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Biomonitoring Approaches for Water Quality Assessments in Marshes of Southern Iraq.

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Abstract— Majority portions of the the Iraqi Marshlands suffer the problem of pollution in water due to irregular deterioration in water resources. In this study be use of living organisms to monitor and control the quality of water source an attempt refers to assess the effectiveness of biomonitoring approach to water quality monitoring in water resources. In this current investigation of the biological communities of aquatic plants and some of the different physical properties such Air Temperature (AT) , Water Temperature (WT) , Water Hydrogen Ion Concentration (pH) , Water Electrical Conductivity (EC) , Reactive Phosphate (PO4-2), Reactive Nitrite (NO2-1), Reactive Nitrate (NO3) , and Cd, Pb in six types aquatic plants , *Ceratophyllum demersium* , *Typha domengensis* , *Phragmites australis* , *Potatmogeta, Pctinitus* , *p. perfoliatus* , *p. lucens*, during the period from April 2014 to April 2015. Biological indicator calculated by measuring water quality. The results showed that biomonitoring significant correlations pointing comparisons between and increased biological contamination indicators (six types with Pb more Cd) were statistically significant (p> 0.016. 0.05) p. It was linked to biological indicator index significantly with both physical Parameters (p> 0.21 , 0.05). the results obtained that the property caused by the environmental balance in the aquatic environment through the processes of absorption as a biomonitoring in nature .

Keywords: Iraqi marsh, pollution, Biomonitoring, Aquatic plants , Pb,Cd .

1 INTRODUCTION

Biomonitoring in aquatic plants is the use of biological response to assess the changes in the environment, and generally change o anthropogenic causes. Biomonitoring programs have been quantitatively and qualitatively or semi-quantitative. Biomonitoring is a tool to assess the value that receives an increase in the use of water quality monitoring programs of all types [1]. Based bio-monitoring of pollutants using the species accumulation on the ability of some of the plant has to accumulate relatively large amounts of some pollutants, even from a much diluted solutions without apparent harmful effects. Biomonitoring has several advantages may be performed in two ways, based on the types of sample organism native or endemic organisms passive biomonitoring and introduced organisms active biomonitoring [2]. Aquatic plants growing in or near the water can be classified as emerging, submerged or floating plants. There was great interest in the use of aquatic plants to remove different contaminants, including heavy metals from water bodies [3]. Moreover, the task of aquatic plants, particularly in heavy metal contamination studies, since the analysis of these plants can give an indication that they have been the state of the aquatic environment [4]. Studies in the investigation of the capabilities of some of the big papers have been carried out to remove the different concentrations of heavy metals [5] in the role as biomonitors environmental levels of metals [6]. The marshes in southeast Iraq aggregate into the largest wetland ecosystem in the Middle East. As a unit, they are both culturally and ecologically distinct. They are important sources of food (e.g. fishes) and fresh water for many people in southeast Iraq. They are also important intercontinental flyways for migratory birds [7]. Thus, the marshlands serve important global ecological service. However, due to past international armed conflict and continued civil conflicts, there are concerns about the degradation of the water quality in form of heavy metal contamination [8].

The sources of marshland water were of multi origin namely rivers, precipitations and groundwater. Flow from the Tigris and Euphrates rivers almost wholly regulates the marshland since local rainfall is negligible. The marshlands constitute the largest wetland ecosystem in the Middle East and Western Eurasia. Marshes which are located at the confluence of Tigris and Euphrates rivers in southern Iraq.

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This area supported a marsh Arab population of 500,000 as well as numerous endemic species of birds, mammals, amphibians, reptiles, fish and invertebrates [9, 10]. About the description the study areas are points along the major marshes (Hawizeh, Hammer and The Central Marsh) in southeast Iraq. Hawizeh marsh is located to the east of the Tigris River in Missan Governorate. Depending on the time of the season, Hawizeh marsh could cover about 3,000 km2. Al-Hammar Marsh is situated almost entirely south of the Euphrates, extending from near Al-Nasiriyah in the west to the outskirts of Basra on Shatt al-Arab in the east. Al-Hammar Marshes are bordered by a sand dune belt of the Southern Desert. Estimates of this marsh area range from 2800 km2, extending to a total area of over 4500 km2 during periods of seasonal and temporary inundation. Al-Hammar dominates the marshes is the largest water body in the lower Euphrates [11]. Nutrients especially nitrate and phosphates are represented as principal parameters in the aquatic environment, they are important factors for primary productivity and phytoplankton growth which represents the base of pyramid in the food chain [19].

Direct discharge in marshes by input depositions of contaminants increase the concentrations of trace elements, As the aquatic plants in marshes concentrate great amount of various substances of heavy metals and are consequently useful indicators of local pollution, the aim of the present study was to assess the toxicity status induced by five heavy metals (Pb, Cd) in selected plant parts (roots, stems, leaves) of eight native aquatic plants species (passive biomonitors).

2 Materals and Methods

2.1 Study Area and Sample Collection

The study areas are points five major marshes include (Hawizeh, Hammer and The Central Marsh) in southeast Iraq. Hawizeh marsh is located to the east of the Tigris River in Misan Governorate and extending to the Iranian territory. Depending on the time of the season, Hawizeh marsh could cover about 3,000 km2 [9]. Hammar marsh is located to the south of the Euphrates. It is bordered by a sand dune belt of the Southern Desert. It covers about 2,800 km2 and could extend to about 4,500 km2 when it inundates. The Central Marshlands is located in a triangular area between the Tigris and the Euphrates, bounded by cities of Al-Nasiriyah, Qalaat-Saleh and Al-Qurnah. The preparation of different models of plants and herbs, environment marshlands. The researchers have followed the methods of internationally adopted for the collection of models and by focusing on the parts which have been prepared for the purpose of measuring the biomonitoring contamination by analyzing after calibration laboratory instrumentation and measurement. Aquatic plants samples were collected from five locations (Al-Hammar (31°07′58″ N, 47°03′07″ E), Cross of Al Fuhod and Al-Tar (31°35′30″ N, 47°35′21″ E), Downstream of Al-Mashab and Al-Salal (33°40′22″ N, 47°43′03″ E), Al-hawizah (32°41′22″ N, 47°33′03″ E) and Al-chebayesh (30°07′52″ N, 47°05′12″ E) in Southeastern Iraq. To obtain accurate results in statistics were collected three replications water for each station, 15 samples (three sample of each one station) were collected three replicates from field observations were made at the selected sites were taken to record species of aquatic plants that are dwelling at each location wherever it is possible. Photographs were taken for each species of aquatic plants. For conspicuous species laboratory test was necessary to ascertain proper identification. The aquatic plants were collected from study marshes in cleaned polyethylene bags. These samples dried in oven at (105 oC) and fallowed the ashing procedure (Yang, et al., 2008). Six species of plants were chosen (*Ceratophyllum demersum ,Typha domengensis, Phragmites australis, P. pectinatus , P. perfoliatus , P. lucens)*. It was dominate at all study sites the sampled plants were rinsed thoroughly with deionized water and dried at (50 oC), then grind with an agate mortar and sieved through a 63mm plastic sieve to be ready digestion before analysis.

2-2 Field Testing

During the sampling process of water samples from the selected sites different physical and chemical properties measurements have been covered out using field instruments, these measurements have been:

1- Air Temperature (AT) °C: air temperature was measured by mercuric thermometer which was divided until 0.1 °C.

2-Water Temperature (WT) °C: water temperature was measured directly in the field by digital portable multi meter.

3- Water Hydrogen Ion Concentration (pH): Water pH was measured directly in the field by digital portable multi meter; model 340i/SET.

4- Water Electrical Conductivity (EC) ms/cm: Water electrical conductivity was measured directly in the field by digital portable multi meter; model 340i/SET, The Ec is measured by micro-mhos/cm (or microsemens/cm) [12].

5- Reactive Phosphate (PO4-2)µgP/l: The reactive phosphate was measured according to the procedure which is explained by [13] whereas 50 ml from the filtered sample (by 0.45GF/C filter paper) was taken into volumetric flask and add to it 1 ml mixed solution which consists from (100 ml ammonium molybdate, 250 ml diluted H2SO4 and 50 ml potassium antimony solution

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which is prepared by dissolving 3.25 gm from potassium antimony in 100 ml DW) and then shake the sample and leave it for 3-5 minutes; after that add 1 ml of ascorbic acid solution (it is prepared at using time by dissolving 7 gm ascorbic acid $C_6H_8O_6$ in 100 ml DW) then shake the sample and leave it for 10-15 minutes, whereas the blue color is formed; then measure the sample by spectrophotometer which is (type Aquarius, model CE 7200, 700 SERIES) on wavelength 885 nm; from the reading of the absorbance, we get the concentration by the standard curve.

6- Reactive Nitrite (NO_2^{-1})µg N/l: The reactive nitrite concentration was measured according to the procedure which is explained by [13], whereas 50 ml was taken from the filtered sample(by 0.45 GF/C filter paper) into the volumetric flask then add to it 2-3 ml of buffer solution (it is prepared by dissolving 100 gm of ammonium chloride in one liter of DW) and shake it, then add 1 ml of sulfanil amide solution (it is prepared by dissolving 5 gm from sulfanil 500 ml DW) and shake it then leave it 2-5 minutes, after that add 1 ml N-(1-naphthyl)ethylene diamine dihydrochloride solution (it is prepared by dissolving 0.5 gm dihydrochloride in 500 ml DW then it is kept in dark bottle) and then shake it and leave it for 15 minutes, so that result pink color which its extensity agrees directly with nitrate concentration, and then is measured by spectrophotometer (type Aquarius, model CE 7200, 700 SERIES) on wavelength 543 nm in cell which its thickness is 1 cm. and from reading of the sample absorbance, we get the nitrate concentration in the sample by standard curve.

7- Reactive Nitrate (NO_3)µg N/l: The reactive nitrate was measured according to cadmium column procedure, which is explained by [13] whereas 50 ml was taken from the filtered sample(by 0.45 GF/C filter paper) into the volumetric flask then add to it 2-3 ml of buffer solution and shake it well, then pass the sample in cadmium column where we collect down 5 ml from each sample that to remove the previous sample and then collect 25 ml from the passed sample; after that add 0.5 ml sulfanil amide solution and shake it, and after 2-5 minutes add 0.5 ml N-(1-naphthyl)ethylene diamine dihydrochloride solution and shake it well, and leave it for 15 minutes whereas the pink color is formed, after that read the absorbance of sample by spectrophotometer (type Aquarius, model CE 7200, 700 series) on the wavelength 543 nm in the cell, where its thickness is 1 cm; and from the absorbance of sample, we get the concentration by the standard curve and then subtract the nitrite value which was measured originally in the sample, so that get the nitrate concentration[13].

2-6 Statistical method

The statistical analysis was performed according to the AOAC Protocol [34,35] was assessed using different measures of statistical sigma plot and coefficient of determination, interclass correlation coefficient and concordance correlation coefficient, mean prediction error the concentration was the concentration of component standard method. The coefficient of determination, r^2, was calculated where N is the total num-ber of paired observations. A value of $r^2 = 1$ indicates 100% precision between the methods.

3- Results and Discussion

Temperature is an important parameter that controls the quality, dispersion and distribution of living organisms. The sun and air temperature are the two main factors that influence water temperature, but there are other influence as well as Flood, drought, climatic conditions, etc.. [16]. Maximum temperature was recorded during June in summer months and lowest January in winter months for all monitored stations. Changes in the water temperature synchronized with air temperature. The gradient increase of water temperature is well known phenomenon and has been observed by many authors in different Iraqi inlands waters [17]. There are some differences in the temperatures between the stations within the same location and this is due to the time of taking the samples. The large differences in month are due to the absorption of light by the dense submerged and floating plants that reduce the temperatures below [18].

The previous studies states that no differences or minor differences were recorded between the temperature at the surface and lower layers within the water column due to shallowness of water in the marshes [17]. This contrast in the water temperature helps in abundance and growth of different living organism species in this area. Water temperature follows air temperature clearly that may be caused by shallow the water. In general both variables air and water temperature showed a spatial oscillation. Local variations in recorded temperature are probably related to difference in the time of measurements. About pH meter is another important factor influencing the species and metabolism of organism inhabiting. Low pH interferes with oxygen uptake and pH outside a range . The pH is greatly affected CO_2 concentration, DO, ammonia, photosynthesis, water temperature, organic matter content [19,20].

About Electrical conductivity (EC) depending [21,22,23] EC is routinely used to measure salinity .The types of salts (ions) causing the conductivity usually are chlorides, sulphates, carbonates, sodium, magnesium, calcium and potassium [24], the low EC values in all time is because of the dilution by the relatively higher water level, and may be due to the high temperatures that causes evaporation of the water its increases with increasing temperature [21.22] and the increasing of vegetation extension [25].

Table (3-1) shows the Mean Max, Min and average values of Physical properties under the study

	Test 1		Test 2	
	Phosphate (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)	Nitrate (mg/l)
Max.-Min.	79.5-9.5	70-13	161-26	159-25
Mean	30	28.4	66.7	63.53
SD	14.790	12.706	25.59	24.85
LSD	2.283	1.915	0.885	0.753
$P < 0.05$				

Table (3-2) shows the Mean Max, Min and average values of

	Air Temp. °C	Water Temp. °C	pH	Cond. (ms/cm)
Max.-Min.	40.02-36.9	17.2-11.4	8.4-7.2	15.5-4
mean	38.21	13.69	7.81	8.60
SD	0.999	1.696	0.317	2.930
LSD	0.157	0.268	0.5	0.248
$P < 0.05$				

Chemical properties under the study

The average values of phosphate have generally showed pronounced monthly variations at each station, lower reaches may be mainly due to land runoff during raining in winter; which has drained cultivated lands fertilized by phosphate and the release of large amount of adsorbed phosphate by the increasing water current this increase of PO4 levels .

Nutrient bioassays are useful indicators as to which nutrient has the potential or is likely to limit phytoplankton and aquatic plant growth at a particulate time and space [12,20,21]. Nitrogen is the most abundant nutrient in commercial fertilizer; it enters the water from human and animal waste.

The waters of marshlands have been characterized by lower contents of nitrates which reflect the unpolluted water of the studied sites. Most of the levels recorded in the Al-Hammar marsh during this study, are lower than previously measured [26]. The low concentration may be explained by the increase of number of aquatic plant species that leads to the consuming of more amounts from these nutrients [17, 27] The different concentration between stations refers to the nitrite and nitrate concentration may be because high sediment organic matter and waste water by activity human native [3, 17].

The present study results show that the heavy metals content of plants have wide defferent concentration ranges which reveal that these plants concentrate and accumulate these metals from their environment water and sediments [13] analyzes heavy metals (Cd, Pb) in six species The results of the study that the plant *Ceratophyllum demerium* is the most absorbent for more items and this is due to the nature of the plant that have the ability to absorb this element and the volumetric space of the branch Meloudi the twigs of this plant over a number of other species[22] *Ceratophyllum demersium* >*Typha domengensis* > *Phragmites australis* > *Potatmogeta, Pctinitus* > *P. perfoliatus* > *P. lucens* of Al-Hammar marshes. The use of plant bioindicater positive of pollution in the areas of study that the total concentration of elements in the plant is represented by the take the plant from soil or water as well as absorption the tissue plant [27]. The cadmium concentrations were found comparable in biota sites marshes study is within normal limits allowed by (0.05-0.2) ppm, note that the sources indicate that the highest concentration permitted by cadmium in plants is (5 - 30) ppm [28]. From the Table (4-33) that represent the Ceratophyllum demerium was more plants that ability to adsorption of this metal:

Ceratophyllum demersium > *Typha domengensis* > *Phragmites australis* > *Potatmogeta, Pctinitus* > *p. perfoliatus* > *p. lucens.*

Figures (3-1) show spatial analysis of mean study Pb in the distribution of these metals concentrations in six species of plants in all locations under study .

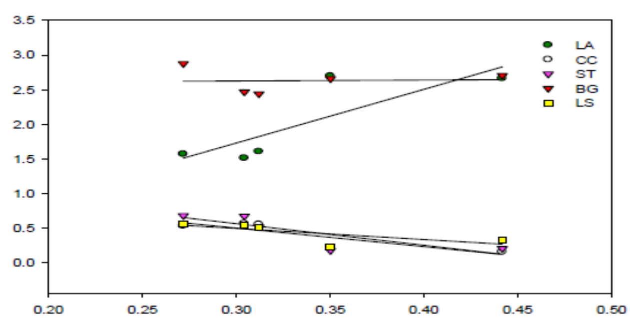

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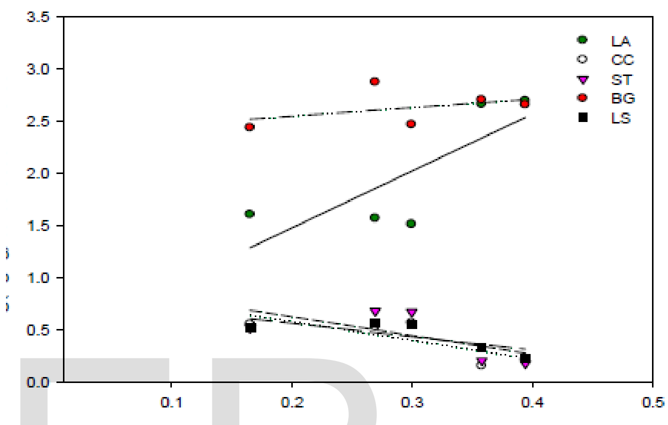
Table (3-3) show spatial analysis of mean study Cd, Pb in

		Cd (ppm)		Pb (ppm)	
		Test1	Test2	Test1	Test2
Max.-Min.	*Cer.demerium*	9.91-3.06	9.65-2.25	7.31-4.11	7-4
Mean		5.106	4.82	5.16	4.96
SD		1.53	1.47	0.58	0.57
LSD		3.22	3.03	4.33	4.26
Max.-Min.	*Ty. domengensis*	7.5-2.5	5.2-2.1	8.91-1.21	8.67-1.11
Mean		14.28	13.07	4.81	4.50
SD		10.01	8.74	2.32	2.19
LSD		11.32	10.65	4.33	4.00
Max.-Min.	*Phr.australis*	17.3-4.11	16.4-3.67	16.2-0.95	15.3-0.89
Mean		6.53	6.22	3.046	2.88
SD		2.29	2.21	2.52	2.39
LSD		5.44	5.10	3.44	3.04
Max.-Min.	*P.pectinatus*	17.52-2.75	15.65-2.66	4.66-0.75	4.44-0.66
Mean		8.52	7.922	2.352	2.212
SD		4.47	4.06	1.11	1.07
LSD		11.45	10.32	2.87	2.16
Max.-Min.	*P.perfolitus*	19.34-2.25	18.12-2.17	4.51-0.45	4.32-0.49
Mean		8.789	8.316	2.119	1.96
SD		5.32	5.01	1.00	0.96
LSD		6.77	6.08	1.34	1.22
Max.-Min.	*P.lucens*	16.95-2.12	16.7-2	3.99-0.41	3.87-0.4
Mean		7.47	7.02	2.01	1.88
SD		4.70	4.39	1.02	0.99
LSD		8.55	8.56	1.09	1.03

the distribution of these metals concentrations in six species of plants in all locations under study.

The lead is the element most affected by the gain of the plant, it is the most prevalent of other pollutants in the environment, and that levels in the environment are much higher than normal levels. That lead poisoning is one of the main problems in our urban areas the most forward, as often infected plants vegetative spread in public areas of dead resulting from car exhausts [29]. The content of lead plant varies according to type of plant and the molecule, with up to concentration of lead in the complex vegetation to grass pastures (12-350 ppm) in radish roots and leaves (56 ppm) and herbal plants (10-30 ppm) [29].

Figures (3-2) show spatial analysis of mean study Cd in the distribution of these metals concentrations in six species of plants in all locations under study



We found a bullet in the biota of the current study, which is identical to the international standards and identified by presence of this element (5-10) ppm as the highest extent permissible, and be toxic if the concentration reached to (30-300) ppm as stated in the [32].

4 Recommendation

Establishment of terminals of meteorology and environmental monitoring program to monitor the long-term environmental changes of the marsh areas periodically (monthly or quarterly) to monitor changes and environmental impact assessment in order to maintain the environment of the marshes out of the risk of contamination and determine the nature reserved in the marshes to control the flow of water that focus on the marshes, especially in the estuary and a similar study to measure the physical and chemical properties of that region , Also increase the amount of water pumped to the lagoons to normal with the budget in the rate of water discharge rate to improve the quality of water which reflect positively on the improvement of the environment.

Since Iraq has entered the international Ramsar Convention on Wetlands, and the existence of some wetland areas in the province, therefore, it is suggested that these areas should be added to national parks and to develop programs for the purpose of supporting this trend and create an advanced research stations in the marshes, and a

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station for remote sensing and geographic information systems GIS to diagnose, monitor and address environmental problems and agricultural, as well as use as a database to support research projects and projects of Graduate Studies.

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