Heavy Element Accumulation in Some Hydrophilidae (Coleoptera), Collected From Rural Part of Erzurum Province, Turkey

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***Abstract*—**This study aimed to find out the measures of some heavy elements (Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Sr, Pb) as heavy element pollution in rural part of Erzurum (Turkey) and accumulation level of Hydrophilidae (Coleoptera) species. Heavy elements levels in biotic and abiotic samples were analyzed by Energy Dispersive X-Ray Fluorescence (EDXRF) spectrometer. According to the results of analysis derived through EDXRF Spectrometry, heavy element concentrations display differences for certain metals between stations and insects. The results pointed out that the insects were contaminated by the sediment and water, therefore Hydrophilidae species accumulate higher concentration of certain elements than their environment.

***Keywords*—** EDXRF, Heavy element, Hydrophilidae, Erzurum.

I. Introduction

FRESHWATER are definitely today`s prominent endangered ecosystems. Industrialization and other human activities have caused major changes in this reservoir` water quality. Elements are present in varying concentration in all ecosystems but anthropogenic activities increase the level of this pollutants. Heavy elements are stable and persistent environmental contaminants since they cannot be degraded or destroyed. Therefore, they tend to accumulate in soils, seawater, freshwater, sediments and bioconcenrated in biota [1; 2]. Aquatic insects constitute an important part of the aquatic ecosystems and they are often used to assess the biological impacts of metal pollution [3; 4]. Hydrophilidae also called water scavenger beetles is a chiefly aquatic beetles, comprising about 2500 known species. The family is known among entomologists especially due to its aquatic representatives, which are often abundant in most kind of stagnant waters, but also commonly inhabit streams, rivers and seepage habitats. Adult beetles are mostly saprophagous, feeding on different kind of decaying organic matter, whereas larvae are predaceous, preying on various invertebrates [5]. The objective of this study is a preliminary survey of the effect of anthropogenic activity on the water, the sediment and the aquatic insect of rural part of Erzurum.

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II. Materials and Methods

A. Sampling Sites

Erzurum is located in eastern Anatolia in Turkey. It is a rapidly growing city. Erzurum province is very rich in water resources. Heavy metals are emitted into the Erzurum environment from different sources, i.e. transportation, industrial activities, fossil fuels, agriculture and other human activities. First station is one of the most important ski center in Turkey. There is no settlement around it. Second station is near the Erzurum-Çat highway and there is a small village around it. Information of stations were given in Table I.

TABLE I: Description of Sampled Sites

Station Number	Altitude (m)	Location	Coordinates
I	2472	Palandöken ski center	39°50'25'N 41°16'35E
II	1981	Teke Stream	39°48'49'N 41°09'45E

B. Collection of Samples

Insects were sampled from two sites, along with contiguous sediment and water. Insects were collected via 1 mm mesh aperture sieve and mouth aspirator. Only one specie belonging to genus Laccobius were determined. Sediments were taken from 30 cm depth benthic zone via plastic shovel, then stored in glass bottle and noted describing the information of the station. Before taking the water samples, the glass bottles were washed 4-5 times with the water in the study area.

C. Elemental Analysis

An EDXRF spectrometer with 1 Ci 241Am radioactive source and an HPGe detector with resolution ~180 eV at 5.9 keV was used to determine the heavy elements in all samples. All measurements were carried out under vacuum. Measurement time for water and sediment samples was 4 h and insect samples was 24 h. Insects were pulverised and then cellulose was added as a binder. Five tons of pressure applied to make 13 mm diameter pellets of each species. The concentration of elements in each samples were determined by Win AXIL software, which use Fundamental Parameters Method (FPM) for quantitative analysis.

III. Results and Discussion

To determine heavy element levels EDXRF Spectrometry

was used, which can measure simultaneously quantitative and qualitative analysis virtually every element from Al to U in the periodic table, in concentrations ranging from a few ppm to nearly 100 percent. In general, determined heavy element are shown in Table 2. The concentrations of these elements were found to vary in water, sediment and insects. Ti, Cr, Ni, Cu, Zn and Pb were measured in all samples of stations. It appears that L. bipunctatus accumulated relatively more Ni, Cu, Zn, As, Se, Br and Pb compared to their environment. In water samples Ti, V, Mn, Co and Sr had highest concentration. Generally the heavy element concentration were observed as hydrophilid>water >sediment. Ga, Ge, Ru, Rh, Pd, I, Cs, La, Ce, Pr, Nd elements were qualitatively detected in some samples but their concentrations were quantitatively not determined due to the detection limit of spectrometer.

In the present study it is concluded that, contaminants residues in biota are reflective of environmental quality. Aquatic insects are a vital component of freshwater ecosystems. High concentration of the elements in insect samples seems related to the high level of these elements in sediment and water samples. Due to wide spread pollution in Erzurum, this rural stations were contaminated with certain metals. Industrial activity is major source of heavy elements. But these stations are away from major anthropogenic sources and this can be explained by transboundary atmospheric long-range transport only.

TABLE II: CONCENTRATION OF HEAVY ELEMENTS IN WATER, SEDIMENT AND INSECT SAMPLES (PPM)

Heavy Element	**Station I**			**Station II**		
	Water	**Sediment**	***Laccobius bipunctatus***	**Water**	**Sediment**	***Laccobius bipunctatus***
Ti	139	70	2.16	98	70	27.4
V	-	11.6	-	18	12	-
Cr	35	15	920	25	15.6	2.65
Mn	12	5.32	-	9,8	5.55	0.833
Fe	6	2.21	310	4	-	1
Co	3	-	-	-	-	0.145
Ni	1.32	13	19.5	0.95	13.6	900
Cu	0.6	0.301	10	0.51	0.322	338
Zn	0.3	0.46	14	0.28	0.68	186
As	-	-	9	-	-	760
Se	0.55	-	10.5	0.4	-	-
Br	-	-	80	-	-	204
Sr	-	230	0.8	313	216	29
Pb	2.04	469	198	660	515.5	921.5

(-): Not detected.

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REFERENCES

[1] C. Leal, M. Grandos, M. D. Prat, and R. Compano, "Labelling of organotin compounds for fluorometric detection," *Anal. Chim. Acta*, vol. 314, pp. 175, 1995.

[2] B. Rainbow, "Trace metal bioaccumulation: Models, metabolic availability and toxicity," *Environment international*, vol. 33, pp. 576-582, 2007. http://dx.doi.org/10.1016/j.envint.2006.05.007

[3] D. M. Rosenberg, H. V. Danks, and D. M. Lehmkuhl, "Importance of insects in evironmental impact assessment," *Environmental Management*, vol. 10, pp. 773-783, 1986 http://dx.doi.org/10.1007/BF01867730

[4] R. B. Nehring, "Aquatic insects as biological monitors of heavy metal pollution," *Bulletin of Environmental Contamination & Toxicology*, vol. 15, pp. 147-154, 1976. http://dx.doi.org/10.1007/BF01685153

[5] M. Fikáček, E. Gentili, A. E. Z. Short, "Order Coleoptera, family Hydrophilidae," *Arthropod fauna of the UAE*, vol. 3, pp. 135-165, 2010.