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First record of the invasive apple snail *Pomacea canaliculata* (Lamarck, 1822) (Gastropoda: Ampullariidae) in Shatt Al-Arab River, Southern Iraq with some ecological aspects

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Abstract

The present study dealt with record the invasion of the freshwater snail *Pomacea canaliculata* to Shatt Al-Arab River during 2014. Occurrence of *P. canaliculata* was studied from April 2014 to March 2015. Occurrence and abundance of the invasive snail with six native gastropod snails were recorded during this study from Shatt al-Arab River. The mean population density of *P. canaliculata* in Shatt Al-Arab were ranged from 2-26 ind./m² during December and July, respectively. Some morphological features were measured.

Key wards: Ampullariidae, Invasion, Shatt Al-Arab River, *Pomacea canaliculata*

Introduction

The Ampullariidae (Gastropoda) is a family of freshwater prosobranchs that are widely distributed in Asia, Africa, and South America (Perera and Walls, 1996).

The apple snail *Pomacea canaliculata* is a freshwater snail of the Ampullaridae family (Cowie, 2002). It is indigenous to south America (Yusa, 2001), and formerly found also in Central America, West Indies and the southern USA (Michelson, 1961). It recognized from California and Arizona, and there are two other species of *Pomacea* also occurred in the same locality, *P. insularum* from Florida, Texas and Giorgia and *P. hausrum* from Florida (Rawlings *et al*., 2007).

The snail *P. canaliculata* was introduced to Taiwan for commercial purposes in 1979 (Chang, 1985), and through irrigation channels it spread into different water streams and now become widely distributed in Taiwan (Wu *et al*., 2011). Since 1980s, the snail was distributed in many tropical, subtropical and temperate regions (Halwart, 1994). It spread to many locations such as Philippines in 1980 (Mochida, 1991; Anderson, 1993 and Halwart, 1994), Japan in 1981 (Fujio *et al*., 1991), Korea in 1986, Malaysia in 1987, Indonesian and Viet Nam in 1989 (Cowie, 2002), Hawaii in 1989 (Acosta and Pullin, 1991; Lach and Cowie,1999 and Mochida, 1991), then into others Asian countries.

The apple snails are of one group of freshwater gastropods which can feeding on diverse food by using different mechanisms including shredding, scraping and collecting (Saveanu and Martin, 2013).

In general, channeled apple snails represent a major risk to ecosystem and agriculture in native wetland (Rawlings *et al*., 2007). After invasion to many Asian countries, *P. canaliculata* has the worst pests of rice (Mochida, 1991; Halwart, 1994; Naylor, 1996; Yusa, 2001; Cowie, 2002 and Baloch *et al*., 2012) and causes serious damages to different aquatic crops (Cowie *et al*., 2006 and Wu *et al*., 2011) such as *Colocasia esculenta* (Taro), *Ipomoea aquatica, Nelumbo nucifera, Juncus decipiens, Cyperus monophyllus,* and others (Mochida, 1991) and it also causes damages to other submersed macrophytes

(Saveanu and Martin, 2013). On the other hand the snail *P. canaliculata* serve as intermediate host of the rat lungworm causing eosinophilic meningoencephalitis in human in countries of Taiwan and Japan (Mochida, 1991).The introduced *Pomacea* snails are serve as host for some parasites that threaten human health directly (Cowie, 2002).

P. canaliculata infest large areas in many countries estimated in Taiwan in 1986 as 171425 ha, in Japan in 1989 as 16196 ha and in Philippines in 1989 as 400000 ha (Mochida, 1991). In Singapore, this species was introduced via the aquarium trade, and was currently well-established in the reservoirs and other water bodies (Yeo & Chia, 2010). The reproduction seasons in south America extended from Spring to Summer (Andrews, 1964) While extend much wider in Taiwan (Wu *et al*., 2011). *Pomacea* snails lay their egg masses on the plants stems (Yusa, 2001) and on the objects that protruding above the water surface (Teo, 2004). As well as, these snails chracteristic with high fecundity and fast growth (Cowie, 2002).

Before 2014, *P. canaliculata* had not been reported from Iraq. However, early in that year, individuals of the snail *P. canaliculata* started to appear frequently in benthic samples from the Shatt Al-Arab River and in some its shallow branches. The purpose of the present study is to confirming record of the apple snail *p. canaliculata* from Shatt Al-Arab River for the first time in addition to evaluate the variability of the population density of this invasive snail compared with the other native snails live near it.

Materials and Methods

The samples for the population density purposes were collected by using the quadrate (30 X 30 cm) from shallow water bank between two sites along about 5 km sector of Shatt Al-Arab River (Fig. 1), during the period from April 2014 to March 2015 by monthly intervals. For the identification and measurement studies, different sizes of live specimens of *Pomacea canaliculata* were collected by hand picking. All specimens were brought to the laboratory and kept live in glass aquarium for further study.

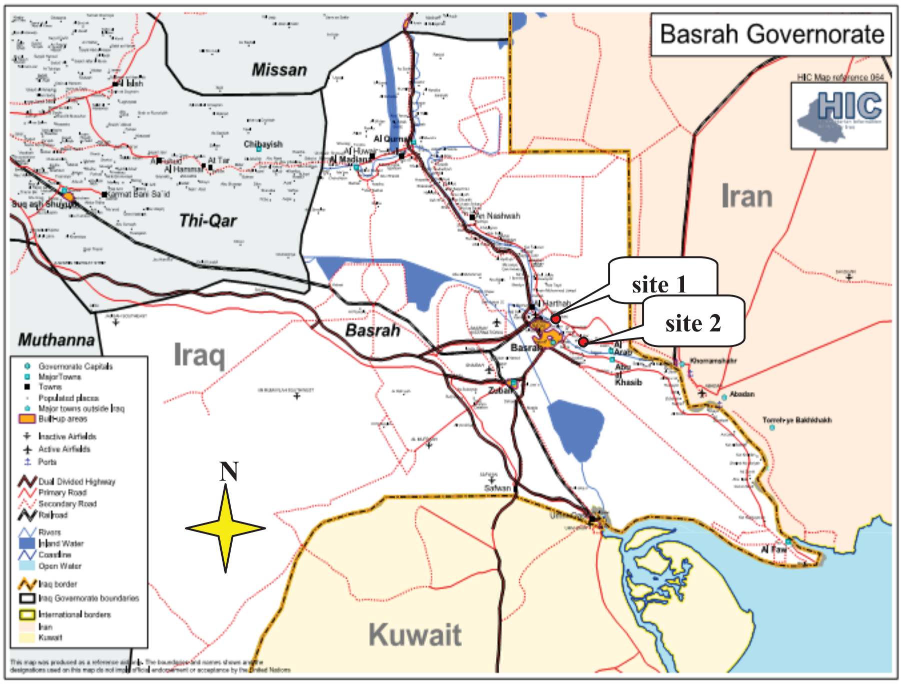

Figure 1: Map showing the study sites

The shell length, width and height and the aperture of the snail P. canaliculata were measured by using digital vernier caliper (Fig. 2). While the weight of the animals was measured by using Metler electric balance. Some of the physical and chemical parameters of the water in addition to the air temperature were measured in site. The identification of specimens was conducted by using several references (Clench, 1976 and Baloch et al., 2012).

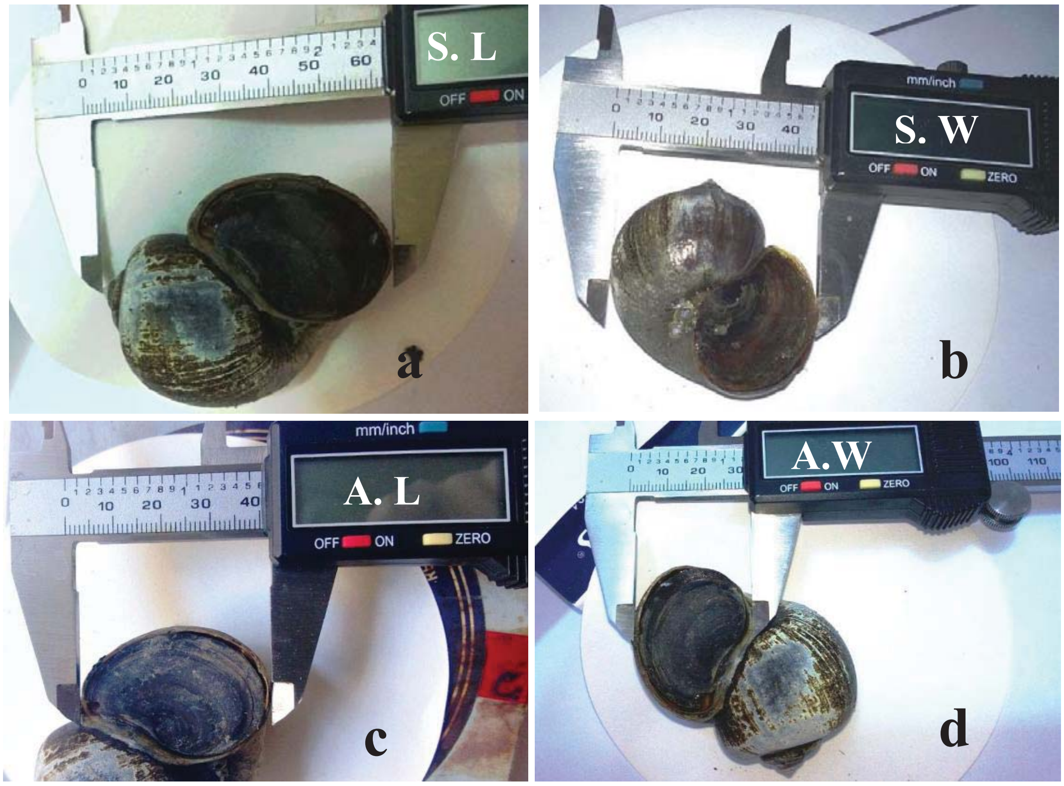

Figure 2. Body measurements of *P. canaliculata*. a: S.L= shell length, b: S.W= shell width, c: A.L= aperture length, d: A.W=aperture width

Results

The values of dissolve oxygen, salinity, pH, as well as water and air temperatures were measured in site, during the period from April 2014 to March 2015 at the study area of Shatt Al-Arab River. The values of dissolved oxygen, salinity and pH ranged between 5-11.5 mg/L, 1.2-2.8 psu and 7.6-8.9 respectively. While the water and air temperatures ranged from 14.7-29ºC and 18-39 ºC, respectively (Table, 1).

During the study period eight species of native Gastropod snails were recorded. Occurrence of all collected gastropod species were calculated, and the results refer that the two snails *Melanoides tuberculata* and *P. canaliculata* only recorded during all the study period with occurrence of 100% (Table,2).

The mean monthly densities of *P. canaliculata* were ranged from 4 ind./m² recorded during six months (October 2014-March 2015) to 26 ind./m² in July 2014 (Table, 3). *P. canaliculata* deposited their eggs in the field on aquatic plants (Fig. 3a, b) and any objects protruding on surface of the water during all months of the year except the three months December 2014-February 2015.

Table 1. Some Physical and Chemical parameters of the water from Shatt Al- Arab River during April 2014 to March 2015.

Parameters	Apr. 2014	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 2015	Feb.	Mar.
D.O (mg/L)	8	6.2	7.6	6	5.5	5	7	7.5	9	10.5	11.5	11
Sal (psu)	1.9	1.4	1.2	1.5	2	2.7	2.8	2.6	2.5	2.5	2	2.6
pH	8.4	7.6	8.2	8	8.1	8.2	8.3	8.8	8.7	8.8	8.9	8.8
W.T(ºC)	26	29	28.8	28	28	28.1	22.6	22	17.9	15.5	14.7	17
A.T (ºC)	38	39	34.5	38	36	34.5	25	26	18	18	18	21

D.O= Dissolve Oxygen, Sal.= Salinity, W.T= Water Temperature, A. T= Air Temperature.

Table 2. Occurrence of snails collected from Shatt Al-Arab river southern of Iraq during April 2014 to March 2015

species	Apr. 2014	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 2015	Feb.	Mar	Abundance
Bellamya bengalensis	+	-	-	-	-	-	-	-	+	-	-	-	16.6%
Melanopsis praemorsa	+	-	-	-	-	-	-	-	-	-	-	-	8.4%
Melanoides tuberculata	+	+	+	+	+	+	+	+	+	+	+	+	100%
Melanopsis nodosa	-	-	-	-	-	-	+	-	+	-	-	-	16.6%
Neritina violacea	-	+	-	-	-	-	-	-	-	-	-	-	8.4%
Pomacea canaliculata	+	+	+	+	+	+	+	+	+	+	+	+	100%
Radex auricularia	-	+	+	+	+	-	-	-	-	-	-	-	33.3%
Theodoxus jordani	+	-	+	-	-	+	+	+	+	+	-	+	66.6%

Table 3. Mean monthly densities (ind./m²) of the snail *Pomacea canaliculata* from banks of Shatt Al-Arab river southern of Iraq during April 2014 to March 2015

species	Apr. 2014	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 2015	Feb.	Mar.
Pomacea canaliculata **(Lamarck, 1822)**	7	7	22	26	15	11	4	4	4	4	4	4

Description:

The shell was bright to dark brown in color with dark horizontal lines, and these lines were more obvious in the younger animals. The body (soft tissues) was bright yellow to orange in color with some black or brown spot. The shell was rounded with six whorls and the sixth one was very small (Fig. 2) The snail depositing round pinkish eggs up to 2.8 mm in diametre (Fig. 3).

Measurements

The shell length of the collected individuals varied between 27 to 82 mm, while the width was ranged from 42-76 mm. The snail weight increases advanced in the age from 4.39 g of 27 mm length to 56.17 g of 62 mm length. The concentrically operculum (Fig. 1c) was oval and ranged between 18-48 mm in length, while reached 13-35 mm in width (Table, 4).

Figure 3: Different age stages of the snail *Pomacea canaliculata*. (Scale= 30 mm).

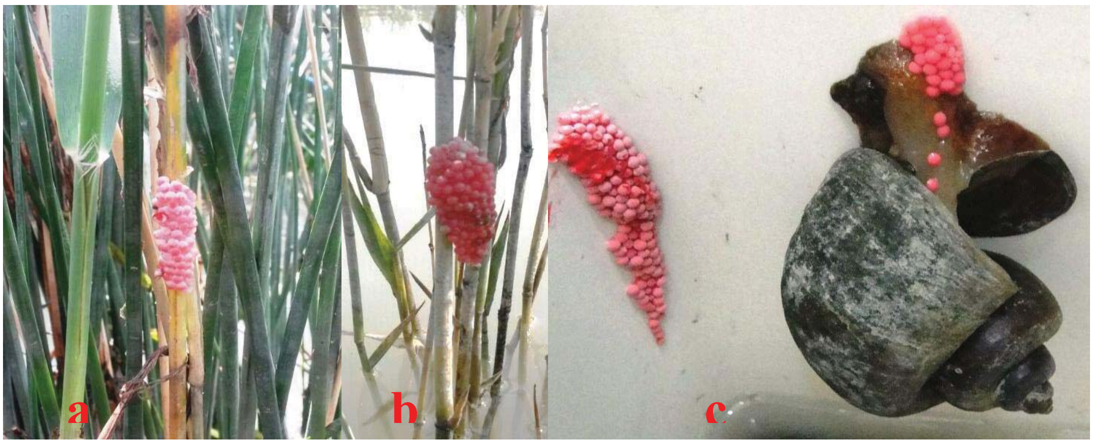

Figure 4: Pinkish eggs depositing by the snail *Pomacea canaliculata* on some costal plants of Shatt Al-Arab River (a, b) and in the aquarium in the laboratory (c).

Table 4. Body measurements of the snail *Pomacea canaliculata* from Shatt Al-Arab River southern of Iraq

No.	W	S. L	S. W	A. L	A. W
1	4.39	27	24	19	15
2	4.93	27	22	18	13
3	8.5	32	29	20	15
4	11.76	38	35	26	21
5	12.53	39	36	27	22
6	22.44	45	42	29	22
7	23.78	47	43	32	25
8	25.36	49	45	37	28
9	27.26	48	45	33	25
10	33.28	53	46	33	25
11	37	55	52	35	28
12	56.17	62	58	42	30
13	-	82	76	48	35

W= Snail weight, S.L= Shell length, S.W= Shell width, A.L= Aperture length, A. W= Aperture width

Discussion

The sources by which the snail *Pomacea canaliculata* enters to the Shatt Al-Arab river are unknown, but the invasion to this new environment may be through the negligence or escape from the commercial ornamental fish aquarium or by ships came from different Asian countries to the Basrah ports at Shatt Al-Arab River. The minimum size of sexually maturated females and produced eggs was 25mm (Estebenet and Cazzaniga, 1992; Tanaka *et al*., 1999). The sizes of *P. canaliculata* which collected during the study period indicated that the snail have produced many generations after the invasion of the region, and occurred in the region may began before more than two years. *P. canaliculata* lays its eggs masses on any object prominent above the water surface not only on the aquatic plant stems. Wu *et al.* (2011) record the egg masses on a cement wall, the egg masses were measured in general as 12-30 mm long and 9-15 mm width, and the clutch sizes ranged from 14-327 eggs, also report that the eggs were 2.57 ± 0.25 mm in diameter which corresponds what was recorded in our study (2.8 mm).

The temperature was effective factor on biological activities of different species of snails (Cowie, 2002; Khalaf, 2011 and Al-Khazali, 2012). The mean monthly densities of the snail *P. canaliculata* that recorded by our study refer that the snail could spread in the study area and reproduce at rates as well as that recorded in other countries e.g. Kwong and Dudgeon (2010) from different wetlands in Hong Kong which ranged between 25.6 ± 4.6 to 42.7 ± 7.35 ind./m² depending on variation in water temperature. We also believe that temperature may be plays an important role in the reproduction activity then in the density of this species, and the high densities during the months of June-August 2014 may reflect its willingness to pass the next winter season. Temperature is an important limiting factor for growth and reproduction in apple snails (Cowie, 2002 and Estebenet and Martín, 2002). In the present study, the snail *P. canaliculata* was inactive, Breeding stopped during the period December 2014 to February 2015).

In addition to our study, there are many studies refer that the reproduction activity stopped during periods of low temperatures. Kwong and Dudgeon (2010) in Hong Kong report that the reproduction and growth processes continued for a period of 7-10 months of the year in the warm, wet areas, on the contrary of the cold dry areas. In southern Japan, apple snails hibernate for 5 months (November-March) (Sugiura and Wada 1999), while the reproduction of *P.canaliculata* in its native South America extend for seven months from October to April (Andrews, 1964).

The apple snails seems to inhabit stand or slow-moving running waters in tropical to warm temperate areas, the snails occur both in clean and polluted waters, they also feed on a wide range of food materials (Andrews, 1965; Lach, *et al*., 2000; Aditya and Raut, 2001; Kwong *et al*., 2009 and Kwong *et al*., 2010). The occurrence of the invasive snail *P. canaliculata* during all the study months compared with the most other recorded snails indicate the ability of this snail to adaptive with limiting factors of the new habitat of Shatt Al-Arab River. On the other hand, the east coast of Shatt A-Arab River was more suitable to inhabit by *P. canaliculata*, probably because characteristic of this habitat with shallow and slow-running water that are warm during most months of the year. In addition to growth of different types of submersible and prominent plants and filaments algae which can uses by this snail as a source of food. The apple snails have the ability to diversify their food intake by several ways such as shredding, scraping and collecting (Saveanu and Martín, 2013). They are also tolerable to starvation, without eating any visible food for five months in the water (Lach *et al*., 2000), taking in account that the snail can feed on vegetal, detrital and animal materials such as dead fish (Cazzaniga amd Estebenet, 1984; Cowie, 2002), and its high fecundity (the most females lay once a week and the clutch contain typically 300-400 eggs (Teo, 2004)) indicates potential competition with other native macroinvertebrate primary consumers (Kwong and Dudgeon, 2010). It could be aestivate underground for more than 10 months (Teo, 2003). They bury themselves in the mud during dry season, to river irrigation and drainage channels. Apple snails able to spread into all parts of freshwater ecosystems as happen in Taiwan (Wu *et al*., 2011). Its control will be almost impossible as postulated by Baloch *et al.* (2012). This snail consider as the only freshwater snail listed as one of the most 100 worst invaders worldwide (Lowe *et al*., 2000; Cowie, 2002). We must act urgently to contain the presence of *P. canaliculata* and immediately to combat them before spreading to rivers and marsh areas in different parts of Iraq, and even to occurred neighboring marshes of Iran, *P. canaliculata* and *M. tuberculata* known as aquarium snails.

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تسجيل أول للقوقع التفاحة الغازي

Pomacea canaliculata (Lamarck, 1822) (Gastropoda: Ampullariidae)

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المستخلص

تناولت الدراسة الحالية تسجيل غزو قوقع المياه العذبة *Pomacea canaliculata* الذي لوحظ تواجده في مياه شط العرب منذ بداية عام 2014 . درس ظهور القوقع من شهر نيسان 2014 الى شهر آذار 2015 ، كذلك درس تواجد وكثافة القوقع الغازي مع ستة أنواع من القواقع بطنية القدم المحلية المتواجدة معه في مياه شط العرب. تراوح معدل كثافة الجماعة السكانية للقوقع *P. canaliculata* بين 2 - 26 فرد/م^2 وسجلت خلال شهري كانون الأول وتموز على التوالي. قيست بعض الصفات المظهرية لصدفة للقوقع الغازي خلال الدراسة.

Determination of the Specific Activity for the natural radioactive isotopes (^{40}K ,^{212}Pb, ^{214}Pb ,^{214}Bi,^{228}Ac) in soils and sediments for selected areas of the marshes southern Iraq, Basra province and the northern Arabian Gulf

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Abstract

The radioactive background in the environment of Southern Iraq and areas of Basra Province was determined by Radioactive Activity measurement of (^{40}K, ^{212}Pb,^{214}Pb,^{214}Bi, ^{228}Ac) in both soil and sediment mud by using a Gamma Ray Spectrometry analysis system that have high-purity germanium detector,with energy resolution 1.8 keV analytical ability in energy of 1332Kev and efficiency up to 40%. Gamma Vission program equipped by US Aortek company has been used to extract the data from the resulted Spectra and complete the process of spectral analysis.

The measurements included 15 locations of Southern Iraq marshes' environment and areas in Basra Province. The Specific Activity measurements results were around [320.1 - 1310.9 Bq/kg for ^{40}K, 0 – 12.1 Bq/kg^{212}Pb, 0 – 6.3 Bq/kg for ^{214}Pb, 3.2 -10.2 Bq/Kg for^{214}Bi, and 0 – 4.4 Bq/Kg for ^{228}Ac].

When the results of the studies were compared against results of other areas in Iraq and the world, it was noticed that the gained values are matching with some other studies but the difference might be due to the geographical and geological factor of those areas.

Key word :- Specific Activity, Sediments, Gamma Ray Spectrometry, Isotopes (^{40}K, ^{212}Pb, ^{214}Pb, ^{214}Bi, ^{228}Ac).

1. Introduction

Day by day, increased dependence on ionizing radiation in various aspects of life such as industrial, scientific, medical, military life aspects, and the scopes of using these rays became one of the means in the industrial progress and age's technology in spite of the adverse risks to humans.

Besides the above mentioned, there are a lot of natural radioactive elements that pollute the environment other than the nuclear uses, mostly these elements are caused by some industrial waste like the cement, phosphate and petrochemical industries, oil and gas extraction and production.

It should be noted that during the Second Gulf War in 1991 and the occupation of Iraq in 2003. The environment in Iraq, especially the southern region has been exposed to a new generation of Weapons that contain nuclear material.

Naturally Occurring Radioactive Materials (NORM) are belong to one of the natural radioactive decay series which are Uranium series ^{238}U , Actinium ^{235}Uand Thorium ^{232}Th. Emit from those elements different types of ionizing radiation in the environment and these radiation accompanied with the dissolution of Potassium isotope ^{40}K (UNSCEAR 2000,2006), (M. K. khodiar 2014)

Some of natural radioactive elements have a half-life of hundreds of million years and this period is almost the age of earth (World Health Orgnization 2004). The existence of natural Uranium or one of its products degradation series in the environment in large quantities either in soil or water is a major source of radioactive pollution. The radioactive background in that area is relatively high which cause a great damage to human health and the environment as indicated by many researchers (Al-Jundi *etal* 2003), (Sigh S., *etal* 2005) . As a result of dusty wind coming from various quarters to cities from a time to another Lead to the transfer of dust contaminated by radiation to the cities and villages in its way and thus cause an increase of radioactive contamination (Technical Reports Series 1989). when the air polluted will lead to the spread of pollution in wide areas, as winds will move the radioactive cloud- as in the Chernobyl incident-(GEMS/Food Total Diet Studies Report 1999) and in turn will cause in polluting land and water by dropping the radioactive dust over them GEMS/Food Total Diet Studies Report 1999), (A. S. Mohammed*etal* 2013)
The human body is exposed to radioactive isotopes directly by the process of external exposure to the radioactive material that are deposited on the surface of Earth, or as a result to inhaling the lingering radioactive material in the air. While the indirect method for receiving radiation it's going to be through food and water, or the intervention of radioactive isotopes in the soil to plants then to humans and animals through the food chain, the radioactive isotopes move from soil to plant's tissues as well through the roots or the adsorption by metabolic processes that take place in leaves (Rasheed M. Yousuf*etal* 2008)

Both Bismuth Isotope ^{214}Bi and Lead Isotope ^{214}Pb are from the most dangerous solid products of Radon Gas ^{222}Rn because of its very small half-life and they are within the products of Uranium ^{228}U degradation series, as the ratio of the ^{238}U is (99.79%) of depleted Uranium which its amount is 19.04 gm/cm^3(Dietz, L. A., 1993). Radon Gas ^{222}Rn forms a major threat to human and animal lives, as inhaling it is the primary cause of lung cancer (ICRP, 2006), (Al-Sultaiti, H., Nasir, T., *etal* 2012) because of its lefts that will stick to the liner of the lung.
Lead Isotope ^{212}Pband Actinium Isotope ^{228}Ac are resulted of the ^{232}Th degradation series and their half-life is 6.1, 11 hours in sequence, and they are products of Radon ^{220}Rn which is more dangerous than the Radon Isotope ^{222}Rn due to its little half-life which is 56 seconds.
Potassium ^{40}K is one of the natural radioactive isotopes that contributes with the biggest radiation dose entering human bodies, as well as the Potassium is the key element in the muscle cells then the pollution relatively be bigger (Mollah, A.S., *etal* 1996). If a human' body weights 70 kg, the potassium in that body is about 160 g which is equivalent to a degeneration of 4900 nucleus of Potassium ^{40}K per second (Supian Bin Samat,*etal* 1997)
The study of radioactivity in South Region is essential especially when it comes to human health and environment, as well as the assessment of radiation risks resulting from nuclear accidents or the use of radioactive materials in the regional struggles (Laboratory Procedures Manual, report, 1994).

2. Theory

The radioactive decay rate (Radioactivity) A(t) in sample given in the following equation :

$$A(t) = A_0 e^{-\lambda t} \qquad (1)$$

Were A_0It represents the radioactivity at the start time t = 0,A_t radioactivity after a time of t, λrepresents a constant decay of radioactive material,λ can be calculated from the following equation (W. e. Mayerhof ,1967) :

$$\lambda = \frac{0.693}{T_{1/2}} \qquad (2)$$

Were $T_{1/2}$is represents the half-life of the sample.

The measurements unit of radioactivity is Becquerel(Bq),which evens one analysis per second (*dps)*.Alsoradioactivity measured by using Curie unit Ci, Which is defined as the radioactivity of one gram of radium ^{226}Ra, which is equivalent to $3.7x10^{10}$ Becquerel.The specific activity (specificconcentration)A_s(Bq/kg)is calculated according to the standards of the International Atomic Energy Agency for International as follows (W. e. Mayerhof ,1967):

$$A_s\left(\frac{Bq}{kg}\right) = \frac{\sum N}{\varepsilon I_\gamma mt} \qquad (3)$$

Were $\sum N$ is the Net Count (cps), ε: System Detection Efficiency (always less than 1), I_γ: Absolute Transition Probability for gamma decay, m: Mass of the sample (kg), t: Time of Counting (sec).

3- Area of Study

The area of study is located in South of Iraq within the sedimentary plain area, and positioned between the longitudes (48^0 30') and (46^0 59') to the east, (31^0 45 ') and (29^0 39') latitudes to the north.The area includes the marshes of Southern Iraq (Al-hoiza, Chebaish, and Al-Hammar Marshes) besides selected areas of Basra province, Shatt Al-Arab and North-West of Arabian Gulf, as shown in the map in Figure No. (1).

4. Samples Collection

The samples were collected from specific sites in the area of study in accordance of the international Atomic Energy Agency (IAEA). A group of at least six samples were taken from thesoil for a minimum of 10 m^2 especially from the with the recommendations of The Internationalfour corners of each site in a depth between(0-15) m. Muddy sediments of water bodies were collected as well from Shatt Al-Arab and Arabian Gulf using a collector of mud samples (Grap Sampler).

5. Preparation of samples:

The sample were prepared after transfer to Maritime Radioactive Contamination Lab where soil samples and sediments mud dried after purification from impurities and outstanding solids in a drying oven on $105C^0$ for one week, then milled and sifted by 2mm sieve. Each sample was packed with a weight of 500 gm in plastic bags labeled by a code indicating the sample type and location.

6. Measurement of Samples:

After preparation of laboratory samples, they were sent to Ministry of Science and Technology/ Radioactive Waste Treatment Directorate/ Laboratory physical properties, in order to measure their concentration level by using Gamma Rays Spectrometry system.In this system a germanium detector with high purity was used, with energy resolution 1.8 KeV in energy of 1332 Kev, besides an efficiency up to 40%, The system used a program of Gamma Vission-32 equipped by US Aortek company to extract the data from the resulted Spectra and complete the process of spectral requirements as mentioned above.

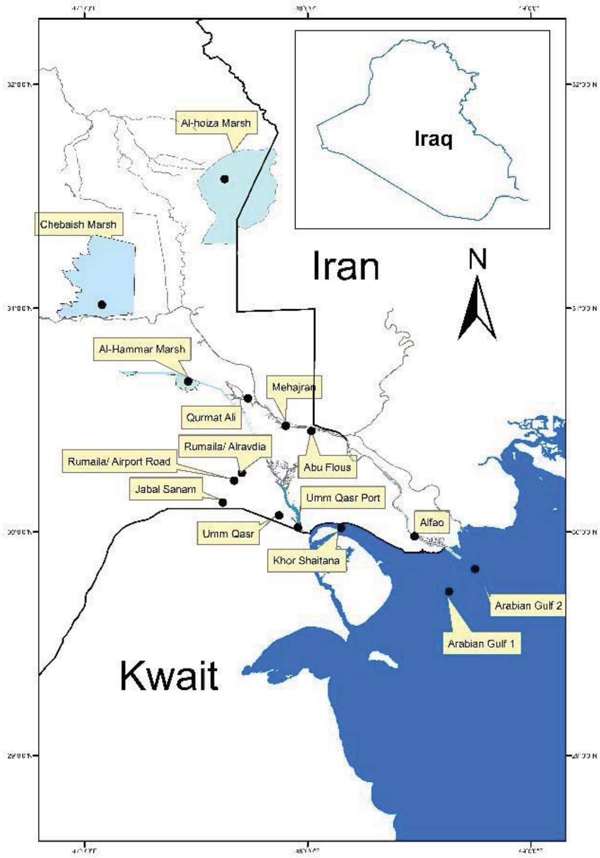

Figure 1: Map of studyarea

7. Results and discussion:

7.1Specific activity of Potassium ^{40}K in soil and sediments for the areas of the study:

Potassium is one of the most basic mineral elements in Earth's crust, and it has three natural isotopes (^{39}K, ^{40}K, ^{41}K). Potassium ^{40}K has a half-life of (1.28x10^{9}y) which emits gamma ray and beta particles. Due to its abundance in nature that reaches to 0.01178% of the total Potassium (Hil Rutherford, 2002), the ^{40}K is the most effective in Earth's crust and it does not belong to the two radioactive series ^{238}U and ^{232}Th. Therefore studying it considered as a fundamental of natural radiation background.

After collecting the samples and laboratory preparation, Gama Spectrum for samples had been studded. Then determine the Potassium ^{40}Kpeak site. The maximum value in the peak at 1460 Kev is belong to Potassium ^{40}K, The specific activity was calculated after knowing the quality intensity of Potassium ^{40}K and efficiency of the counter.

Table (1) shows the specific activity of Potassium ^{40}K in soil and mud sediment and clearly notice a discrepancy between the values of the ^{40}K specific activity according to the study area as in Fig. (2).

Table (1) specific activity of Potassium ^{40}K in soil and sediments for the areas of the study

No.	sample	Type of sample	Area of collect	Position	specific activity A_c (Bq/kg)
1	S1	sediments	Qurmat Ali	47° 43' 56.366" E 30° 35' 48.531" N	570.2
2	S2	sediments	Al-Hammar Marsh	47° 27' 2.254" E 30° 41' 20.423" N	750.0
3	S3	sediments	Umm Qasr Port	47° 57' 9.21" E 30° 1' 41.869" N	770.8
4	S4	sediments	Khor Shaitana	48° 8' 49.877" E 30° 2' 0.307" N	800.0
5	S5	sediments	Arabian Gulf 1	48° 37' 43.086" E 29° 44' 47.757" N	740.8
6	S6	sediments	Arabian Gulf 2	48° 44' 47.169" E 29° 50' 38.087" N	700.1
7	S7	sediments	Alfaw	48° 28' 29.934" E 29° 59' 32.800" N	850.5
8	S8	sediments	Abu Flous	48° 0' 50.478" E 30° 27' 12.256" N	1020.5
9	S9	sediments	Mehajran	48° 37' 43.086" E 29° 44' 47.757" N	1020.0
10	B1	soil	Qurmat Ali	47° 43' 56.366" E 30° 35' 48.531" N	500.1
11	B2	soil	Umm Qasr	47° 51' 55.765" E 30° 5' 41.568" N	630.8
12	B3	soil	Al-hoiza Marsh	47° 37' 29.16" E 31° 34' 11.827" N	320.1
13	B4	soil	Rumaila/ Airport Road	47° 40' 13.5" E 30° 13' 45.2" N	690.4
14	B5	soil	Rumaila/ Alravdia	47° 42' 18.11" E 30° 15' 49.2" N	690.2
15	B6	soil	Jabal Sanam	47° 36' 52.283" E 30° 8' 27.514" N	1310.9

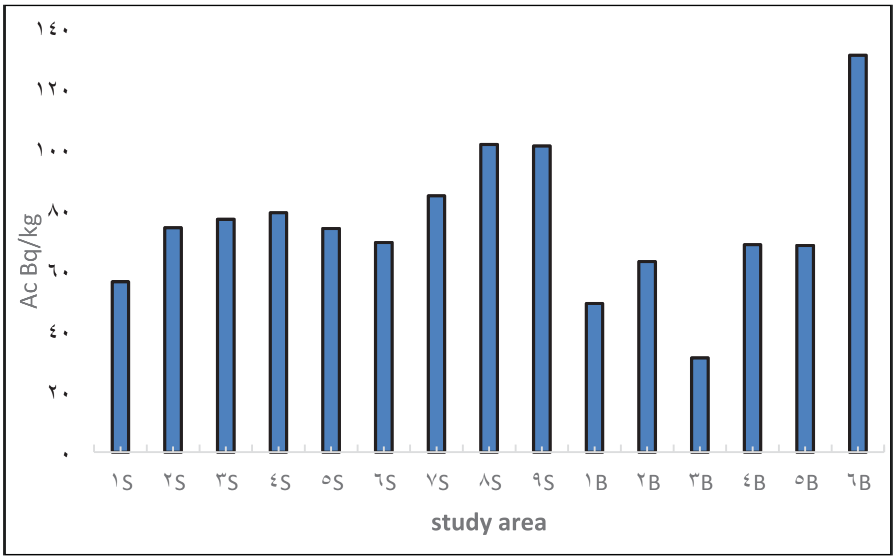

Figure 2: A comparison specific activity of ^{40}K in soil and sediment mud within areas of the study.

7.2 Specific activity of ^{212}Pb, ^{214}Pb, ^{214}Bi & ^{228}Ac in soils and sediments for the areas of the study:

The samples were collected from the study areas as shown in table(1) , prepared and sent to the Radioactive Waste Treatment Directorate for measurement. The Specific activity values in table(2) are related to the samples of the above mentioned elements compared to fingers(3,4,5 & 6).

Table (2) specific activity of ^{212}Pb , ^{214}Pb, ^{214}Bi &^{228}Ac in soil and sediments for the areas of the study

No.	Simple of sample	Specific activity of ^{212}Pb	Specific activity of ^{214}Pb	Specific activity of ^{214}Bi	Specific activity of ^{228}Ac
1	S1	12.10	0.59	4.30	3.20
2	S2	N.D*	3.20	3.20	N.D*
3	S3	10.00	3.40	6.19	2.90
4	S4	11.75	2.80	6.80	1.31
5	S5	11.00	4.80	10.20	2.80
6	S6	10.60	4.00	9.60	4.40
7	S7	11.10	3.20	9.80	2.03
8	S8	8.09	N.D*	8.60	N.D*
9	S9	6.50	3.20	7.00	N.D*
10	B1	N.D*	3.20	3.20	N.D*
11	B2	7.00	2.90	5.90	1.80
12	B3	11.50	2.96	6.70	2.80
13	B4	5.30	5.20	6.40	1.60
14	B5	8.89	6.30	9.20	3.60
15	B6	9.20	3.40	6.16	4.00

*(N.D) Not Detect

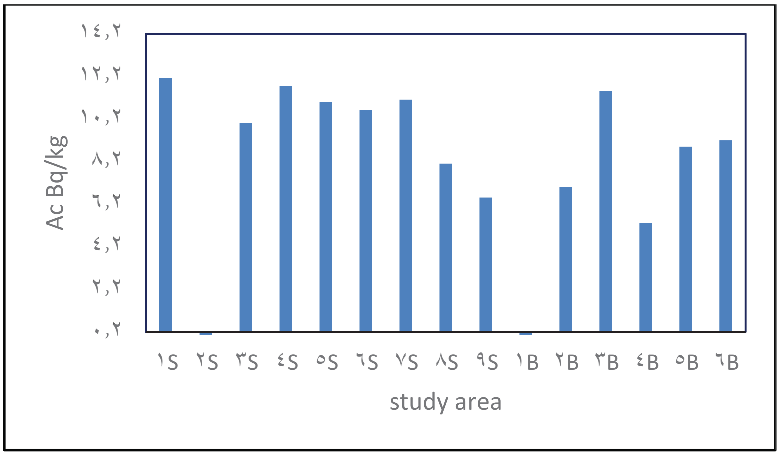

Figure 3:A comparison specific activity of ^{212}Pb in soil and sediment mud within areas of the study.

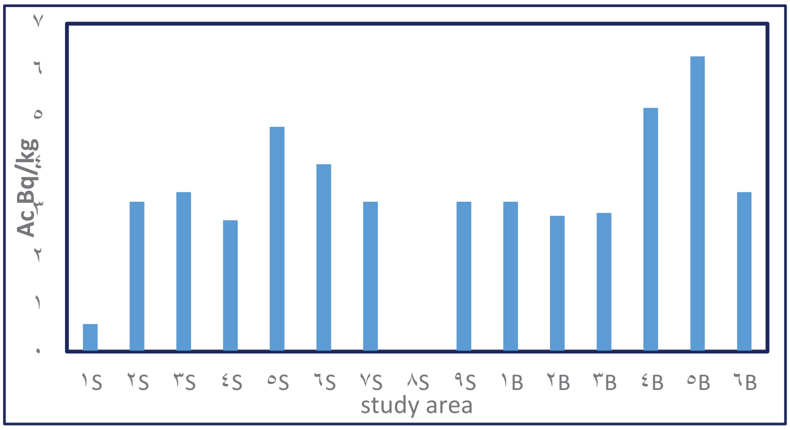

Figure 4:A comparison specific activity of ^{214}Pb in soil and sediment mud within areas of the study.

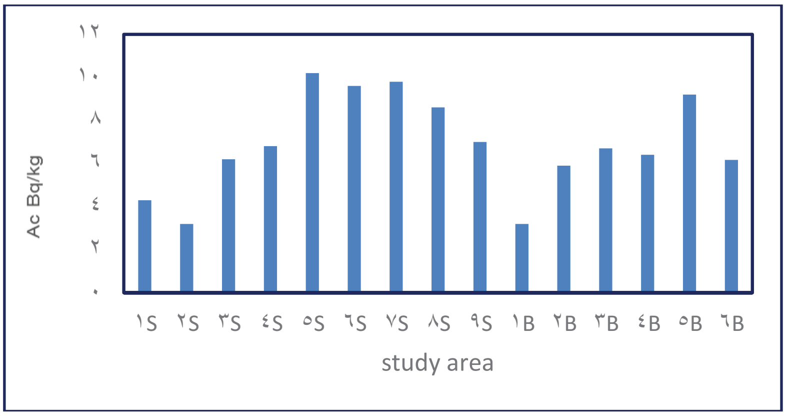

Figure 5:A comparison specific activity of ^{214}Bi in soil and sediment mud within areas of the study.

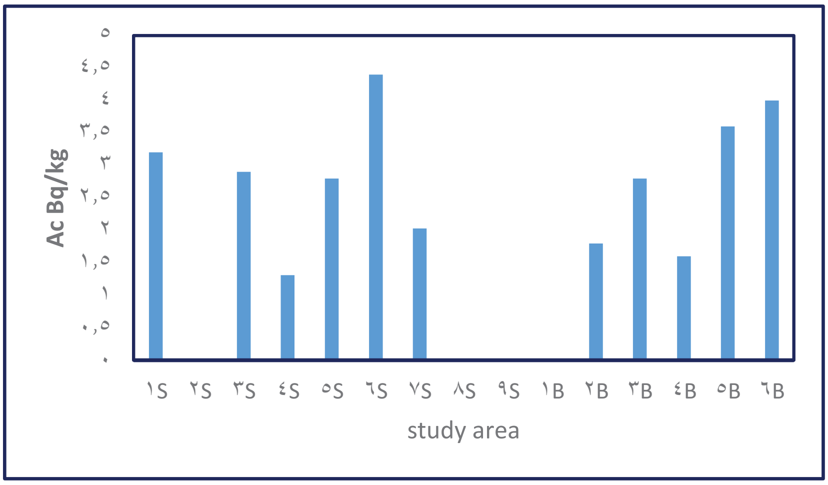

Figure 6: A comparison specific activity of Actinium ^{228}Ac in soil and sediment mud within areas of the study.

Conclusion

It's seen from the above tables and figures the revealed Specific activity after spectral analysis which were calculated for these nuclides that are natural radionuclides within the natural decay outputs of Thorium ^{232}Th and Uranium ^{238}U series besides the Potassium isotope ^{40}K as all of them were a part of the normal range. Potassium isotope ^{40}K quality effectiveness in this study of soils and sediments are fairly consistent with other studies around the world with some differences that might be due to the geology and geography of these areas (Rasheed M. Yousuf etal 2008),(Hamid, B.N., Chowdhry, 2000), (Nasim, A.O.,2003), (Piotr Godyn, *etal* 2014) as shown in figures (7) and(8).

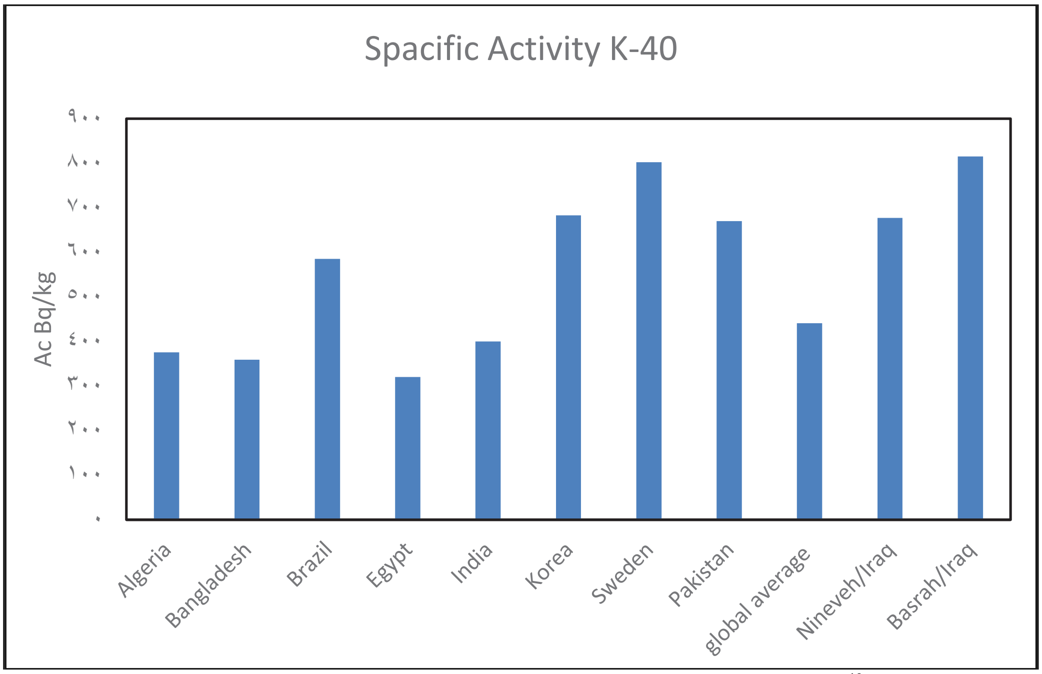

Figure 7:A comparison the current study with other studies of specific activity for^{40}K (Rasheed M. Yousuf etal 2008).

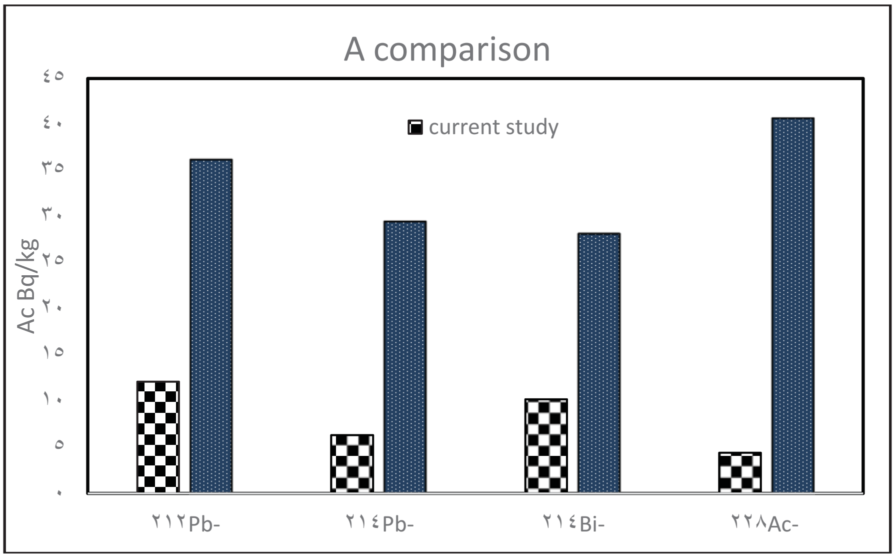

Figure 8:A comparison the current study with other studies of specific activity for^{212}Pb, ^{214}Pb,^{214}Bi &^{228}Ac(Piotr Godyn, etal 2014)

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Piotr Godyn. Agnieszka Dołhanczuk-Srodka. Zbigniew Ziembik. Ewa Moliszewska, **2014**Journal of Radio analytical and NuclearChemistry, 299(3) 1359-1364.

تحديد الفعالية النوعية للنظائر المشعة الطبيعية ($^{228}Ac, ^{214}Bi, ^{214}Pb, ^{212}Pb, ^{40}K$) في ترب وترسبات مناطق مختارة من اهوار جنوب العراق,محافظة البصرة وشمال الخليج العربي.

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المستخلص

حددت الخلفية الاشعاعية في بيئة اهوار جنوب العراق ومناطق من محافظة البصرة وشمال الخليج العربي من خلال قياس النشاط الاشعاعي لكل من ($^{228}Ac, ^{214}Bi, ^{214}Pb, ^{212}Pb, ^{40}K$) في كل من التربة والترسبات الطينية، باستخدام منظومة تحاليل أطياف اشعة كاماGamma Ray Spectrometry فيها كاشف جرمانيوم عالي النقاوة ، الذي يتصف بقدرة تحليلية مقدارها 1.8Kev في طاقة 1332Kev وبكفاءة تصل الى 40%، ويستخدم في المنظومة البرنامج Gamma Vission المجهز من شركة اورتك الامريكية لاستخلاص البيانات من الاطياف الناتجة واتمام عملية التحليل الطيفي.

شملت القياسات 15 موقعا لبيئة اهوار جنوب العراق ومناطق من محافظة البصرة وشمالالخليجالعربي. وقد تراوحت نتائج قياس الفعالية النوعية للـ K^{40}بين (320.1 - 1310.9)Bq/kg ، اما بالنسبة للـ Pb^{212}فقد تراوحت النتائج بين (0 – 12.1)Bq/kg، وللـ Pb^{214} فقد تراوحت النتائجبين (0 – 6.3)Bq/kg ، في حين كانت النتائج للـ Bi^{214} تتراوح بين (3.2 -10.2)Bq/Kg ، واخيراً للـ Ac^{228} فـــقد تراوحـــت النتائج بين (0 -4.4)Bq/kg.لدى مقارنة النتائج مع دراسات أجريت في مناطق أخرى من العراق والعالم لوحظ ان القيم التي تم الحصول عليها تتفق مع بعض الدراسات الاخرى وان وجود بعض الاختلافات قد يعزى الى جغرافية وجيولوجية تلك المناطق.

كلمات مفتاحية:- الفعالية النوعية ، الرواسب،منظومة أطياف كاما، نظير البوتاسيوم K^{40}،نظير الرصاصPb^{212}، نظير الرصاصPb^{214}، نظير البزموثBi^{214} ، نظير الاكتنيوم Ac^{228}.

A comparison in accumulations of heavy metals in two species of aquatic plants in Al-Chibayish marsh south of Iraq

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Abstract:
The current study estimated the concentrations of heavy metals Zinc(Zn), Copper(Cu), Lead(Pb), Nickel(Ni) and Cadmium(Cd) in each of the dissolved and particulate phases water, sediments and in two species of plants (*Typha domingensis* and *Vallisneria spirallis*) in Al-Chibayish marsh in Thi-Qar province, southern Iraq. Samples were collected during the winter and spring of 2013 from two stations within the Al-Chibayish marshlands. Station one was exposed to various types of pollution, while the station two was not exposed to contaminated. Also the percentage of organic carbon in sediments as well as sediment texture were analyzed to identify their impact on the concentration of heavy metals. The results indicated that the mean concentration of heavy metals in all phases(water and sediment) and selected plants were highest at station one compared with station two , the results indicated that the accumulation patterns of heavy metals was greatest in the particulate phase followed by the sediment and plants respectively. Higher concentration of the studied heavy metals were observed in *Typha domingensis* more than their concentration in *Vallisneria spirallis* the range of concentration were Zn(87-131),(64-93); Cu(1.1-1.7), (0.9-1.4); Pb (0.7-4.6), (1.8-3.3); Ni (42-69), (32-66); Cd (0.7-1.8), (0.4-1.5) µg/g dry weight respectively, so it can be use this species in removing this type of pollutants from the aquatic environment. Metals accumulated by aquatic plants were mostly distributed in roots, suggesting that an exclusion strategy for metal tolerance widely exist in them. This technology involves efficient use of aquatic plants to remove detoxify or immobilize heavy metals. .

Key words: *Heavy metals, Metal accumulation, Phytoremdiation, Aquatic*

Introduction:

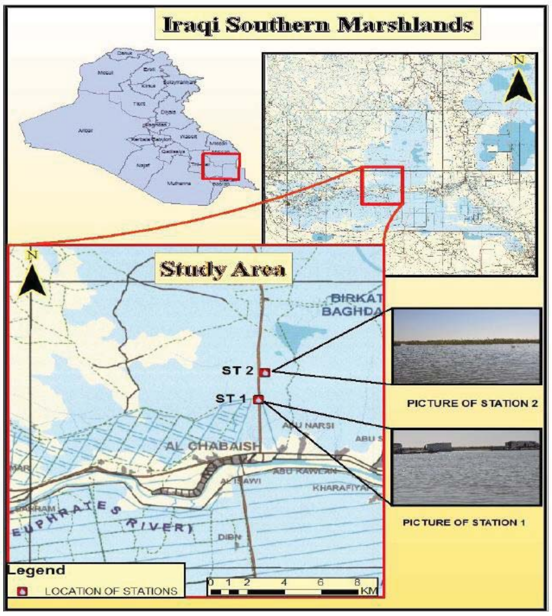
Heavy metals are the elements which have a specific gravity greater than 5 g/cm^3 (Järup 2003). Environmental pollution by heavy metals began with the use of fire. The process of releasing small amounts of metals into the air, as a result of burning wood, led to a change in the levels of metals in the environment (Nriagu 1990, 1996). A number of heavy metals and their toxic compounds are known as toxic substances, which can affect human health and living organisms. Some of these heavy metals accumulate in the water, soil and in the tissues of living organisms, and are able to persist in the environment, resulting in a range of harmful future effects (Ilyin *et al*. 2009 There are many global and local studies that have identified the close relationship between agriculture waste and an increase in heavy metals (Abychi and Doubul,1985; Singh *et al*.,1997). Many local studies have been done about the concentration and distribution of heavy metals in water, sediment and biota in inland water of Iraq among them marshs (Al-Khafaji,1996; Qzar,2009; Al-Haidary,2009; Al-Khafaji,2010). So, the aim of this study is to estimate the concentration of some heavy metals in water and sediments in the Al-Chibayish Marsh, and to determine the ability of the selected plants (*Typha domingensis* and *Vallisneria spirallis*) to accumulate this type of pollutants.

Materials and Methods:

Study area:

Al-Chibayish marsh is one of the largest marshes in the province of Thi-Qar. It is occupied the site 3100N, 47000E, which include large area, provid by water from Tigris and Euphrates rivers, this marsh comprises two sites, the first Al-Baghdadia which represented the second station (St.2). There is dense growth of aquatic plants specially *Phragmites austeralis* and *Typha domingensis* and water is available during all seasons. St.1 is exposed to contamination because many people living near by. The people are involved in many different livelihood including, buffalo breeding, fishing and boating industry.

Wastewater and animals waste are discharge into the marsh without treatment, in addition there are oil spills from fishing boats specially at St.1. Further more some people use chemical toxins in the process of fishing. St.2 is not exposed to pollution and it is far away from St.1 about 2Km, it was used as reference station for comparison of heavy metals pollution with the St.1.



Figure(1): study area within Iraqi marshlands.

Sample collection

Samples of water, sediment and a quatic plants were collected from two stations in the study area during the winter and spring of 2013. The Water was preserved in plastic bottles by the addition of few drops of nitric acid. Sediment samples were collected by using the samples collector (grab sampler) at the same stations of the study area, then preserved in plastic bags. Plant samples were collected manually then washed by marsh water for the purpose of disposal of suspended solids. After that, they were saved in plastic bags until reaching the laboratory.

Extraction of heavy metals from water

5L of water was collected from each station. Samples were filtered by using a filter glass and vacuum pump through filter papers (0.5 um pore size). The filtered water was considered as dissolved, while the retained matter was particulate. Extraction of heavy metals in the dissolved phase was performed according to the method of Riely and Taylor (1968). After filtration, the filters were dried in an oven at 60°C for 6 hours until dry, and then weighed to get the values of the total suspended matter. Sturgeon *et al*. (1982) method was used for the extraction of heavy metals from the particulate phase in water

Extraction of heavy metals from sediments

Sediments samples were digested after drying according to Yi, *et al*. (2007)

Extraction of heavy metals from plants

The a aquatic plant were drying then digested according to (Barman *et al.,*2000).

Determination of Total organic carbon (TOC%) and sediment grain size:

The TOC% content in sediment was measured according to ICARDA(1996). The sediment grain size was calculated according to a well tested method (Day, 1965).

Measuring of heavy metals

Concentrations of some heavy Metals (zinc, copper, lead, nickel and cadmium) were measured by using the flam atomic absorption spectrophotometer, model 210 VGP proved with hollow cathode lamps

Statistical analysis

This study was used to analyze the variance (ANOVA), F test, mean, standard deviation and correlation coefficient to find the significance among the stations by statistical system (SPSS-10).

Results and discussion:

Heavy metals take various chemical forms in the aquatic environment, including soluble free ions, organic or inorganic complexes, or they can be connected with solid suspended matter (clay, silt and sand, zoo and phytoplankton) (Hem 1985). These metals are affected by various factors such as temperature, pH and salinity (Al-Hjaj 1997; Mustafa 1985). In addition, heavy metals enter the aquatic environment through wastewater such as sewage (Chipasa 2003). Heavy metals in water can be distributed between the dissolved and particulate phases (Al-Khafaji, 1996).

The results of the present study found the mean heavy metal concentration in the particulate phase of the study area were Zn (550.5), Ni (110.8), Pb (13.1), Cu (11.57) and Cd (8.05) µg/g dry weight respectively. These values were higher than the mean concentrations in the dissolved phase, which were Zn (23.37), Ni (6.37), Pb (1.05), Cu (0.25) and Cd (1.37) µg/L respectively (Table 1). This was due to the particulate phase containing colloids, organic materials and metal hydroxides, which have a large surface area so it can adsorb heavy metals. Thus, the increased of concentrations for suspended matter in water due to the transfer of metals from the dissolved phase to the particulate phase (Warren & Zimmerman 1994). The results of this study agree with many previous studies (Al-Abadi 2011; Al-Awady 2012; AL-Tai 1999; Qzar 2009).

Table (1): concentration, (mean ±SD) for heavy metals in dissolved phase and particulate phase for station 1 and 2 in Al-Chibayish marsh, Iraq.

Dissolved phase (µg/l)							Particulate phase (µg/g) dry weight				
Season	stations	Heavy metals					Heavy metals				
		Zn	Cu	Pb	Ni	Cd	Zn	Cu	Pb	Ni	Cd
Winter	St.1	23.5	0.3	1.5	7.5	1	570	12	14.6	140	9.7
	St.2	15	0.1	1	4	0.5	450.9	9.7	6	58	3.5
Spring	St.1	34.8	0.4	2	8.5	2	680.9	14	22.5	173.5	12
	St.2	20.2	0.2	1	5.5	0.7	500.3	10.6	9.3	72	7
Mean		23.37	0.25	1.37	6.37	1.05	550.5	11.57	13.1	110.8	8.05
Standard deviation		7.25	0.11	0.41	1.74	0.57	86.34	1.622	6.23	47.63	3.16

he results also showed clear differences in heavy metal concentrations between stations and seasons (Table 1). Higher concentrations of these metals were found in Station 1compared with Station 2. This was due to the exposure of Station 1 to the various types of pollutants such as sewage, oil spill from boats, animal waste and chemicals used in fishing, because this station was located close to residential areas.

Statistical analysis showed significant differences between stations for Pb, Ni and Cd in the dissolved phase, and for Cu in the particulate phase. Also, there were significant differences between seasons at ($p<0.05$) for each of Cd, Zn, and Cu in the dissolved phase and Zn, Ni and Pb in the particulate phase. These differences are thus due to different levels of contamination between stations, as well as the impact of the different physical and chemical factors between the seasons. Generally, the heavy metal concentrations in the dissolved phase were below Iraqi WHO, EU and Australian standards (Table 2). Tables (3) show compare the results of current study with results of previous studies in relation to the dissolved phase.

Table (2): Comparison between heavy metals concentration in water (dissolve phase) µg/l) in Al-Chibayish marsh with some global and Iraqi standard.

Heavy metals	Present study	Iraqi standard µg/l (Barbooti *et al*.(2010)	WHO Standard µg/l (world Health Organization, 1993)	EU Standard µg/l (EU, 1998)	Australia Standard µg/l (NHMRC, 2011)
Zn	23.37	3000	3000	Not mentioned	Not mentioned
Cu	0.25	1000	2000	2000	2000
Pb	1.37	10	10	10	10
Ni	6.37	20	20	20	20
Cd	1.05	3	3	5	2

Table (3): Comparison between the mean heavy metals concentration µg/l in water in Al-Chibayish marsh with results of previous local studies.

Location	Heavy metals concentrations in dissolved phase µg/l					References
	Zn	Cu	Pb	Ni	Cd	
East Hammar marsh south of Iraq	4.57	1.52	6.04	-	0.22	(Qzar, 2009)
Al-Hammar marsh south of Iraq	2.29	0.7	0.17	2.13	0.45	(Al-Khafaji,2010)
Abu-Zariq Marsh South of Iraq	5.42	0.52	1.61	1.71	0.21	(Al-Abadi,2001)
Euphrates river in Nassyria city, south Iraq	10.03	-	22	7.21	2.22	(Farhood,2012)
Al-Chibayish marsh south of Iraq	23.37	0.25	1.37	6.37	1.05	Present study

Heavy metals in sediments

The concentration of heavy metals in sediments is affected by several factors, including human activities and some environmental factors such as temperature, salinity, the proportion of organic matter in sediments, and sediment grain size (Bentivegna *et al*. 2004), as well as plant density. In the present study sediment showed higher concentrations of heavy metals at Station 1 compared to station two (Table 4). This was due to the location of Station 1 near to residential areas, which discharged their waste directly into the marshes. These wastes increased the organic matter in the sediments, which absorbed the heavy metals. TOC% content at st.1 was more than its content at St.2 (Fig.2). This is also was proved through the results of this study where the mean concentrations of Zn (109.47) , Ni (81.25), Pb (5.1), Cd (2.32) and Cu (2.25)µg/g dry weight respectively in the sediment were more than the mean concentration of Zn (23.37), Ni (6.37), Pb (1.374), Cd (1.05) and Cu (0.25) µg/l respectively in the dissolved phase of water. .

In addition, increasing plant density in the marshes played an important role in increasing the heavy metals concentration in the sediments. Plants work to reduce the velocity of water flow and this leads to the deposition of suspended matter containing heavy metals in the sediments. This was confirmed by the result of the current study which found high concentrations of heavy metals in sediment compared with heavy metal concentrations in the dissolved phase (Table 1)

Sediment grain size also play an important role in the distribution and accumulation of heavy metals in the sediments. Small particle sizes, such as silt and clay tended to have higher concentrations of heavy metals because of the availability of a large surface area that allowed adsorption of metals on the particles surface of the (Bentivegna *et al.* 2004). This was confirmed by the results of the present study which found that the concentration of heavy metals in the sediment at Station 1 was higher than their concentrations at Station 2. This due to that Station 1contained a high level of silt (60.6%) and clay (21.2%) compared with Station 2, which contained a high amount of sand (38.2%) (Fig 3). This result was consistent with other studies findings (Al-Asadi 2009; Al-Khafaji 2010).

Table (4): Concentrations (means ±SD) of heavy metals µg/gm dry weight in the sediment in the study stations during the study period.

Heavy metals	Winter		Spring		Mean	Standard division
	Station 1	Station 2	Station 1	Station 2		
Zn	108.4	88	140	101.2	109.47	19.08
Cu	2.5	1.5	3	2	2.25	0.55
Pb	6.5	3.5	6.5	3.9	5.1	1.40
Ni	8.5	60	110	70	81.25	18.83
Cd	2.5	1	4	1.8	2.32	1.10

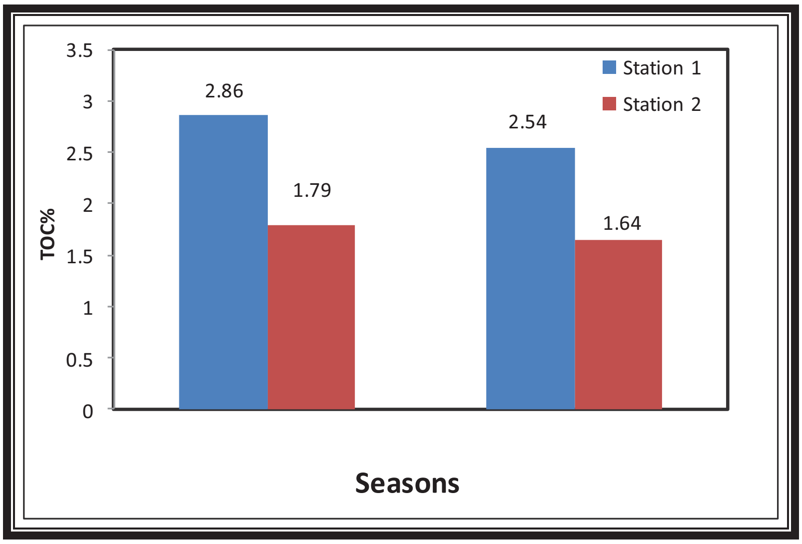


Fig.2: Total organic carbon (Toc%) content in the study stations during the study period.

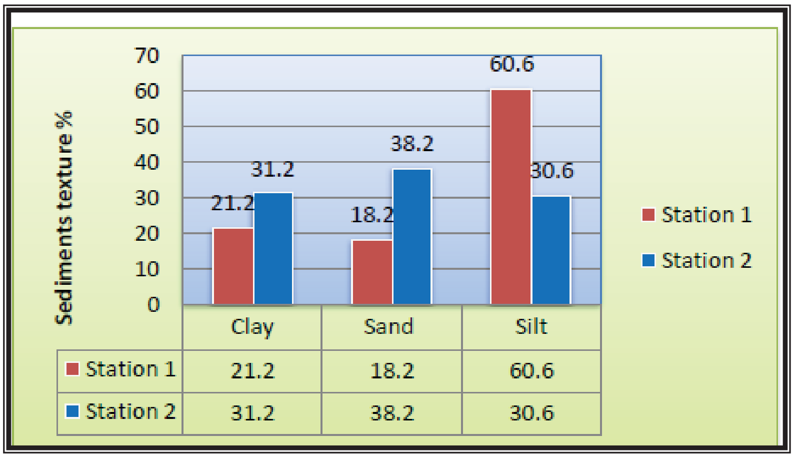


Fig. 3: Sediment texture% for the study.

Heavy metals in plants:

Plants have been used as a good indicator of heavy metal pollution, as they have the ability to absorb heavy metals from soils and sediments and accumulate them in their tissues (Cheng 2003). Absorption of heavy metals varies depending on the plant species (Ebrahimpour & Mushrifah 2008), and is affected by the bioavailability of the metals, the extent of their survival in the water (Fritioff & Greger 2003), the pH and the content of organic matter in the sediments (Jackson & Kalff 1993). The accumulation of heavy metals varied between the species plants and also between the plant parts (root, stem, leaves) (Bareen & Khilji 2008). The mean concentrations of heavy metals in *T. demersum* were Zn (99.75), Ni (54.5), Pb (3.72), Cd (1.35) and Cu (1.42) µg/g dry weight respectively, while the mean concentration of heavy metals in *Vallisneria spirallis* were Zn (83.5), Ni (44), Pb (2.77), Cd (0.95) and Cu (1.15) µg/g dry weight respectively . There were no clear variations in the concentrations of heavy metals between the plants studied (Table 5). This was due to the growth of these plants in the same area, making them similar in their exposure to different pollutants.

Seasonally, the concentration of heavy metals in tissues of plants during the spring was more than their concentration in the winter. This due to increased salinity and pH in spring, which works to increase deposition of suspended materials in sediments as well as increase organic carbon in sediments in spring which absorbed the heavy metals. In this case plants have a greater chance to absorb these metals from the sediments through their roots and store them in their parts. This is consistent with the research conducted by others (Farhood 2012; Salman 2006.

Table(6): Concentration (means ±SD) of heavy metals in plants µg/g dry weight in the plants at the study stations.

T. demersum (µg/g) dry wt.							*V. spirallis* (µg/g) dry wt.				
Season	stations	Heavy metals					Heavy metals				
		Zn	Cu	Pb	Ni	Cd	Zn	Cu	Pb	Ni	Cd
Winter	St.1	93	1.7	4.3	69	1.6	87	1.2	3.2	66	0.9
	St.2	88	1.1	0.7	42	0.7	93	0.9	1.8	38	1.5
Spring	St.1	131	1.5	4.6	45	1.8	90	1.4	3.3	40	1.00
	St.2	87	1.4	3.5	62	1.3	64	1.1	2.8	32	0.4
Mean±SD		99.75	1.42	3.72	54.5	1.35	83.5	1.15	2.77	44	0.95
Standard deviation		24.07	0.44	1.63	18.96	0.92	19.40	0.57	0.80	20.25	0.75

Conclusions:

The key findings for this study were that heavy metal concentrations were higher in Station 1 and these in turn were higher than at Station 2, and levels were higher in spring than in winter. In addition, the highest mean for heavy metal concentration was in the particulate phase, followed by the sediments, then the plants and was lowest in the dissolved phase.

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مقارنة تراكم المعادن الثقيلة في نوعين من النباتات المائية في هور الجبايش في جنوب العراق

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المستخلص

تقيسم الدراسة الحالية تراكيز المعادن الثقيلة (الخارصين والنحاس والرصاص والنيكل والكادميوم) في كل من الطورين الذائب والعالق للماء ، وكذلك في الرواسب ونوعين من النباتات المائية (*V. spirallis* and *T. domingensis*) في هور الجبايش خلال شتاء وربيع ٢٠١٣ جمعت من محطتين في الهور المذكور .والمحطة الاولى تتعرض الى انواع مختلفةمن التلوث في حين المحطة الثانية لاتتعرض الى ذلك كذلك تم قياس الكاربون العضوي ونسجة التربة كنسبة مئوية لمعرفة مدى تاثيرهما في تركيز المعادن قيد الدراسة .اشارة النتائج ان تركيز المعادن للماء والرواسب في جميع الاطوار وكذلك في النباتات في المحطة الاولى اعلى من تراكيزها في المحطة الثانية ، وقد كان تركيز المعادن في المادة العالقة اكثر من تركيزها في الرواسب والنباتات. ان التراكيز المرتفعة للمعادن ظهرت في نبات البردي اكثر من نبات ال *V. spirallis*

اذ كان مدى التركيز كالاتي: (٨٩-١٣١) ،(٦٤-٩٣) خارصين : (١,١ -١,٧) ، (٠,٧- ١,٤) نحاس : (٠,٧-٤,٦) ،(١,٨- ٣,٣) رصاص: (٤٢-٦٢) ،(٣٢-٦٦) نيكل: (٠,٧-١,٨) ، (٠,٤-١,٥) كادميوم ميكغم/غم وزن جاف على التوالي ، استنتج من الدراسه امكانية استخدام كلا النوعين من النباتات في ازالة هذ النوع من الملوثات من البيئة، و ، لذا ان استخدام هذه النباتات في الازالة تعد عملية كفوءة وواعدة.

Evaluation of some heavy metals from water and soil of Bazian Oil Refinery within Sulaimani Governorate, IKR

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Abstract

This study aimed to investigate evaluation some physicochemical properties of the well water, wastewater and soil within the oil refinery, and determination the concentration of some heavy metals such as Chrome, Lead, Cadmium, Copper, Zinc and Nickel in the water and soil. Sampling was carried out from April to December 2012 at the studied area, which is located at the north west of Sulaimani city. The result showed that the mean of pH was 7.12, 7.39 for well and wastewater respectively, while soil pH was ranged from 7.11 to 8.58, the well water electrical conductivity EC was ranged from 399 µS cm^{-1} to 1570 µS cm^{-1}, while wastewater ranged from 789.6 to 3350 µS. cm^{-1}, on the other hand soil EC ranged from 422 to 5735 µS cm^{-1}, Chrome concentration was ranged from 0.31 to 0.36 mg l^{-1}, 1.27 to 1.34 mg l^{-1}, and 19.2 to 38.91 mg kg^{-1} for well water, wastewater and soil samples respectively. Lead concentrations mean was 0.51, and 1.64 mg l^{-1} for well and wastewater samples while in soil the concentration ranged from 7to 64.5 mg kg^{-1}.Cadmiumconcentrations was between 0.065 and 0.082 mg l^{-1} in well water, in wastewater it was ranged from 0.71 to 0.88 mg l^{-1}, while soil samples was ranged from 0.09 to 0.977 mg kg^{-1}.The mean concentration of heavy metals Cu, Ni, and Zn were 0.094 and 0.188 mg l^{-1}, 0.074 and 0.76 mg l^{-1}, 0.37 and 1.44 mg $l^{-1}$for well water and wastewater respectively, while for the soil samples was ranged from 31.27 to 61 mg kg^{-1}, 43.4 to 95.8 mg kg^{-1} and 69.37 to 346.7 mg $kg^{-1}$for Cu, Ni, and Zn respectively, so the oil refinery cause obvious impact on ground water and soil pollution by heavy metals.

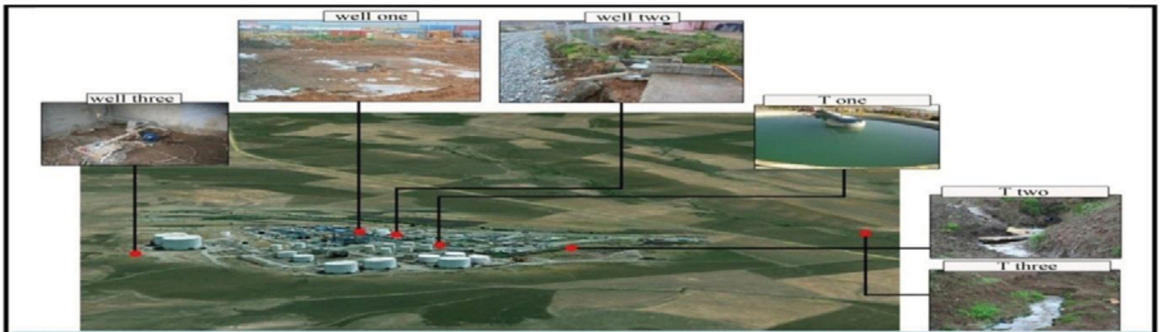
Key words: *oil refinery, Sulaimani governorate, heavy metals, wastewater.*

I. Introduction

Abundant release of organic and inorganic compounds into the environment occurs each year as a result of human activities; many of those compounds are both toxic and accumulative in terrestrial and aquatic environments. Soil, surface and ground water contamination is the result of sustained accumulation of those toxic compounds in excess of permissible levels. Among these activities is oil industry and their developments at the last century causing many different problems of environmental pollution (Al-Zahrani, 2010 ; EPA, 2004).Ground water contamination by crude oil therefore is becoming an increasing sensitive issue (Pathak*et al*., 2011).The refinery effluents consist of compounds from original crude oil stock, metallic (Zn, Cr, Va, Ni, Pb, Cu) and non-metallic constituents as stated by (Solanki,2011).The distribution of metals in water and soil provides a record of the spatial and temporal history of pollution in a particular region or ecosystem(Adeniyi, 2011).Heavy metals, such as Zinc ‹Cadmium, Copper, Lead, Nickel, and Chromium are present in all soils but are usually found at low concentrations, the back ground concentration of metals in soil depends primarily on the bed rock type from which the soil parent material was derived (Kadhum and Hussain, 2011).Heavy metals are stable and persistent environmental contaminants since they cannot be degraded or destroyed, therefore, they tend to accumulate in soils, sediments and the body of organisms (Sevgi, 2010).Chronic problems associated with long-term heavy metal exposures are mental lapse (lead); toxicological effects on kidney, liver and gastrointestinal tract (cadmium) (Adeleka and Abegunde, 2011).

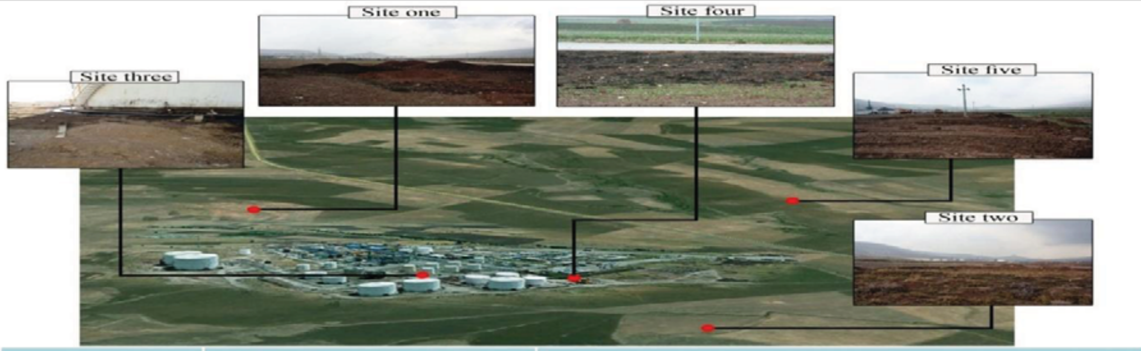
II. Description of the Study Area

Bazian oil refinery is one of the greatest and largest refinery in Kurdistan region, that located at the north west of Sulaimani governorate 35°.67'38.49"N - 45°-01'89.69"E, with the elevation of 890 m nearly 35 km far from the city centre of Sulaimani. Geological formation of a certain area have a great affect on water quality due to erosion action or leaching land crust or during percolation toward different aquifers (Hassan,1988).Four selected sites located outside the refinery, and seven sites inside it. Fig (1) and (2) show the sites, coordination and description of each water and soil sampling sites, respectively.



Sites	Coordinates North (N) , East(E) and elevation	Site descriptions
I- Site one well water represented as (W 1)	35°67 41.9-45°01'91.9"- -898m	Located inside the refinery near the reception, drilled in 2008 with depth of 30m
2- Site two well water (W 2)	35°67' 33.4" - 45.01'99-897m	Located inside the refinery just near the restaurant, drilled at 2008 with depth of 25m
3-Site three well water (W 3)	35°67' 28.9"- 45.01' 56" -900m	Located up word of the refinery was drilled at 2008 with depth of 70m
4- physically treated wastewater represented as (T 1)	35°67' 32.6"- 45°01' 86.1" -901m	Located inside the refinery (pool of wastewater treatment)
5- Chemically treated wastewater (T 2)	35°67' 31"- 45°01' 88"-900m	Located inside the refinery(point of discharged out o the refinery)
6- wastewater outside of refinery (T 3)	35°67'27.6"- 45°02' 38.8"- 874m	located about 500 m in opposite site of the refinery

Fig. (1) Shows water sampling sites.



Sites	Coordinates North (N) , East(E) and elevation	Site descriptions
1- Site one	35°67′92.5″- 45°01′81.4″-903m	Located 500 m up word of the refinery
2- Site two	35°66′63.4″ - 45°02′39.5-875m	Located 500 m down word of the refinery
3- Site three	35°67′33.7″-45°01′59.2″-913m	Located around the crud pool inside the refinery
4- Site four	35°67′30.3″- 45°01′85.5″-901m	Located inside the refinery(point of waste accumulation and discharged out refinery)
5- Site five	35°67′58.7″ - 45°02′06.6 ″ -897m	The corresponding area of refinery nearly 500 m opposite to the refinery

Fig.(2) Shows soil sampling sites

III. Materials and Methods

Monthly sampling for well water, wastewater and soil were carried out in and around Bazian oil refinery in order to determine certain physical properties of water and soil from April to December 2012, while samples for heavy metals were analyzed seasonally, every season select one month as an example for the selected season (APHA, 2005).Soil samples were collected primarily from a depth of (0 to 30) cm of the surface.

The digestion of the acidified water samples was done by adding 2ml of 1:1 HNO_3 and 10 ml of 1:1 HCl, heating until the volume reduced to 25ml then adjusting the volume to 100 ml by double distilled water (APHA, 2005).Analysis of the samples was done by Atomic Absorption Spectrophotometer, (Lokhande*et al*., 2011), Analyst 700-Atomic absorption spectrophotometer and Varian - 24fs Flame Atomic Absorption Spectrophotometer was used for determination heavy metals, while the analysis of soil samples was done according to (Baruah and Barthakur, 1997).Statistical package for the social science (SPSS), version 17 programs were used for analyzing the results. Monthly collected data were treated with the analysis of variance (ANOVA) and (Duncan) to detect the variation of different variables at the period and site sampling (Ravanbakhsh*et al*, 2009).

IV. Results

Generally, pH of well water were ranged from 6.53 to 7.87, minimum was recorded at W1 during July, while maximum was recorded at W3 during June as shown in table 1

Table (1) pH values as (mean± S.E) of the water studied sites during the periods from April to December 2012.

Months / Sites	Periods of the study from April to December 2012								
	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Mean ±SE
Well Waters										
Well 1	6.63	7.10	6.95	6.53	6.93	7.13	7.11	7.06	6.75	6.91± 0.04a
Well 2	6.75	7.2	6.94	6.65	7.07	7.08	7.21	7.30	6.72	6.99± 0.05 a
Well3	7.14	7.8	7.87	7.23	7.08	7.59	7.69	7.40	7.38	7.46 ±0.05 b
Mean ±Se	6.84±0.08 a	7.36±0.13 c	7.25±0.15 bc	6.8±0.12 a	7.03±0.05	7.26±0.08 bc	7.34±0.09 c	7.25±0.08 bc	6.95±0.1ab	7.12
Wastewater										
T1	7.45	7.60	7.48	7.17	7.36	7.76	7.39	7.4	7.20	7.42 ±0.03 b
T2	7.47	7.48	7.47	7.13	7.21	7.45	7.14	7.33	7.06	7.30 ± 0.03a
T3	7.13	7.69	7.34	7.79	7.52	7.78	7.42	7.20	7.16	7.45 ± 0.05b
Mean ±SE	7.35±0.05 b	7.59±0.03 cd	7.43±0.04 bc	7.36±0.1b	7.36±0.05 b	7.66±0.05 d	7.31±0.04 ab	7.31±0.06 ab	7.14±0.0 a	7.39

The studying sites showed that maximum mean was 7.46 recorded at W3, the results indicated that there were only significant differences among studied sits ($P<0.05$). Wastewater results vary from 7.06 at T2 during December to 7.79 during July at T3, the mean of the studying sites was varied between 7.30 and 7.45 in T2 and T3 respectively. Soil pH in the studied sites during the studied period was illustrated in table 2, the minimum value 7.11 recorded at site 3 during April, while the maximum value8.58 was recorded at site 1 during September. Table 3 represent the EC value of well and wastewater , well water data revealed variation between 399 and 1570 $\mu S.cm^{-1}$ minimum level recorded at W3 during April, while the maximum level was recorded at W3 during May. On the other hand wastewater EC was ranged between minimum of 789.6 $\mu S\ cm^{-1}$recorded during July at T2, and T1 during April maximum level of 3350 $\mu s.cm^{-1}$ at T1.Results of soil EC obtained during the studying period was ranged from 422.0 to 5735.0 $\mu S.cm^{-1}$the minimum value observed was at site 1 during April, while the maximum value was observed at site 4 during June, as it shown in Table 4.

Table (2) pH values of soil as (mean ± S.E) of the studied sites during the periods from April to December 2012

Period of sampling	Sampling Sites					
	Site 1	Site 2	Site 3	Site 4	Site 5	Mean± SE
April	7.4	8.11	7.11	7.61	7.51	7.5±0.35 a
May	8.21	8.06	7.26	7.56	7.64	7.7±0.39b
June	8.21	7.97	8.26	8.52	8.37	8.2±0.19d
July	8.36	8.12	8.36	8.43	8.28	8.3±0.11 d
August	8.13	8.21	8.35	8.44	8.26	8.2±0.11 d
September	8.58	8.30	8.30	8.46	8.31	8.3±0.12 d
October	7.70	7.67	8.18	8.27	8.16	8±0.26 c
November	7.82	7.50	7.32	8.10	7.42	7.6±0.30ab
December	7.89	7.68	7.55	8.13	7.57	7.7±0.22 b
Mean± SE	8 ±0.06 ab	7.9 ±0.05 ab	7.8 ±0.09 a	8.1 ±0.071b	7.9 ±0.074 ab	7.9±0.39

Table (3) EC (µS cm^{-1}) as (mean ± S.E) for the water studied sites during the periods from April to December 2012.

Months / Sites	Periods of the study from April to December 2012									
	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Mean ±SE
Well Waters										
W 1	630	643	690.3	723.6	745.3	691	681.6	651	664.6	60.07±10.2ab
W2	565	543	638.6	671	686.3	642.6	634.6	620.6	593.6	621.74±11.5 a
W3	399	1570	1161	946.6	1016.6	963.3	1246.6	697	710	967.81±83.1 b
Mean ±SE	531.3±44.8 a	918.6±2.3 b	830±83.09ab	780±42.2 ab	816.1±50.8ab	765.6±49.9ab	854.3±98.3 b	656.2±11.1ab	656.1±16.9ab	756.54
Wastewater										
T1	3350	3004	1971	1411.	1542.3	2502	1633.6	2007	1495.3	2101.81±15a
T2	2440	3004	2872	789.6	1652	1894.3	2111.3	2014	1671	2049.81±13a
T3	2116	30300	1981.3	1760	1353	1683.3	1121	2014.6	965	1780.48±12a
Mean ±SE	2635.3±342de	3012.6±166e	2274.7±149cd	1320.2±141a	1515.7±43a	2026.5±122bc	1622±142ab	2011.8±1.25bc	1377.1±106a	2136.76

Table (4) EC (µS.cm^{-1}) as (mean, ± S.E) of the soil studied sites during the periods from April to December 2012.

Period of Sampling	Sampling Sites					
	Site 1	Site 2	Site 3	Site 4	Site 5	Mean± SE
April	422.07	718.7	390.6	4977.0	973.1	1496.2±468.5 a
May	450.3	772.8	471.7	5643.0	1012.0	1669.9 ±533.8 a
June	452.2	900.8	529.6	5735.0	943.0	1712.1±540.08 a
July	517.8	792.0	717.8	4729.0	881.9	1527.7±428.9 a
August	526.0	765.0	790.0	4801.0	903.0	1557±434.73 a
September	879.4	804.0	880.2	4331.0	855.4	1550.02±371.6 a
October	570.0	645.7	794.5	4891.0	938.7	1567.9±445.34 a
November	531.0	732.0	808.0	4731.0	942.0	1548.8±426.7 a
December	503.0	702.0	792.0	4562.0	901.0	1492.02±411.72 a
Mean± SE	539.1±25.14 a	759.2±13.38b	686.0±32.36 b	4933.3±86.5 e	927.8±8.85 d	1569.1±146.96 a

Table (5) showed Chrome concentration of well and wastewater, Statistical analysis for the studied sites showed that the minimum value 0.31 mg $l^{-1}$was recorded in W2 and show significant difference with other studied sites, while the maximum value 0.36 mg l^{-1} recorded in W 3 with no significant differences as compared to other sites . Values of chrome in wastewater were ranged from 1.26 to 1.43 mg l^{-1} as minimum and maximum value observed during winter and spring season respectively, soil data was between 19.26 and 38.91 mg $kg^{-1}$the minimum value was recorded at sites 4 and 5 during summer, while the maximum value were obtained at site 1 during spring, Table 6.The results of lead in water samples are presented in table 7, the minimum value was recorded in W1 during spring while the maximum value was recorded in W3 during winter. For the studying period the maximum value1.9 mg l^{-1} recorded during spring that revealed significant differences with all other studying seasons. Statistical analysis of the soil table 8 samples revealed that the minimum value 9 mg kg^{-1} was recorded at site 2, while the maximum value of the studied site 41 mg $kg^{-1}$was recorded at site 3 with significant differences from other site except site 4.Cadmium concentration in water samples for the studied period is illustrated in table 9, it shows that the minimum value 0.065mg l^{-1} for well water was recorded in W2 during winter season, while maximum value 0.082mg $l^{-1}$was recorded in W2 during spring season. Wastewater samples show variation in concentration of cadmium ranged from 0.71 to 0.88 mg $l^{-1}$the minimum value was in T2 during summer while the maximum concentration recorded during spring and winter. The variation of cadmium concentration in soil samples is shown in Table 10 revealed that the minimum value of 0.09mg $kg^{-1}$was recorded at site 2 during winter, while maximum value 0. 97mg $kg^{-1}$was recorded at site 4 during spring. Results of Copper concentration in the water samples in the different sites throughout this investigation are shown in table 11,minimum value for well water was 0.07mg

l^{-1} which measured inW3during summer and the maximum value was 0.131 mg l^{-1} which was determined in the same site during winter. For soil samples, the value of Cu concentration was between 31.27 and 61.00 mg kg^{-1} as minimum and maximum in both site1 and 2 respectively as in table 12.

The concentration of Ni of all water sites was illustrated in table 13 Well water concentration arranged from 0.70 to 0.083mg l^{-1} and both recorded in W1 during autumn and summer respectively. Studying seasons showed that minimum value recorded during spring that show significant differences with summer and winter but the maximum mean recorded during winter, soil samples during the studying period show variation in Ni concentration as illustrated in table 14, the data vary from minimum value of 43.4mg kg^{-1} at site 4 during spring to the maximum value of 95.86 mg kg^{-1} that was recorded at site 5 during spring. Zinc concentration of all sites during the studied period is shown in table 15, minimum value for well water 0.05 mg l^{-1} occurred in W3 during spring while the maximum value 0.7mg $l^{-1}$was obtained in W1 during spring. Wastewater data for Zn concentration revealed variation in the range between 1.25 and 1.91 mg l^{-1}during spring and winter respectively, both studied sites and period revealed significant differences at ($P < 0.05$) among the data, soil samples showed great variation between the data from minimum 69.37 mg kg^{-1} at site 4 during summer to maximum value 346.73 mg kg^{-1}at site 5 during spring table 16.

Discussion

Chrome (Cr) : Natural waters, usually contain much lower levels of Cr than those obtained during this study, the maximum recommended levels of water quality standard is 0.05 mg $l^{-1}$by (WHO, 2006). The present results agreed with results obtained by Rashid (2010) in wells in Tanjaro /Sulaimani province, but lower than results of 0.1 to 0.8mg l^{-1} which recorded in well water around Warri Refinery in Nigeria by (Nduka and Orisakwe ,2009), while the results of soil samples was below the maximum permissible level that recommended by (EPA, 2011) for industrial soil. (Kadhum and Hussain, 2011) reported that Cr concentration decreased with the increasing of organic matter, and this agreed with results obtained through this study, in which maximum concentration corresponded with the maximum rate of organic matter, this attributed to the strong absorption of transition metals namely chrome by soil organic matter.

Lead (Pb): The concentration value for well water ranged from 0.2 mg l^{-1} as minimum level to 0.92 mg l^{-1} as maximum level, Lead concentration in all well water samples exceeded the level of 0.05 that are recommended by (WHO, 1988) and of 0.03 $\mu g.l^{-1}$ which recommended by (Al-Manharawi and Hafiz, 1997). In this study high concentration of lead in well water illustrates the impact of oil refinery waste penetrated soil profile towards groundwater, and this may be the cause of the maximum level of pb found during winter, so the effect of rainfall lead to increase leaching of pollutant toward ground water, similar results mentioned by (Rashid, 2010) in Tanjaro well water. Pb in wastewater present in high level with the average of 1.64 mg l^{-1}.Untreated wastewater may cause various problems when entering in to the water system. (Nudka and Orisakwe, 2009) reported lower concentration of pb in Nigeria wastewater discharged from Warri refinery ranged between 0.02 and 1 mg l^{-1} as consequence for refinery effects, in the other hand, Lead concentration in soil studied area varied from 7 to 64.5 mg kg^{-1}, which was within the standard ranges of 120 mg kg^{-1} that stated by (EPA, 2011). Clay, minerals and organic matter content have a contrary effect on heavy metal retention in soils. There are factors dependent on (e.g., clay minerals) and independent (e.g., organic matter) of bedrock, which have common effect on the distribution of soil heavy metals. Trace metals concentrations in clay surface soils are higher than in the sandy soils, and organic matters capture the elements. Sites under study were containing clay in their composition and generally most of the highly polluted soil contains high clay concentration as was carried out by (Al-Ameri, 2011).

Cadmium (Cd): The high level of cadmium concentration in ground water samples indicates a high degree of contamination. The values of cadmium concentration in well water exceeding the permissible level 0.003 and 0.005 mg l^{-1} according to (WHO, 2006). Pollution of groundwater in the studied area may result from leakage of pollutants towards groundwater by leaching process (EPA,2004).Wastewater samples recorded high value for Cd concentration, the overall average was 0.7٨ mg l^{-1}. The high rate of Cd concentration in all sites of wastewater during study seasons is due to the presence of large amount of petroleum products and crude oil byproducts (Asia *et al*., 2007).soil samples recode results ranging from 0.09 to 0.98 mg kg^{-1}, as minimum and maximum values. Naturally, cadmium concentration is at the range of 0.03 - 0.30 mg kg^{-1} according to (EPA, 2011) Therefore; Cadmium concentration in the studied soil is out of this range. The minimum concentration of Cadmium was recorded during winter season because of the effect of the weathering and precipitation (Pendias and Pendias, 1992), while the maximum value was recorded during spring season which also contains higher level of zinc, and this is compatible with the idea of (Sofi,2008), who reported that cadmium is found to be as a pathfinder for zinc, because impure zinc compound always contain ratio of cadmium

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Table (5)and (6) Chrome concentration in water and soil samples represented as (mean± S.E) of the studied sites during the periods from April to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Well Waters					
W 1	0.34	0.39	0.29	0.31	0.33±0.01a
W2	0.35	0.28	0.34	0.27	0.31±0.010 b
W3	0.38	0.33	0.36	0.38	0.36±0.00 c
Mean ±SE	1.35±0.0 a	1.33±0.01a	1.33 ±0.0a	1.32±0.01a	0.33
Wastewater					
T1	1.36	1.29	1.34	1.32	1.32 ±0.00 b
T2	1.42	1.29	1.37	1.29	1.34±0.01 b
T3	1.30	1.29	1.26	1.26	1.27 ±0.00 a
Mean ±SE	1.36±0.01 c	1.27±0.0a	1.32 ±0.01bc	1.30±0.0ab	1.31

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	38.91	30.21	29.57	31.80	32.62 ±0.13 a
Site 2	26.30	21.14	22.82	25.3	23.89 ±0.07 a
Site 3	23.80	21.08	22.65	23.04	22.64 ±0.03 a
Site 4	23.24	19.26	21.98	22.46	21.73 ±0.04 a
Site 5	28.91	19.26	22.46	23.13	23.44 ±0.05 a
Mean ± SE	28.08 ±0.05 c	22.19 ±030 a	23.89±0.04 a	25.14 ±03 b	24.84

Table (7) and (8) Lead) concentration in water and soil samples represented as (mean ± S.E) of the studied sites during the periods from April to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean± SE
Well Waters					
W1	0.20	0.43	0.31	0.33	0. 31±0.00 a
W2	0.30	0.30	0.50	0.42	0. 38±0.00 a
W3	0.70	0.90	0.102	0.92	0.8±0.00 b
Mean± SE	0. 40 ±0.0a	0. 54±0.0a	0. 61 ±0.01a	0. 56±0.0 a	0.51
Wastewater					
T1	3.10	1.06	1.57	0.93	1.66±0.01 a
T2	1.10	1.62	1.46	1.80	1.4±0.00 b
T3	1.55	1.80	1.60	2.40	1.8±0.01 c
Mean± SE	1.9±0.01a	1.49±0.01b	1.54±0.0b	1.71±0.02b	1.64

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	9.10	13.00	13.00	11.00	12± 0.006 a
Site 2	7.00	9.10	11.27	10.53	9± .005 a
Site 3	17.30	18.00	64.50	53.00	41±0 .07 b
Site 4	28.00	31.00	35.50	30.00	32± 0.01 b
Site 5	15.00	18.00	19.50	19.00	18± 0.006 a
Mean ± SE	15±.019a	17±0.01 a	32±0.06 b	24±0.042 ab	22.22

Table (9) and (10)Cadmium concentration in water and soil samples represented as (mean ± S.E) of the studied sites during the periods for April to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Well Waters					
W1	0.077	0.071	0.07	0.073	0.073±0.00 a
W2	0.082	0.076	0.076	0.065	0.074±0.00 a
W3	0.077	0.074	0.075	0.073	0.074±0.00 a
Mean ±SE	0.078±0.0b	0.074±0.0 a	0.074±0.0 a	0.07±0.0 a	0.074
Wastewater					
T1	0.79	0.74	0.74	0.75	0.75±0.00 a
T2	0.88	0.71	0.72	0.74	0.76±0.00 a
T3	0.79	0.87	0.85	0.88	0.8±0.00 b
Mean ±SE	0.82±0.0 a	0.77±0.0 a	0.77±0.0 a	0.79±0.0a	٠,٧٨

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	0.11	0.09	0.09	0.12	0.1±0.06 a
Site 2	0.10	0.09	0.09	0.09	0.09±0.001 a
Site 3	0.70	0.88	0.88	0.96	0.85± 0.001b
Site 4	0.98	0.91	0.96	0.70	0.88±0.001 b
Site 5	0.97	0.88	0.91	0.93	0.92± 0.001b
Mean ± SE	0.57±0.00a	0.57±0.05 a	0.58±0.001a	0.56±0.02a	0.56

Table(11)and (12)Copper concentration in water and soil samples represented as (mean ± S.E) of the studied sites during the periods from April to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Well Waters					
W 1	0.11	0.07	0.07	0.10	0.089 ±0.01 a
W 2	0.10	0.08	0.08	0.11	0.095±0.00 b
W 3	0.12	0.07	0.08	0.13	0.101±0.00 c
Mean ±SE	0.114±0.0a	0.075±0.01a	0.074±0.0a	0.114±0.01a	0.094
Wastewater					
T1	0.13	0.06	0.07	0.12	0.42±0.00 a
T2	0.13	0.06	0.08	0.12	0.41±0.00 a
T3	0.11	0.09	0.07	0.12	0.098±0.00 a
Mean ±SE	0.123±0.0b	0.072±0.0a	0.076 ±0.0a	0.121±0.0b	0.188

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	49.03	31.27	38.72	47.00	39±0.02 a
Site 2	58.03	32.63	43.50	61.00	44±0.04 a
Site 3	48.70	36.43	40.87	51.00	41±0.02 a
Site 4	42.87	33.93	38.78	47.13	38±0.02 a
Site 5	48.53	33.70	43.50	48.00	42±0.01 a
Mean ± SE	49±0.01 b	33±0.005 a	31±0.01 a	50±0.01 b	40.7

Table (13)and (14) Nickel concentration in water and soil samples represented as (mean, ± S.E) of the studied sites during the periods from April to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Well Waters					
W 1	0.08	0.08	0.07	0.08	0.076 ±0.01 c
W 2	0.07	0.07	0.07	0.07	0.072 ±0.01 a
W 3	0.07	0.08	0.07	0.07	0.073±0.01 b
Mean ±SE	0.074±0.01a	0.078±0.02b	0.071±0.0 a	0.073±0.0 a	0.074
Wastewater					
T1	0.73	0.85	0.70	0.77	0.76±0.01 a
T2	0.81	0.78	0.71	0.79	0.77±0.01 a
T3	0.79	0.72	0.701	0.81	0.75±0.01 a
Mean ±SE	0.783±0.01 a	0.788±0.01b	0.707±0.0 a	0.790±0.0 b	0.76

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	51.06	50.03	47.51	53.30	49±0.14 a
Site 2	59.73	70.90	64.50	61.00	64.9±0.17 a
Site 3	51.90	51.83	50.85	51.37	51.3±0.07 a
Site 4	43.40	52.56	51.70	50.73	49.8±0.13 a
Site 5	95.86	50.50	69.65	77.96	73.49±0.13 a
Mean ± SE	60.3±0.500 a	55.14±33.76 a	54.8±0.24 a	58.8±0.27 a	57.5

Table (15)and (16) Zinc concentration in water and soil samples represented as (mean, ± S.E) of the studied sites during the periodsApril to December 2012. (mean, ± S.E) of the studied sites during the periodsApril to December 2012.

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Well Waters					
W 1	0.70	0.55	0.52	0.67	0.61±0.02 b
W 2	0.22	0.22	0.20	0.30	0.71±0.01 b
W3	0.05	0.09	0.09	0.09	0.084±0.27 a
Mean ±SE	0.32±0.4 b	0.28±0.1 a	0.27±0.1 a	0.35±0.09 c	0.37
Wastewater					
T1	1.66	1.45	1.82	1.91	1.71±0.15 b
T2	1.33	1.34	1.32	1.34	1.33±0.00 a
T3	1.25	1.34	1.30	1.31	1.30±0.01 a
Mean ±SE	1.41±0.2 b	1.37±0.01 a	1.48±0.08 bc	1.52±0.09 c	1.44

Sites	Periods of the study from April to December 2012				
	Spring	Summer	Autumn	Winter	Mean ±SE
Site 1	133.53	194.70	164.83	134.67	164±0.09 bc
Site 2	121.47	72.27	93.33	112	95.10±0.06 a
Site 3	171.03	111	136.32	162	138±0.084 ab
Site 4	254.5	69.37	105.67	124	133±0.218 ab
Site 5	346.73	99.17	162.33	221	192±0.30 c
Mean ± SE	205±0.22 b	109±0.12 a	114.2±0.11 a	150±0.10 a	144.4

Copper (Cu)

Copper is an essential micronutrient required in the growth of both plants and animals, but it is toxic even in low concentration (Wuana and Okieimen, 2011). The minimum value of Cupper for well water was 0.07 , while the maximum value was 0.131, the highest value were recorded during rainy season (winter), while lower values were recorded during dry season (summer) and this agrees with the findings found by (Muhammad, 2010). All ground water samples from well number 1, 2 and 3 have exceeded the recommended levels of 0.003 mg l^{-1} according to (WHO, 2004).Soil samples show results ranging between 31.27 and 61mg kg^{-1} these results were within the range of (EPA, 2001)which 92 mg l^{-1} and common world ranges of (2-100 mg l^{-1}) as stated by (Lindsy, 1979).

Nickel (Ni)

The toxic functions of nickel probably result primarily from its ability to replace other metal ions in enzymes and proteins or to bind to cellular compounds containing O-, S-, and N-atoms, such as enzymes and nucleic acids, which are then inhibited (Cempel and Nikel,2006). The minimum and maximum concentration of Ni in well water was 0.07 and 0.083 mg l^{-1} in W1 during autumn and summer respectively. These results were higher than standards of 0.02 mg l^{-1} recommended by (WHO, 1996). Nearly same results of 0.063 to 0.083 mg l^{-1} obtained by (Hamamin, 2011) in well located adjacent to Bazian refinery, while the soil concentration of nickel was varied from 43.4 to 95.867 mg kg^{-1}. The maximum rate obtained at site 5 that contain the minimum level of sulfur concentration, concentration of Ni decreased with the increase of sulfur and its compound (sulphide and sulphate) concentration(Kadhum and Hussain, 2011), in the nature nickel is incorporated with sulphides compound concentration that make it having low environmental mobility (EPA, 2004).

Zinc (Zn)

Zinc concentration for the studied well water varied from 0.05 to 0.7 mg l^{-1}, these are exceeded the recommended level of 0.05ppm y (WHO, 2006).The higher value recorded in W1 is due to leaching of pollutant and this because of its location which is near to the crude pools point and oil processing stations, similar findings was found by (Otokunefor and Obiukwu, 2005).

Zn content in the soil sites ranged from 69.37 to 346.73mg kg^{-1}, which was in the common world ranges for total Zn concentrations in soil 10 - 300 mg kg^{-1} as reported by (Lindsy, 1979 and EPA, 2011) except for the maximum value at site 5 which was 346.73 mg kg^{-1}.Results were higher than 15 to 128.9mg kg^{-1} which found by (Al-Ameri, 2011) around Al-Duara refinery in Baghdad city, this may be related to the type of crude oil and its composition.

Conclusion: From this study the following conclusions has been estimated:1- Bazian oil refineries release untreated wastewater to the environment.2- Bazian oil refinery has an obvious impact on well water (ground water) and soil pollution by heavy metals.3- The effect of refinery pollution causes an increase level of Lead and cadmium in the well water which are exceeding allowable levels stated by WHO.4- copper is one of the elements that are toxic even in low concentrations, in this study the copper level in the ground water are exceeding the permissible level stated by WHO.

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تقييم بعض المعادن الثقيلة من المياه والتربة من مصفاة النفط بازيان في محافظة السليمانية، كردستان

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المستخلص

هدفت الدراسة إلى تقييم بعض الخصائص الفيزيائية والكيميائية لمياه الآبار ومياه الصرف الصحي والتربة في مصفاة للنفط، وتحديد تركيز بعض المعادن الثقيلة مثل الكروم والرصاص والكادميوم والنحاس والزنك والنيكل في الماء والتربة. جرى أخذ عينات من أبريل إلى ديسمبر ٢٠١٢ في منطقة الدراسة التي تقع في الشمال الغربي من مدينة السليمانية. وأظهرت النتيجة أن متوسط درجة الحموضة كان ٧,١٢، ٧,٣٩ للابار ومياه الصرف الصحي على التوالي، في حين تراوحت حموضة التربة 7.11-8.58 والموصلية الكهربائية EC لمياه الآبار تراوحت من 399 ميكرو سمنز سم $^{-1}$ -1570 ميكروسمنز سم-١، في حين تراوحت مياه الصرف الصحي 789.6- 3350 ميكروسمنز. سم-١. و للتربة فقد تراوحت الموصلية الكهربائية 422 - 5735 ميكروسمنز. سم-١.

تراوح تركيز الكروم 0.31- 0.36 ملغم. لتر $^{-1}$ و 1.27- 1.34 ملغم لتر-١ و19.2- 38.91 ملغم. كغم-١ لمياه البئر والصرف الصحي وعينات التربة على التوالي. كان معدل تركيز الرصاص 0.51 - 1.64 ملغم.لتر $^{-1}$ لعينات ماء البئر ومياه الصرف الصحي بينما تراوح وجوده في التربة بتركيز 7.0 - 64.5 ملغم. كغم $^{-1}$. كان تركيز الكادميوم بين 0.065 - -0.082 ملغم.لتر $^{-1}$ في مياه الآبار وفي مياه الصرف الصحي فقد تراوحت بين 0.71- 0.88 ملغم. لتر $^{-1}$، بينما تراوحت عينات التربة بين 0.09 -0.977 ملغم. كغم -١ . يستنتج وجود تأثير واضح لمصفاة النفط على المياه الجوفية وتلوث التربة بالمعادن الثقيلة.

Concentrations of chemical elements in two species of aquatic birds: Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*)

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Abstract

This study included the determination of six chemical elements (Cadmium, Cobalt, Copper, Lead, Manganese, and Nickel) in the muscles , liver and digestive canal for two male and female species of aquatic birds Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*). Samples were collected from marshes of Kahla district within Maysan Governorate. Chemical elements were detected by flame atomic absorption spectrophotometry. Recorded Copper and lead concentrations were found to be the highest in the range (8.275 - 120.780) and (12.321- 54.085) µg / gm dry weight respectively, being the highest values in liver of the Teal (*Anas crecca*) . Nickel is found in the concentration of (26.24 and 31.49) µg / gm dry weight for males and females respectively in liver of Teal (*Anas crecca*). The concentrations values of Cadmium, Cobalt, and Manganese ranged (ND-2.676), (ND-23.195), (ND-19.480) µg / gm dry weight respectively. The results showed that the liver tissues of both birds recorded high concentrations compared with the muscle tissues and digestive canal, and chemical elements reported higher concentrations during winter compared to their concentrations during spring. The concentrations of all studied chemical elements in muscles were within the tolerance limits with the exception of Lead, which was higher compared to the literature.

Keywords: chemical elements , aquatic birds , Maysan marsh, Atomic absorption spectrophotometry.

Introduction

The marshes of Mesopotamia, one of the largest bodies of water in the Middle East, characterized by heavy vegetation and good biodiversity. This unique environment with qualities picturesque suffered from one of the biggest crimes of the times against the environment and it dries during the nineties of the last century (UNEP, 2001), which led to the destruction of its unique eco-system , because the remaining of these marshes exceed 10% of its size (Khalaf and

Almukhtar, 2005), which called for the need to conduct studies on the new environment to assess the amount of damage they faced , and the current study focused on determining the concentrations of chemical elements in the two species of water birds as they are important species for food.

Birds as aquatic organisms are expected to concentrate chemical elements in their tissue of trace elements (Abaychi & Mustafa, 1988). Waterfowl contains high concentrations of chemical elements on consumption by human being will cause toxic effects (Akinola *et al*., 2008). This is happened due to the bioaccumulation of these chemical elements (GESAMP, 1993). Accordingly the concentration of chemical elements in the environmental media depend upon different factors , (Arkadiusz *et al*., 2007).

Birds are good bioindicator for chemical elements contamination and could be used to effectively and accurately monitor their level for several reasons. Birds are abundant in numbers , have wide geographic distribution range , feed at different trophic levels and many birds are long lived migratory birds can be used to assess exposure in distant regions(komosa and komosa ,2012 ; Rothschild and Duffy 2005).

The aim of this study was to investigate expected accumulation of some chemical elements in the tissues of aquatic birds from marshlands / Southern Iraq.

Materials and methods

Samples of aquatic birds (*Gallinula choropus* & *Anas crecca*) were collected from marshes of Maysan Governorate (Kahla), as shown in (Fig.1), during the winter and spring seasons within the year 2014. Aquatic birds sample were also taken from fishermen in the marshes during the study period.

Bird samples as shown in figure 2, were transferred to the laboratory of Marine Science Centre, and classified according to Allouse , (1961). The

total weight to the nearest 10 gm were measured, the specimens (males & females) were identified accordingly to examining the genital organs (Tab. 1). The muscle tissues , liver and digestive canal for males and females were separated. Chemical elements were analyzed according to the

method used by ROPME, (1982) as follows: 1 gm of dry samples were weighted and transferred to a digestion glass tubes 150 ml in size and Pyrex made, then to each tube, 10 ml of a mixture of two concentric acids, nitric acidic HNO_3 and per chloric acid $HClO_4$ in the ratio 4 : 1, respectively were added , mixed well and left for 4-6 hours for primary digestion , and then samples were transferred to aluminum holder and heated to the degree of 70 ^{o}C for 2-3 hour in a water bath , then the contents of the digestion tube were transferred to Teflon beakers with volume of 150 ml and each sample washed twice with deionized distilled water, and then washing water is added to the Teflon beaker, then each solution is vaporized to 70-80 ^{o}C using a hot plate to near dryness. To the produced sludge nitric acid in a concentration of 5 % was added and the volume was completed to 50 ml and the solutions were filtered by using filter paper type Whatman No.1 to reject of the small particles. Finally, the resulted solution is transferred to plastic bottles to be ready for analysis. Chemical elements in each sample were measured by Flame Atomic Absorption Spectrophotometer Model SensAA, GBC Scientific Equipment Australian made, provided with Cathode Lamps suitable for each chemical element.

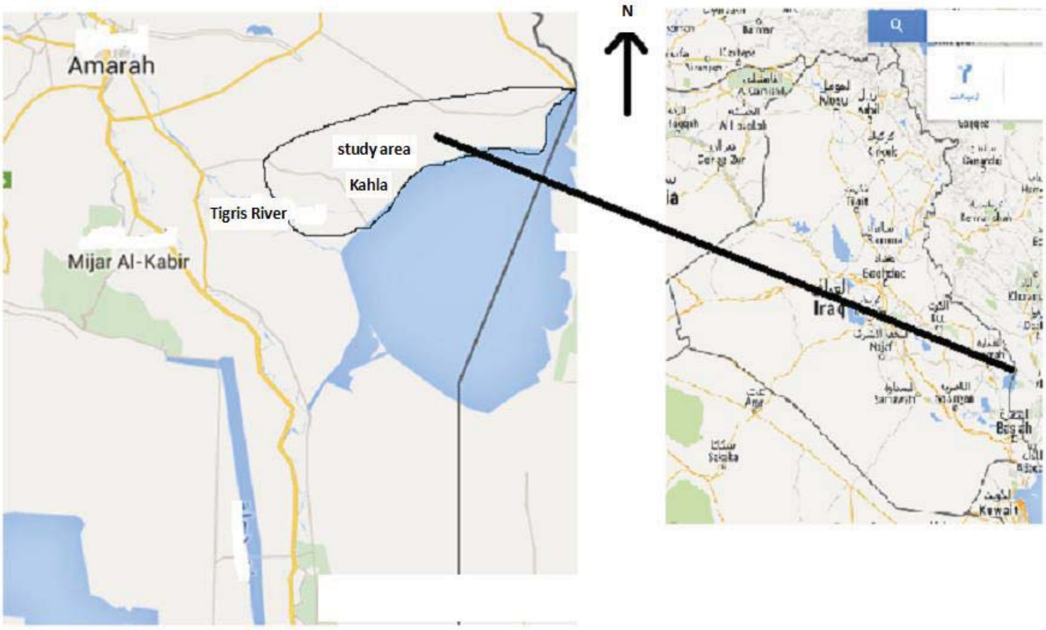


Figure 1. Location map of the study area showing the sampling Station .

Teal, *Anas crecca*

Moorhen, *Gallinula choropus*

Figure 2. Photos of aquatic birds Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*) from marshes of Maysan Governorate (Kahla) .

Result and discussion

Concentrations recorded (µg / gm) dry weight for chemical elements in muscle , liver and digestive canal tissues for males and females , Moorhen (*Gallinula choropus*) and Teal (*Anas crecca*) were in the range of (8.275–120.780) Cu , (12.321–54.085) Pb , (N.D–31.490) Ni , (N.D–2.676) Cd , (N.D–23.195) Co and (N.D–19.480) Mn during winter 2014, (Tab. 2) and (Fig.3). While during spring 2014 range recorded were (1.665–65.756) Cu , (1.769–28.260) Pb, (N.D) Ni , (N.D–2.417) Cd, (N.D–21.410) Co and (N.D–17.709) Mn, (Tab. 3) and (Fig.4).

The study showed that concentrations of most elements were higher during winter than spring, it explained upon nutrition activity in birds which has been recorded in higher activity during winter than during spring, it is played a great role in increasing of concentrations during winter in addition to the effect of surrounding environment (high or low concentrations in the water). Recorded concentrations of the studied elements in the Teal *A. crecca* were higher than the Moorhen *G. choropus* which could be explain on the basis of the different

feeding habitat the type of food, as well as the influence of environmental factors that vary from one type to another. Birds are particularly useful as bioindicator of pollution because they are often high in the food chain (Burger *et al*., 1994). Several physiological and biological processes, such as feeding habits, growth, age, reproduction, molting, and migration may influenced metal concentration and distribution in birds (Kim *et al*., 2007).

The average of the chemical elements concentration's in different tissues of the common teals and moorhens ranked from highest to lowest , were as follows: liver > digestive canal > muscles . In this study the highest levels of trace metals in common Teal tissue were detected in liver which explained as : once elements are taken up and ingested they can be stored in internal tissues such as the kidneys and liver (Ahmad mahmoodi *et al*., 2009). Recorded Copper and lead values were the highest in the range of muscle tissues , liver and digestive canal (Tab. 4).Chemical elements reach in aquatic environments from different sources, mainly human activities, e.g. industry, urban and agricultural discharge, mine runoff, solid waste disposal and atmospheric deposition (Merciai *et al*., 2014). The results showed that concentration of Pb in aquatic birds were highest than the permissible limits of ANZFA (2001) and WHO/FAO (2000) , representing a potential risk for human consumption as food.

Conclusions

As a conclusion, the concentrations of all detected elements in the liver were found to be the highest in both Moorhen (*G. choropus*) and Teal (*A. crecca*). Moreover, the study revealed that concentrations of chemical elements were higher during winter compared to spring. And recorded concentrations of the studied elements in Teal (*A. crecca)* were higher than in Moorhen (*G. choropus).* The concentrations of all studied chemical elements were within the tolerance limits with the exception of Pb, which was the highest than reported by ANZFA (2001) and WHO/FAO (2000) tolerance limits.

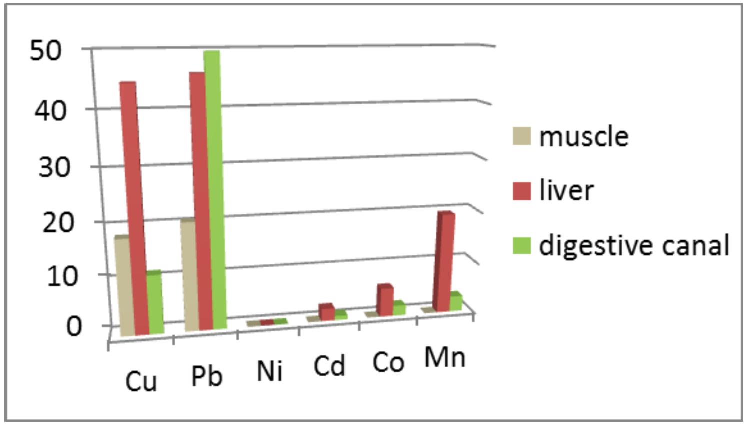
Table 1. Number of birds and the average weight for studied samples caught in Maysan marshes (Kahla) Southern Iraq.

Aquatic birds	**Sex**	**winter 2014**		**spring 2014**	
		number of species	**Weight average (gm)**	**number of species**	**Weight average (gm)**
Gallinula choropus	Males	8	750	10	690
Gallinula choropus	Females	10	580	10	598
Anas crecca	Males	8	225	7	239
Anas crecca	Females	6	242	7	251

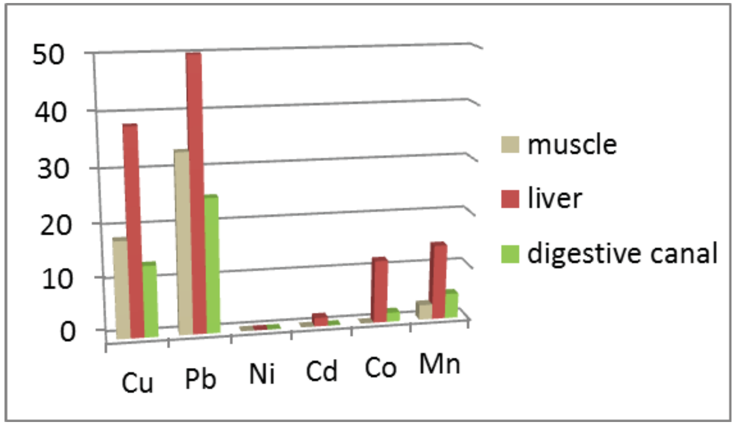
Table 2. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during winter 2014.

Elements	*Gallinula choropus*						*Anas crecca*					
	Muscles		Liver		digestive canal		Muscles		Liver		digestive canal	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Cu	18.012 ± 1.35	18.200 ± 1.44	38.055 ± 2.98	44.670 ± 2.11	13.232 ± 1.01	11.233 ± 0.66	19.855 ± 1.40	31.435 ± 0.70	62.870 ± 3.01	120.78 ± 4.11	8.275 ± 0.99	11.233 ± 0.87
Pb	33.285 ± 1.04	20.594 ± 1.69	49.925 ± 2.78	46.012 ± 3.21	24.965 ± 1.23	49.510 ± 1.78	20.805 ± 1.52	20.711 ± 0.45	29.250 ± 1.47	54.085 ± 2.08	12.480 ± 0.50	12.321 ± 0.99
Ni	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	26.240 ± 1.28	31.490 ± 0.88	N.D	N.D
Cd	N.D	N.D	1.611 ± 0.12	2.417 ± 0.65	N.D	0.806 ± 0.09	N.D	N.D	2.676 ± 0.11	2.215 ±0.32	0.806 ± 0.04	1.611 ± 0.04
Co	N.D	N.D	11.748 ± 0.44	5.617 ± 0.31	1.721 ± 0.01	1.958 ± 0.04	N.D	N.D	15.664 ± 0.33	23.195 ± 1.20	N.D	3.916 ± 0.29
Mn	2.808 ± 0.19	N.D	14.042 ± 1.20	19.480 ± 0.97	4.680 ± 0.13	3.010 ± 0.42	0.936 ± 0.01	1.655 ± 0.22	2.808 ± 0.03	3.916 ± 0.32	2.808 ± 0.19	3.744 ± 0.33

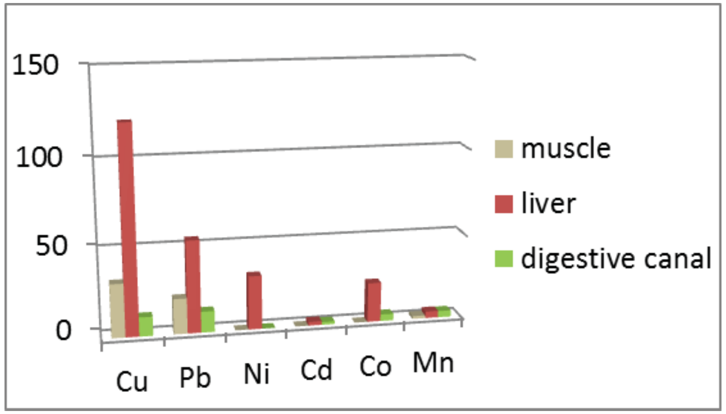
N.D. : not detected



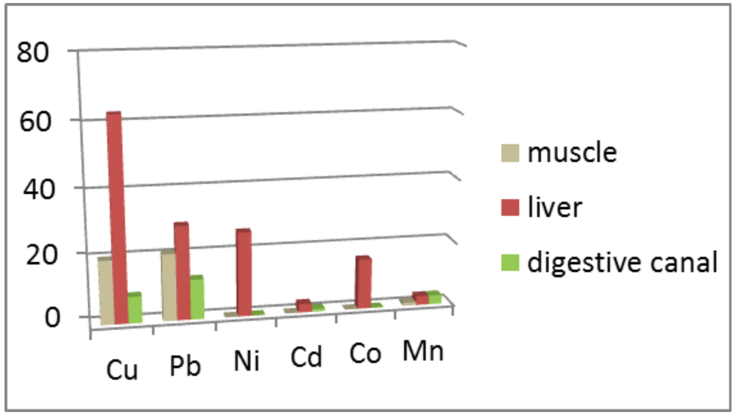
Gallinula choropus (Females)



Gallinula choropus (Males)



Anas crecca (Females)

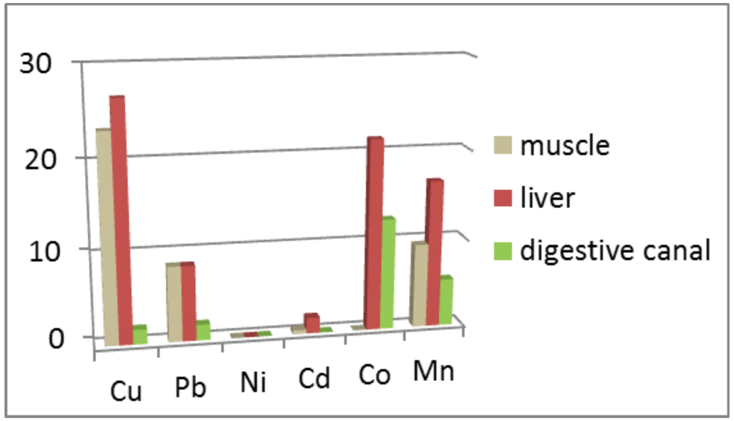


Anas crecca (Males)

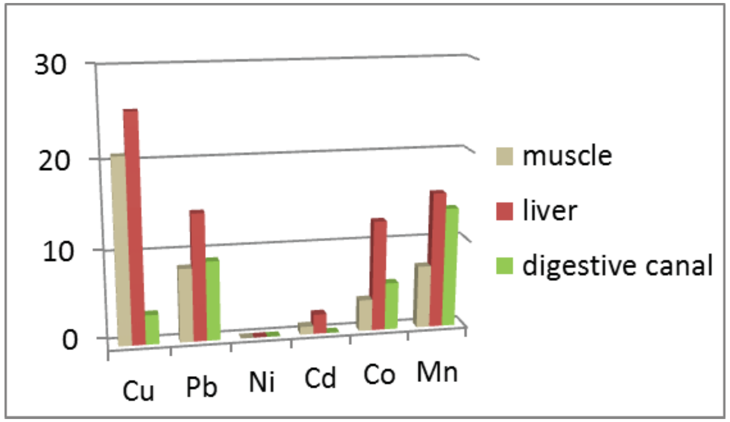
N.D. : not detected

Table 3. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during spring 2014.

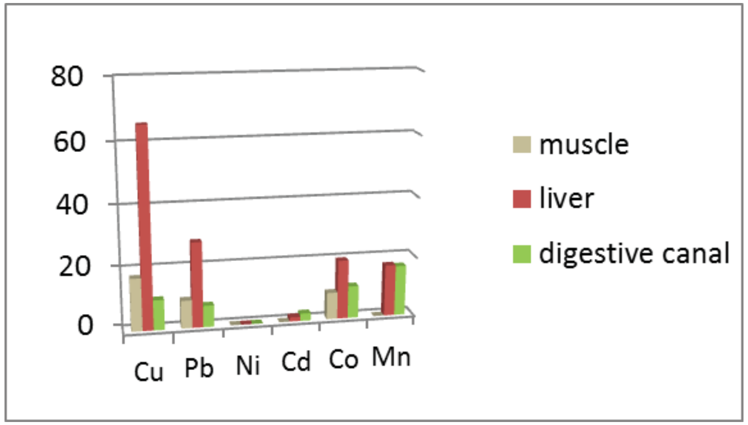
Elements	*Gallinula choropus*						*Anas crecca*					
	Muscles		Liver		digestive canal		muscles		liver		digestive canal	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Cu	20.809 ± 1.28	23.306 ± 0.70	25.434± 1.33	26.635 ± 1.23	3.329 ± 0.28	1.665 ± 0.11	12.485 ± 1.09	17.479 ± 1.32	32.462 ± 1.77	65.756 ± 2.01	9.156 ± 0.33	9.988 ± 0.57
Pb	8.325 ± 0.63	8.478 ± 0.23	14.370 ± 1.04	8.478 ± 0.60	8.981 ± 0.54	1.769 ± 0.09	8.478 ± 0.23	9.260 ± 0.63	14.130 ± 1.32	28.260 ± 2.01	8.478 ± 0.98	7.156 ± 0.88
Ni	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Cd	0.500± 0.009	0.445 ± 0.008	2.230 ± 0.32	1.784 ± 0.76	N.D	N.D	N.D	N.D	0.446 ± 0.005	1.338 ± 0.12	0.445± 0.005	2.417 ± 0.035
Co	3.568 ± 0.25	N.D	12.489 ± 0.63	21.410 ± 1.98	5.353 ± 0.50	12.489 ± 0.72	N.D	8.905 ±0.63	8.905 ± 0.45	19.580 ± 1.35	N.D	10.706 ± 0.55
Mn	7.084 ± 1.18	9.445 ± 0.98	15.348 ± 1.90	16.528 ± 2.09	13.577 ± 0.97	5.313 ± 0.54	14.167 ± 1.02	N.D	17.709 ± 1.91	17.117 ± 1.52	8.264 ± 0.87	16.640 ± 2.01



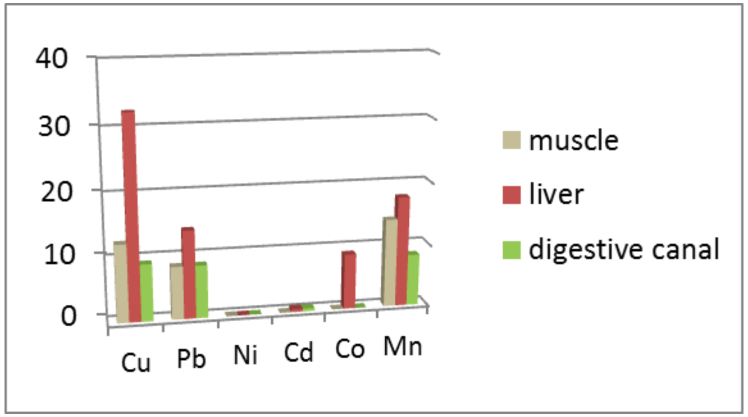
Gallinula choropus (Females)



Gallinula choropus (Males)



Anas crecca (Females)



Anas crecca (Males)

Figure 4. Concentrations of chemical elements (µg / gm) in different tissues of aquatic birds during spring 2014.

Table 4. Ranges of concentrations of chemical elements (µg / gm) in different tissues of aquatic birds Maysan (Kahla) marshes.

Elements	muscles	Liver	digestive canal
Cu	12.485–31.453	25.434–120.780	1.665–13.232
Pb	8.325–33.285	8.478–54.085	1.769–49.510
Ni	N.D	N.D- 31.490	N.D
Cd	N.D–0.500	0.446–2.676	N.D-2.417
Co	N.D-8.905	5.617–23.195	N.D-12.489
Mn	N.D-14.445	2.808–19.480	2.808–16.640

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دراسة تراكيز العناصر الكيمياوية في نوعين من الطيور المائية : دجاج الماء (*Gallinula choropus*) و الحذاف الشتوي (*Anas crecca*)

علي مهدي ناصر و سامي طالب لفته الياسري و فارس جاسم محمد الامارة

قسم الكيمياء و تلوث البيئية البحرية- مركز علوم البحار ، جامعة البصرة

المستخلص

تضمنت هذه الدراسة تقدير ستة عناصر كيمياوية : النحاس و الرصاص و النيكل و الكادميوم والكوبلت والمنغنيز في العضلات والكبد والقناة الهضمية لنوعين من الطيور المائية لذكور واناث دجاج الماء *Gallinula choropus* والحذاف الشتوي *Anas crecca* المستجمعة من منطقة الكحلاء ضمن اهوار ميسان \ جنوب العراق. تم تقدير العناصر الكيمياوية بواسطة جهاز الامتصاص الذري اللهبي . كان لعنصري النحاس والرصاص اعلى القيم المسجلة اذ تراوحت تراكيزهما بين (8.275 – 120.780) ، (12.321-54.085) مايكغم / غم وزن جاف على التوالي ، اذ سجلت اعلى القيم في كبد اناث الحذاف الشتوي . سجل النيكل قيمتين فقط لفصل الشتاء هما 26.240 و 31.49 مايكغم / غم وزن جاف للذكور والاناث على التوالي في كبد الحذاف الشتوي ايضا ، اما تراكيز الكادميوم والكوبلت والمنغنيز تراوحت تراكيزهما (2.676-N.D) ، (23.195-N.D) ، (19.480-N.D) مايكغم / غم وزن جاف على التوالي . اظهرت نتائج الدراسة بأن انسجة الكبد سجلت تراكيز عالية مقارنة بأنسجة العضلات والقناة الهضمية وكانت التراكيز في الشتاء اعلى من الربيع . كما اظهرت النتائج ان التراكيز في جميع العناصر المدروسة في العضلات كانت ضمن الحدود المسموح بها مقارنة مع كل من ANZFA (2001) و WHO/FAO (2000) ماعدا عنصر الرصاص .

كلمات مفتاحية : العناصر الكيمياوية ، الطيور المائية، اهوار ميسان، الامتصاص الذري اللهبي.

Freshwater Snails of East Hammar Marsh and Shatt Al-Arab During 2008-2009

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Abstract

Richness and abundance of some freshwater snails were determind in Basrah province southern Iraq since October 2008 until July 2009, Six stations of East Hammar marsh and it's lower reaches were chosen for getting samples for aquatic gastropods. Ten species were found, *Bellamya bengalensis* (Lamarck, 1822), *Bellamya unicolar* (Olivier, 1804), *Bithynia hareerensis* (Glöer, and Nasser, 2009), *Gyraulus ehrenbergi* (Beck, 1837), *Melanoides tuberculata* (Müller, 1774), *M. costata* (Olivier, 1804), *M. nodosa* (Fèrussac, 1823), *Physlla acuta* (Draparnaud, 1805), *Lymneae auricularia* (Linnaeus,1758), and *Theodoxus jordani* (Sowerby, 1832). Individual density varied from zero to more than 100 ind./metre^2 for many species according to spatial and temporal changes.

Introduction

Gastropoda including freshwater snail species, is an important ecological component in the aquatic habitats (Costil et al., 2001). They are represent a food source for many fishes, turtles, and aquatic birds, as well as being essential in recycling of dead plant materials, also they are excellent water quality indicator because of their sensitivity to certain chemicals (Johnson,2003; Van der Valk, 2006).

They can be found at the bottoms and on aquatic plants of rivers, lakes, small streams and ponds (Johnson,2003).

Populations of freshwater snails as a part of the Iraqi marshlands were subjected to knowledge severe ecological stressors imposed by wide temporal fluctuations in their environment which have a big influence on the niche availability and snail abundance (Niggebrugge et al., 2007).

Al-Qarooni (2005) found four species of snails in Hammar marsh; *Lymnaea auricularia*, *Gyraulus ehrenbergi*, *M. tuberculate*, and *M. nodosa*. And the most common species in Hammar according to his study was *L. auricularia*. Qazar (2009) showed that numbers of aquatic snails were not only differ from one station to another, but they also differs at the same station by being much higher at the aquatic plants compared with that on sediments.

Khalaf (2011) found seven species of snails; *Bellamya bengalensis, Bithynia badiella*, *Melanopsis costata*, *Melanopsis nodosa*, *Melanoides tuberculate*, *Neritina violacea*, and *Theodoxus jordani* in Shatt Al-Arab. The most common one was *M. tuberculate*. The aim of the study was to investigate the effect of some ecological factors on the structure and intensity of snails in six chosen station adjust the Hammar marsh.

Materials and methods

Sampling sites

Aquatic macroinvertebrates were sampled seasonally at six stations (Table, 1). Two of them Burga and Sadda undergo a drainage and restoration process, whereas the others represent a normal natural ecosystem, in Jazzera, Najebia, Qarmma, and Hareir (Figure, 1).

Sampling methods

Seasonally macrophyte samples were collected with its attached snails at each station by using an aluminum trap box which designated for this purpose (Qazar, 2009). At the laboratory we separated the gastropoda species for counting and classification process according to Ahmed (1975) and Frandsen (1983).

Environmental measurements

Many environmental measurements were taken in this study at each collection, like air and water temperatures, pH using Elmetron pH meter mod. CP-411, dissolved oxygen according to (APHA, 2003), salinity using WTW electrical conductivity meter mod. LF91, total hardness according to (APHA, 2003), and light penetration using a Secchi disk.

Table1: Stations of the study area.

No.	Station	Longitude	Latitude
1	Jazzera	30.35.659	047.46.171
2	Najebia	30.35.579	047.46.026
3	Qarmma	30.35.410	047.44.794
4	Hareir	30.35.592	047.42.580
5	Sadda	30.36.655	047.40.218
6	Burqa	30.40.047	047.38.574

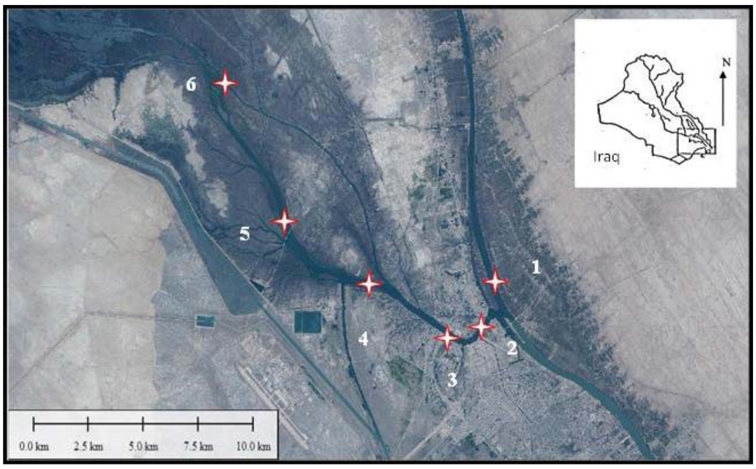

Figure 1: map of study area.

Biological indices and statistical analysis

Some indices were carried out like diversity index (Shannon and Weaver, 1949), richness (Margalefe, 1968), evenness (Pielou, 1977), Jaccard coefficient (Jacared, 1908), and domination. As well as statistical analysis of spss ver.16.

Results

Environmental factors

Air and water temperature as well as salinity values raised at Summer months. Dissolved oxygen rated from 7 to 12.5mg/l, while pH ranged from7.3 to 8.21. Salinity ranged from 1.8 to 6.81psu. Hardness values were generally high, reached 2000mg/l at Burqa station in Spring. Statistical results for environmental factors under L.S.D. ($p<0.05$) showed that Oxygen, pH, and salinity were affected by temporal and spatial variations. As well as for the total hardness except for St.4 and 5 which showed no differences between them (Table, 2).

Table2: Environmental factors for the stations during 2008-2009.

Season	Station	Total hardness (mg/l)	Salinity (PSU)	pH	Dissolved oxygen(mg/l)	Air temperature (°C)	Water temperature (°C)
Autumn	**1**	837	2.12	7.3	8.8	30	**20.9**
	2	822	2.43	7.75	8.8	30	**21.6**
	3	817	2.95	8	8.8	30	**21.8**
	4	896	1.9	7.63	11	28.3	**21.4**
	5	1019	2.21	7.52	12.6	34	**21.2**
	6	1170	3.04	7.69	12.5	20	**14**
Winter	**1**	1400	1.8	7.93	11.6	10	**8.5**
	2	1400	1.92	8.01	11.4	10	**9.4**
	3	1500	2.24	8.13	12	10	**9.3**
	4	1460	2.75	8	12	11	**8.4**
	5	1540	2.11	8	12.2	10	**8.2**
	6	1700	3.84	8.01	11.6	10	**8**
Spring	**1**	1100	2.07	8.16	12.5	24	**20**
	2	1160	3.03	8.05	7.4	28	**20**
	3	1600	2.12	8.21	10	28	**20**
	4	1600	2.96	8.13	10.2	30	**23**
	5	1640	4.01	8.15	11.5	30	**23**
	6	2000	5.33	8.17	11	29	**21**
Summer	**1**	1098	3.6	7.79	9.88	40	**33.2**
	2	1080	3.62	7.85	7.1	40	**33.2**
	3	1082	3.62	7.81	8.8	40.2	**34**
	4	1077	5.38	7.59	8.8	39.8	**34.1**
	5	1510	5.8	7.69	10.5	39	**30.2**
	6	1441	6.81	7.64	10.5	38.7	**30.2**

Snail species

Ten gastropod species were found in the study area; *Bellamya bengalensis, B. unicolar,Lymneae auricularia,Physa acuta,Theodoxus jordani, Melanoides tuberculata, M. costata, M. nodosa, Gyraulus ehrenbergi, Bithynia hareerensis*. (Figure, 2-11). These snails were found nearly in most stations during the study period, most numbers of snail species were recorded in Summer in most of the study area, while *B. hareerensis* were recorded at St.2, St.4, and St.6 only (Table, 3).

Figure 2: *Bellamya bengalensis*

Figure 3: *Bellamya unicolar*

Figure 4: *Bithynia hareerensis*

Figure 5: *Melanoides tuberculata*

Figure 6: *M. nodosa*

Figure 7: *M. costata*

Figure 8: *Physa acuta*

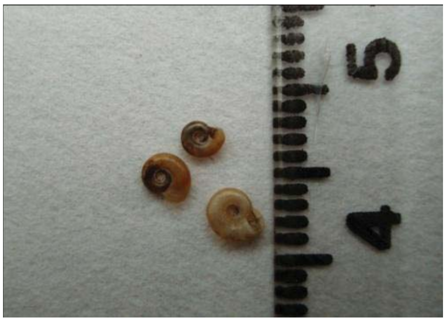

Figure 9: *Gyraulus ehrenbergi*

Figure 10: *Theodoxus jordani*

Figure 11: *Lymneae auricularia*

Ecological indices

The highest value for diversity indices 1.79 recorded in Autumn, 2008 at St.4, while the lowest was 0.075 for Autumn, 2008 at St.6. (Fig. 12) The highest value of richness was 2.23 at st.5 in Spring 2009, meanwhile it was the lowest level 0.21 for St.6 in the same season (Figure, 13).

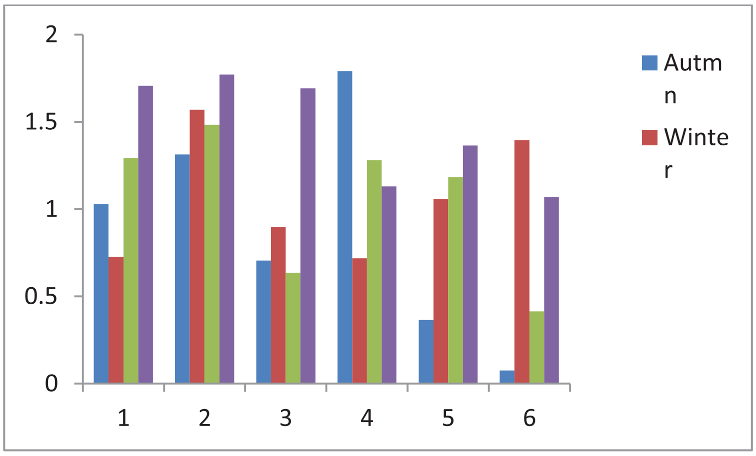

Figure 12: Diversity values of snails for the stations during study period.

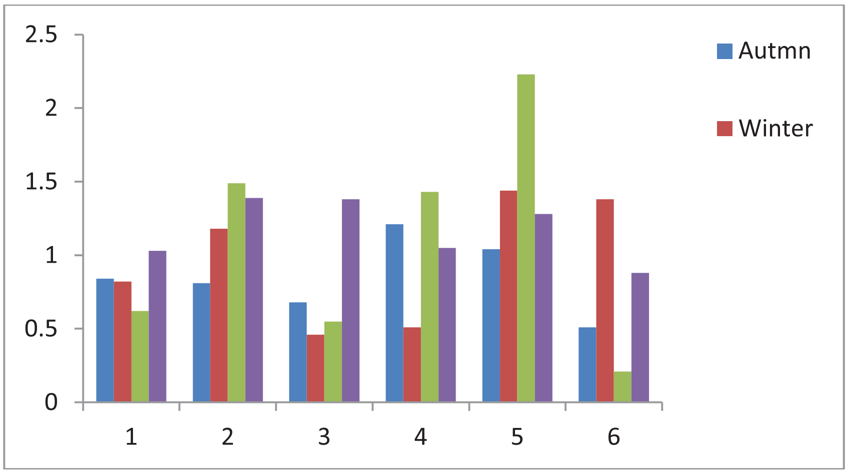

Figure 13: Richness values of snails for the stations during study period.

Table 3: Numbers of snails/m^2 at study area 2008-2009.

Species	Sum of Density																							
	Autumn						Spring						Summer						Winter					
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
B. bengalensis	0	12	14	3	0	3	0	9	4	12	1	0	0	0	12	0	2	8	0	14	8	0	1	1
B. hareerensis	0	0	0	0	0	0	0	0	0	3	0	0	0	20	7	55	0	1	0	0	0	0	0	0
B. unicolar	0	12	1	3	2	0	0	7	0	0	4	0	0	8	0	4	5	0	0	15	0	0	2	0
G. ehrenbergi	2	0	0	4	3	0	2	0	0	8	1	0	108	3	4	4	0	0	32	0	0	0	0	0
L. auricularia	18	12	0	34	112	35	151	28	0	12	16	17	80	8	4	20	95	29	26	50	20	36	1	4
M. tuberculata	2	0	0	254	1	0	0	4	0	32	1	100	28	4	4	184	63	180	0	2	0	4	0	8
Melanopsis costata	24	0	0	3	0	0	46	2	0	4	1	0	8	0	0	10	2	0	4	0	0	0	0	0
Melanopsis nodosa	102	0	0	6	0	0	201	1	2	12	7	0	20	15	0	24	54	68	0	8	0	0	0	3
P. acuta	0	4	4	9	2	11	0	0	0	0	2	0	44	16	6	0	1	0	60	13	44	8	0	0
T. Jordani	226	0	0	0	1	0	178	5	0	50	3	0	52	0	0	0	8	6	8	56	0	0	0	2
Grand Total	**374**	**40**	**19**	**316**	**121**	**49**	**578**	**56**	**6**	**133**	**36**	**117**	**340**	**74**	**37**	**301**	**230**	**292**	**130**	**158**	**72**	**48**	**4**	**18**

The evenness values were moderate to high during study period for most stations especially in Spring, it ranged from 0.05 in St. 6 at Autumn to 0.96 at St.5 in Winter (Figure, 14).

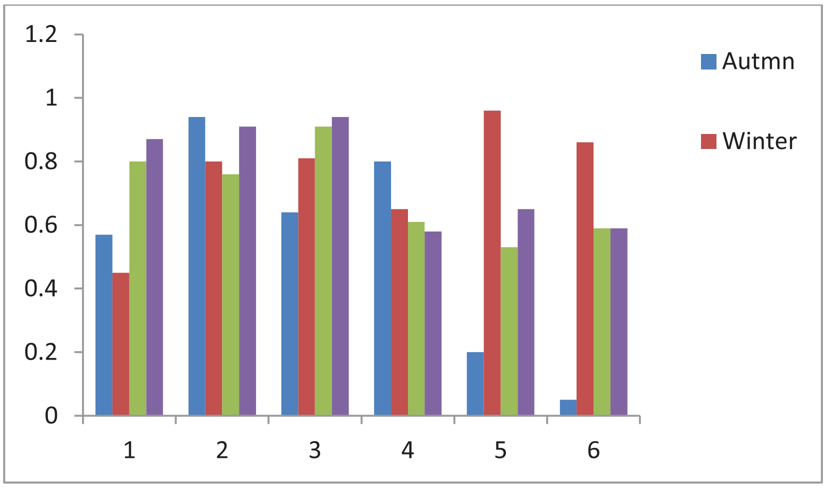

Figure 14: Evenness values of snails for the stations during the study period.

Domination measurements during the study period showed that the dominated species in st.1 and 2 were *T. jordani* with values of 46.9 and 40.8 and *L. auricularia* with values of 25.6 and 29.3 respectively. Meanwhile at St.3 the snail *T. jordani* with value of 21 was dominated. While at St. 4, 5, and 6 dominant species was *M. tuberculata* with values of 72.4, 22.5, and 60.9 respectively, and the second species *L. auricularia* with values 11.7, 52.7, and 22.2 respectively.

Similarity index for the species among stations shows high similarity 77.77 between St.2 and 5 in Spring, While it was zero in Autumn for St.1 and 3 as well as for St.3 and 6 in Spring (Table, 4).

Results of statistical analysis showed that snails species, occurrence, and density varied significantly ($P < 0.05$) between the six stations.

Table 4: Monthly changes in Jaccard similarity index values for the study area.

Month	Station	1	2	3	4	5	6
Autumn	1		20	0	55.6	50	12.5
	2			75	50	42.8	75
	3				37.5	28.5	50
	4					55.5	37.5
	5						28.5
	6						
Winter	1		33.3	33.3	33.3	20	25
	2			42.8	42.8	42.8	71.4
	3				50	50	46
	4					20	33.3
	5						33.3
	6						
Spring	1		50	16.66	62.5	55.55	20
	2			28.57	66.66	77.77	28.57
	3				25	22.22	0
	4					70	25
	5						22.22
	6						
Summer	1		55.55	44.44	55.55	66.66	44.44
	2			57.14	75	50	44.44
	3				44.44	40	50
	4					50	44.44
	5						55.55
	6						

Discussion

As habitat availability and macrophyte abundance changes along the stream of studying area, it is doubtful that samples from one or two stations can reflect community composition in the whole stream properly (Grubaugh et al., 1996), so six stations were chosen to determine the abundance and distribution of aquatic snails in East Hammar marsh and Shatt Al-Arab river.

Aquatic snails community at St.5 and 6 were exterminated at the nineties of the past century due to the marshes drainage, various invertebrates were affected negatively by this drainage which considered as a threat to the life at wetlands (Lewin and smolinski, 2006); that leads to changes in the snail's community, some native species disappear and new ones appear.

In aquatic ecosystems environmental requirements of the organisms determines their natural distribution (Flores and Zafaralla, 2012; Al-Akel and Suliman, 2012). Some of these important factors according to Van Duinen et al., (2003) are salinity, current velocity, duration of drought periods, acidity and trophic state. The results of the environmental measurements of this study showed a direct relationship between snail numbers with the temperature and hardness of the water.

The high hardness levels of Iraqi rivers which ranged from 817 to 2000 mg/l in this study would be suitable for the diversity and richness of the snails. Supian and Ikhwanuddin (2002) and Vollan (2003) mentioned that the diversity of snail species usually increases along with the amount of calcium in the environment.

Researches confirmed that gastropod population size including freshwater snails depends on macrophyte abundance (I.F., 2003; Van Duinen et al., 2003), Aquatic vegetation plays an important role in aquatic systems, providing shelter, breeding habitat, and epiphytic forage for numerous fishes and aquatic macroinvertebrates (Lodge, 1985; Grubaugh et al., 1996; Colon-Gaud, 2003).

Aquatic macrophytes presence and density also may differs from one station to another according to the difference of water velocity, macrophytes can be affected negatively or even damaged by the high water velocity (Van der valk, 2006), that explain the low density of macrophytes in the third station during the whole study period, so current velocity considered as a limiting factor for the snails distribution (Giovanelli et al., 2005).

Numbers of species per site in restarted sites represented in station 5 and 6, tended to increase with the time elapsed after rewetting, it also could be inhibited by new population of snails (Van Duinen et al., 2003).

The snail *M. tuberculata* dominated the gastropod in stations 4, 5, and 6, this high population densities may be attributed to its high salinity tolerance which reaches in Summer 6.81 psu (Murray et al., 2010), also it's the commonest and most wide-ranging member of the family Thiaridae, found in almost any kind of freshwater (Supian and Ikhwanuddin, 2002).

According to the richness indices St. 2, 4 and 5 was the most rich ones because of the stable conditions of that stations and their high density of different macrophytes. A stable environment contains more species, more niches, and involves a higher degree of organization and food web complexity (Van Duinen et al., 2003).

Station 6 showed the lowest values of species richness, it might be due to the changes in water depth at that station which almost dry out at summer season, according to Flores and Zafaralla (2012) gastropod communities can be affected by the pond surface area, nitrates, chlorides concentrate, alkalinity and substrate.

Species evenness were higher in Autumn, Winter, and Spring for most stations and moderate for Summer, evenness is known to be sensitive to environment changes in stream ecosystems, and is used as a ecological indicator of habitat disturbance (Park et al.,1999).

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قواقع المياه العذبة في هور شرق الحمار وشط العرب خلال ٢٠٠٨-٢٠٠٩

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المستخلص

تم قياس الغنى والوفرة لبعض النواعم بطنية القدم (القواقع) في محافظة البصرة جنوب العراق، اذ اختير ست محطات لغرض جمع العينات منها في منطقة هور شرق الحمار وشط الكرمة. شخصت عشرة انواع من القواقع في هذه المنطقة وتباينت اعداد افرادها من صفر الى اكثر من مئة فرد للمتر المربع الواحد وعزي ذلك الى الاختلافات المكانية والزمانية بينها، كما تم قياس بعض المتغيرات البيئية والتي بينت وجود علاقة مباشرة بين كل من اعداد القواقع المائية مع درجة الحرارة وكثافة الغطاء النباتي في تلك المنطقة.

Concentration of some heavy metals in water, sediment and two species of aquatic plants collected from the Euphrates river, near the center of Al-Nassiriyia city, Iraq.

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Abstract*:*

Concentration and accumulation of six trace elements (Cd, Cu, Pb, Ni, Fe and Zn) were measured in water (dissolved and particulate) phase, sediment and two species of aquatic plants *Phragmits australis* and *Ceratophyllum demerssum* collected during summer season, 2014 from the Euphrates river, some environmental parameter (Temperature, dissolved oxygen, salinity, pH) of water were measured, also total organic carbon (TOC%) and sediment texture were measured and expressed as percentage.

Higher concentration of elements under study were observed in sediment more than their concentrations in water and plants, while particulate phase of water concentrated trace elements more than their concentration in dissolved phase,

whereas the accumulation of trace elements in plants, showed that their concentration in *Ceratophyllum demerssum* was more than their concentration *Phragmits australis* in

The study observed that it can use the two species of plants as bioindicator for accumulation of trace elements also the concentration of TE in the study samples were in acceptable range, when its compared with world wide range. The study showed that the possibility of using both plants to remove these type of pollutant from the aquatic environment and can be used in bioremediation for processes.

Key words; *Trace elements, Aquatic plants, Water, Sediment, Euphrates river*

Introduction:

The pollution of water course with non biodegradation pollutants such as trace elements, chlorinated hydrocarbons and oil, is a serious problem [1].

Environmental pollution is a problem with high urgency in modern society out of the various kinds of pollution, the high contamination of aquatic system with toxic trace elements is one of a major concern since, these elements aren't biodegradable and their elevated uptake by crops may also affected food quality system mainly through nature input such as weathering and erosin of rocks and anthropogenic sources including urban, industrial and agricultural activities, terrestrial runoff and sewage disposal [2]. Trace elements discharge into aquatic system may be immobilized within the stream sediment by main processes such as adsorption and co-precipitation therefor, sediments in aquatic environmental serve as a pool that can retain metals or release metals to the water column by various processes of remobilization [3] .

[4] reported high levels of Cd, Co, Cu, Cr, Fe, Ni, Pb and Zn in fish and submergent plants of the Ganges river and in water, sediment, plant and fish of the Yamma river, India. [5] studied trace elements in aquatic plant tissues, they found that *Potamogeton pedtinatus* accumulated trace elements more than those of *G. densa* therefore, all plants can be used as biological indicators while determing environmental stress, however *phragmits australis* has provide more appropriate [6] as well as [7] study the concentrations of trace elements in aquatic plants and sediment of the southern marsh. Despite the different matrices, sediments have been more analyzed because they present a clear indication of metal inputs and accumulation in aquatic environments [8]. Although the plants are considered an essential part of the food web in the region [9].

The development of the industry and expansion of the using of chemical compounds in different branches of industry leading to the environmental spread of trace elements and the increasing pollution with many trace elements in the southern river of Iraq has been the subject of considerable interest [10, 11, 12].

The aim of this study is to investigate trace elements (Cd, Cu, Ni, Pb, Fe and Zn) concentration and distribution in water, sediment and plants from the Euphrates river and to assess the contamination status using various elements assessment indices, also to know the potential of using the plants under the study in phytoremedation in future.

In this work the concentrations of Cd, Cu, Ni, Pb, Fe and Zn were determinate in water, sediment and two of plants species *Ceratophyllum demerssum and Phrgamtus australis* collected from the Euphrates river.

Material and Methods

Sampling area:

The Euphrates river from the main river in south west Asia with an average length of about 2800 km .It extend inside Iraq , about 35% from the total length of the river. Which irrigate vast areas of sediment land about 765381 km2. Its Discharge rate reaches up to 18 $m^2.min^{-1}$. The running water of Euphrates is warm and fresh and its salinity increase as river passing south.

The Euphrates river in the city of Al-Nasiriya by the lack of reservoirs and dams and ports. There are irrigation systems originated from the river including 15 small rivers on the right side and (3) other small river on the left side. On the right side of river thermal a power station at the beginning of the entrance of the river to the city which uses a large quantities of river water for cooling purpose . As well as the sewage water, water drainage water disposal directly to the river, A number of village are exist over both banks of the river, characterized by the presence of farm land, orchards and field crops and livelihood of most people are agriculture as well as fishing.

The study area extend about 15 km , three stations were chosen in the stouth area to execute this study as fallowing:

Station 1: this station is in north before the river entering to city .

Station 2: it is near the electric power station (EPS) of the city .

Station 3: it is in southern part of the river near the sewage treatment unit of the city.

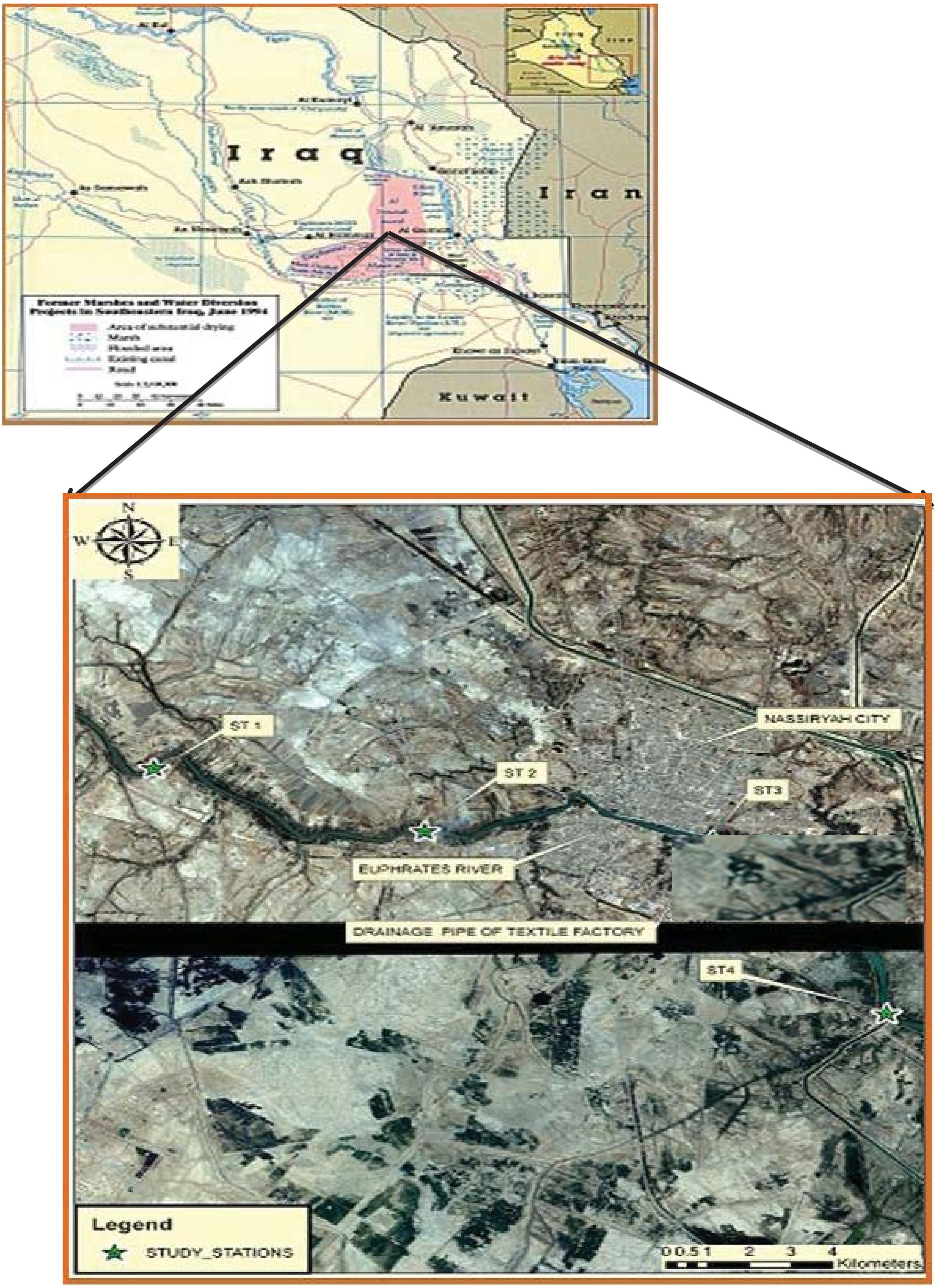

Fig.1: Map shown the study area.

Samples collection:

Samples of water, sediment and plants were collected from Euphrates river during summer (May, June, July, August and September) 2014. 5 litters of water were taken from each station were collected by using polyethylene bottles with capacity 5L. The sediment samples were collected by using van veen grab sampler, and plants were collected from the same area, then placed in plastic bags and all samples (water, sediment and plants) preserved in a cooling box until reaching the laboratory. Also air and water temperature (°c), pH , dissolved oxygen (Do) mg/L and water electrical conductivity (EC µs/cm) were measured in the field by using Cyberscan 600 water proof portable meter, made in Singapore . The salinity was calculated according to the following equation.

Salinity‰=EC(µs/cm*0.64/1000.

The salinity values expressed as part per thousands (ppt).

Procedure:

Trace elements measurement:

Water samples were digested according to the method described by [15], while sediment were digested after drying according to [16] method. The samples of plant were freez dried and ground with agate morter (1g dry weight) then digested according to the procedure described by [17]. Triplicates with blanks solution were used for each samples (water, sediment and plants) in the present study. The levels of (Cd, Cu, Ni, Pb, Fe and Zn) in extractions were determined by air-acetylene flame atomic absorption spectrophotometers (Shimadzu- 630-12) using different cathode lamps with air acetylene flam method, while elements concentration value were calculated from the calibration curve according to a specific method [18].

Total organic carbon (TOC%) content in the sediment was estimated by using a procedure described by [19], while sediment particles size analysis was analyzed mechanically by using a hydrometer and the percentage of different sediment particles (sand, silt and clay) were calculated according to the method of [20, 21].

Results and Discussion:

Table(1) shows the values of physical and chemical factors in the study area. The values of air temperature ranged from 31.00°c at st.1 in September to 44.01°c at st.2 in August, whilst water temperature values ranged from 23.12°c at st.1 in September to 36.00°c at st.2 in August. Temperature is an important factor, which regulates the biogeochemical activities in the aquatic environment [22].

The present study data showed that water temperature was affected by changes in air temperature that was due to the shallowness and small surface area in comparison with volume [23].

There are differences in the temperature among the station over the day and that come from the different time of sampling taking. These are agree with the [24, 25, 12]. The water salinity values for all stations varied between (2.23-3.16)‰.

The highest levels of salinity (3.16)‰ was recorded in september at station 3, while the lowest level (2.23)‰ was recorded in August at station 1. The higher values of salinity was observed in the study for the Euphrates river because this river used as drainage water supply and this due to the levels of salinity were increased during the summer months, that was caused by increasing of the evaporation rate and low water level [26].

Hydrogen ion concentration (pH) showed slight fluctuations in water during the study period the pH was alkaline level, it has being know that Iraq water mainly tend to be alkaline, this agree with obtained by [27, 28]. The daily differences in pH values were because of removing carbon dioxide from bicarbonate by photosynthesis process during hours [29] or in water with high plant concentration. pH played an important role in solubility and hence trace elements mobilize in the water column. The low pH value lead to an increased concentration of metals in the dissolved phase[30]. Dissolved oxygen play an important role in aquatic environment. Some physical and biological factors affected the bioavailability of DO in water. These include, temperature, salinity and amount of organic matter [31]. Oxidative consumption was confirmed by the result of this study when the lowest value of Do at st.2, the water here was affected by the input of easily biodegradable human and animal waste. Rising temperature lead to an increased metabolic activity for microorganisms and this lead to increase Do consumption through the respiration [25], The values of Do in this study were consistent with the [1, 25, 32] studies.

Table(1): Mean values of some environment factors in the study area during the study period.

Months	Stations	Air Temp.°c	Water Temp.°c	Salinity ‰	pH	Do (mg/l)
May	1 2 3	34.01 36.60 35.30	26.03 28.40 27.98	2.60 2.65 3.00	8.35 8.20 8.10	10.75 7.40 7.43
June	1 2 3	37.80 39.01 38.23	29.23 31.02 30.00	2.20 2.45 2.65	8.11 8.00 7.35	8.01 6.88 6.95
July	1 2 3	37.99 38.01 39.23	29.21 32.10 31.22	2.30 2.40 2.82	8.00 8.13 7.15	7.75 5.59 6.00
August	1 2 3	41.02 44.01 42.20	33.15 36.10 34.31	2.23 2.37 2.79	7.99 8.12 7.20	6.65 5.40 5.39
September	1 2 3	31.00 32.31 32.03	23.12 24.13 24.00	2.75 2.80 3.16	8.30 8.20 8.18	8.89 6.88 7.00

Trace elements in water:

The result of analysis for Cd, Cu, Ni, Pb, Fe and Zn in water (dissolved and particulate) clarify in Table(2).

Table(2):Concentrations (Mean ±SD) of trace elements in water (dissolved µg/l and particulate µg/g dry weight) phases in the study station.

Metals	Station 1		Station 2		Station 3		Mean concentration in the region	
	Diss. ±SD	Parti±SD	Diss.±SD	Parti±SD	Diss.±SD	Parti±SD	Diss.±SD	Parti±SD
Cd	0.05±0.001	12.87±1.16	0.08±0.01	17.58±1.20	0.13±0.03	18.14±1.98	0.08±0.013	16.19±1.45
Cu	0.09±0.009	22.03±2.76	0.11±0.009	26.01±3.95	0.16±0.016	29.06±2.93	0.12±0.01	25.7±3.21
Ni	0.97±0.08	47.06±0.44	2.02±0.16	66.82±0.50	5.14±0.86	69.85±0.66	2.71±0.36	61.24±0.53
Pb	0.50±0.15	37.28±3.31	0.63±0.20	40.29±5.91	1.10±0.08	45.63±8.13	0.74±0.14	41.06±5.78
Fe	124.37±25.36	1000.69±887.68	160.19±30.25	2399.71±896.59	196.62±19.17	3197.21±578.621	160.39±24.92	2199.20±787.63
Zn	16.10±2.50	65.06±8.01	20.13±4.00	92.35±10.0	24.16±2.92	99.01±4.03	20.31±2.14	85.47±11.68

The partition of metals between dissolved and suspended particulate matter determines their ultimate fate in the aquatic environments. The mean concentrations µg/L of the mentioned metals in dissolved phase at the study station (1,2 and 3) were follows; Cd (0.05, 0.08, 0.13); Cu (0.09, 0.11, 0.16); Ni (0.97, 2.02, 5.14); Pb (0.50, 0.63, 1.10); Fe(124.37, 160.19, 196.62and Zn (16.10, 20.13, 24.16) respectively. Metals concentration at St.3 were higher than their concentration in station 1, 2, this may be due to the high metals content discharged from the waste- water treatment until which was located near station3. The effluents of municipal and industrial was contain considerable amount of heavy metals

Trace elements in particulate matter were higher than their concentrations in dissolved phase for three station (Table2). This may be due to the high amount of particulate matter in the study area during the study period. Decrease metals concentration in dissolved for river water may be due to adsorb (TMs) on sediment surfaces or complexes compound with organic matter [33, 34, 32] or accumulation (TMs) in plankton, aquatic plants and aquatic organism [35, 36]. [37] has indicated that the plankton organisms tend to concentrate (TMs) as high also 10^6 times their level in water, also the concentration of the trace elements in aquatic environment depends on many factors such as water discharge of the river, seasonal variations in quantities and qualitative of plankton and suspended material load of the river [38].

The concentration of dissolved trace elements is similar to those reported elsewhere, also its concentrations in the present study are in an acceptable range compared with the world wide (Table 2 and 3) respectively.

Table (3):Comparison mean values of dissolved trace elements (µg/L) in the present study with the other studies elsewhere.

Location	Cd	Cu	Ni	Pb	Fe	Zn	References
Al-Hillia river- Iraq	1.09	1.81	0.27	4.21	6.74	8.73	39
Shatt Al-Arab river Basrah-Iraq	25.00	-	1209.00	95.00	-	1364.00	40
Euphrates river (between Al-Hindia dam, Kufa region)	2.14	2.48	0.07	0.10	105.69	10.50	41
Al-Hammar marsh south of Iraq	-	0.7	2.13	0.16	-	-	42
World wid	0.22	7.0	-	3.0	-	20	43
Euphrates river near Al-Nassiriyia city	0.08	0.12	2.71	0.74	160.39	20.31	Present study

Trace elements in sediment:

A major part of the heavy metals, that enter the aquatic environment eventually settle in the sediment [44]. So the sediment act as archives for many pollutants one of these are heavy metals [42]. Concentration of heavy metals in sediment showed in (table 4). In the present study there were higher concentration of heavy metals observed at st.3 compared to st.1 and st.2 this was due to the location of st.1 near to residential areas , which a high discharge of waste-water from the waste treatment unit near the former station. These wastes increased the organic matter in the sediment Toc% content in the st.3 was more than its content in st.1 and st.2 during summer (Fig.2). The mean concentrations of trace elements were Cd(5.87), Cu(17.75), Ni(46.26), Pb(24.4), Fe(2237.58) and Zn(23.65)µg/g dry wt. concentration of TMs under study in sediment were higher than their concentrations in dissolved phase of water and lower than their concentrations in particulate phase of water. This mean that particulate phase play an important role to support sediment by heavy metals. In addition, the increasing of the plants density in the study area played an important role in increasing the concentration of trace elements in the sediment. Plants work to reduce the velocity of water flow and this led to the deposition of suspended matter containing trace elements in the sediments. Sediment particles size also play an important role in the distribution and concentration of heavy metals. Description of the sediment texture at st.1. Small particle size, such as silt and clay tend to accumulate higher concentration of heavy metals because of the availability of large surface area that allowed adsorption of metals into the surface of particles [45,42]. This was confirmed by the high concentration of heavy metals in the sediment at st.3 comparing with st.1 and st.2, because st.3 contained a high content of silt (28.06%) and clay (50.08%) compared with st.1 which contained a high amount of sand (38.01%) (Fig.3), as well there was an increased concentration of trace elements in sediment in summer month (Table 4) this is due to the high temperature which have a role in killing some phytoplankton and zooplankton and thereby increasing the deposit and accumulation of these materials, which increase the metal concentration in the sediment [46]. In addition high temperature lead to increase salinity through evaporation, when salinity increase the bond between the metals and suspended matter becomes stronger. This strong bond makes suspended material insoluble in water and then increases the deposition of these substances in the sediment.

Table(4): Mean concentrations (µg/g dry weight) of trace elements in sediment for all study stations during study period.

Trace elements	Stations			Mean µg/gm dry wt.	Standard deviation
	Station 1	Station 2	Station 3		
Cd	3.38±0.04	6.09±0.07	8.16±0.10	5.87	0.07
Cu	10.47±2.23	17.40±1.64	25.39±1.89	17.75	1.92
Ni	41.10±4.05	46.69±11.86	51.01±20.70	46.26	12.20
Pb	10.26±2.04	28.69±3.35	34.25±11.65	24.4	5.68
Fe	1809.3±199.80	2281.5±280.97	2621.96±391.61	2237.58	290.79
Zn	17.90±2.08	21.89±4. 36	31.17±1.32	23.65	2.58

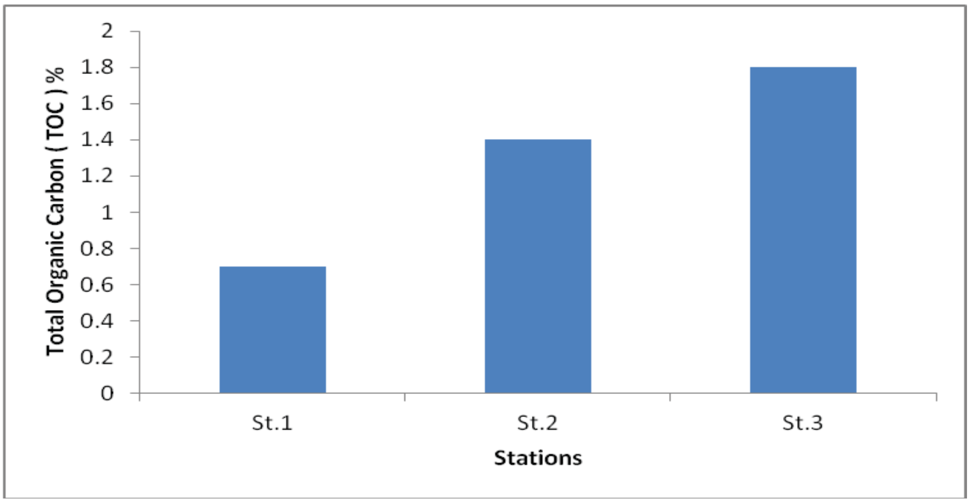

Fig.2: Total organic carbon (Toc%) content in the study stations during the study period.

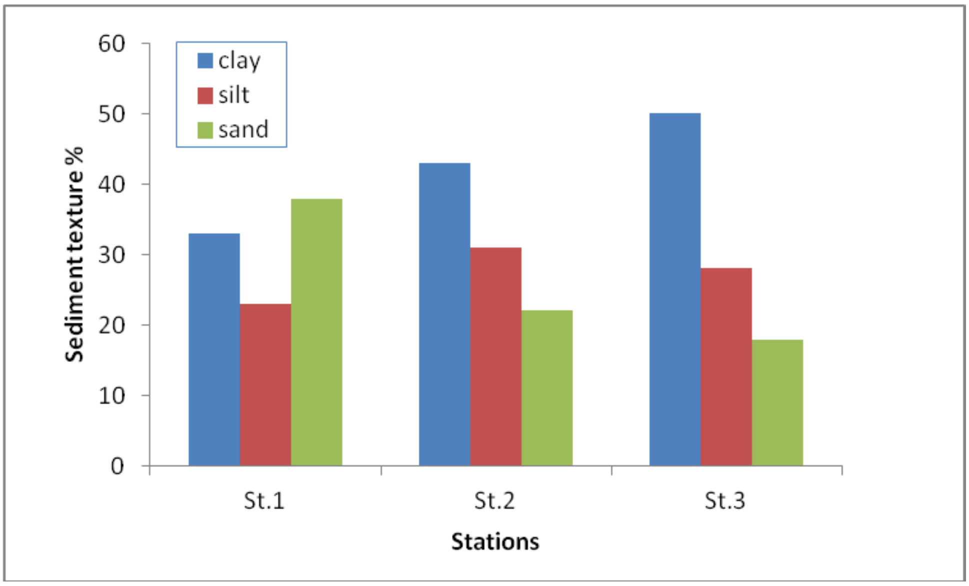

Fig.3: Sediment texture% for the station.

Trace elements in plants:

Aquatic plants have been shown to accumulate trace elements in their tissues and therefore have been used as biological indicators for metal pollution monitoring in the aquatic ecosystem. Table(5)show the distribution of trace elements in aquatic plants of Euphrates river. The ability of plants to accumulation and elimination trace elements in relation to their concentration in ambient led to the observed variation in metal concentration in plants. The results showed higher concentration of trace elements in sediment than their concentration in plants these result were agreed with [7, 47, 48].

In this study there were differences in the trace elements concentrations between stations and a less clear difference between the selected plant. There were higher levels of trace elements in both species of plants (*P. austeralis* and *C. demerssum)* in station 3 than in station 1and station 2. This was due to two reasons. Firstly, station 3 had exposure to different types of pollutants such as sewage, oil spilt from boats and chemicals used for fishing, while station 1and 2 was less polluted. Secondly, the level of organic carbon in the sediment at station 3 was higher than its level at station1 and 2(fig.2) as a result of sewage pollution. The metals remained in the sediments at station 3 for long periods of time and this provided greater opportunity for the plants to absorb, the range of cadmium concentration was (0.82- 2.01)µg/g dry weight followed by lead (0.83- 2.23) µg/g dry weight, while Iron have shown the highest levels in the two species. The other elements are generally arranged in the following order of abundance Zn> Ni> Cu.

Generally, this study showed that the highest mean for trace elements concentration was in the particulate phase, followed by the sediments, then the plants and was lowest in the dissolved phase. The reason for the high concentrations in the particulate phase is due to continuous movement of water and the lack of time for deposition of the suspended solids [27, 48]. The reason for the higher concentrations in sediment compared with plants and in dissolved phase is due to the plants density in the study area, which reduced water speed and thus provided an opportunity for the deposition of the maximum amount of suspended matter.

The higher concentration of elements in plants than in the dissolved phase is due to the concentration in sediments, which work to keep the trace elements as long as possible and thus provide the opportunity for plants to absorb these metals [7]. The cause of the low concentration in the dissolved phase compared to other phases is due to the effect of various physical and chemical factors such as salinity, temperature and pH, which leads to adhesion of metals with suspended materials, thereby reducing the concentrations of metals in the dissolved phase.

Finally, the results also showed the highest of metals in all stages (water, sediment and plants) were Fe, Ni and Zn . This is probably due to the source of pollution (sewage, oil splits from boats the use of toxic chemicals in the process of fishing) which have high levels of these metals. There may be some contribution from the geology of the region, which may contain naturally higher concentrations of these metals [28].

Table(5): Concentrations (Mean ±SD) of trace elements in two plants (*C. demerssum and P. austeralis)* µg/g in the study station.

Metals	Station 1		Station 2		Station 3		Mean concentration in the region	
	C.demerssum. Mean±SD	*P.austeralis* Mean±SD	*C.demerssum.* Mean±SD	*P.austeralis* Mean±SD	*C.demerssum.* Mean±SD	*P.austeralis* Mean±SD	*C.demerssum.* Mean±SD	*P.austeralis* Mean±SD
Cd	0.86±0.12	0.82±0.06	1.55±0.56	1.30±0.35	2.01±0.82	1.78±0.76	1.47±0.5	1.3±0.39
Cu	0.99±0.13	0.90±0.11	2.00±1.00	1.86±0.85	2.78±0.99	2.60±0.96	1.92±0.70	1.78±0.64
Ni	9.16±1.06	8.13±1.96	12.20±3.23	10.17±3.21	18.19±3.12	16.03±3.03	13.18±2.47	11.44±2.73
Pb	0.87±0.09	0.83±0.09	1.80±0.65	1.79±0.67	2.23±0.85	1.9±0.82	1.63±0.53	1.50±0.52
Fe	86.31±10.10	80.91±4.31	113.03±18.01	107.20±18.01	180.57±28.01	170.13±16.31	126.63±18.70	119.41±12.87
Zn	12.10±2.06	11.13±1.16	3.13±1.28	13.08±3.21	28.77±6.01	24.86±4.21	14.72±3.11	16.35±2.86

Conclusions:

The variability in the levels of trace elements concentration in two species could be ascribed to biological variation between them rather than environmental factors. TEs in *P. austeralis* and *C. demerssum* come from the same source. Low concentrations of studied elements in the study area were that the study area was non polluted by this type of pollutant according to WHO.

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تركيز بعض العناصر النزرة في الماء والرواسب ونوعين من النباتات المائية المستجمعه من نهر الفرات قرب مركز مدينة الناصرية_ العراق.

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المستخلص

قيس تركيز وتراكم ست من العناصر النزرة (الكادميوم، النحاس، الرصاص، النيكل، الحديد والخارصين) في الماء بجزئية الذائب والعالق والرواسب ونوعين من النباتات المائية القصب *Pharagmits australis* والشمبلان *Ceratophyllum demerssum* جمعت خلال فصل الصيف ٢٠١٤ من نهر الفرات قرب مركز مدينة الناصرية، تم قياس بعض الخصائص الفيزيائية والكيميائية درجة الحرارة(الماء والهواء)، الأوكسجين المذاب، الملوحة والدالة الحامضيه) للماء فضلا عن قياس كمية الكاربون العضوي الكلي ونسجه الرواسب وعبر عنها كنسب مئوية.

أظهرت الدراسة أن تركيز العناصر في الرواسب أعلى مما هو عليه في الماء (الجزء الذائب) ، أما تراكيزها في الجزء العالق من الماء أعلى مما هو عليه في جزءه الذائب، في حين سجل تراكمها في نبات الشمبلان أعلى مما هو عليه في نبات القصب .

لوحظ من الدراسة بالإمكان استخدام هذا النوعين من النباتات كدليل حيوي لتراكم العناصر النزرة، وكذلك كانت تراكيز العناصر النزرة في عينات الدراسة ضمن الحدود المقبوله مقارنة بالحدود العالمية.

بينت الدراسة أمكانية استخدم كلا النباتين في إزالة هذا النوع من الملوثات في البيئة المائية وبذلك يمكن استخدامها في المعالجة الحيوية لهذا الغرض.

الكلمات المفتاحيه: العناصر النزرة، النباتات المائيه، الماء، الرواسب، نهر الفرات

Author Index

MARSH BULLETIN 10(2) 2015

Photo: Iraqi marshes

MARSH BLLLETIN

Aims and scope

Marsh Bulletin is a perfect Journal stated by College of Science and Marine Science center, University of Basrah concerned with all aspects of wetlands biology, ecology, hydrology, water chemistry, Geochemistry Biodiversity conservation, Agriculture and Fisheries, Pollution, Natural Resources, Social and Health issues and Tourism.

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Contents