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DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MACROINVERTEBRATES IN COLOMBO CANAL SYSTEM AND THE POTENTIAL OF USING THEM AS BIOINDICATORS FOR STREAM HEALTH MONITORING

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INTRODUCTION

Macroinvertebrates have been used as bioindicators for monitoring of stream (wetland) health since they are known to respond with a range of sensitiveness to many kinds of natural or man-made stressors. Main advantages of using macro-invertebrates for monitoring are; it provides a short to medium term record of the pollution history of the site and acts as the simplest and the cheapest method of measuring stream (wetland) health with minimum impact to the system (Hodkinson and Jackson, 2005).

Colombo canal system is comprised with several branches and outfalls to the sea while holding three main marshes. Due to the rapid urbanization and development of the area, the canal system has been heavily contaminated with pollutants. Main objectives of the study were to assess the environmental characteristics of the wetland and the canal system, to survey the quality of the water and macroinvertebrate diversity, their abundance and distribution within the ecosystem and then to find out what are the organisms or taxonomic groups that can be used as bioindicators to monitor the health of the canal system.

METHODOLOGY

Sixty eight macroinvertebrate samples were obtained from 10 stations namely Kotte, Nawala, OUSL, Kirimandala Mw., Wellawatta, Orugodawatta, St. Sebastian, Beira Lake, Buthgamuwa and Royal Park representing main canals and marshes covering dissimilar environmental conditions of the canal system during the period of Nov. 2008 to June 2009 on monthly basis. Macroinvertebrates were collected using a D – framed kick net (with a 400 μm mesh bag) by dragging it about 10 meters distance along both banks in each and every station. At the same time habitat characteristics and water quality parameters of all stations were recorded. Then these sampled macroinvertebrates were identified and counted up to species level or at least up to order level referring guides and keys of Fernando (1990), Bouchard (2004), etc.. When analysing data seven species/taxa were shortlisted based on their number of occurrence and considering their tolerance values (Mandaville, 2002). Then Pearson's correlation coefficient (r) between collected macroinvertebrates and water quality data was calculated to assess the relationship between them and explore potential macroinvertebrate species as bioindicators for stream (wetland) health monitoring.

RESULTS AND DISCUSSION

During the study fifty three species of macroinvertebrates belonging to four main phyla (Arthropoda, Mollusca, Annelida and Platyhelminthes) were revealed from the overall canal system. Sampling station at Royal Park recorded the highest species richness which was 38 species while Beira Lake showed the lowest species richness. When considering the species density variation, the highest average density of macroinvertebrates was recorded from

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Kirimandala Mw. as 567 individuals/630L of water whereas the lowest from Wellawatta station as 38 individuals/ 630L.of water. Figures 1 and 2 show the variation of macroinvertebrate species /taxa richness and average density among ten sampling stations.

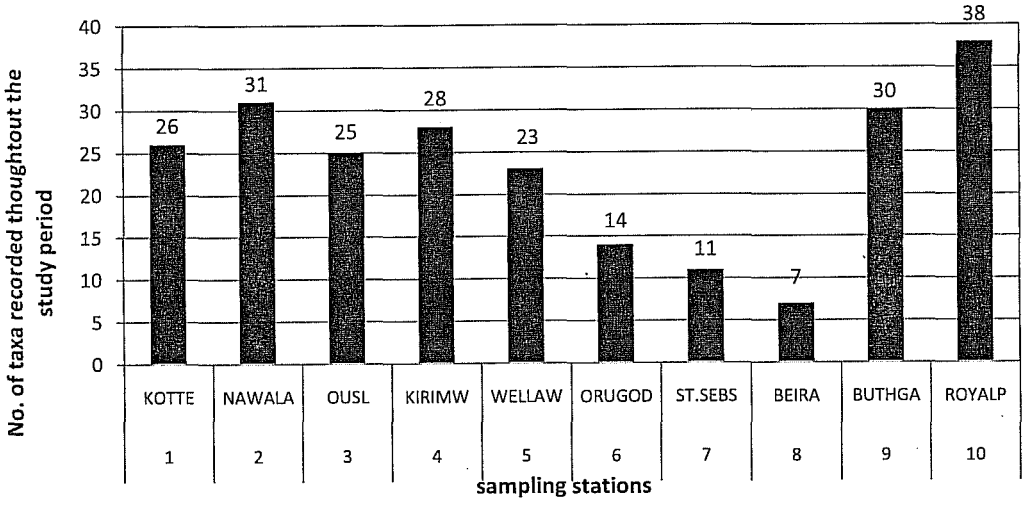

Figure 1: Taxonomic richness and its variation within ten sampling stations recorded throughout the study period of Nov 2008 to June 2009.

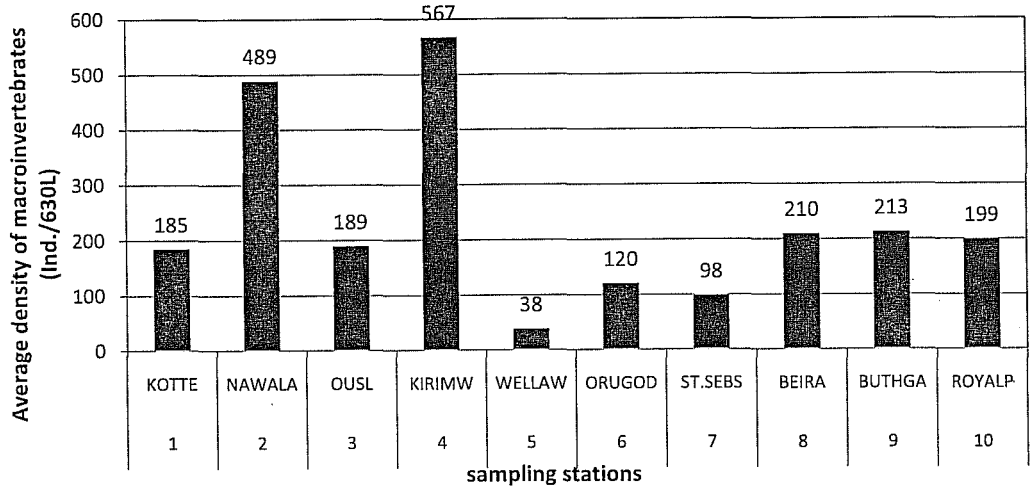

Figure 2: Average density variation of macroinvertebrates in ten sampling stations (no of individuals/630L of water).

Seven macroinvertebrate species/taxa such as 1.*Tubifex* spp., 2.*Lymnaea stagnalis*, 3.Dragonfly nymphs, 4.Chironomidae larva, 5.Horsefly larva, 6.Freshwater shrimps and 7.Damsel fly larvae were selected as candidate bioindicators. Among them *Lymnaea stagnalis* was recorded in 55 samples out of 68 total samples. Figure 03 shows their distribution pattern and abundance within ten sampling stations. Kirimandala Mawatha station showed the highest overall density while Wellawatta and St. Sebastian stations showed lower values. According to the graph plotted below (Fig 03) it has realized that the most abundant bioindicator taxa out of the seven taxa was fresh water shrimps in Kotte, Nawala and Buthgamuwa, which also reported high Dissolved Oxygen

(DO) levels but it has replaced by Chironomidae larva in Kirimandala Mw and Beira Lake. Also there was a remarkable increase of Conductivity and Cl^- concentration values but least density from Wellawatta station which was located closer to the sea.

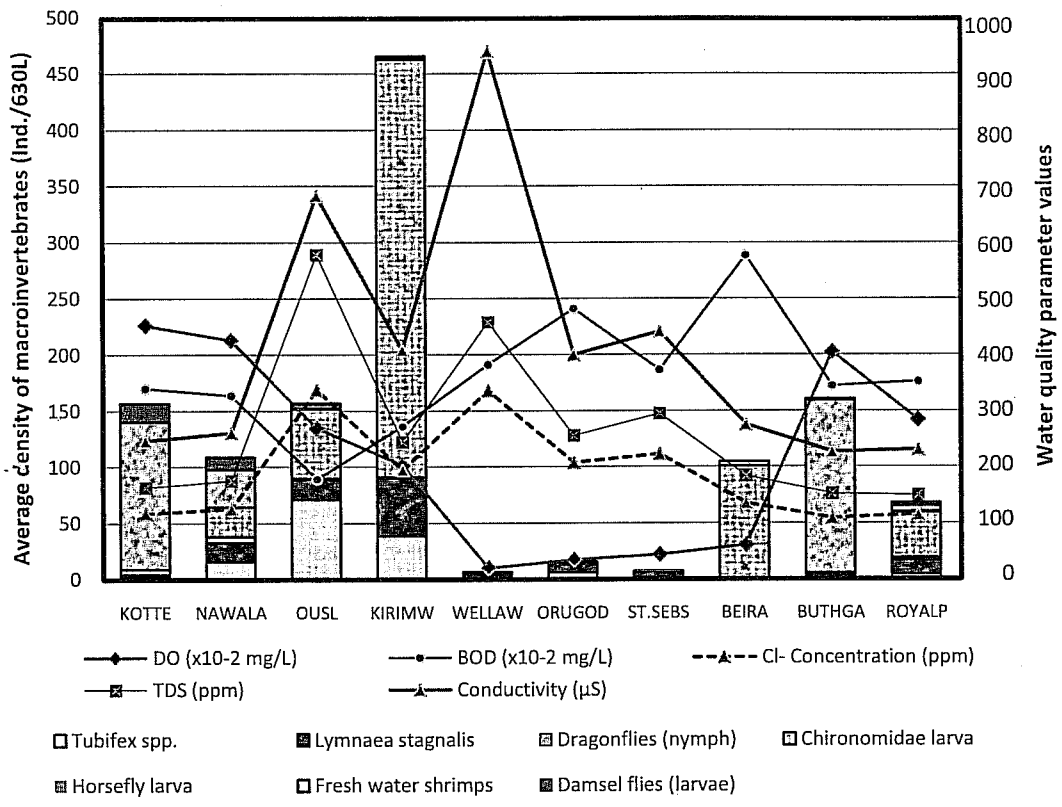

Figure 3: Distribution pattern and abundance of seven selected candidate bioindicator species/taxa and variation of some significant water quality parameters along ten sampling stations.

	Candidate Indicator Species/ taxa	No. of Occurrence (out of 68 samples)	Tolerance value (Hilsenhoff)	r values obtained for parameters				
				DO	BOD	Cl- concentration	Total Dissolved Solids (TDS)	Conductivity
1	*Tubifex spp.*	29	9	0.14	0.72	0.52	0.64	0.34
2	*Lymnaea stagnalis*	55	6	0.10	-0.54	0.10	0.09	0.02
3	Dragonflies (nymph)	27	2	0.65	-0.21	-0.45	-0.37	-0.41
4	Chironomidae larva	34	8	-0.06	-0.23	0.01	-0.03	-0.04
5	Horsefly larva	15	10	-0.17	-0.44	0.22	0.20	0.05
6	Fresh water shrimps	38	6	0.72	-0.12	-0.52	-0.44	-0.45
7	Damsel flies (larvae)	33	6	0.73	-0.20	-0.44	-0.36	-0.38

Table 1: Candidate bioindicator species/taxa, their number of occurrence, Hilsenhoff's tolerance values and Pearson's correlation coefficient values (r) between density values and some water quality parameters

Pearson's correlation coefficient values (r) obtained for candidate bioindicator species/ taxa and some water quality parameters such as Dissolved Oxygen –DO (mg/L), Biochemical Oxygen Demand-BOD (mg/L), Cl^- concentration (ppm), Total Dissolved Solids - TDS (ppm) and

Conductivity (µS) have given in table 01. They are most significant when considering the health of a stream or a wetland.

According to the statistical analysis *Tubifex spp* showed very high negative correlation with BOD and high significant positive correlation with TDS values. Meanwhile freshwater shrimps and Damsel flies larvae have shown very high positive correlation with DO. Candidate bioindicators like Chironomidae larva, horsefly larva and *Lymnaea stagnalis* do not show any high significant relationships with any parameter.

CONCLUSIONS/ RECOMMENDATIONS

Royal Park, Nawala and Buthgamuwa areas of Colombo canal system were very significant due to their high species richness. It seemed species like Chironomidae larva, *Lymnaea stagnalis* and *Tubifex* spp can easily dominate the community regardless the environment condition which is important to keep the system live and continue all nutrient cycles. There is a potential of using *Tubifex spp,* Freshwater shrimps and Damsel flies larvae as bioindicators for monitoring stream (wetland) health particularly for some parameters like DO, BOD and TDS. However, it would be more effective to use them collaboratively rather independently to give an overall view on stream (wetland) health.

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REFERENCES

Bouchard, R.W., Jr. (2004). Guide to aquatic macroinvertebrates of the Upper Midwest. Water Resources Center, University of Minnesota, St. Paul, MN. 208pp.

Fernando, C.H. (1990). The Freshwater fauna and fisheries of Sri Lanka. Natural Resources, Energy & Science Authority of Sri Lanka (Colombo).

Hodkinson, I.D., and Jackson, J.K. (2005). Terrestrial and Aquatic Invertebrates as Bioindicators for Environmental Monitoring, with Particular Reference to Mountain Ecosystems, Environmental Management. 35(5): 649–666.

Mandaville, S.M. (2002). Benthic Macroinvertebrates in Freshwaters – Taxa Tolerance Values, Metrics and Protocols. (Project H-1), Soil & Water Conservation Society of Metro Halifax [http://chebucto.ca/Science/SWCS/SWCS.html].