Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 14	No. 2	pp. 431-434	2015

Original Research Paper

Accumulation of Heavy Metals in the Surface Water of Asthamudi Lake, Kollam, Kerala

L. Razeena Karim† and E. Sherly Williams
Environmental Sciences, Aquaculture and Fish Biotechnology Unit, Department of Zoology, Fatima Mata National College, Kollam, Kerala, India
†Corresponding Author: L. Razeena Karim

Nat. Env. & Poll. Tech.
Website: www.neptjournal.com
Received: 20-9-2014
Accepted: 13-10-2014

Key Words:
Heavy metals
Asthamudi lake
Pollution

ABSTRACT

Ashtamudi Lake, the Ramsar site, is subjected to severe pollution by domestic sewage, agricultural activity and industrial wastes. In this study, the distribution of heavy metals (Fe, Cu, Pb, Zn, Cr, Cd) was measured from three sites of the lake for a period of one year from November 2010 to December 2011. The results of the study show that the heavy metal concentration was remarkably high, especially in Site-2 and Site-3. Iron was found to exceed the maximum permissible limit in all the sites which indicates the severity of pollution in the lake. Chromium exceeds the limit in Site-2 and Site-3, whereas all other metals are within the permissible limit. Constant monitoring of water quality of Ashtamudi Lake is needed to record any fluctuation in the quality and mitigate occurrence of health disorders and the harmful impacts on the aquatic system.

INTRODUCTION

Ashtamudi estuary, the second largest wetland in Kerala, India is of extraordinary importance for its hydrological functions, biodiversity and rich fishery resources. Large quantity of waste is accumulated at this beautiful lake as a result of municipal solid dumping, mechanized boats, etc. All human activities inevitably produce some wastes. With the development of civilization drastic changes have taken place in our lifestyle and through every activity like feeding, clothing, housing, recreation and travelling, lots of wastes are generated. Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application (Petrus & Warchol 2005). Hydrographic data on the Ashtamudi estuary has been reported by Babu et al. (2010), Sujatha et al. (2009), Ramadevi & Abdul Aziz (1995) and Nair et al. (2001). Although, many works have been carried out regarding the water quality of Ashtamudi Lake, data on heavy metal content in this water body were scarce, so the present work aims to analyse the heavy metal content from three sites of Ashtamudi Lake.

MATERIALS AND METHODS

Study area: Ashtamudi wetland, situated in the Kollam district, Kerala (Lat. 8°59' N; Long. 76°36' E), is the second largest wetland in Kerala with a palm shaped extensive water body and eight prominent arms. For the present study, three sites from the Ashtamudi lake were selected. Site-1, Site-2 and Site-3 are situated approximately 18, 7 and 5 kms respectively from the bar mouth (Neendakkara). The Site-1 (Perumon), where anthropogenic influx is less, was found to be comparatively less polluted. This site is considered as reference site and is about 11-13 km away from the other two sites. Site-2 (Kureepuzha) is located near the Municipal waste dumping site of Kollam district. Site-3 (Kavanadu) is located near the Neendakkara fishing harbour, where mechanized fishing trawlers are harboured. Oil spillage from mechanized boat is a major source of pollution here.

Methodology: Water samples from the three sites of Ashtamudi Lake were collected monthly from December 2010 to November 2011. One litre of each sample was preserved with 10 mL of 6N nitric acid and stored at 5°C. The water samples for heavy metal analysis were filtered through Whatman filter paper. One litre of the filtered samples were acidified to pH 2 with 20 mL of 6N HNO_3 and heavy metals (Cu, Fe, Zn, Pd, Cr, Cd) were determined by atomic absorption spectrophotometer (APHA 2005).

RESULTS AND DISCUSSION

Results of the heavy metal analysis are shown in Figs. 1-6. Iron (Fe) showed higher values in all the three sites and the highest value was shown by Site-2 (10.15mg/L) in the month of July, which is the site adjacent to waste dumping site of the Kollam district. Site-1 showed comparatively lesser values than the other two sites. As per WHO (2003), the iron concentration in rivers has been reported to be 0.7 mg/L. In

Table 1: Analysis of variance (One Way ANOVA) of heavy metals comparing three sites of the Ashtamudi Lake.

Parameters	Site-1	Site-2	Site-3	F value (Comparing sites)
	Mean± SD	Mean± SD	Mean± SD	
Copper	0.02±0.11[a]	0.08±0.02[b]	0.03±0.02[a]	50.103***
Lead	0.01±0.006[a]	0.04±0.008[b]	0.02±0.005[c]	37.031***
Zinc	0.03±0.009[a]	0.10±0.032[b]	0.05±0.017[c]	32.456***
Chromium	0.01±0.007[a]	0.04±0.008[b]	0.03±0.009[c]	22.962***
Cadmium	0.003±0.001[a]	0.005±0.002[b]	0.004±0.001[ab]	4.379*
Iron	8.41±0.64[a]	9.52±0.50[b]	9.18±0.51[b]	12.828***

*** = p < .001, ** = <.01, * = <.05, NS = Not significant, df = (2,35), SD = Standard Deviation, a,b,c = Means within rows with differing subscripts are significantly different, using Fisher's LSD post hoc test.

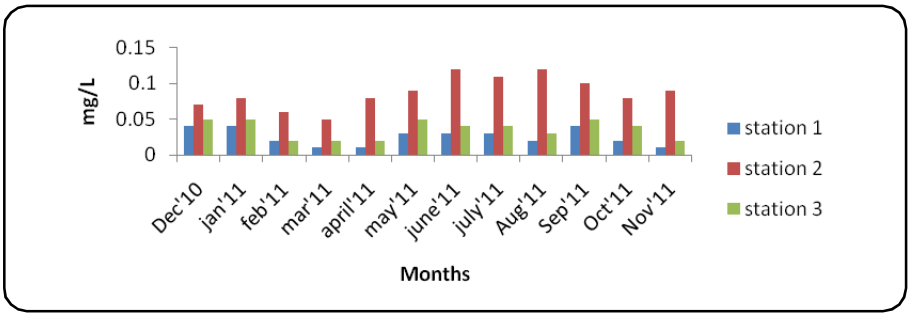

Fig. 1: Coppen at the three stations.

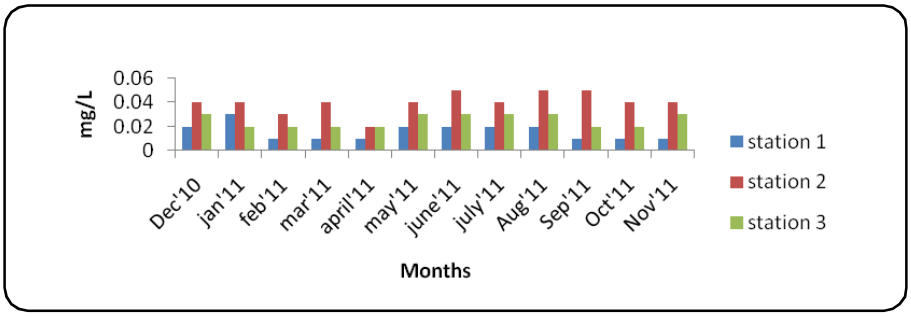

Fig. 2: Lead at the three stations.

the present study all the three sites exceeded this limit, which indicates the severity of pollution in the lake. The very high value of iron in the surface water may be due to the result of mixing of untreated domestic and industrial wastes. Zinc is an essential trace element found in aquatic environments in the form of salts or organic complexes (WHO 2003). The values of zinc were found in the range of 0.02 to 0.15mg/L in the Ashtamudi Lake. Highest value was recorded in the Site-2 and lowest value at Site-1. Zinc is one of the important trace elements that plays a vital role in the physiological and metabolic processes of many organisms. Higher concentrations of zinc can be toxic to the organisms (Rajkovic et al. 2008). It plays an important role in protein synthesis and is a metal which shows fairly low concentration in surface water due to its restricted mobility from the place of rock weathering or from the natural sources (Rajappa et al. 2010). Presence of copper in the study sites may be due to the presence of industrial and domestic wastes. Due to rapid urbanization and lack of solid waste management, lake was highly polluted. The presence of cadmium, chromium and lead, which are highly toxic metals, can be attributed to industrial and agricultural discharge (Mason 2002). The maximum allowable limit for chromium as per WHO guidelines is 0.03 mg/L. In the present study, the Site-2 and Site-3 exceeded this limit indicating the heavy metal pollution. The presence of lead in Site-2 and Site-3 could be attributed to

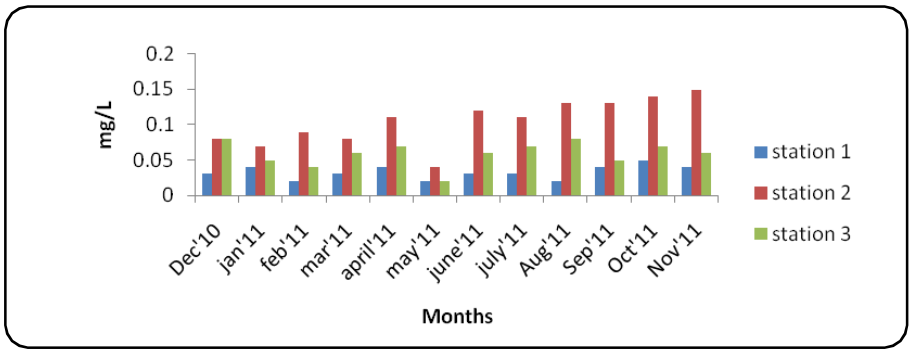

Fig. 3: Zinc at the three stations.

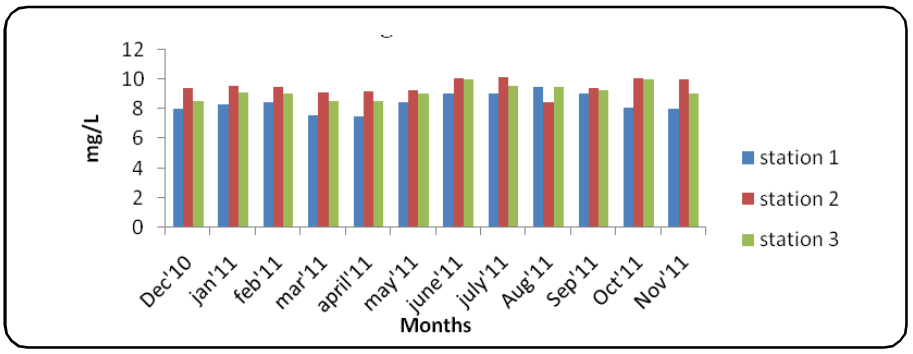

Fig. 4: Iron at the three sites.

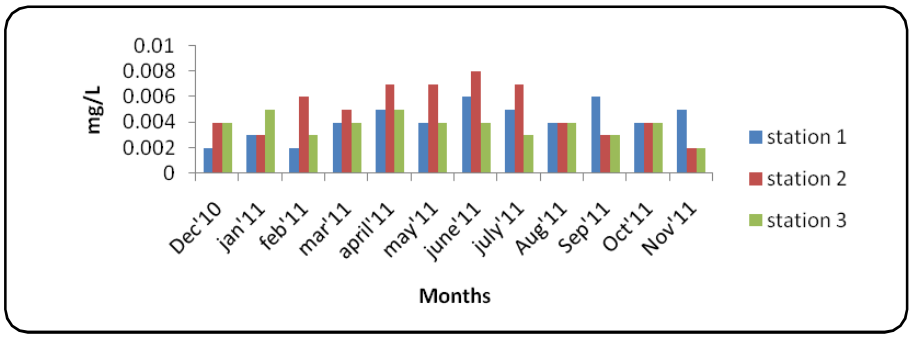

Fig. 5: Cadmium at the three stations.

the industrial and agricultural discharge as well as from spill of leaded petrol from fishing boats. Higher levels of lead often occur in water bodies near highways and large cities due to high gasoline combustion (Banat et al. 1998). Results of ANOVA showed that the values of copper [F (2, 33) = 50.103 p = 0.00], lead [F(2, 33) = 37.031, p = 0.00], zinc [F(2, 33) = 32.456, p = 0.00], chromium [F(2, 33) = 22.96 p = 0.00] and cadmium [F(2, 33) = 4.37 p = 0.21] have significant variation among the three sites (Table 1). Post hoc multiple comparison (LSD) showed significant variation of Site-2 from Site-1 and Site-3 in case of copper. Three sites showed significant variations in case of lead, zinc and chromium. Site-1 was found to be significantly varying from Site-2 and Site-3 in case of iron. Cadmium was found to be significantly varying between Site-1 and Site-2 only. The persistence and concentrations of these trace elements in the water column and bottom sediment may reflect the concentrations found in resident aquatic organisms

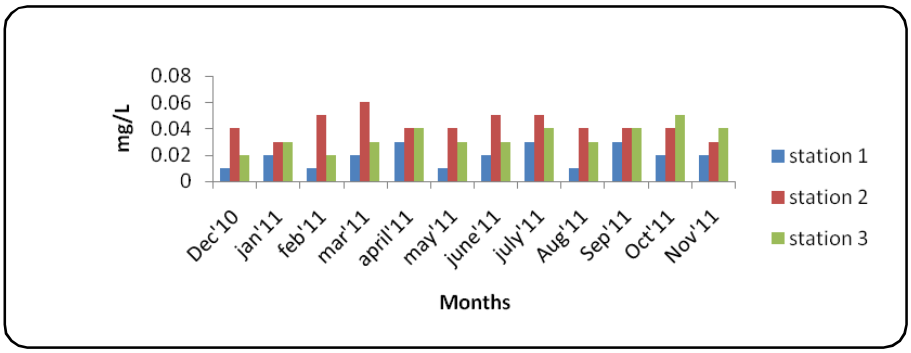

Fig. 6: Chromium at the three stations.

(through bioaccumulation), such as fish. This presents a human health concern if contaminated aquatic organisms, like fish and shellfish, are consumed.

ACKNOWLEDGEMENTS

The authors are thankful to University Grants Commission, New Delhi, India for financial support in favour of first author under the scheme of 'Maulana Azad National Fellowship for Minority Students'.

REFERENCES

APHA 2005. Standard Methods for Examination of Water and Wastewater. 21st ed. American Public Health Association/American Water Works Association/Water Environment Federation, Washington D.C., USA.

Babu, K. N., Omana, P. K. and Mohan, M. 2010. Water and sediment quality of Ashtamudi estuary, a Ramsar site, southwest coast of India - A statistical appraisal. Environ. Monit. Assess., 165(1-4): 307-19.

Banat, I. M., Hassan, E.S., El-Shahawi, M.S. and Abu-Hilal, A.H. 1998. Post-gulf-war assessment of nutrients, heavy metal ions, hydrocarbons, and bacterial pollution levels in the United Arab Emirates coastal waters. Environ. Inter., 24(2): 109-116.

Mason, C. F. 2002. Biology of Freshwater Pollution. 4rd ed., Essex Univ., England. 387pp.

Nair, M.N.M., Prakash, T.N., Kurian, N.P. and Rejith, K. 2001. Hydrography and sediment chemistry of Ashtamudi estuary. Tech. Rep. No.10, Submitted to Govt. of Kerala, India.

Petrus, R. and Warchol, J. K. 2005. Heavy metal removal by clinoptilolite. An equilibrium study in multi-component systems. Water Res., 39: 819-830.

Rajappa, B., Manjappa, S. and Puttaiah, E.T. 2010. Monitoring of heavy metal concentration in groundwater of Hakinaka Taluk, India. Contemporary Engineering Sciences, 3(4): 183-190.

Rajkovic, M.B., Lacnjevac, C.M., Ralevic, N.R., Stojanovic, M.D., Toskovic, D.V., Pantelic, G.K., Ristic, N.M. and Jovanic, S. 2008. Identification of metals (heavy and radioactive) in drinking water by indirect analysis method based on scale tests. Sensors, 8: 2188-2207.

Remadevi, V., Abdul Aziz, P.K. 1995. Pollution status of Ashtamudi estuary - need for management measures. Proceedings of the 7th Kerala Science Congress, State Committee on Science Technology and Environment.

Sujatha, C.H., Nify Beeny., Ranjitha Raveendran, Fanimol, C.L. and Samantha, N. K. 2009. Nutrient dynamics in the two lakes of Kerala, India. Indian Journal of Marine Sciences, 38(4):451-456.

WHO 2003. Guidelines for Drinking Water Quality. World Health Organization, Geneva, 249pp.