Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Archives of Applied Science Research, 2012, 4 (6):2552-2556
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-508X
CODEN (USA) AASRC9

Study to detect impacts of pollution on the distribution of Zooplankton in the Northern tropical ponds in Sri Lanka

A. E. S. Patrick*, J. M. Kadotgasan and G. Naveendrakumar

Department of Biological Science, Faculty of Applied Science, Vavuniya Campus of the University of Jaffna

---

ABSTRACT

Although the Limnological survey are well documented in Sri Lanka. However, not much work has been done in Northern Province after the early nineteen eighties. Zooplankton community distribution can be taken as an indicator of the well-being of the water bodies. The Ariyakulam pond and Vavuniya tank were chosen to investigate the distribution of major Zooplankton; Rotifera, Cladocera and Copepoda along with the pollution impacts during January-June, 2012. Oil and Grease pollutant is common in Vavuniya tank, not in Ariyakulam, where Biological Oxygen Demand (BOD_5) was determined in various regions of the pond to distinguish the polluted and non-polluted regions in both water bodies. Random Plankton sampling was done in the littoral zones, as it was densely packed with vegetation, Sieve-set (50μm) was used to filter the water sample, preserved with 4% formalin and taken to the laboratory for qualitative and quantitative analysis using low-power light microscope. Sedgewick-Rafter cell was used to estimate the zooplankton abundance as individuals/m^3. Comparing the distribution of zooplankton community in both non-polluted regions, Rotifers were higher, followed by Cladocerans and Copepods. Relative abundance of Rotifers were significantly higher ($p<0.05$) in non-polluted region (BOD_5=1.095-1.800mgL^{-1}) than polluted region (BOD_5=3.500-4.012mgL^{-1}) within Vavuniya tank, justifies the less tolerability to pollution or vulnerability to predation by Copepods. When comparing the Rotifer distribution within Vavuniya tank, there was a significantly higher ($p<0.05$) abundant was observed in non-polluted (BOD_5=1.100-1.800mgL^{-1}) region than the polluted region (BOD_5=3.500-4.200mgL^{-1}). Copepods were significantly ($p<0.05$) higher in the polluted region of Vavuniya tank than the polluted region of Ariyakulam pond (BOD_5=2.000-2.500mgL-1) indicating the high tolerability to pollution. Cladocerans also showed the second largest abundance in the non-polluted regions compare to the polluted regions in the water bodies, indicating the impact of pollution.

Keywords: Zooplankton, pollution indicators, tropical pond

INTRODUCTION

Plankton as bio-indicators has been extensively used in the establishment of water quality status. Their suitability for theoretical and experimental population ecology studies is conferred by their small sizes, short generation time and relatively homogenous habitats [1]. The influence of pollution on the abundance of major zooplanktons like Rotifera, Cladocera and Copepoda were investigated at polluted and non polluted regions of two different fresh water bodies in Vavuniya tank and Ariyakulam pond in Vavuniya District and Jaffna District respectively. Zooplankton study is of necessity in fisheries, aquaculture and paleolimnological research [2]. Vavuniya tank (0.6 km^2) is a perennial and more productive by means of its inland capture fisheries and irrigation, subjected to Oil and Grease pollution [3], while Ariyakulam (0.015 km^2) is an ephemeral and not used for fisheries or irrigation. The abundance and quality of the world's freshwater resources are declining rapidly. Changes in land use degrade natural freshwaters and reduce biodiversity by eliminating valuable habitats and adding excess nutrients. The scope of this preliminary study is to seek the current trend of these water bodies.

MATERIALS AND METHODS

Vavuniya tank (in between 8˚45’13.75-59.23” latitude and 80˚30’7.50-53.21” longitude) in the Vavuniya District and Ariyakulam pond (in between 9˚40’3.09-7.98” latitude and 80˚1’6.77-10.47” longitude) in Jaffna District (**Fig. i**) was chosen, the polluted and non polluted regions were identified by measuring the BOD_5 with replicates, during December 2010 to February 2011, around 7.00-7.45 am on every occasions.

Fig. i: Map showing the study site, Vavuniya tank at Vavuniya district (left) and Ariyakulam pond at Jaffna district (right) in Northern Province of Sri Lanka

Water samples were collected in the littoral zones just below the water surface (15-20cm depth). As this regions are densely packed with vegetations, sieve-set (50µm) were used to filter the water samples, washed carefully into the 10mL vials, preserved in 4% formalin [4] and taken to the laboratory for microscopic analysis as follows (**Fig**. **ii**).

Sampler [4L] 4L of water sample was taken from pond → **Sieve-set [50µm]** Used to filter the zooplankton from pond water sample → **Vial [10mL]** 4L water sample of zooplankton was rinsed in to 10mL vial and preserved with 5% → **Sedgewick-Rafter cell [1mL]** 1mL of sub-sample was taken from vial and spread in to counting chamber

Fig. ii**: Method of sampling for zooplankton estimation**

Sedgewick-Rafter cell was used to estimate the zooplankton abundance. Predesigned pathway used to count the 200 grids out of 1000 (**Fig. iii**).

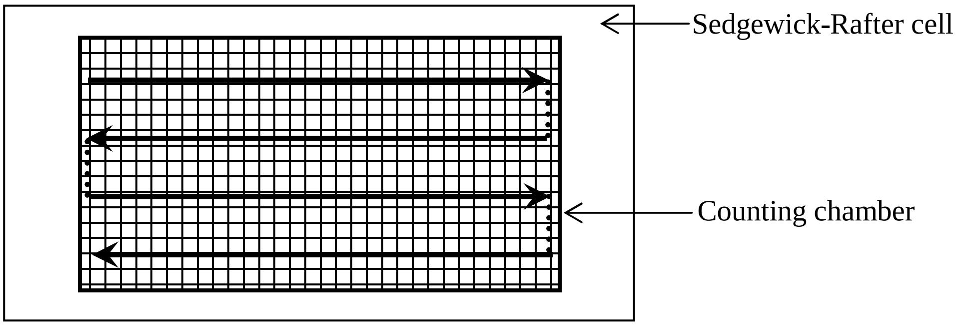

Fig. iii**: Method of counting zooplankton in Sedgwick-Rafter cell**

The qualitative (identification to order level using Malaysian zooplankton identification key & quantitative (abundance) estimation was performed under the low-power of light microscope. Along with this study BOD_5

(Winkler's method) was determined in each regions and occasions to find the pollution effect. According to [5] the level of pollution in lake can be categorized in to clean (1.1-1.9), moderately polluted (2.0-2.9), polluted (3.0-3.9), very polluted (4.0-10.0) and extremely polluted (>10) by respective BOD_5 range.

Abundance of zooplankton was estimated as individuals/m^3 of the original sample using the equation [6,7].

$$n = \frac{a \times C \times 1000 \times 10^6}{N \times L}$$

Where,
n = Total number of plankton in $1m^3$ (individual/m^3)
a = Total number of planktons in 1mL
C = Volume of concentrate expressed in mL (Here it is 10×10^{-3}L)
1000 = Number of grids in the counting chamber
N = Number of grids are employed
L = Volume of water filtered expressed in L (Here it is 4L)
Statistical analysis was done by using Minitab 14.0 and Ms Excel to find out the significant variation of the zooplankton abundance in varying regions and regions.

RESULTS AND DISCUSSION

Table I: Observed zooplankton abundance in Ariyakulam pond and Vavuniya tank at polluted and non polluted regions in 3 different occasions

Abundance of Zooplankton (n/m^3)			**Ariyakulam**			**Vavuniya tank**		
			ROT	**CLAD**	**COPE**	**ROT**	**CLAD**	**COPE**
Non polluted	Occasion	R1	6842	3962	1738	31848	8634	15063
		R2	6002	4777	1542	38991	20777	12063
		R3	8542	7642	1641	20653	8277	3277
	Mean±SD		7129±1294	5460±1933	1640±98	30497±9243	12563±7116	10134±6125
	BOD_5 range		0.025 - 0.080 mg/L			1.095-1.800mg/L		
Polluted	Occasion	R1	3042	5102	3340	2920	2205	16491
		R2	3950	4731	2042	2733	1134	21848
		R3	9755	5752	1346	2653	4705	18991
	Mean±SD		5582±3642	5195±517	2243±1012	2769±137	2681±1833	19110±2680
	BOD_5 range		2.000 - 2.500 mg/L			3.500-4.200mg/L		

Where the abbreviates ROT-Rotifera, CLAD-Cladocera and COPE-Copepoda and SD-Standard deviation, BOD_5-Biological Oxygen Demand (5 days) and n-Number of individuals

The use of zooplankton community structure as an indicator of the wellbeing of lakes dates back to as early as Birge-Juday era, 1879-1910 [8]. The zooplankton community structure in the non polluted regions of both water bodies were Rotifera>Cladocerans>Copepods; where the Vavuniya tank leads the Ariyakulum (**Fig. vi**), justifies the well being of the water body (non polluted region); especially the abundance of Rotifer was significantly higher ($p<0.05$) in Vavuniya tank than Ariyakulum.

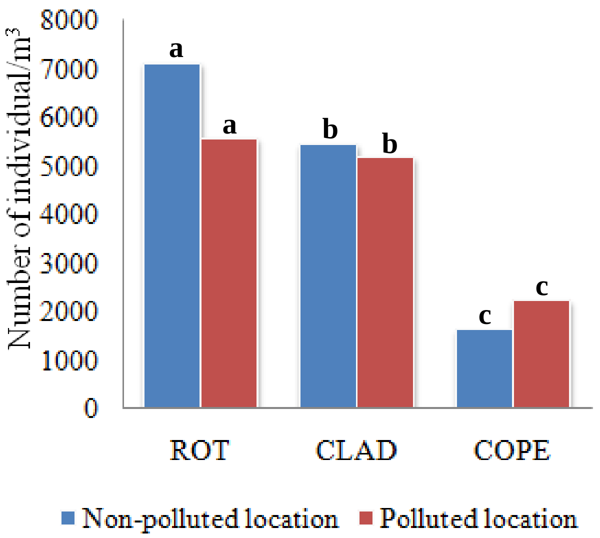

Fig. iv: Zooplankton abundance in two locations of Ariyakulam

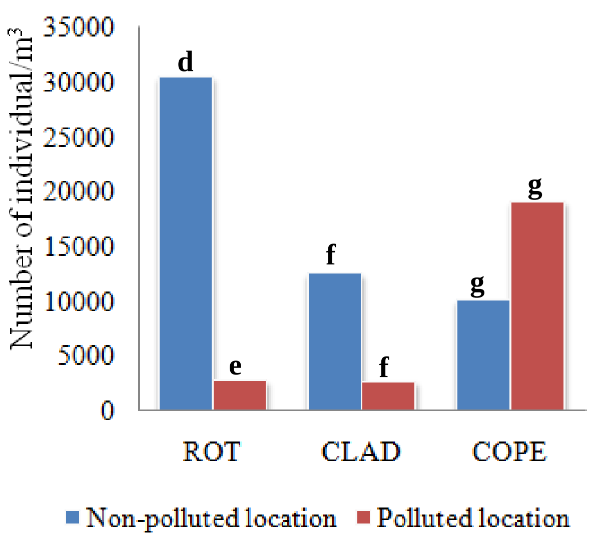

Fig. v: Zooplankton abundance in two locations of Vavuniya Tank

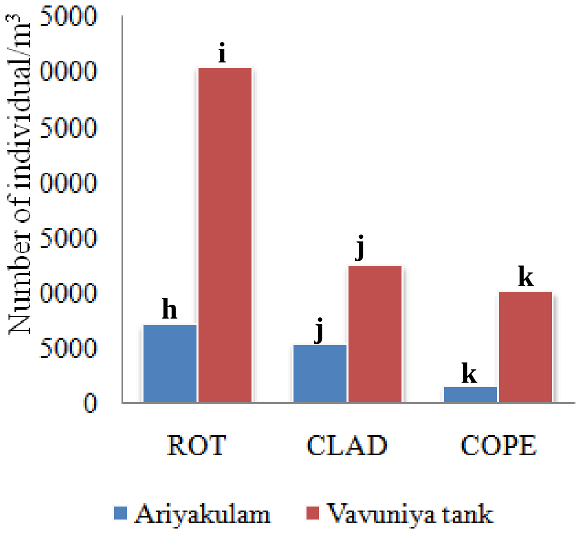

Fig. vi**: Zooplankton abundance in Non-polluted locations**

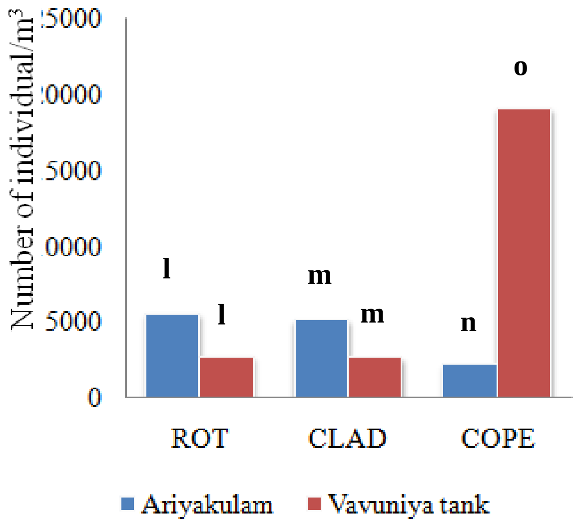

Fig. vii**: Zooplankton abundance in Polluted locations**

[Fig. iv-vii**: Bars with different alphabetical suffixes indicate the significant differences (*P<0.05*) and same alphabetical suffixes indicate no significant difference (*P>0.05*)]**

comparing the Rotifera abundance within the Vavuniya Tank, there was a significantly higher ($p<0.05$) abundance was observed in non polluted (BOD_5=1.100–1.800mg/L) region than polluted region (BOD_5=3.500–4.200mg/L).

This may be due to the less tolerability or susceptibility to the pollution effects or heavy predation pressure caused by Copepods, justifies the higher Copepod abundance (**Fig. v**).

Zooplankton species succession and spatial distribution result from differences in ecological tolerance to abiotic and biotic environmental factors [10].

The abundance of Copepods was significantly ($p<0.05$) higher in the polluted region of the Vavuniya tank (BOD_5=3.500–4.200mg/L), when compare to the polluted region of the Ariyakulum (BOD_5=2.000-2.500 mg/L) in Jaffna district (**Fig. vii**). This can be explained by the [11] size efficiency hypothesis; "When fish predation is intense, it will eliminate the larger zooplankton allowing the smaller zooplankton to escape form predation" the high abundance of planktivorous fish predation (*Tilapia*) is intense in Ariyakulum (no inland fisheries take place) compared to the Vavuniya tank where the fishing mortalities occurred considerably by means of inland capture fisheries. The second largest abundance goes to Cladocera in the non polluted regions of both water bodies where Vavuniya tank (12563±7116) leads the Ariyakulam (5460±1933). On the contrary, Ariyakulam (5195±517) leads the Vavuniya tank (2681±1833) in both polluted regions.

This could be due to the higher pollution effects seen in Vavuniya tank than the Ariyakulam pond in the particular regions.

CONCLUSION

The abundance of Rotifer population was significantly higher in the non polluted region in Vavuniya tank than that of Ariyakulam pond. When comparing the polluted regions in the Ariyakulam with Vavuniya tank, where the pollution effect was higher (BOD_5=3.500–4.200mg/L) than Ariyakulam (BOD_5=2.000-2.500mg/L) that justifies the significantly higher abundance of Copepod population. Although this study reveals the strong conclusion, as it was a preliminary study, the future studies needed to investigate the influence of other biotic and abiotic factors on the zooplankton community structure and abundance in both water bodies.

REFERENCES

[1] Ogbuagu DH, Ayoade AA, Okoli CG. *Journal of Microbiology and Biotechnology Research*. **2012**; 2(2): p. 289-297.

[2] Guy D. The ecological of the fish pond ecosystem of the fish pond ecosystem with special reference to Africa: Pergamon Pess; **1992**.

[3] Patrick AES, Naveendrakumar G, Arjunan K. Some aspect of linear morphometrics and sex ratio of Tilapia sp. in polluted and non-polluted location of Vavuniya tank. In Vavuniya Campus Annual Research Session (VCARS); **2011**; Vavuniya: Vavuniya Campus of The University of Jaffna. p. 13.

[4] Okorafor KA, Andem AB, Okete JA, Ettah SE. *European Journal of Zoological Research*. **2012**;: p. 31-36.

[5] Bashkin MRaVN. Practical environmental analysis: Royal Society of Chemistry (Great Britain); **1999**.

[6] Boyd CE. Water quality in warm water fish ponds USA: Auburn University Press; **1981**.

[7] American Public Health Association. Standard methods for the examination of water and wastewater. **1998**.

[8] Frey DG. Limnology in North America. **1963**;: p. 3-54.

[9] Gannon JE, Stemberger RS. Zooplankton (especially crustaceans and rotifers) as indicators of water quality. **1978**; 97: p. 16-35.

[10] Marneffe Y, Comblin S, Thomé J. Ecological water quality assessment of the Bûtgenbach lake (Belgium) and its impact on the River Warche using rotifers as bioindicators; **1998**.

[11] Brooks JL, Dodson SI. Predation, body sige, and composition Of plankton; **1965**.