwaniya near the Al-Hamz-al Shrqee, Al-Rumaytha River, which stretches for 30 kilometers from Al Hamza bridge to Alnajame regulator.Al- Rumaytha River is the only source of water in Al-Muthanna Province. Through a system of distributaries and branch canals, River Al-Rumaytha irrigates an area of about (50000 ha.[13].

The three sampling sites selected on the Al-Rumaytha River, the first site (″23.31'31̊33 N – ″21.30'945̊ E) called Al- Arthiat area is located about 8 km north the center of Al-Rumaytha. The second site (6.70'31̊31 N - ″31.07'45̊ 12 E) located at Al-Rumaytha center. The third site northwest (″24.04'31̊29 N - ″45.33'45̊14 E) located at Al-Dyoalim village is about 6 km form at Al-Rumaytha center.(Fig 3-1).

Fig (1): Map showing sampling sites in Al- Rumaytha River during the study period



2.2: Sampling methods

In order to determine the concentrations of heavy metals in the water, samples were taken at a depth of 30 cm, transferred to polyethylene bottles of 5 L, filtered through 0.45 m Millipore filter paper, and then digested. [14,15].Was acidified by adding 1.5 ml of HNO3 to each litter the solution was ready for reading by flame atomic absorption spectrophotometer, Then the mineral concentration is calculated in µg / L after being determined from the standard curve of absorption [16].

3. Results and Discussion

Due to their toxicity and accumulative tendency, heavy metals have become a severe threat to the aquatic ecology. Metals are carried into waterways via weathering of rocks and soils, industrial wastewater discharges, sewage, and atmospheric deposition[17]. The current study found that average river water parameters were higher than the standards set for Iraqi water. 1967 NO.[18].

The results of Cd ranged between (0. 06-49 µg/L) during the study period. The mean lowest value of dissolved cadmium was (0 .06 µg/L) at St.3 in March, while the highest lowest mean value (49 µg/L) at St.1 during May (Fig 2), the statistical analysis of the data showed significant differences among months and sites at ($P \leqslant 0.05$) was St .1 highest value in Cd superior to St.3, was a significant decrease in March, October at St.2,St.3 and November St.2 (0. 3 µg/l,0.19 µg/l,0. 23 µg/l,0.23 µg/l), respectively. The significant positive correlation Cd with Cu (r=0.124) respectively,

while correlation between Cr, Pb be weakly (table 1). While negative correlation was found between Cd and NO3 (r= -0.135) the increase of NO3 leads to reduction the cadmium.

Cd pollution of the Euphrates has been documented[19,20]. Runoff from chemical fertilizer-rich agricultural fields is the primary cause of the high levels of Cd in water. Mastoi et al.,[21] Agricultural activities can the main source of cadmium in surface waters, as the agricultural drainage water is high cadmium content[22] ,the cadmium is particularly highly adsorbed on muds, humus, and organic debris, potentially allowing it to enter the food chain via fish and fish food and accumulate in tissue. [7].

The results of Pb ranged between (0. 0 - 163.13 µg/L) during the study period. The lowest mean value (0.0 µg/L) at St.1 in October, while the highest mean value of dissolved lead was (163.13µg/L) at St.2 during November (Fig 3), the statistical analysis showed a significant differences among sites and month, was a significant increase in the July at,St.2 ,November at St.1 recorded as (109.72 µg/l,103.80 µg/l,) respectively, related to the other months, Pb excellence in October at St. 1,This is due to the effect of the rains, which wash away the sources of pollution from the air and soil, which contain high concentrations of lead, and wash them into rivers ,was a significant decrease in December at St.2 and St.3 ,September at St.1 and St.2 , and November at St.3, at St.2 in August (0 µg/l, 0 µg/l, 0 µg/l,0 µg/l, 0 µg/l , 0 µg/l) respectively compared to the other months. Decreasing lead concentrations as a result of the ability of the reverse osmosis desalination process and mechanical filtration processes to reduce lead concentrations[23].The significant positive correlation Pb with Cr (r= 0.13,table-1) respectively ,while correlation between Cu, Cd be weakly correlation .

The reason for the presence of lead may be attributed to Car exhaust that play a major role in transporting lead to the aquatic environment [24].Or it may be because Surface sediments often exchange with suspended matter, which affects the release of minerals into the water above the water surface [25]. The measured Pb levels in Al- Rumaytha River in all the sites except December at St.2 and St.3 followed September at St.1 and St.2 , and November St.3 Due to the river's path through agricultural areas where various Pb-containing chemicals are utilized in the production of agricultural products, these compounds concentrate in agricultural soils and eventually make their way to streams during rainy seasons or as a consequence of soil erosion. [26].

The lowest mean value of dissolved Copper was (0 µg/L) at St.1 in December, while the highest mean value (1328.9 µg/L) at St.2 during May, (Fig 4) The statistical analysis showed a no significant differences among sites and month , was a significant increase in May at St.1 ,August at St.2 and October at St .2 recorded as (791.13 µg/l, 259.19 µg/l,126.04 µg/l) respectively. Corrosion of water and sewage pipelines [27] or an increase in the flow of untreated residential sewage, particularly at St.2[28], may be the cause of the rise in Cu content throughout the spring and summer. Hence, may be ascribed to the release of heavy metals from sediments to the overlying water as a consequence of both high temperatures and the fermentation process that follows the breakdown of organic materials [29]. Was a significant decrease in August at St.1 .March at St.3,September at St.3 and April at St.3 (0.13 µg/l,3.13µg/l,5. 82 µg/l,6.07 µg/l) respectively, compared to the other month . The significant positive correlation Cu with TSS (r= 0.35), The

significant correlation between heavy metal be weakly (table 1).Copper was a naturally occurring element that was found in air, water and food. Cu metal performs a crucial role as a co-enzyme in enzyme action but, in excess, may be poisonous [30] .Study Researchers Storelli et al., [31] copper is a necessary mineral, but high dietary intake has been linked to adverse health consequences such inflammation and liver cirrhosis.

The lowest mean value of dissolved Cr was (0 µg/l,0 µg/l, 0 µg/l) at St.2 in March ,June and July, While the highest mean value (28.33g/L) was recorded at St.2 in November (Fig 5), the increasing in Cr rates during Autumn may be attributed to cement dust, electro plating, wearing down asbestos, or agricultural waste fertilizers and pesticides. These results are consistent with the observation made by [32] in Karachi, Pakistan, that the recorded concentrations of Cr in groundwater investigated under study are lower than the recommended value [33]. [34].The statistical analysis showed a significant differences among month , The statistical analysis showed a no significant differences among sites (table 1). A significant increase in December at,St.2 followed January at St.1 and St.2 recorded as (27.20 µg/l,20.23 µg/l,20.26 µg/l) respectively ,compared to the rest months, was a significant decrease in March at St.2 followed June at St.2 and St.1, July at St.2 and St.1and October at St.2 (0 µg/l,0 µg/l,0 µg/l,0 µg/l) respectively. The significant positive correlation Cr with TPH, Pb, (r=0.64, r=0.13) concentrations of some heavy metals in the aquatic environment increase with TPH due to the existence of a positive relationship between them, while negative The coefficient of determination for the relationship between Cr and BOD was -0.27, whereas the association between Cu and Cd was very marginally significant. Throughout the research period, the concentration of chromium in the Al-Rumaytha river was found to be highest in the fall and winter, and lowest in the spring and summer. Both animals and humans need Cr for proper nutrition. [35].

The levels of Cu ,Cr Cd and Pb are high in water because of industrial and agricultural discharge [36].

Fig (2): Monthly variation of Cd means in Al- Rumaytha River during the study periods.

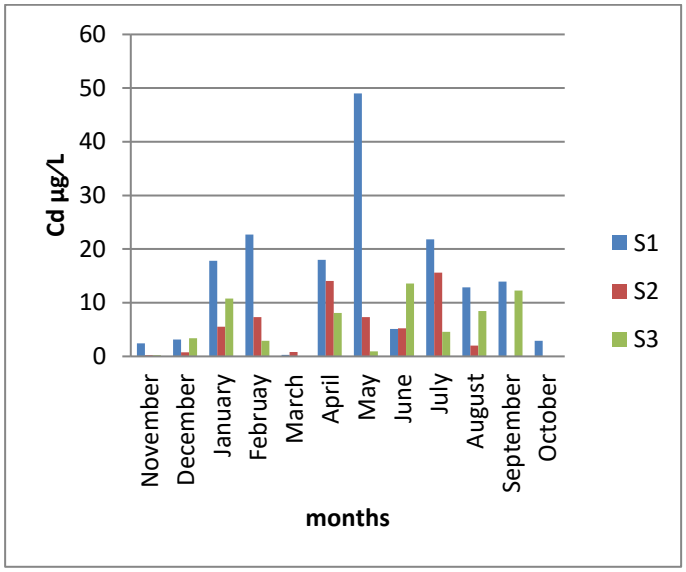


Fig (3): Monthly variation of Pb means in Al- Rumaytha River during the study periods

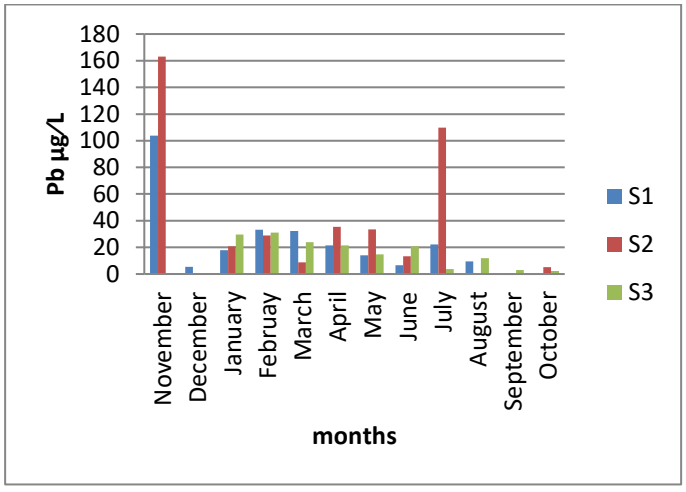


Fig (4): Monthly variation of Cu means in Al- Rumaytha River during the study periods.

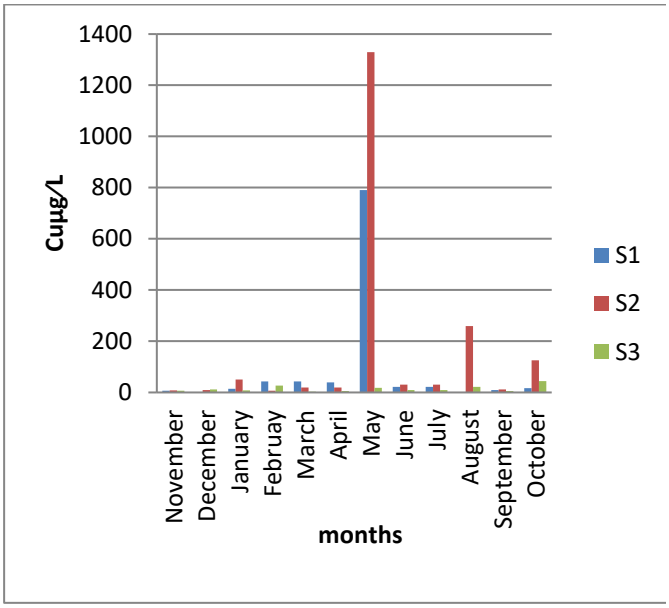


Fig (5): Monthly variation of Cr means in Al- Rumaytha River during the study periods.

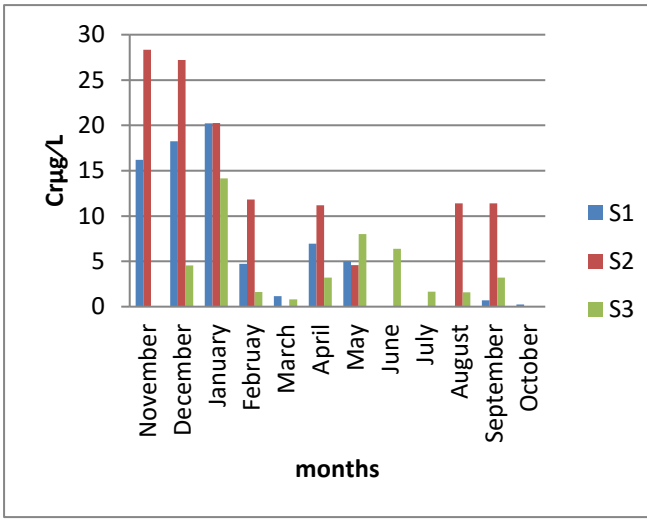


Table (1): The correlation among heavy metals

	Cd	Pb	Cr	Cu
Cd	1			
Pb	0.009	1		
Cr	-.062	0.138	1	
Cu	0.124	0.026	0.033	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. Conclusion

There are seasonal and geographical variations in the concentration of metals (cd, pb) in water. The levels of studied heavy metals in water were above the permissible limits set by Iraqi determinants in 1967 and the limits set by the World Health Organization. High annual values of Cu and pb in the dissolved phase indicate to constantly input of anthropogenic pollutants to the river, which refers to continuous supplement of metals pollutants (2006). Site 3 is the most contaminated section of the Al-Rumaytha River due to sewage from the surrounding cities being dumped into the waterway. BOD5 values were shown to be clearly influenced by excreta untreated wastewater, and a negative association was discovered between heavy metal (Cr, Cu,Pb) and BOD5 levels.

Reference

[1] Rahimi, M.; Farhadi, R. and Mehdizadeh, R. (2013). Phytoremediation: using plants to clean up contaminated soils with heavy metals. Intl. J. Agric: Res & Rev.Vol.,3(1):148-152.

[2] Moore, J. W., & Ramamoorthy, S. (1984). Heavy metals in natural waters springervelarge. New York Inc, 268

[3] Ametepey, S. T., Cobbina, S. J., Akpabey, F. J., Duwiejuah, A. B., & Abuntori, Z. N. (2018). Health risk assessment and heavy metal contamination levels in vegetables from Tamale Metropolis, Ghana. International Journal of food ontamination,

[4] Raikwar, M. K.; Kumar, P.; Singh, M. and Singh, A. (2008).Toxic effect of heavy metals in livestock health Veterinary World, Vol.1(1):28-30.

[5] Brodny, J., & Tutak, M. (2019). Analysis of the diversity in emissions of selected gaseous and particulate pollutants in the European Union countries. Journal of environmental management, 231, 582-595.

[6] Yap, C. K.; Jusoh, A.; Leong, W. J.; Karami, A. and Ong, G. H. (2015).Potential human health risk assessment of heavy metals via the consumption of tilapia Oreochromis mossambicus collected from contaminated and uncontaminated ponds. Environmental Monitoring and Assessment, 187(9):584

[7] EPA, (2001). United States Environmental Protection Agency. Quality Assurance Guidance Document-Model Quality Assurance Project Plan for the PM Ambient Air, 2.

[8] Boyd, R. S. (2010). Heavy metal pollutants and chemical ecology: Exploring new frontiers. J. Chem. Ecol., 36:46-58

[9] Al-Zurfi, S. K. L., Shabaa, S. H., & Tsear, A. A. (2019). Assessment of physicochemical parameters and some of heavy metals in Bahr Al-NajafIraq. Plant archives, 19(1), 936-940.

[10] Al-Taher, Q. M., Akbar, M. M., & Al-Qarooni, I. H. (2020). Estimation of Heavy Metals in Water, Sediment and bioaccumulation in Pseudodontopsis euphraticus and Bellamya bengalensis in Euphrates Riverin Al-Nassiriyah City/South of Iraq. Plant Archives, 20(2), 1454-1460.

[11] Razzaq, W. S., Al-Taee, I. A., & Al-Fanharawi, A. A. (2022). Comparative study of heavy metals between water and sediment for Euphrates river in Al-Muthanna Province. In AIP Conference Proceedings (Vol. 2398, No. 1, p. 040015). AIP Publishing LLC.

[12]Radi R. H and Al-Fanharawi A. A ,(2022). Water quality assessment of Sawyer river using some environmental indices, BNIHS, ISSN: 1343-4292 ,Volume 140, Issue 02.

[13] Awad, A. M. (2016). Hydraulic Model Development using HEC-RAS and Determination of Manning Roughness Value for Shatt Al-Rumaith. Muthanna Journal of Engineering and Technology, 4(1), 9-13

[14] J. Hlavay, T. Prohaska, M. Weisz, W. W. Wenzel, and G.I. (2004). Stingeder, Determination of trace elements bound to soils and sediment fractions. Pure Appl. Chem., 76 (2) : 415 – 442,

[15] L.Yi,Y.Hong, D. Wang, and Y Zhu, (2007). Determination of free heavy metal ion concentration in soils around a cadmium rich zinc deposit. Geochemical J., 41: 235 – 240,

[16] APHA (American public Health Association). (2017) ‘standard methods for the examination of water and wastewater. 23rd’, Washington DC

[17] Leena, S.; Choudhary, S. K. and Singh, P. K.(2012).Status of heavy metal concentration in water and sediment of River Ganga at selected sites in the Middle Ganga Plain. Int. J. Res. Chem. Environ. Vol.2 (4): 236-243.

[18] Al-Atbee, R. S., Al-Hejuje, M. M., & Al-Saad, H. T. (2019). Heavy elements accumulation in dominants aquatic plants at Al-Chibayish Marshes, South of Iraq. Mesopotamian Journal of Marine Science, 34(2).

[19] Al-Imarah, F. J.; R. A. Ghadhon and S. F. Al-Shaway, (2000). Levels of trace metals

in water from Southern part of Iraq. Marina Mesopotamia J. 15(2):365- 372

[20] Al-Obeidi, A. H. A. (2017). Study and evaluate the causes of the euphrates river water salinization in middle and Southern Iraq (Doctoral dissertation, M. Sc. Thesis, College of Agricultural, University of Al-Muthanna, Iraq).

[21] Mastoi, G. M., Shah, S. G. S., & Khuhawar, M. Y. (2008). Assessment of water quality of Manchar Lake in Sindh (Pakistan). Environmental monitoring and assessment, 141(1), 287-296.

[22] Suleiman, M. M. (2009). Environmental geography, Syrian General Book Organization - Damascus, p. 769.(in Arabic).

[23] Sagle, A., & Freeman, B. (2004). Fundamentals of membranes for water treatment. The future of desalination in Texas, 2(363), 137.

[24] Al – Saad, H. T. ; Saeed, A. and Salman, N. A. (2003). Marine pollution, Hadida University Pub. Yamen, 260p.

[25] Zvinowanda, C. M.; Okonkwo, J. O.; Shabalala, P. N.; Agyei, N.M. (2009). Anovel adsorbent for Heavy metal remediation in aqueous environments. Int.J. Environ. Sci. Tech. 6 (3), 425-434).

[26] Fahad, K. K. (2006): Ecological survey for southern sector of Al-Garaf River, southern Iraq. M.Sc. Thesis, College of Agric. Univ. of Basrah., 103p.

[27]Arnolds, J. L.; Snyman, R. G.; and Odendaal, J. P. (2018). Bioaccumulation of Al, Cu and Zn in coontail (Ceratophyllum demersum L.) after experimental exposure to a metal cocktail “pollution event”. Fresenius Environmental Bulletin, 27 (2): 928-937.

[28]Taghizadeh, M.; Solgi, M.; Karimi, M.; Sanati, M. H .and Khoshbin, S.(2018). Heavy metals effects on Brassica oleracea and elements accumulation

by salicylic acid. Archives of Hygiene Sciences, 7(1):1-11.

[29] Elewa, A. A.; Shehata, M. B.; Abdel Satar, A. M.; Ali, M. H. H. and Gohar, M. E. (2001). Effect of the drainage water on Lake Qarun ecosystem, Egypt. Presented in 9th international Conference on the Conservation and Management of Lakes 11–16 November, 2001. Shigha Prefectural Government – Japan.

[30] Abel, P. D., 2002, Water pollution biology ". 2nd ed. Copyright © Taylor & Francis Ltd.

[31] Storelli, M.; Barone, G.; Garofalo, R. and Marcotrigiano, G. (2007).Metals and organochlorine compounds in eel (Anguilla anguilla) from the Lesina Lagoon, Adriatic Sea (Italy). Food Chem. 100: 1337-1341.

[32] Siddique, A. (2006). Geographical Information System (GIS) linked evaluation of the groundwater pollution and its sources affecting environment of the Karachi City and its coastal region (Doctoral dissertation, University of Karachi).

[33] WHO. (2006). Guideline for Drinking water Quality 3rd Edition. Volume 1.Recommendation. World Health Organization Press. Genova. 562p.

[34] Abbasi, M. N., (2014). Determination of heavy metal settling velocities with respect to particle size and density. World Appl. Sci. J. 31 (12).

[35] Rajappa, B. ; Manjappa,S. ; and Puttaiah, E.T., (2010). Monitoring of Heavy Metal Concentration in Groundwater of

Hakinaka Taluk, India. Contemporary Engineering Sciences, 3(4): 183-190.

[36] Mason, C. F. (2002). Biology of freshwater pollution. 4rd. ed. Essex Univ. England. 387 pp.