Assesment of Some Heavy Metals in Water, Sediments And Fish During 2013 in Lake Quaron Protected Area, Fayoum, Egypt.

Lamia I. Mohamedien*, Medani G.G., Gamal Eldien M.A. and Hammad M. H. *****

Marine Ecology Department, Suez Branch National Institute of Oceanography and Fisheries, Department of Wildlife Management, Faculty of Veterinary Medicine, Suez Canal University**, and Egyptian Environmental Affairs Agency****

Abstract:

Heavy metal concentrations in the environment are of great concern due to their serious effects through the food chain on animal and human health. In this study, 26 water samples and 26 sediment samples were collected from the 13 site in Lake Quaron Protected area during summer and spring seasons with 40 fish samples of four species (*Atherina*sp. *Tilapia zillii, Mugil cephalus* and *Solea vulgaris*) were examined for evaluation of heavy metals pollution. The results revealed that the annual average concentrations (µg/l)of the heavy metals in water samples were in the following order; Zn > Fe >Ni >Mn >Cu >Pb > Cd and within the permissible limits , the annual average concentrations (µg/g)of the heavy metals in surface sediment samples were in the following order; Fe >Mn> Zn >Pb>Cu > Ni > Cd and within the permissible limits of Sediment quality guide lines except Cu was higher and the levels of heavy metals in fish were in the following order ;*Atherina sp.> Tilapia zillii>Mugil cephalus>Solea Vulgaris*. The evaluation of examined heavy metals pollution in Lake Quaron showed that Lake Quaron protected area suffers from a serious pollution problem.

Key words: Heavy metals, Lake Quaron

Introduction

Lake Quaron considered one of oldest lake in Egypt and it was declared as protected area in 1989 by the decision No. 348 of the Prime Minister for protecting the geological, biological and archaeological diversity that found in the area.

The Lake is in the Fayoum Province, 40 km in length, 5.7 km in width and 34 to 43m below sea level (with a mean depth of 4.2 m.). Lake Quaron receives the agricultural and sewage drainage through a system of twelve drains, most of the drainage water reaches the lake by two main drains .El-Batts and El-Wadi , whereas there are minor drains discharged its drainage water into the lake by mains of hydraulic pumps but in small amounts ***(Authman and Abbas 2007).***

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Aquatic organisms absorb the pollutants directly from water and indirectly from food chains. Some of the toxic effects of heavy metals on fishes and aquatic invertebrates are; reduction of the developmental growth, increase of developmental anomalies, reduction of fishes survival especially at the beginning of exogenous feeding or even cause extinction of entire fishes population in polluted reservoirs ***(Khayatzadeh and Abbasi 2010).*** This work aimed to detect the heavy-metal levels in Lake Quaron through water, sediment and fish samples.

Material and methods

Five liter of water and 100 g of sediment samples were collected from (13) site,these sites were distributed in southern part where sources of pollution found (as El-Batts , El-Wadi drain and the hydraulic pumps) ,center of Lake Quaron and the northern part which away from direct sources of pollution as shown in photo (1), these samples were collected during summer and spring seasons (lowest and highest water level) from the study area according to ***A.P.H.A. (1985)***.

One liter of water was pre-concentrated using APDC and MIBK extraction procedure according to ***(Brewer et al, 1969; APHA, 1985)*** and the results expressed by µg/l. Sediment samples were dried at room temperature then preserved in plastic bags. About 2g of dry sediments were heated in water bath at 90°C with 4 ml HNO_3 and 2 ml H_2SO_4 for one hour then allowed to cool, the volume adjusted to 25ml using deionized water ***(Adeloju et al, 1994).*** The results expressed by µg/g and interpreted with Sediment Quality Guidelines (SQG) according to ***Persaud et al (1990).***

Fish samples (10 Sand smelt (*Atherina* sp.), 10 Bolti (*Tilapia zillii)*, 10 Bouri *(Mugil cephalus*) and 10 Mousa (*Solea vulgaris*) of variable sizes and weights were collected by fishermen from the study area. Each sample labeled and preserved in icebox then transferred to the laboratory for analysis. (5) g. of fish muscles and the whole fish of *Atherina* sp were digested by using Nitric/ Percholoric acid (4:1) according to ***Al Ghais (1995)***. The results were expressed by µg/g.

Cd, Cu, Fe, Mn, Ni, Pb and Zn were determined using Atomic Absorption Spectrophotometer ***(Perkin Elmer, Aanalyst 100 Spectrometer)*** at National Institute of Oceanography and Fisheries, Suez Branch.

Data were analyzed using SPSS software (version 17.0) according to ***Snedecor and Cochran (1989).*** The values were taken as significant at $P \leq 0.05$ ANOVA (analysis of variance).

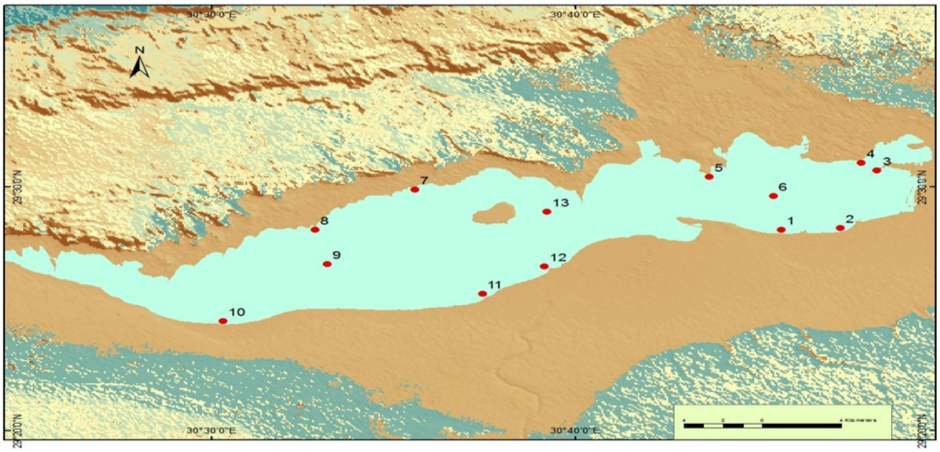


Photo (1): *Location of water and sediment sampling sites in Lake Quaron.*

RESULTS

1-Water

The annual average concentrations(µg/l) of different metals in water samples that were collected from (13) sites from Lake Quaron are presented in Tables (1,2) and in Figures (1,2,3,4) as follow:-

Site (1) was the highest in different metals except site (3) was higher in Fe and site (13) was higher in Cu.

The average concentration values of metals (min. -max.) were found as follow; Cd (0.51-0.144 µg/l), Cu (0.711-1.275 µg/l), Fe (5.361-11.175 µg/l), Mn(0.201-2.205 µg/l), Ni (0.255-6.39 µg/l), Pb (0.333-1.131 µg/l) and in Zn (1.203-44.736 µg/l).

The annual average concentrations of the heavy metals in water samples found to have the following order; Zn > Fe>Ni >Mn >Cu >Pb > Cd.

2-Sediment

The annual average concentrations(µg/g) of different metals in water samples that were collected from (13) sites from Lake Quaron are presented in Tables (3,4) and in Figures (5,6,7,8) as follow:-

The average concentration values of metals (min. -max.)Were found as follow; Cd (0.055-0.94), Cu (2.13–230.27), Fe (229.57-320.89), Mn(56.495-192.18), Ni (1.59–18.49), Pb (1.865–13.5) and in Zn (6.66– 36.75).

Site (3) was the highest in different metals levels except site (2) was higher in Mn, site (5) was higher in Ni and site (6) was higher in Pb.

3-Fish

The concentration average(µg/g) of Cd, Cu, Fe, Mn, Ni, Pb and Zn in the muscle tissues of different fish and whole *Atherina sp.* of Lake Quaron were summarized in Table (5) and illustrated in Figures (9,10,11,12) which were found in the following order :- in *Atherina sp.*as 0.622, 4.023, 151.49, 40.299, 3.709, 8.885, 28.647 µg/g respectively, in *Mugil cephalus*as 0.279, 2.816, 99.399, 2.256, 2.148, 2.591, 14.266 µg/g respectively, in *Solea vulgaris* as 0.224, 1.951, 109.37, 3.262, 1.218, 2.187, 13.674 µg/g respectively and in *Tilapia zillii* as 0.355, 2.471, 117.57, 2.086, 2.517, 3.046, 20.256 µg/g respectively.

The average concentration of metals in different fishes found to have the following order: *Atherina sp.>Tilapia zillii>Mugil cephalus>Solea vulgaris* except in Cu , *Mugil cephalus* was higher than *tilapia zilli* , in Fe *Solea vulgaris* higher than *Mugil cephalus* and in Mn were *Atherina sp.>Solea vulgaris >Mugil cephalus> Tilapia zillii*.

Statistically table (7) showed that Cd, Cu, Fe, Mn, Ni, Pb and Zn contents in water were significantly($P \leq 0.01$) and positively correlated with Cd, Cu, Fe, Mn, Ni, Pb and Zn contents respectively in sediment and fish spp.

Table (8) showed that Cd, Cu, Fe, Mn, Ni, Pb and Zn content in fishes were significantly influenced ($P \leq 0.05$) by species.

Table (9) showed that Cd, Cu, Fe, Mn, Ni, Pb and Zn contents in water and sediment were significantly influenced ($P \leq 0.05$) by season.

Table (1): *Heavy metals annual concentration (μg/l) in water collected from Lake Quaron during spring and summer (2013) (average ± sd):*

Annual Water	Cd	Cu	Fe	Mn	Ni	Pb	Zn
Site1	0.144± 0.127	0.951± 0.318	8.322± 2.257	2.205± 2.652	6.39± 8.935	1.131± 1.184	44.736± 59.685
Site2	0.072± 0.008	0.888± 0.034	7.503± 1.549	0.3±0.0 59	0.354± 0.161	0.621±0 .148	3.459±2. 796
Site3	0.084± 0.008	1.008± 0.042	11.175 ±1.532	0.486± 0.255	0.3±0.1 02	0.549±0 .055	4.941±1. 286
Site4	0.096± 0.008	0.774± 0.093	6.648± 0.365	0.303± 0.064	0.255± 0.208	0.417±0 .038	1.662±0. 959
Site5	0.09± 0.008	0.738± 0.025	5.403± 0.938	0.279± 0.106	0.471± 0.250	0.384±0 .093	1.203±0. 411
Site6	0.075± 0.021	0.711± 0.064	6.459± 0.242	0.285± 0.039	0.528± 0.187	0.339±0 .115	2.1±1.57 9
Site7	0.057± 0.004	0.879± 0.055	7.368± 2.613	0.318± 0.0	0.462± 0.475	0.333±0 .098	6.996±1. 782
Site8	0.051± 0.013	0.903± 0.064	6.399± 0.148	0.201± 0.013	0.45±0. 305	0.414±0 .187	5.229±6. 105
Site9	0.06± 00	0.888± 0.297	5.361± 0.386	0.252± 0.043	0.441± 0.089	0.465±0 .386	1.653±0. 199
Site10	0.085± 0.037	0.972± 0.271	6.981± 2.188	0.312± 0.110	0.484± 0.262	0.647±0 .106	1.316±0. 602
Site11	0.063± 0.013	0.969± 0.047	6.858± 0.229	0.243± 0.021	0.42±0. 433	0.768±0 .179	1.695±1. 201
Site12	0.078± 0.008	0.918± 0.008	6.375± 0.301	0.3±0.0 08	0.267± 0.165	0.57±0. 178	1.827±1. 439
Site13	0.092± 0.014	1.275± 0.505	11.029 ±0.529	0.228± 0.025	0.476± 0.039	0.341±0 .078	3.272±2. 047

Table (2): *Comparison of heavy metals concentration (μg/L) in water of Lake Quaron (2013) with previous studies.*

Area-water	Cd	Cu	Fe	Mn	Ni	Pb	Zn	References
Lake Quaron	0.051 – 0.144	0.711– 1.275	5.361– 11.17	0.201– 2.205	0.255– 6.39	0.333– 1.131	1.203 – 44.736	**Present study**
Lake Quaron	1.58 – 2.21	35.80– 56.50	0.33 – 0.60	39.10– 78.30	38.81 – 44.0	84.50 – 99.85	28.50 – 49.50	**Ali and Fishar (2005)**
Lake Quaron	-	40	346	51	-	384	626	**Mohamed and Gad (2008)**
Lake Quaron	5.0 – 77.33	21.0 – 56.50	434.2 – 7.33.0	31.0 – 131.83	-	38.0 – 400.8	64.0 – 85.33	**Abdel-Satar et al.(2010)**
Lake Quaron	96.8	96.9	625.6	111.8	-	106.0	85.0	**Ibrahim and Ramzy(2013)**

Lake Borollus	7.06	12.68	19.14			7.27	15.56	**Shakweer and Radwan (2004)**
Lake Edku	11.25-11.75	20-31.5	300-820	28.83-75.25	26.25-51.50	18.5-95.5	8.85-57.55	**Masoud et al. (2005)**
Lake Manzala	20.0	55.0	-	-	-	22.0	311	**Bahnasawy et al., (2011)**
Lake Manzala	92	1351	-	-	-	1320	3363	**Salah-Eldein (2012)**
Permissible limit	10	1000	300	1000	632	50	5000	**USEPA (1986)**

Table (3): *Heavy metals annual concentration (µg/l) in sediment collected from Lake Quaron during (2013) (average ± sd):*

al Se di	**Cd**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**
Site1	0.94±0.057	10.145±2.864	270.6±2.758	168.31±1.482	2.565±1.591	12.345±1.888	14.795±1.846
Site2	0.585±0.021	17.92±16.292	264.678±2.234	192.178±41.123	9.325±11.759	10.63±1.287	14.405±5.678
Site3	0.619±0.044	230.265±275.977	320.797±64.696	138.192±6.361	13.471±0.694	11.783±1.749	36.747±16.386
Site4	0.364±0.359	157.551±219.501	285.125±75.483	56.495±54.143	11.787±4.874	6.739±7.353	24.523±19.337
Site5	0.235±0.092	5.165±2.468	256.248±0.527	97.245±45.686	18.49±7.891	3.9±0.806	10.025±1.209
Site6	0.62±0.014	41.42±29.571	272.475±0.233	152.699±3.241	4.67±4.158	13.5±2.121	28.925±13.315
Site7	0.055±0.064	2.295±0.389	235.766±7.671	90.923±95.549	2.385±1.506	1.97±0.523	6.66±0.608
Site8	0.11±0.071	2.13±0.099	229.565±1.888	98.332±84.699	15.97±6.505	1.865±0.568	6.745±1.138
Site9	0.52±0.141	20.22±0.481	272.305±0.502	100.845±59.630	1.59±0.240	11.37±0.325	28.53±15.132
Site10	0.63±0.057	8.545±0.879	268.015±0.879	104.545±66.956	7.59±8.796	9.325±0.940	13.36±3.323
Site11	0.595±0.078	12.08±7.396	268.085±2.793	154.099±13.108	16.59±4.936	9.63±00	14.755±3.599
Site12	0.51±0.127	12.565±3.387	269.385±1.869	106.18±54.164	6.31±5.473	10.33±0.396	24.125±10.034
Site13	0.525±0.078	4.27±1.499	252.92±7.349	129.895±23.879	16.93±10.762	5.84±1.895	21.7±19.799

Table (4): *Comparison of heavy metals concentration (µg/g) in sediment of Lake Quaron(2013) with previous studies.*

Area-sed.	Cd	Cu	Fe	Mn	Ni	Pb	Zn	References
Lake Quaron	0.055-0.94	2.13–230.27	229.57-320.89	56.495-192.18	1.59–18.49	1.865–13.5	6.66–36.75	**Present study**
Lake Quaron	0.97 – 1.80	23.76-54.50	11.19 – 26.38	213.58-456.30	38.78–83.60	16.98 – 24.8	72.50 – 180.49	**Ali and Fishar (2005)**
Lake Quaron	5.80 – 11.50	38.8 – 85.50	2.590 – 2.730	492.30-1097.8	-	37.0 – 76.80	115.80 – 190.30	**Abdel-Satar et al. (2010)**
Lake Edku	0.62-1.56	11.83-2.57	27400-36290	226.35-273.17	13.79-18.35	1.15-2.41	52-71.25	**Masoud et al. (2005)**
Lake Manzala	1.567	21.065	-	-	-	10.243	173.108	**Salah-Eldein (2012)**
*** SQG (µg/g dry wt)**	0.6 – 10.0	16 - 110	2 % – 4%	460 - 1100	16 - 75	31 - 250	120 - 820	**Persaud et al. (1990)**

*Sediment quality guidelines: it showed two levels: The lowest level indicates a level of contamination which has no effect on the majority of the sediment-dwelling organisms while the highest level representing the sediment is considered heavily polluted and likely to affect the health of sediment-dwelling organisms,at the Severe Effect Level a management plan may be required.

Table (5): Heavy metals concentration (µg/g dry wt.) in fishes collected from during Lake Quaron(2013):

Species	Cd	Cu	Fe	Mn	Ni	Pb	Zn
Atherinasp	0.622±0.184	4.0231±0.673	151.399±50.801	40.299±17.443	3.709±1.193	8.885±2.639	28.647±7.643
Mugilcephalus	0.279±0.054	2.816±0.595	99.399±15.361	2.256±0.477	2.148±0.671	2.591±0.629	14.266±2.394
Solea vulgaris	0.224±0.132	1.951±0.574	109.367±23.807	3.262±1.322	1.218±0.330	2.187±0.491	13.674±1.875
Tilapia zilli	0.355±0.064	2.471±0.488	117.57±37.708	2.086±0.420	2.517±0.491	3.046±0.899	20.256±4.171

Table (6): *Comparison of heavy metals concentration (µg/g dry wt.) in fish muscles of Lake Quaron(2013) with previous studies.*

Area	Species	Cd	Cu	Fe	Mn	Ni	Pb	Zn	References
Lake Quaron	*Atherina sp.*	0.622	4.023	151.49	40.299	3.709	8.885	28.647	Present study
	Mugil cephalus	0.279	2.816	99.399	2.256	2.148	2.591	14.266	
	Solea vulgaris	0.224	1.951	109.37	3.262	1.218	2.187	13.674	
	Tilapia zilli	0.355	2.471	117.57	2.086	2.517	3.046	20.256	
Lake Quaron	*Mugil sp.*	1.04 - 1.16	8.91 - 9.00	55.74 - 85.56	7.01 - 8.38	6.04 - 6.72	6.36 - 6.62	27.52 - 30.84	Ali and Fishar (2005)
	Solea sp.	1.58 - 1.87	9.38 - 13.68	43.35 - 82.35	7.20 - 12.59	5.66 - 6.23	6.34 - 8.16	29.18 - 32.11	
	Tilapia sp.	1.10 - 1.33	6.43 - 10.54	19.61 - 42.39	5.47 - 8.82	5.42 - 5.53	5.82 - 7.86	22.83 - 26.29	
	Crustacea	0.15 - 0.24	5.32 - 8.16	44.39 - 73.27	6.50 - 11.04	6.02 - 10.53	2.47 - 3.68	20.29 - 21.45	
Lake Quaron	*Mugil cephalus*	-	1.31 - 5.01	-	-	-	-	0.79 - 3.85	Authman and Abbas (2007)
	Tilapia zilli	-	5.93 - 17.85	-	-	-	-	3.0 - 13.56	
Lake Quaron	*Mugil capito*	-	1.75	46.25	4.25	-	11.88	46.38	Mohamed and Gad (2008)
	Solea vulgaris	-	3.88	53.67	12.63	-	8.50	60.38	
	Tilapia zilli	-	1.75	42.81	10.25	-	19.50	55.88	
Lake Edku	*Oreochromis niloticus*	0.19	2.80	75.19	1.98	-	0.59	27.60	Saeed and Shaker (2008)
Lake Borollus	*Oreochromis niloticus*	0.014	1.77	21.44	0.23	-	0.016	9.88	
Lake Manzala	*Tilapia sp.*	0.491	2.057	-	-	-	2.612	160.222	Salah-Eldein (2012)
Permissible limits		1.0	30	100	1.0	0.5 – 0.6	2.0	100	WHO(1989) FAO (1983).

Permissible limits (dry wt.) according to WHO (1989), FAO (1983).

Table (7): *Correlation coefficients between heavy metals content (i.e. Cd, Cu, Fe, Mn, Ni, Pb and Zn) in water, sediment and fishes collected from Quaron Lake during (2013).*

Sources	Cd						Cu					
	Water	Sediment	Mugil cephalus	Tilapia zillii	Solea vulgaris	Atherina sp.	Water	Sediment	Mugil cephalus	Tilapia zillii	Solea vulgaris	Atherina sp.
Water	1						1					
Sediment	0.921**	1					0.946**	1				
Mugil cephalus	0.980**	0.980**	1				0.996**	0.914**	1			
Tilapia zillii	0.966**	0.990**	0.998**	1			0.985**	0.875**	0.996**	1		
Solea vulgaris	0.990**	0.967**	0.998**	0.993**	1		0.990**	0.982**	0.973**	0.950**	1	
Atherina sp.	0.993**	0.961**	0.997**	0.990**	1.000**	1	0.983**	0.871**	0.996**	1.000**	0.947**	1
Sources	Fe						Mn					
Water	1						1					
Sediment	0.980**	1					0.947**	1				
Mugil cephalus	0.988**	0.999**	1				0.902**	0.993**	1			
Tilapia zillii	1.000**	0.979**	0.987**	1			0.889**	0.989**	1.000**	1		
Solea vulgaris	0.991**	0.998**	1.000**	0 .990**	1		0.794*	0.947**	0.979**	0.984**	1	
Atherina sp.	0.966**	0.897**	0.916**	0.968**	0.924**	1	0.906**	0.994**	1.000**	0.999**	0.977**	1
	Ni						Pb					
Water	1						1					
Sediment	0.859**	1					0.928**	1				
Mugil cephalus	0.769*	0.988**	1				1.000**	0.931**	1			
Tilapia zillii	0.878**	0.999**	0.981**	1			0.958**	0.996**	0.961**	1		
Solea vulgaris	0.880**	0.999**	0.980**	1.000**	1		0.998**	0.950**	0.998**	0.975**	1	
Atherina sp.	0.904**	0.995**	0.968**	0.998**	0.998**	1	0.988**	0.974**	0.989**	0.991**	0.996**	1
	Zn											
Water	1											
Sediment	0.947**	1										
Mugil cepha	0.820**	0.961**	1									

lus						
Tilapia zillii	0.952**	1.000**	0.956**	1		
Solea vulgaris	0.917**	0.997**	0.980**	0.995**	1	
Atherina sp.	0.958**	0.999**	0.949**	1.000**	0.993**	1

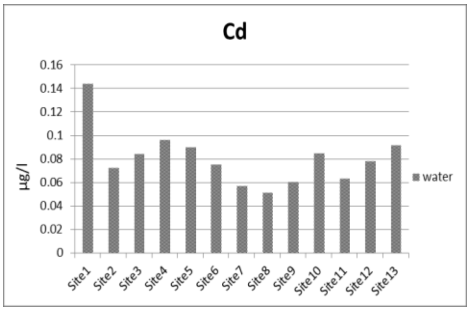
*Correlation coefficient significant at *P ≤ 0.05, ** P ≤ 0.01 and NS; non-significant.*

Table (8): *Compare between heavy metals in muscles of fishes species by two-way ANOVA (F-test)*

Sources	Heavy metals													
	Cd		Cu		Fe		Mn		Ni		Pb		Zn	
	T-test	*P*-value	T-test	*P*-value	T-test	*P*-value	T-test	*P*-value	T-test	*P*-value	T-test	*P*-value	T-test	*P*-value
Water	1.622	0.122	0.843	0.410	1.404	0.177	1.109	0.282	6.218	0.000	1.389	0.182	3.845	0.001
Sediment	0.715	0.483	2.463	0.024	0.118	0.908	0.063	0.951	2.754	0.013	0.718	0.482	2.127	0.048

Table (9): *Compare between heavy metals in spring and summer in water and sediment by independent samples (T-test)*

Species	Heavy metals													
	Cd		Cu		Fe		Mn		Ni		Pb		Zn	
	F-test	*P*-value	F-test	*P*-value	F-test	*P*-value	F-test	*P*-value	F-test	*P*-value	F-test	*P*-value	F-test	*P*-value
Fish	13.000	0.001	513.860	0.000	24.833	0.000	10.905	0.003	31.879	0.000	27.529	0.000	19.068	0.000



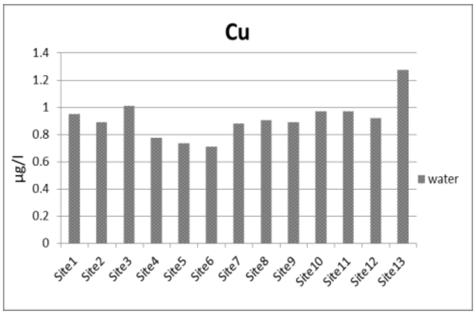
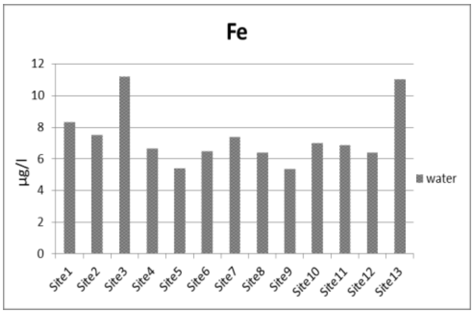


Figure (1): *The annual concentrations (µg/l) of Cd and Cu in water samples collected from Lake Quaron.*



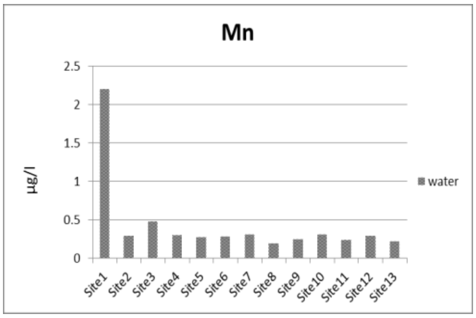
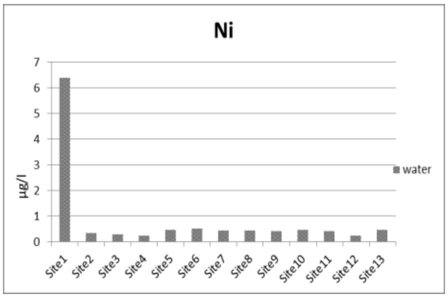


Figure (2): *The annual concentrations (µg/l) of Fe and Mn in water samples collected from Lake Quaron.*



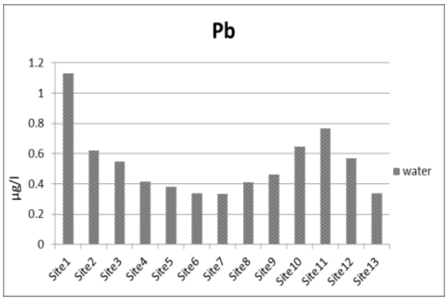
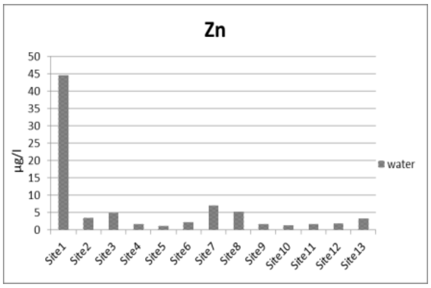


Figure (3): *The annual concentrations (µg/l) of Ni and Pb in water samples collected from Lake Quaron.*



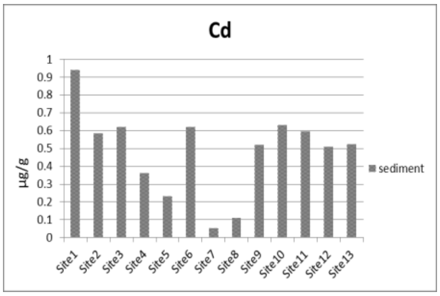


Figure (4): *The annual concentrations (µg/l) of Zn in water samples collected from Lake Quaron.*
Figure (5): *The annual concentrations (µg/g) of Cd in sediment samples collected from Lake Quaron.*

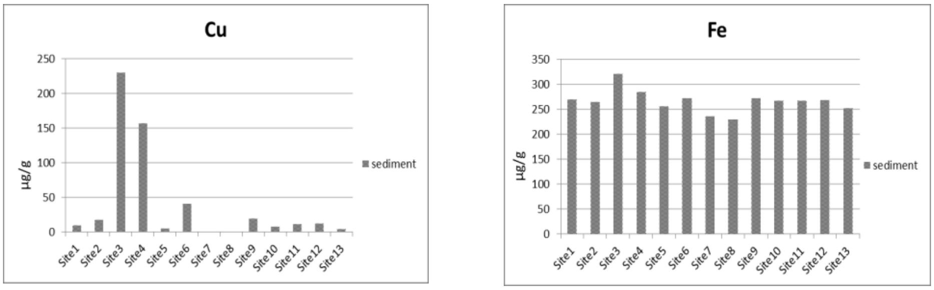


Figure (6): *The annual concentrations (µg/g) of Cu and Fe in sediment samples collected from Lake Quaron.*

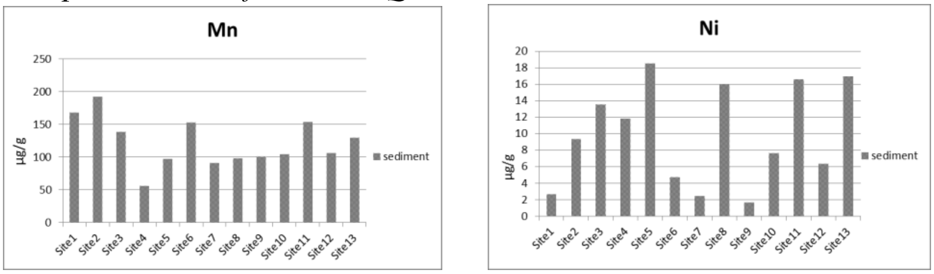


Figure (7): *The annual concentrations (µg/g) of Mn and Ni in sediment samples collected from Lake Quaron.*

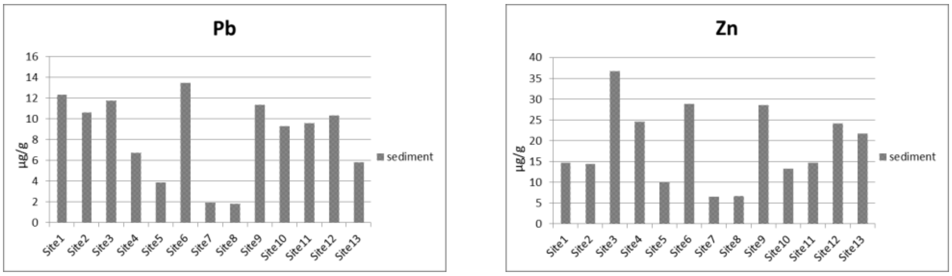


Figure (8): *The annual concentrations (µg/g) of Pb and Zn in sediment samples collected from Lake Quaron.*

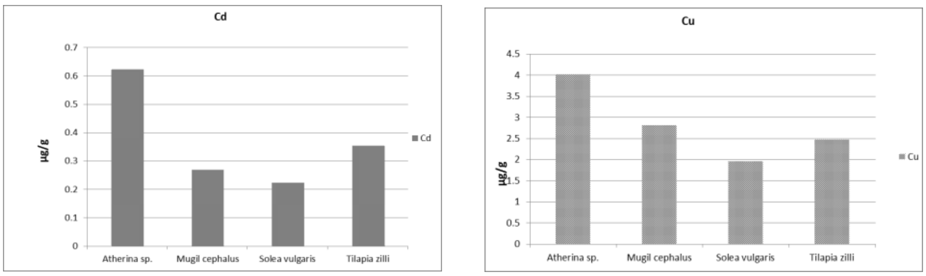
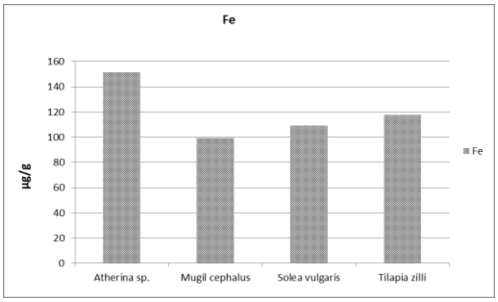


Figure (9): *The average concentrations (µg/g dry wt.) of Cd and Cu in fish samples collected from Lake Quaron.*



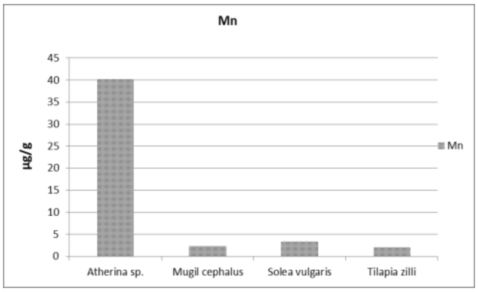
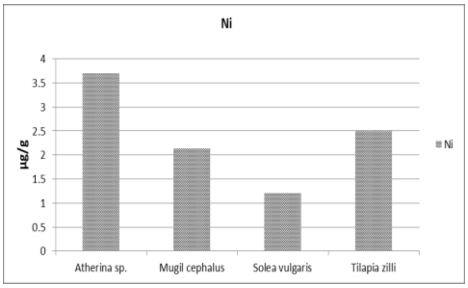


Figure (10): *The average concentrations (µg/g dry wt.) of Fe and Mn, in fish samples collected from Lake Quaron.*



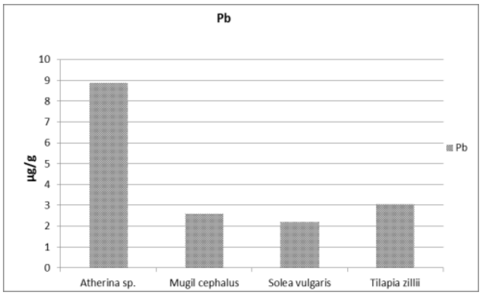


Figure (11): *The average concentrations (µg/g dry wt.) of Ni and Pb in fish samples collected from Lake Quaron.*

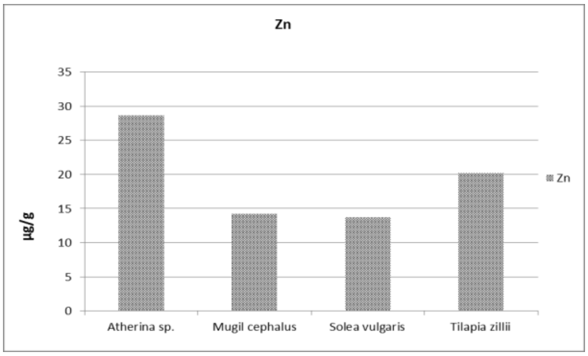


Figure (12): *The average concentrations (µg/g dry wt.) of Zn in fish samples collected from Lake Quaron.*

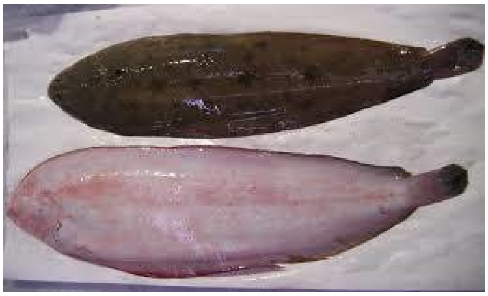


Photo (2): *Tilapia (Tilapia zillii)* **Photo (3):** *Common Sole (Solea vulgaris)*

Photo (4): *Flathead Mullet (Mugil cephalus)*
Photo (5): *Sand Smelt (Atherina presbyter)*

Discusion

Heavy metal pollution is one of the five major types of toxic pollutants commonly present in surface waters. If they reach high enough levels, they may become toxic to aquatic organisms ***(Mason, 1991).***

Lake Quaron was a fresh water lake then became a brackish water lake, as the lake is closed ecosystem and the main source of water is agricultural drainage water of El-Fayoum Province. Highly evaporation of water leads to increases concentration of heavy metals, salts, pesticides and finally , leads to changes of the water quality and biodiversity ***(Ali et al, 2008).***

In the present study, the annual average concentrations of the heavy metals in water were within the permissible limits according to ***USEPA (1986).***The same order of concentrations were recorded by ***Abdel-Satar et al (2010)*** in order Zn >Cu >Pb> Cd, while ***Ibrahim and Ramzy (2013)*** recorded higher concentrations of Fe, Mn, Pb , Cu , Cd, , and Zn than the concentrations of same metals in the present study . It is noticed that site (1) had the highest concentrations of Cd, Fe, Mn, Ni, Pb and Zn in water samples and that is related to presence of the pumping station (hydraulic pump that pumping the agricultural and sewage drainage that collected from the minor drains into lager drain namely Dayer El-Birka which transfers a part of wastewater to the lake by pumping station ,this result agreed with ***Authman and Abbas (2007).***

In comparison with the other lakes in Egypt, the water in the present study was showed lower levels of Cd, Cu, Fe, Mn, Pb, and Zn than that recorded in Lake Edku ***(Masoud et al, 2005)*** and Lake Manzala ***(Salah-Eldein, 2012 and Bahnasawy et al, 2011).***

In the present study, the annual average concentrations of the heavy metals in surface sediment samples which were collected from the study area were in the following order; Fe >Mn> Zn >Pb>Cu > Ni > Cd and within the permissible limits of sediment quality guidelines (SQG) according to ***Persaud et al (1990)*** except Cu was higher **.** Unlike that, ***Abdel-Satar et al (2010)*** recorded the Cd level was exceeded the permissible limits of (SQG) while the levels of Cu, Fe, Mn, Pb and Zn were within the SQG.

In the present study the levels of all estimated metals in the sediment of Lake Quaron were lower than that detected by ***Abdel-Satar et al (2010)*** and ***Ali and Fishar (2005)*** except Cu and Fe were higher.

In comparison with the other lakes in Egypt, the sediment in the present study was showed lower levels of metals than that recorded in Lake Edku ***(Masoud et al, 2005)*** except Cu, Ni and Pb were higher in Quaron Lake.

It was noticed that the most of levels of metals in sediment were higher than that estimated in the water in same sites and these results agreed with ***Saeed and Shaker (2008),*** who reported that lake sediments are normally the final pathway of both natural and anthropogenic components produced or derived to the environment.

The organic pollutants and heavy metals present in water tend to be concentrated in sediment. Also agreed with ***Silva and Rezende (2002)*** who reported that lake sediments can serve as archives of environmental changes through time.

Generally the eastern sites of water and sediment samples of Lake Quaron had higher concentrations of metals than the western sites and these results in agreement with ***Ali and Fishar (2005)*** who stated that the eastern sites of the lake generally, had more concentrations of heavy metals than the western sites and that may related to presence of El-Batts drain and pumping stations.

Therefore the obtained results in this work may reflect that the sediment of Lake Quaron is the final reservoir for most heavy metals, gives a good indication to the environmental changes, consider as an alarm to the toxic effect in this ecosystem and this may due to this Lake receives heavy loads of organic and inorganic pollutants via several agricultural drains and huge amounts of raw sewage, agricultural and industrial wastewater discharged into the Lake and this agreed to that recorded by ***Badawy et al (1995) and Abdel-Moati and El-Sammak (1997).***

In the present study site (7) and site (8) which located north western of the lake were generally had lower annual levels of most metals in both water and sediment samples than other sites as both sites located away from direct or indirect sources of pollution as El-Batts Drain, El-Wadi Drain, pumping stations, agricultural and touristic activities in the southern coast of Lake Quaron ,also movement and directions of water waves in Lake Quaron as it directed from north western to south eastern part of the lake (from high density to low density water) and these results agreed with ***El Helessy (2011)***.

In the present study Cu generally was higher and that is due to presence of About (615) woody non-motorized fishing boats operating in the lake of Quaron ***(El-Serafy et al, 2014)*** that using antifouling coatings which are the major source of Cu pollution ***(Ghanem , 1986)***.

In estimation the heavy metals levels in *Atherina sp.* were in the following order; Fe >Mn>Zn >Pb> Cu> Ni > Cd, *Mugil cephalus* were in the following order; Fe > Zn > Cu >Pb>Mn> Ni > Cd, *Solea Vulgaris* were in the following order; Fe > Zn >Mn>Pb> Cu> Ni > Cd and *Tilapia zillii* were in the following order ; Fe > Zn >Pb> Ni > Cu>Mn> Cd in the present study .

From the obtained results of levels of heavy metals in fishes were in the following order ;*Atherina sp.*> *Tilapia zillii*>*Mugil cephalus*>*Solea Vulgaris* and this result agreed with ***Authman and Abbas (2007)*** who reported that the concentration of heavy metals in the fish samples indicated that *Tilapia zilli* were higher than those of *Mugil cephalus* which is attributed to their feeding behavior, and disagreed with ***Mansour and Sidky (2002)*** who stated that levels of heavy metals in *Mugil cephalus* were higher than those of *Tilapia zilli*. Also disagreed with ***Ali and Fishar (2005)*** who reported that heavy metals concentration in the fish species were in the following order; *Solea* sp. >*Mugil* sp. > *Tilapia* sp.

Generally the levels of heavy metals of Fe , Mn, Ni, and Pb in all fish species were higher than the permissible limits except Fe in *Mugil cephalus* was within the permissible limits according to ***WHO (1989) and FAO (1983)***, while the levels of Cd, Cu and Zn within the permissible limits ,this result agreed with ***Mansour and Sidky (2002)*** who stated that among the analyzed metals (e.g. Zn , Fe , Mn, Cu , cadmium , Cr , Ni, Pb , Co and Sn) were found in fish at mean concentrations above the permissible limits proposed by FAO.

In comparable to levels of heavy metals in fish and water samples that were collected from lake Quaron , it is noticed that all levels of heavy metals in fish species were higher than that levels estimated in water and that is agreed with ***Gomaa*** **(1995)** who documented that fish has large amounts of some metals such as lead and cadmium due to presence of fish generally, at the top of the aquatic food chain, in turn causes health hazards to humans who consumed this fish. Also agreed with **Silveira *et al (2004), Elghobashy et al (2001) , MaCarthy and Shugart (1990) Shakweer (1998)*** who concluded that the degree fish pollution depending on the degree of pollution in the aquatic environment where fish living.

In comparison with the other lakes in Egypt, generally the fish species in the present study were showed higher levels of Cd, Cu, Fe, Mn, Pb, and Zn than that recorded in *Oreochromis niloticus* in Lake Edku and Borollus ***(Saeed and Shaker, 2008).***

The metals of Cd, Cu, Fe, Mn, Ni, Pb and Zn contents in water were significantly ($P \leq 0.01$) and positively correlated with Cd, Cu, Fe, Mn, Ni, Pb and Zn contents respectively in sediment, fish sp. these results agreed with ***Saeed and Shaker (2008)*** who concluded that Sediment concentrate the heavy metals so it considered as a good indicator for water pollution. Also agreed with ***Gomaa (1995)*** who documented that fish are often at the top of the aquatic food chain so, concentrate large amounts of some metals.

The metals of Cd, Cu, Fe, Mn , Ni, Pb and Zn content in fishes were significantly influenced ($P \leq 0.05$) by species these result agreed with ***Authman and Abbas (2007)*** who reported that the concentration of heavy metals in the fish samples showed that *Mugil cephalus* were lower than *Tilapia zilli* those of which is attributed to their feeding behavior. These results agreed with ***Ali et al (2008)*** who reported that extensive evaporation of water from Lake Quaron increases concentration of heavy metals, leading to changes in the water quality of and biodiversity**.** Also agreed with ***Silva and Rezende (2002)*** who reported that lake sediments can serve as archives of environmental changes through time.

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الملخص العربى

تعتبر تركيزات المعادن الثقيلة الموجودة في البيئة ذو اهميه كبيرة وذلك لتأثيراتها الخطيرة علي السلسة الغذائية بشكل عام وعلي صحة الانسان والحيوان بشكل خاص.

- أجريت هذه الدراسة لتقييم بعض المعادن الثقيلة ، حيث تم تجميع (٢٦) عينة مياة و(٢٦) عينة تربة من (١٣) موقع من محمية بحيرة قارون الطبيعية خلال فصلي الصيف والربيع وكذلك تم تجميع (٤٠) عينة من أسماك (البساريا، البلطي، البوري وسمك موسي) .
- كانت التركيزات السنويه(ميكروجرام/لتر) للمعادن الثقيلة محل الدراسة في عينات المياة كالتالي: الزنك >الحديد > النيكل>االمنجنيز>النحاس > الرصاص > الكادميوم، وكانت جميع التركيزات في الحدود المسموح بها .
- كانت التركيزات السنويه(ميكروجرام/جرام) للمعادن الثقيلة محل الدراسة في العينات السطحية لتربة بحيرة قارون بالترتيب التالي: الحديد > المنجنيز>الزنك> الرصاص>النحاس> النيكل > الكادميوم ، وكانت جميع التركيزات في الحدود المسموح بها عدا النحاس كان أعلي من الحدود المسموح بها. وكانت تركيزات المعادن الثقيلة(ميكروجرام/جرام) في الاسماك كالتالي: البساريا>البلطي >البوري>الموسي ز
- مما سبق فقد كشفت لنا الدراسة أن بحيرة قارون تعاني من مشكلة تلوث خطيرة.