Role of Macrophytes in improving water quality of Meiktila Lake

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Abstract

The heavy metal concentration of water was studied from June to October, 2013; sediments and macrophytes were studied on June, 2013. The heavy metal concentration of water, sediments and macrophytes were measured at the Universities' Research Center (URC), Yangon University. In the water samples, the highest heavy metal concentration was found in As (5.76 mg/L), followed by Hg (3.76 mg/L), Cd (1.88 mg/L) and Pb (0.43 mg/L). In the sediment samples, the highest concentration was found in As (8.59 mg/L), followed by Pb (3.38 mg/L), Cd (3.14 mg/L) and Hg (3.11 mg/L). In the macrophyte samples, the highest heavy metal concentration was found in *Eichhorniacrassipes*(Mart) Solm. with Pb (3.72 mg/L), and then Hg (3.65 mg/L), Cd (2.38 mg/L) and As (2.17 mg/L). The heavy metal concentration of water and macrophytes were higher than the WHO (2000) standard.Therefore it should be prohibited tightly to the public near by the Lake not to have bath and swim in Lake Water and not to discard the household wastes into the Lake water for public health.
Key words*:*Macrophytes, Heavy metal concentrations of water, sediments

Introduction

Littoral zones of aquatic ecosystems are among the most productive ecosystems, are among the most productive communities on earth (Goldsborough *et al*. 2005). In a shallow lake with a large biomass of submerged macrophytes and epiphytes, the littoral zone may be an important contributor production (PP) and an important regular of nutrient fluxes (Galanti and Romo 1997).

Bottom sediments can acts as a reservoir for heavy metals, and should therefore be given special consideration in the planning and design of aquatic pollution research studies. An undisturbed sediment column contains a historical record of geochemical characteristics in the watershed. If a sufficiently large and stable sediment sink can be located and studied, it will allow an investigator to evaluate geochemical changes over time (Horowitz 1997). Heavy metals such as arsenic, cadmium, mercury, lead, copper and zinc are regarded serious pollutants of aquatic ecosystems because of their environmental persistence, toxicity and ability to be incorporated into food chains (Forstner and Wittman 1983).

Macrophytes, as a component of freshwater ecosystems have diverse roles to play in the structure and functioning of these ecosystems (Pandit 1984; Wetzel 2001). Water plants, including macrophytes are universally recognized as important participants in the natural processes of water self-purification (Gayevskaya 1966; Dembitsky*et al*. 1992)

Submerged macrophytes have major effects on productivity and biogeochemical cycles in fresh water because they occupy key interfaces in stream and lake ecosystems. Most macrophytes are rooted, and constitute a living link between sediments and the overlying water (Carpenter 1980).

Materials and methods

Meiktila Lake is a large freshwater lake located between 20° 53' 53" North latitude and 95° 51' 20" East longitude with an elevation of 236.36 m above the sea level. The macrophytes were collected from the littoral zones of emergent, free floating and submerged macrophytes at six stations, June 2013. Among the collected macrophytes, the ten species of macrophytes were selected to measure the concentration of heavy metal in the plant body. The heavy metal concentration of macrophyteswas measured at the Universities' Research Centre (URC), Yangon University.

Results and discussion

According to the data, ten species belong to 10 genera of macrophytes are distributed in study area. The list of the heavy metal concentration and ten species of macrophytes are stated in Table 1-7 and Figure 1-10.

Table 1. Heavy metal concentration in water samples (June, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb (mg/L)	Hg(mg/L)	WHO(2000)
1	5.26	0.05	0.04	2.49	As = 0.1
2	5.23	0.23	0.05	2.33	Cd = 0.05
3	5.76	0.26	0.05	3.76	Pb = 0.05
4	5.55	0.54	0.15	2.21	Hg = 0.001
5	5.14	0.14	0.07	2.14	
6	5.17	0.14	0.24	2.24	

Table 2. Heavy metal concentration in water samples (July, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb (mg/L)	Hg(mg/L)	WHO(2000)
1	5.25	0.15	0.03	1.26	As = 0.1
2	4.23	0.13	0.43	1.17	Cd = 0.05
3	5.63	0.16	0.05	2.74	Pb = 0.05
4	5.61	0.56	0.15	1.75	Hg = 0.001
5	5.26	0.14	0.06	2.27	
6	5.27	0.26	0.03	2.24	

Table 3. Heavy metal concentration in water samples (August, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb (mg/L)	Hg(mg/L)	WHO(2000)
1	5.21	0.25	0.22	1.16	As = 0.1
2	5.16	0.32	0.05	1.16	Cd = 0.05
3	5.23	0.18	0.02	1.26	Pb = 0.05
4	4.82	0.17	0.34	1.68	Hg = 0.001
5	4.46	0.14	0.19	1.17	
6	5.76	0.17	0.16	1.39	

Table 4. Heavy metal concentration in water samples (September, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb (mg/L)	Hg(mg/L)	WHO(2000)
1	0.55	1.25	0.21	1.15	As = 0.1
2	2.16	1.35	0.05	1.61	Cd = 0.05
3	1.22	0.32	0.02	1.26	Pb = 0.05
4	0.82	1.27	0.34	1.32	Hg = 0.001
5	1.86	1.36	0.19	1.17	
6	0.76	1.74	0.16	1.68	

Table 5. Heavy metal concentration in water samples (October, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb(mg/L)	Hg(mg/L)	WHO(2000)
1	0.60	1.32	0.24	1.21	As = 0.1
2	2.66	1.61	0.06	1.35	Cd = 0.05
3	1.89	0.47	0.02	1.24	Pb = 0.05
4	1.90	1.88	0.60	1.41	Hg = 0.001
5	1.72	1.42	0.18	1.29	
6	0.88	1.63	0.26	1.70	

Table 6. Heavy metal concentration in sediment sample (June, 2013)

Station	As(mg/L)	Cd(mg/L)	Pb(mg/L)	Hg(mg/L)	WHO(2000)
1	7.05	1.16	0.87	2.05	As = 1.0
2	7.23	1.23	2.77	2.03	Cd = 1.0
3	7.35	2.16	2.49	2.06	Pb = 5.0
4	8.59	2.55	2.38	2.22	Hg = 0.2
5	7.04	3.14	3.38	3.11	
6	7.14	3.04	3.08	3.01	

Table 7. Heavy metals concentration of macrophytes in Meiktila Lake (June, 2013)

Macrophytes	As(mg/L)	Cd(mg/L)	Pb (mg/L)	Hg(mg/L)	WHO(2000)
Characanescens Loiseleur-Deslongchamps	1.69	1.89	1.31	2.19	As = 1.0
Marseliavestita L.	1.72	1.34	2.10	1.64	Cd = 1.0
*Polygonumglabrum*Willd	1.66	2.11	1.89	1.75	Pb = 5.0
Bacopa monnieri L.	1.22	1.46	1.91	0.89	Hg = 0.2
Hydrilla verticilita (L.) Royle.	1.36	1.46	1.27	1.88	
Potamogeton nodosus Roxh.	1.15	1.43	1.48	1.72	
Potamogeton pectinatus L.	1.18	1.22	1.38	1.34	
Lemna minor L.	1.32	1.87	1.56	2.66	
Eichhorniacrassipes(Mart) Solm.	2.17	2.38	3.72	3.65	
Scripus lacustris L.	1.56	1.72	1.62	1.33	

1. *Characanescens*Loiseleur-Deslongchamps

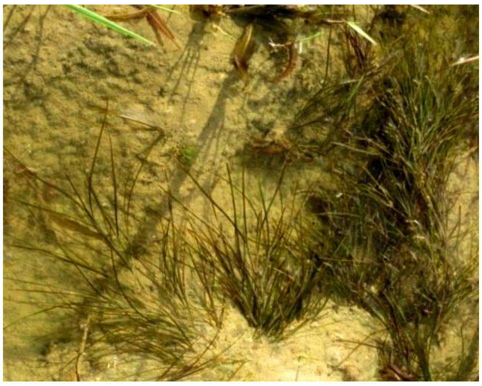
2. *Marseliavestita*L.

3. ***Polygonumglabrum*Willd**

4. ***Bacopamonnieri*(L.) Pennel**

5. *Hydrilla verticillata* (L.) Royle

6. *Potamogeton nodosus* Roxb.



7. *Potamogeton pectinatus* L.

8. *Lemna minor* L.

9. *Eichhorniacrassipes*(Mart) Solms

10.*Scripuslacustris*L.

Discussion and conclusion

The heavy metal concentration of water was studied from June to October, 2013; sediments and macrophytes were studied on June, 2013. According to the data, the concentration of As, Cd, Pb and Hg were highest in *Eichhorniacrassipes*(Mart) in June. As and Cd are lower in *Potamogetonnodosus*Roxh (1.5 mg/L). and *P. pectinatus* L.(1.22 mg/L) Hg is lowest in *Bacopa monnieri* L. and it was 0.39 mg/l and the lowest concentration (1.27 mg/L) was found in *Hydrilla verticillata* (L.) Royle. Similarly, in January the highest data of heavy metal were found in *Eichhorniacrassipes*(Mart) Solm. exceptPb which was the highest in *Marseliavestita*L.

The lowest concentration of As and Cd were found in some species as in June. It was interesting that the lowest concentration of Pb was found in *Eichhorniacrassipes*(Mart.) Solm and the result was different with the data found in June. The lowest concentration (1.62 mg/L) of Hg was found in *Scripuslacustris* L. and it was larger than that of value (0.89 mg/L) found in *Bacopa monnieri* L.According to the results, free floating plant of *Eichhorniacrassipes* (Mart) Solms. may be uptake heavy metals than other emergent and submerged macrophytes. This finding agreed with Lewander*et al.* (1996).They reported that the littoral plants were accumulated with cadmium and lead, and the water samples from the littoral zone contained less heavy metals than water from the bank zone. In the present study, the heavy metal concentration is not permissible limit of WHO (2000) standard.

Therefore, these littoral plant species show potential for use as a biological barrier against the spread of heavy metal pollution in lakes. The present study showed that *Eichhorniacrassipes*(Mart) Solms was the highest biomass and could be absorbed heavy metal than other macrophytes. So this species can serve as good bioaccumulators and bioindicators of heavy metal in water bodies under natural conditions.

Similarly heavy metal concentrations of aquatic macrophytes were also higher than that of WHO (2000) standard except Pb in June, 2013. Especially, the highest concentrations of heavy metal were found in *Eichhorniacrassipes* (Mart) Solms. and therefore the biomass of *Eichhorniacrassipes* (Mart) Solms. should be discarded yearly to reduce the concentration heavy metal in Lake water.

Therefore it may be concluded that it should not be used the water in Meiktila Lake as drinking water without boiling. Spellman (2008) stated that contamination of the aquatic by the heavy metal is a serious environment problem, which threatens aquatic ecosystems, agriculture and human health. Therefore it should be prohibited tightly to the public near by the Lake not to have bath and swim in Lake Water and not to discard the household wastes into the Lake water for public health.

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