DISTRIBUTION AND CIRCULATION OF CHROMIUM (Cr) AND CADMIUM (Cd) METALS IN TIGRIS RIVER

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Abstract

The distribution and circulation of chromium and Cadmium in Tigris river were estimated over a period (2001–2002). Significant difference was observed in the concentration of these metals in any component of the homomorph model in studied area. Result obtained were in agreement with those reported for heavy metal concentrations in other polluted ecosystems. All components of the ecosystem were involved in the circulation of the heavy metals either by accumulation or concentrations processes.

توزيع ودورة عنصري الكروم والكادميوم في نهر دجلة

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الخلاصة

تم حساب توزيع وانتقال عنصري الكروم، والكادميوم في نهر دجلة في مدينة بغداد خلال الفترة ٢٠٠١–٢٠٠٢ وتبين ان كمية العنصرين تختلف في معدلها في مكونات النهر، وان تركيزها مشابه لما سجل لبقية المسطحات المائية الملوثة. كذلك ظهر ان جميع المكونات تشترك في دورة العنصرين اما بعمليات التراكم أوبعمليات التركيز.

Introduction

The energy flux and the circulation of the mineral elements represent two complementary processes which develop at the level of natural ecosystems and which determine their biological productivity [1, 2].

Mineral elements distribution and concentration in major components of natural and arranged ecosystems can be determined according to specific mathematical formulas [3, 4].

The aim of the present work was to determine the distribution and concentration of certain heavy metals (Cr , Cd) in Tigris river using the homomorphous model and to study the effect of accumulation and concentration phenomena on their distribution and circulation in the studied ecosystem [5, 6].

Materials and Methods:

Site description and sampling

Two stations along the Tigris river were selected for collecting samples. One is located north of Baghdad (AL-shuala station) and the other South of Baghdad (AL-jadiriayh station) as shows in (Figure 1).

Samples from different components of the homomorphous model (Figure 2) of the river were taken for the determination of concentration and distribution of Cr and Cd in this ecosystem.

Fifteen water samples were collected from each station in May through the period 2001–2002. Samples were collected by clean bottles (500 ml) and transferred immediately to the laboratory for analysis. Samples of phytoplankton , zooplankton , fish and sediment …… etc, from each station were also collected with the water samples and analyzed to determine the heavy metals.

Determination of Chromium and Cadmium :

Determination of Cr, Cd concentration in the different types of samples was made by ASS-1 type atomic absorption spectrophotometer.
Three replicates from each sample were used to determine the concentration. The mean was considered as the value of each metal concentration.
Ten ml of each water sample were filtered through a glass fiber filter (0.45 µm). The Filtrates were used to determine the concentration of the chromium and cadmium in the river's water.
Deposites on the glass filters of each water sample were collected, oven-dried at 60 °C for 30 h , and then used for analysis of Cr and Cd .

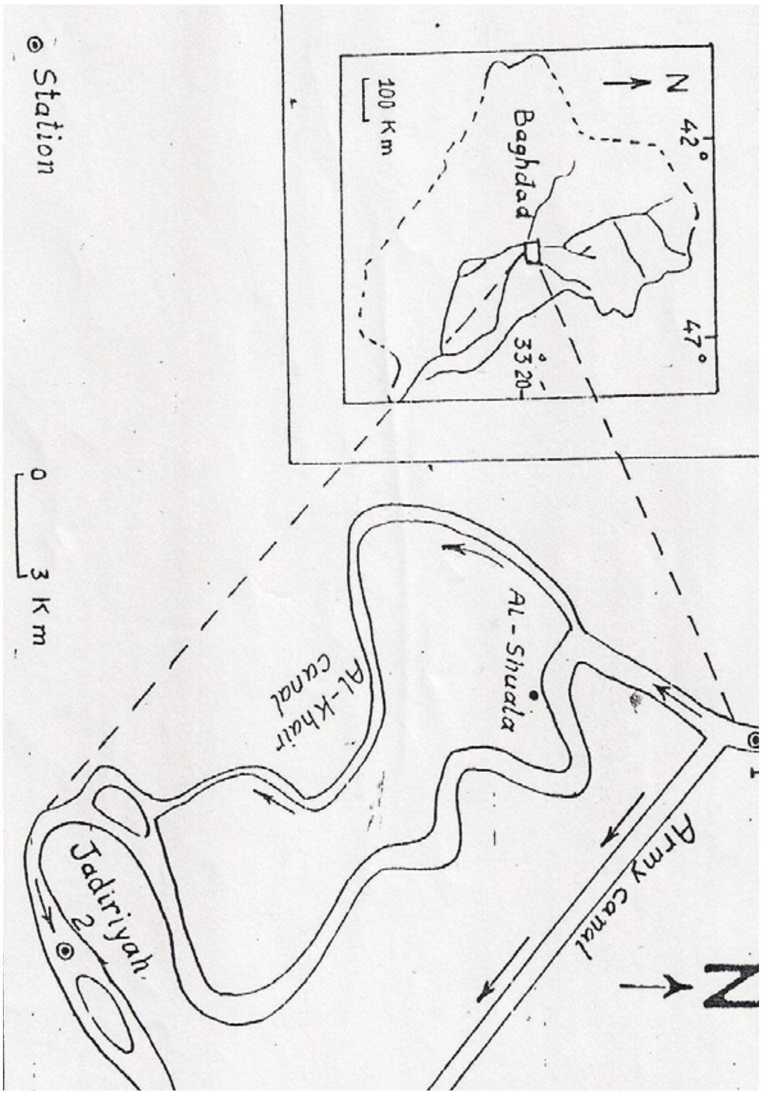

Figure 1: Sampling stations along Tigris River in Baghdad

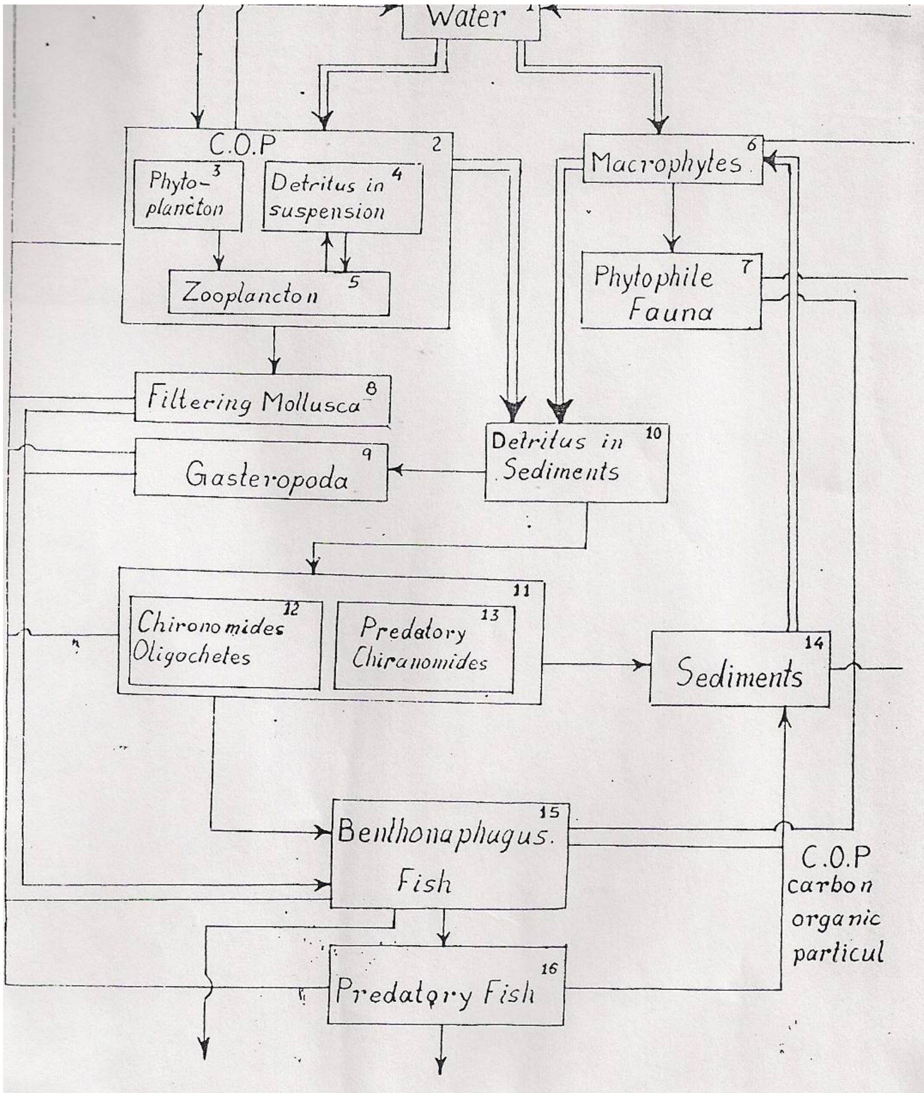

Figure 2: Diagram Model Homomorph Corresponding Caracterized Circuit of Mineral Elements (Cr, Cd) in Ecosystem Aquatic (Tigris River) In Baghdad.

Samples of zooplankton , phytoplankton and macrophyte were oven-dried at for 60 °C for 30 h, while sediment and fish samples were dried at 105 °C for 30 h. before using for analysis [7].
Dry samples were homogenized at 500 c for 2 – 3 h. in homogenizer, resuspended in 1 ml Ammonium acetate solution pH – 7 [8] and used for the determination of the Cd and Cr concentration.
Amounts of 0.5 g dry weight from each of zooplanktons , phytoplanktons and fishs were used for analyses by atomic spectrophotometer , while 10 g dry weight of sediments samples was used for the same purpose.
Calculation of concentration factor (cij) was performed according to the mathematical formula shown in Table (1).

Results and Discussion:

The average values of the concentration of the studied elements in the different components of the homomorphous model of Tigris river in Baghdad are shown in Table (2).
Concentration of Cr (1.8 µg / l), Cd (1. 2 µg / l) were considerably high and were similar or higher than those obtained from polluted water ecosystem [9, 10, 4, 11].
The concentration of Cr and Cd in C. O. P. phytoplankton and zooplankton (3.8– 4.7 µg / L), (2.9 – 3.4 µg / g dry weight) were higher than thet concentration obtained from water.
The concentration of Cr and Cd in those components were within the same range of value recorded for the other components of the analyzed ecosystem [12].

The macrophyte (the submerase and floating vegetation) showed a remarkeably high concentration values for Cr (5.6 – 6.1 µg / g dry weight) and Cd (4.1 – 5) µg / g) as compared with the values of other components of the analysed ecosystem.

The phytophyle fauna which uses the macrophyte as a support and energy source contained high concentration of Cd (7.8 µg / g).

The concentration of two metal were high in case of filtering mollusca (Cr 6.4 µg / g), Cd (6.8 µg / g).

The superficial stratum (h = 5 cm) of sediments which contains up to 30 % detritus , stores significant quantities of Cr (2.1 µg / g dry weight ; Cd 3.5 µg / gdry weight). Also the concentration value for Cr, Cd were high for the penthonophagous and predatory fish.

According to the variation in the metal concentration in the different components of the homomorphous model shown in Figure (2). It is possible to determine the extent of metal circulation in the studied ecosystem and the role of each component of the model in this circulation. The concentration factor values of the different components of the studied ecosystem were calculated according to the formula in Table (1) and presented in Tables (2 and 3).

Taking into consideration that two elements is accumulated by a component if the concentration factor value is higher than zero and lower or equal to one $(0 < c_{ij} < 1)$, while it is concentrated if the c_{ij} value is higher than one [5].

We appreciate from this point of view that the circulation of one of the most toxic heavy metal represented by chromium and cadmium , we find that excepting the phytophyle fauna for the chromium circulation all section intervene by means of concentration phenomena.

The extension of the research in the time and space as well as the differentiated approach of the result obtained out of the analysis of the samples drawn at different moment or coming from different ecosystem would lead in future to the complete characterization of the circulation of these heavy metals and would of course represent the scientific base for valuating the ecological effect determined by the pollution due to them and to the correct determination of the admitted concentration at the residue over following into the medium [13, 14].

Table 1: Direction for calculating the concentration factor.
i = the section in which the transfer is made
j = the section from which the transfer is made

Concentration Factors	Section (X)		Calculum relation
	I	j	
C1.2	C.O.P.	Water	$c_{ij} = \frac{(\mu g/g \text{ dry weight})_i}{(\mu g / L)_j}$
C3.1	Phytoplankton	Water	
C6.1	Macrophytes	Water	
C5.2	Zooplankton	C.O.P.	$c_{ij} = \frac{(\mu g/g \text{ dry weight})_i}{(\mu g / g \text{ dry weight})_j}$
C5.3	Zooplankton	Phytoplankton	
C7.6	Phytphyte fauna	Macrophytes	
C8.2	Filtering mollusca	C.O.P.	
C8.3	Filtering mollusca	Phytoplankton	
C11.10	Benthonic fauna	Detritus + sediments	
C6.10	Macrophytes	Detritus + sediments	
C15.11	Benthonophagous fish	Benthonic fauna	
C16.15	Predatory fish	Benthonophagous fish	

X the numbering is indicated in Figure (2).

Table 2: the distribution of the element Cr , Cd in the components of water ecosystem in the Tigris river (Baghdad) (for water the values represent µg / L and for the other components µg / g dry weight)

No.	Section	Cr	Cd
1	Water	1.8 ± 0.5	1.2 ± 0.6
2	C.O.P.	4.0 ± 1.9	3.4 ± 0.8
3	Phytoplankton	3.8 ± 1.9	3.1 ± 0.8
4	Zooplankton	4.7 ± 1.6	2.9 ± 1.1
5	Submerase vegetation	5.6 ± 1.4	4.1 ± 0.9
6	Floating vegetation	6.1 ± 2.2	5.0 ± 1.7
7	Phytophyle fauna	4.0 ± 1.6	7.8 ± 3.9
8	Filtering mollusca	6.4 ± 2.3	6.8 ± 1.1
9	Sediments + Deritus	2.1 ± 0.4	3.5 ± 0.9
10	Benthonic fauna	3.2 ± 1.9	4.5 ± 1.3
11	Benthophagus fish	4.2 ± 2.4	6.2 ± 2.0
12	Predatory fish	5.7 ± 1.9	7.6 ± 2.4

Table 3: Value of concentration Factor Calculating for Cr, Cd in the component of water in the Tigris river (Baghdad).

No.	Section	Cr	Cd
1	C2.1	2.2	2.8
2	C3.1	2.1	2.5
3	C6.1	3.2	4.1
4	C5.2	1.2	0.8
5	C5.3	1.2	0.9
6	C7.6	0.7	1.5
7	C8.3	1.6	2.0
8	C8.3	1.7	2.2
9	C11.10	1.5	1.4
10	C6.10	2.8	1.3
11	C15.11	1.3	1.4
12	C16.15	1.35	1.3

References

1. Odum, E. P. **1971**. *Fundamentals of ecology,2nd ed. W. B. Saunders Company*, Philadelphia, Toronto.pp.37-65.
2. Otanriuc, N. and Vadineamu, A. **1982**, *Ecologie, Ed. Did. Si. Ped*.: Bucurest. pp.284-312.
3. Hughes, K. M.; Lepp W. N. **1980**. Aeral heavy metal pollution and terrestrial ecosystem In Advances in ecological research Edit, 3th ed Macfadeyn A., *Academic Press London*. **11**.
4. Vadineanu A. (1982), Modelarea – instrument de cercetare fundamentala si de prognoza acomportamentului ecosistemelor. Pontus euximus,11(2):59-62.
5. Foulkes, E.C. **2000**. Transport of toxic heavy Metals across cell membrane. *Environmental Biology and Medicine*, **223**:234 – 240.
6. Robert and Bill R.E. **2001**. River ecology and management, Lesson from pacific coastle, Ecoregion. Spring – verlag. p.408.
7. American public Health Association A.P.H.A. **1976**. Standard methods for examination of water and waste water, 3th ed. Eighteenth street Nw, Washnigton .pp.99-112.
8. Aleen, E. S. **1974**. Chemical analysis of ecological materials, 2nd ed Blackwell Sci. Publi Oxford.P.78.
9. Major, L.; Nedoclang, G.; Moden Nutti, B. G. and Daris, F. **1978**. Levels of metal pollutants in sediments and biota of the gulf of Trieste along term survey. In "Workshop on pollution of the Mediterranean" antalya, C.I.E.S.M.P.219.
10. Orland, E. and. MaurI, M. **1978**, Accu-mulation of manganese in *Donax trunculus* L. (Bivalvia), In workshop on pollution of

the Mediterranean Antalya, C. I. E. S. M., p.297.

11. Al-Shahaf, M. **1976**. Pollution control and water resources of Iraq. (in Arabic), Al-Hurria Printing house, Baghdad. p.36-47.
12. Tabbutum, T. H. Y. **1977**. *Principles of water quality control,* 2nd edition. Pergamon Press Oxford. p.88.
13. Ho, K. C.Y.L. chow and J.T.S. Yau. **2003.** chemical and micro biological Qualities of the east river (Dongjiang) water, with particular reference to drinking water supply in hong. *chemosphere*. **52**:1441 – 1450.
14. Krantz, D. and Kifferstein, B. **2001**.Water Pollution*http://www.Zephryus.demon.co.uk/ gfeography/hom.htm.*