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Seasonal variations of Trace Elements in Aquatic Vascular plants from Al-Hammar Marsh, Iraq

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ABSTRACT

Seasonal variations of trace elements Cd, Cr, Fe, Mn, Ni, pb, V and Zn have been determined in five aquatic vascular plants : Nymphoids indica, Ceratophyllum demersum, Potamogeton lucens , Vallisneria spiralis and Potamogeton perfoliatus from Al-Hammar marsh, sediments sample was also analysed.

It was found that highest concentration of Fe (2.93 ug/g) in N. indica, Cr, pb and Zn (2.83, 1.66 and 0.26 ug/g respectively) in P. lucens, Cd (1.43 ug/g) in V. spiralis and Mn, Ni and V(2.9, 2.82 and 1.26 ug/g respectively) in p. perfoliatus . This variations in the element concentrations were attributed to several factors, including fluctuations in element inputs, and in hydrochemical and geochemical characteristics of the water and sediments, as well as, these are receives different wastes via Euphrates river to the marsh .

INTRODUCTION

The aquatic environment has been polluted by effluent wastes containing trace elements from civilian activities. These inputs arise from various treated or untreated municipal , industrial and agricultural wastes as well as inputs from the atmosphere (Abaychi & Mustafa, 1988). Several organisms have been employed to monitor the concentrations of different pollutants in the aquatic environment. An organism should possess certain characteristice in order to be qualified as a bio-indicator. These characteristics have been revived by several authors, such as Farrington et al. (1983) and Abaychi & Mustafa (1988).

Aquatic vascular plants (AVPS) are useful indicator organisms for pollution monitoring studies (Sculthorpe, 1967). In aquatic environment , trace element concentrations in plants are used frequently to locate point source discharges (Boyed, 1970; Hutchinson, 1975; Welsh & Denny, 1980; Sridhar, 1986).

The aim of the present study is to investigate the seasonal fluctuation of trace elements (Cd, Cr, Fe, Mn, Ni, Pb, V and Zn) in five aquatic vascular plants : Nymphoids indica, Ceratophyllum demersum , potamogeton lucens, Vallisneria spiralis and Potamogeton perfoliatus in the Al-Hammar marsh, south of Iraq.

STUDY AREA

The marsh region is situated in the southern basin of the Tigris and Euphrates rivers, with a maximum length of about 210 km and a width of 170 km and a total area of about 35000 km and is covered by water at the time of peak flood . The seasonal flood cycle of both river reaches a peak between April and May, while the water reaches minimum levels in October (Van der Leeden, 1975). The Euphrates disperses through numerous channels and eventually drains into the largest marsh Al-Hammar. Most of the open water evaporates and only part is discharged via the Shatt Al-Arab into the Arabian Gulf (Anon, 1975). The daily mean (30 Years)temperature is between 12.4° C at January and 33.9°C at August and salinity range from 1.5 - 2.8 %. The annual mean of rain fall lies between 84-296 mm (Al-Saadi et al ., 1981 ; Al-Mousawi & Whitton, 1983; Antoine , 1984).

Little is known on the plant ecology of the marshes in Iraq (Al-Hilli, 1977; Al-Saadi & Al-Mousawi, 1988) , and only slightly more on the limnological parameters (Al-Saadi et al., 1981; Al-Mousawi & Whitton, 1983 ; Antoine, 1984). Abaychi & Al-Obaidy (1987) and Al-Saad et al. (in press) studied only the distribution of trace element concentrations in AVPs at south of Iraq.

MATERIALS AND METHODS

Plant samples were collected seasoally between summer 1986 and spring 1987 from Al-Hammar marsh (Fig. 1). Sediment samples were taken on one oceasion during winter 1987. Plant were washed several times with marsh water at the collection site to remove as much epiphytic material as possible, squeezed gently and placed in polyethylene bags. Upon reaching laboratory , leaves from AVPS were rinsed thoroughly with deionized distilled water, dried at 105°C and ground with agate mortar. Trace elements were extracted by digestion of 1g dry weiht plant according to the procedure described by Goldberg et al . (1983) in which cold extracthion by HNO_3 of triplicate samples, followed by evaporation to near dryness. The extraction was completed by adding 2:1 mixtures of HNO_3 and $HClO_3$ and

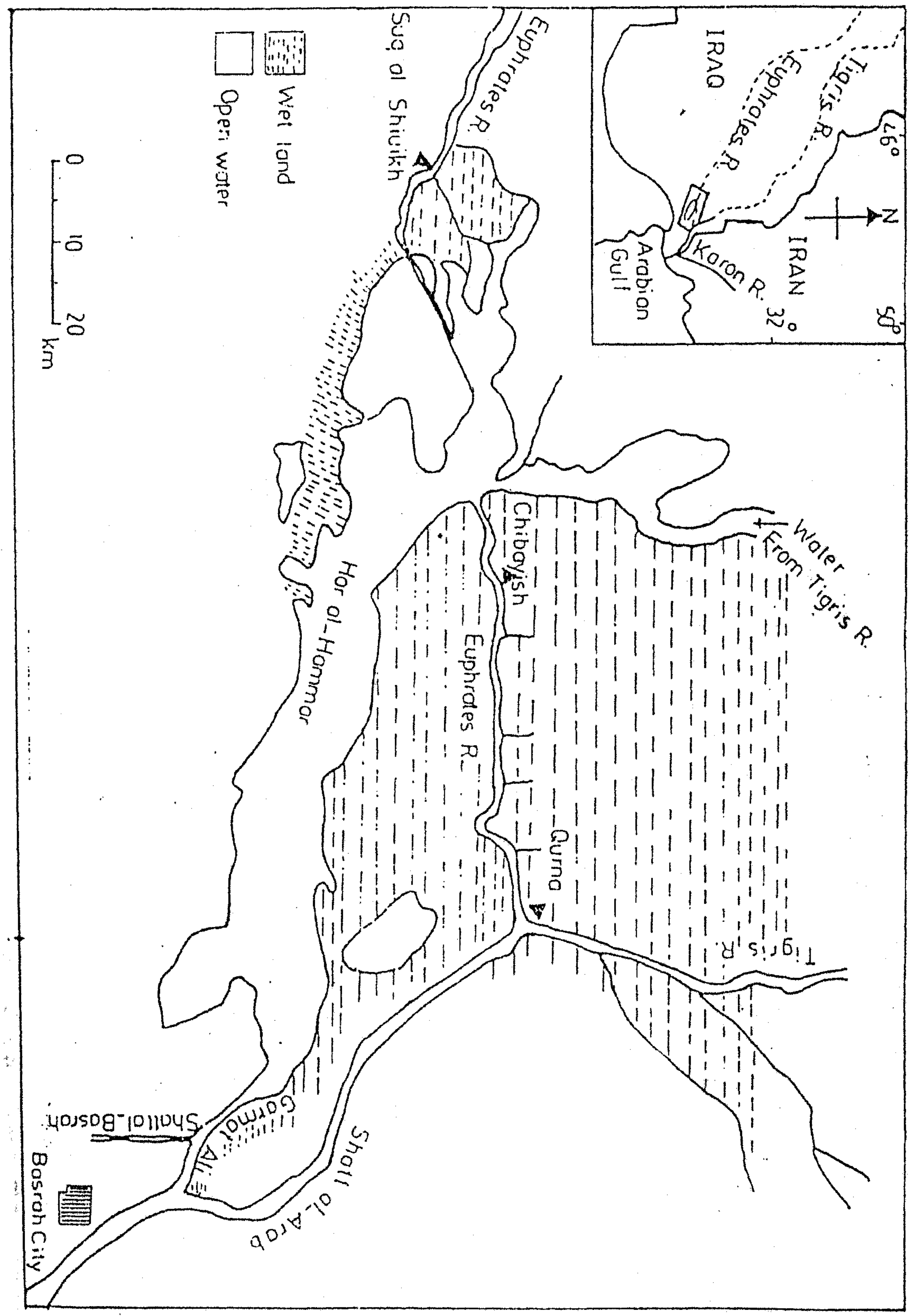

Fig.1 Map of Hor Al-Hammar

evaporation to near dryness . The residue was then dissolved with o.5N HNO3. Sediment samples were obtained by mean of van veen grab samplers . Subsamples were then placed in acid washed plastic containers and freeze-dried upon reaching the laboratory . Trace elements analyses were performed on the <63 μm fraction of the sediment which had been separated by sieving after grinding . A modification of the method described by sturgeon,et al.(1982) was employed for the digestion of sediment , which entails the treatment of the sediments with 1:1 mixture of concentrated Hcl and HNO3 acids. After evaporation to near dryness the digestion was futher proceeded with 1:1 mixture of concentrated HCIO3 and HF acids which were again evaporated to near dryness the residues were dissolved in 0.5N HCI . Atomic absorption grade acids and deionized distilled water have been used throughout the present work .

For the analysis of Cd, Cr, Fe, Mn, Ni, Pb, V and Zn a pye-Unicam flameless AAS model SP9, equipped with graphite furnace , video furnace programmer and data graphice system . The standerd conditions recommended by the manufacturers were found satisfactory after minor modifiction . Duplicates of each sample were analysed,blank values were negligble for all elements studied. A standerd addition method was carried out in order to ovrcome matrix effects whenever these existed . To check for the accuracy of analyses and possible loss of track elements during preconcentration and/or the digestion proceduress quality control samples , trace elements in biota and sediments subblied by the US Environmental protection Agency (US.EPA) , were processed and analysed .

RESULTS AND DISCUSSION

The concentration , ranges and means of trace elements Cd, Cr, Fe, Ni, Pb, V and Zn in AVPS from Al-Hammar for four season are listed in Table 1. It can be seen that there were no significant spatial variations in trace element concentrations , this is in agreement with the findings of Abaychi & Mustafa (1988) who found no significant seasonal variation in trace elements in the biota and in water-quality parameters measured at different sites at the shatt al-arab river . They attributed this to the huge flushing volume of the river . In general, highest concentration of Fe about 2.93 ug/g in *N. indica*, Cr, Pb and Zn about 2.83, 1.66 and 0.26 ug/g respectively in *P. lucens*, Cd, about 1.43 ug/g in *V. spiralis* and Mn, Ni, and V about 2.9, 2.82 and 1.26 ug/g respectively in *P. perfoliatus*, while lowest concentration of trace elements were found in *N. indica*, Cd, Cr and Pb about below detection, 1.51 and 0.62 ug/g respectively and *C. demesum* Mn,Ni and V about 2.32, 0.96 and 0.26 ug/g respectively . This

TABLE I

Concentrations of trace elements (ug/g dry wt.) in AVPs from Hor al-Hammar marsh.

Season	Cd	Cr	Fe	Mn	Ni	Pb	V	Zn
				Nymphoids indica				
Summer	nd	1.76	4.40	2.20	0.53	0.75	nd	0.07
Autumn	nd	2.00	3.00	1.90	1.82	0.23	0.81	0.10
Winter	nd	nd	1.60	3.10	nd	0.55	0.04	0.08
Spring	nd	2.28	2.70	2.60	1.91	0.96	0.77	0.08
Range	nd	nd -2.28	1.60-4.40	1.90-3.10	nd -1.91	0.23-0.96	nd -0.81	0.07-0.10
Mean	nd	1.51	2.93	2.45	1.07	0.62	0.40	0.08
				Ceratophyllum demersum				
Summer	nd	0.97	3.90	1.70	1.19	0.93	nd	0.08
Autumn	nd	2.88	3.0 0	1.20	1.56	1.37	0.58	nd
Winter	1.35	2.78	2.00	2.90	nd	0.60	nd	0.08
Spring	nd	2.86	2.30	3.50	1.08	0.85	0.47	0.12
Range	nd-1.35	0.97-2.88	2.00-3.90	1.20-3.50	nd -1.56	0.62-1.37	nd -0.58	nd -0.12
Mean	0.34	2.37	2.80	2.32	0.96	0.94	0.26	0.07
				Potamogeton lucens				
Summer	1.57	1.80	2.10	2.30	1.67	0.08	0.59	0.08
Autumn	nd	4.37	2.90	2.40	nd	2.59	0.02	0.24
Winter	nd	3.12	1.90	2.80	0.51	2.84	0.29	0.62
Spring	1.42	2.05	2.80	3.80	1.71	1.15	0.54	0.10
Range	nd-1.57	1.80-4.37	1.90-2.90	2.30-3.80	nd -1.71	0.08-2.34	0.02-0.59	0.08-0.62
Mean	0.39	2.83	2.42	2.82	0.97	1.66	0.36	0.26
				Vallisneria spiralis				
Summer	nd	1.25	2.10	1.40	0.16	0.13	0.66	0.07
Autumn	nd	2.93	3.30	2.90	nd	0.59	nd	0.07
Winter	nd	3.84	1.80	2.90	nd	1.74	0.06	0.10
Spring	5.74	2.40	2.10	2.40	6.73	1.39	2.38	0.09
Range	nd-5.74	1.25-3.84	1.80-3.30	1.40-2.90	nd -6.73	0.13-1.74	nd -2.38	0.07-0.10
Mean	1.43	2.60	2.32	2.40	1.72	0.96	0.77	0.08
				Potamogeton perfoliatus				
Summer	nd	1.44	3.20	1.90	2.00	0.84	0.94	0.09
Autumn	nd	2.74	2.90	4.00	nd	0.49	nd	0.14
Winter	nd	3.28	1.20	3.20	5.12	1.98	2.16	nd
Spring	nd	2.71	3.00	2.50	4.16	0.70	1.94	nd
Range	nd	1.44-3.28	1.20-3.20	1.90-4.00	nd -5.12	0.70-1.98	nd -2.16	nd -0.14
Mean	nd	2.54	2.57	2.90	2.82	1.06	1.26	0.06

nd = not detect

is a refection of trace element bioaccumulation and excretion kinetice in plants may be slow compared to the short term variations in element concentration accuring in the water . Abychi & Mustafa (1988) have reviewd processes causing such fluctuations in element concentration of organism , these include temporal variability in element inputs to the environment , temporal variability in hydrochemical and geochemical characterisics of water and sediments , sesonal fluctuation in tissue mass of the organism , and changes in dilution, dispersion of the ambient water . In the al-Hammar marsh , element inputs may be fluctuated through time . A principal factor causing these fluctuation is the fact that the marsh receives agricultural and civilian wastes,this wastes are dicharge via Euphrate river, which penetrate the numerous cities before receiving the marsh (salman, 1987), as well as, the amounts of untreated sewage have increassed in the last decade due to increases civilian activities in the region. Since element concentrations in these wastes are highly fluctuate, the corresponding levels in plants may repidly respond to these variation . On the other hand , trace elements are contributed to the regin environmet through aeolian dust, this source is importance considering that the south of Iraq is a major dust fallout region (Abaychi & Mustafa, 1988). However, the concentratins of trace element in the present work agree with the fidings of Al-Saad et al.(in press) who measured the distribution of trace elements in the AVPs in the al-Hammar marsh. Thereabout, these concentrations are in most cases, relatively lower than those reported for AVPs from Shatt al-Arab river (Abaychi & Al-Obaidy, 1987) except for V which was slightly higher. As well as, comparison of different trace elements observed with those reported for similar and related species from polluted and unpolluted sites (Adams, 1973; Wilton & Say, 1975; Mudroch & Capobianco, 1978; Fraint 1979) In sediment samples, total concentrations of Cr, Fe, Mn, Ni, V, and Zn were 194,44992, 743, 184, 69, and 147 ug/g, respectively these concentration are relatively lower than corrseponding concetratins for the earth's crust.

CONCLUSIONS

The unpolluted nature of the al-Hammar marsh was concluded from the low trace element concetrations encountered in the aquatic plants and surficial sediment. Seasonal changes in the concentrations of trace elements in aquatic plants studied have been atributed to several factor , fluctuations in elements concentration of organism, these include temporal varibility in element inputs to the environment, temporal variability in hydrochemical and geochemical characteristics of water and sediments, seasonal fluctuation in tissue mass of the organism, and changes in dilution,dispersion of the ambient water, and wastes discharge via Euphrate river.

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التغيرات الفصلية للعناصر النزرة في النباتات المائية من هور الحمار – العراق

المستخلص

تم قياس التغيرات الفصلية للعناصر النزرة التالية : الكادميوم ، الكروم ، الحديد ، المنغنيز ، النيكل ، الرصاص ، الفاناديوم والزنك ، في خمسة انواع من النباتات المائية هي
Nymphoids indica و Certo phyllum demers
Potamo geton lncens و Vallisneria spiralis
and Potamogeton Perfoliatus والمأخوذة من هور الحمار
وكذلك حللت عينات الرواسب لنفس المناطق . وجد بان أعلى تركيز للحديد (٩٣ ر٢ مايكروغرام /غم) كان في N. indica ، اما الكروم ، الرصاص والزنك (٨٣ ر٢ ، ٦٦ر١ ، ٢٦ ر٠ مايكروغرام /غم على التوالي) فكان في نبات P. lucens والكادميوم (٤٣ ر١ مايكروغرام / غم) في نبات V. spiralis وكل من المنغنيز ، النيكل والفاناديوم (٩ر٢ ، ٨٢ ر٢ ، ٣٦ ر١ مايكروغرام / غم على التوالي) في نبات P. Perfoliatus وتعزى التغيرات في تراكيز العناصر النزرة المساعدة عوامل منها التغيرات في وصول ومقدار العناصر الداخلة الى البيئة وكذلك الخواص الهيدروكيميائية والجيوكيميائية للماء والرواسب بالاضافة الى ذلك مايدخل الى هذه المنطقة من خلال مايطرح من مخلفات عن طريق نهر الفرات .