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Biodiversity of bacterial pollutants in lentic ecosystems of Kanyakumari district, Tamilnadu

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Abstract

This paper attempts to understand the diversity of bacterial pollutants in lentic ecosystems of Kanyakumari district, Tamil Nadu. Five ponds were selected for this study viz. Theroor pond, Putheri pond, Chunkangkadai pond, Neduvali pond and Nalloor pond for total coliforms, faecal coliforms, *Streptococcus faecalis*, *Salmonella species* and *Shigella* species. Occurrence of bacterial indicators in water depicted the polluted status of the lentic ecosystem. Total coliform count ranged from 146 to $61x10^2$ cfu/100ml, faecal coliforms from 44 to $26x10^2$ cfu/100ml, *Streptococcus faecalis* from 47 to $31x10^2$ cfu/100ml, *Salmonella* species from 2 to $12x10^2$ cfu/100ml and *Shigella* species from $9x10^2$ to $65x10^2$ cfu/100ml. Occurrence of enteropathogenic *E.coli* that causes diarrhea, *Streptococci* causative of dysentery, *Shigella* and *Salmonella* species respectively causing shigellosis, typhoid and other enteric fever warrants urgent attention. Nalloor pond was found to be more polluted because of huge bacterial load.

Keywords

Faecal coliforms, lentic ecosystem, *Salmonella*, *Shigella*, *Streptococcus faecalis*

Introduction

Lentic ecosystems play a significant role in the ecological sustainability of a region by virtue of their service to the ecosystem such as nutrient recycling, purification and recharge of groundwater, supplementing and maintenance of stream flow, habitat provision for various flora and fauna along with their recreation values necessitates their sustainable management through appropriate conservation mechanism (Ahalya and Ramachandra, 2002).Ponds in Kanyakumari district are historically important and linked to agrarian life of the people. These ponds are now under increasing threat from, point sources such as municipal and industrial waste water/ human waste dumping and other pollution, non-point degradation like urban and agricultural run-off within their watershed.

Major degrading factors includes excessive eutrophication due to nutrient and organic matter loading, sedimentation due to inadequate erosion control in agriculture, construction, logging and mining activities; land use change. Failure to restore these ecosystems will result in extinction of species, loss of lentic ecosystem types and cause permanent ecological damage. Major degrading factors include excessive eutrophication due to nutrient and organic matter loading; sedimentation due to inadequate erosion control in agriculture, construction, logging and mining activities; removal of native vegetation in the catchment introduction of alien species etc. (Prasad *et al.,* 2002, Ramachandra *et al*., 2005a, 2005b, Wetzel *et al*., 1991)

Concepts behind the present study

Pond water's profound quality is reflected up on all the life forms it supports. Every species deviation, qualitative or quantitative in a water source, details the physiological state of the liquid medium. Enquiry into the number or diversity of microbes in a lentic ecosystem can be visualized from this holistic perspective. Change in ambient quality ultimately prompts the water medium

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to change its choice of inhabitants and ultimately lead to eutrophication and habitat loss (Eg. organically polluted lentic ecosystem, harbour coliforms and associated enteropathogens). Harmful bacteria in organically polluted water include total coliforms, faecal coliforms, faecal *Streptococci*, *Shigella* sp. and *Salmonella* sp. A change in microbial diversity ultimately will lead to ethical, aesthetical and public health concerns to the human society. If this trend continues, it may not only affect human health and social-economic development, but also lead to the collapse of lake ecosystems themselves (Goldman *et al*., 1983; Constanza *et al*., 1997 and Rapport *et al*., 1998).

Materials and methods

Sample collection

Water samples were collected from ponds- Theroor, Putheri, Chunkankadai, Naduvali and Nalloor in Nagercoil and Marthandam during April (Pre North West Monsoon), July (North West Monsoon period) and October (North East monsoon period).

Analysis

Serial dilution of samples up to 10^{-5} and duplicate plating was carried out for each organism. Enumeration of bacteria was carried out following APHA (American Public Health Association, 1995) using commercially available media.

Media and Enumeration Characters of Organisms

Mc Conkey Agar, M7Hr FC Agar, M-Enterococcus agar and XLD Agar were used respectively for enumeration of TC, FC, FS, *Shigella* and *Salmonella* sp. TC colonies appeared pink to red after an incubation at 37°C for 24hrs, FC developed as blue colonies at 44.5°C after 24hrs, FS as maroon colonies after 24hrs at 37°C and *Shigella* sp. -red colonies and *Salmonella* sp. -red colonies with black centres after 24hrs at 37°C.

Results

The overall inputs of bacterial pollutants in the pond during January 2011 was shown in Table1. The maximum count was obtained in the chungankadai pond ($21x10^2$cfu/ml) and minimum in the putheri pond ($9x10^2$cfu/ml). The maximum count of Faecal coliforms obtained in theroor pond ($9x10^2$cfu/ml) and minimum in the putheri pond ($4x10^2$cfu/ml). *Streptococcus faecalis* was maximum in theroor pond ($21x10^2$cfu/ml) and minimum in the Neduvali pond ($7x10^2$ cfu/ml). *Salmonella* species found to be nil in theroor pond and all other ponds also show limited colonies. *Shigella* species found to be maximum in Chungankadai pond ($47x10^2$ cfu/ml) and minimum in theroor pond ($21x10^2$ cfu/ml).

The overall inputs of bacterial pollutants in the pond during February 2011 was shown in Table 2. The maximum count was obtained in the Chungankadai pond ($17x10^2$ cfu/ml) and minimum in the Nalloor pond (146cfu/ml). The maximum count of Faecal coliforms obtained in Chungankadai pond ($3x10^2$cfu/ml) and minimum in the Neduvali pond (44cfu/ml). S*treptococcus faecalis* was maximum in Theroor pond ($16x10^2$cfu/ml) and minimum in the Nalloor pond (213cfu/ml). *Salmonella* species found only in the Chungankadai pond (34cfu/ml) and absent in the all other ponds. *Shigella* species found to be maximum in Neduvali pond ($65x10^2$cfu/ml) and minimum in the Nalloor pond ($11x10^2$cfu/ml).

The overall inputs of bacterial pollutants in the pond during March 2011 was shown in Table 3. The maximum count was obtained in the Chugankadai pond ($37x10^2$ cfu/ml) and minimum in the Neduvali pond ($21x10^2$cfu/ml). The maximum count of Faecal coliforms obtained in Chungankadai pond ($11x10^2$cfu/ml) and minimum in the Neduvali and Putheri pond ($6x10^2$cfu/ml). *Streptococcus faecalis* was maximum in Neduvali pond ($26x10^2$cfu/ml) and minimum in the Chungankadai pond (78cfu/ml). *Salmonella* species found to be nil in Nalloor and in all other ponds show only limited colonies. *Shigella* species found to be maximum in Theroor pond ($33x10^2$cfu/ml) and minimum in the Chungankadai pond ($17x10^2$cfu/ml).

The overall inputs of bacterial pollutants in the pond during April 2011 was shown in Table 4. The maximum count was obtained in the Chugankadai pond ($20.2x10^2$ cfu/ml) and minimum in the Putheri pond ($7x10^2$cfu/ml). The maximum count of Faecal coliforms obtained in Putheri pond ($7x10^2$cfu/ml) and minimum in the Nalloor pond (121cfu/ml). *Streptococcus faecalis* was maximum in Nalloor pond ($11x10^2$cfu/ml) and minimum in the Chungankadai pond ($2x10^2$cfu/ml). *Salmonella* species found to be nil in Theroor and Chungankadai ponds. Putheri has 32 colonies, Neduvali show 11 colonies and 2 colonies obtained from the Nalloor pond. *Shigella* species found to be maximum in Nalloor pond ($29x10^2$cfu/ml) and minimum in the Chungankadai pond ($9x10^2$cfu/ml).

The overall inputs of bacterial pollutants in the pond during May 2011 was shown in Table 5. The maximum count was obtained in the Putheri pond ($31x10^2$ cfu/ml) and minimum in the Chungankadai pond ($18x10^2$cfu/ml). The maximum count of Faecal coliforms obtained in Putheri pond ($17x10^2$cfu/ml) and minimum in the Theroor pond ($2x10^2$cfu/ml). *Streptococcus faecalis* was maximum in Chungankadai pond ($26x10^2$cfu/ml) and minimum in the Nalloor pond (47cfu/ml). *Salmonella* species found to be maximum in Theroor pond ($21x10^2$cfu/ml) and minimum in the Neduvali pond (4cfu/ml) and found to be nil in Nalloor ponds. *Shigella* species found to be maximum in Theroor pond ($43x10^2$cfu/ml) and minimum in the Neduvali pond ($18x10^2$cfu/ml) and found to be nil in Nalloor ponds.

Table 1: Distribution of bacteria during January 2011

Name of organisms	Count of organisms in different stations (cfu/ml)				
	Theroor	Putheri	Chungankadai	Neduvali	Nalloor
Total coliforms	$13x10^2$	$9x10^2$	$21x10^2$	$11 x10^2$	$23 x10^2$
Faecal coliforms	$9x10^2$	$4x10^2$	218	$6x10^2$	124
Streptococcus faecalis	$21x10^2$	$11 x10^2$	$16 x10^2$	$7x10^2$	189
Salmonella Species	NIL	4	18	6	4
Shigella Species	$21 x10^2$	$24 x10^2$	$47 x10^2$	$31 x10^2$	$23 x10^2$

Table 2: Distribution of bacteria during February 2011

Name of organisms	Count of organisms in different stations (cfu/ml)				
	Theroor	Putheri	Chungankadai	Neduvali	Nalloor
Total coliforms	$6x10^2$	$3x10^2$	$17x10^2$	237	146
Faecal coliforms	166	46	$3x10^2$	44	88
Streptococcus faecalis	$16x10^2$	$8x10^2$	$4 x10^2$	$7x10^2$	213
Salmonella Species	NIL	NIL	34	NIL	NIL
Shigella Species	$33 x10^2$	$18 x10^2$	$22 x10^2$	$65 x10^2$	$11 x10^2$

Table 3: Distribution of bacteria during March 2011

Name of organisms	Count of organisms in different stations (cfu/ml)				
	Theroor	Putheri	Chungankadai	Neduvali	Nalloor
Total coliforms	$23x10^2$	$27x10^2$	$37 x10^2$	$21 x10^2$	$29 x10^2$
Faecal coliforms	$10 x10^2$	$6 x10^2$	$11 x10^2$	$8 x10^2$	$6 x10^2$
Streptococcus faecalis	$12x10^2$	$14 x10^2$	78	$26 x10^2$	$27 x10^2$
Salmonella Species	21	17	4	6	NIL
Shigella Species	$31 x10^2$	$22 x10^2$	$17 x10^2$	$22 x10^2$	$24 x10^2$

Table 4: Distribution of bacteria during April 2011

Name of organisms	Count of organisms in different stations (cfu/ml)				
	Theroor	Putheri	Chungankadai	Neduvali	Nalloor
Total coliforms	$17x10^2$	$7x10^2$	$20.2 x10^2$	$18 x10^2$	$18 x10^2$
Faecal coliforms	$4 x10^2$	$7 x10^2$	$3 x10^2$	$6 x10^2$	121
Streptococcus faecalis	$5x10^2$	$6 x10^2$	$2 x10^2$	$7 x10^2$	$11 x10^2$
Salmonella Species	NIL	32	NIL	11	2
Shigella Species	$28 x10^2$	$18 x10^2$	$9 x10^2$	$28 x10^2$	$29 x10^2$

Table 5: Distribution of bacteria during May 2011

Name of organisms	Count of organisms in different stations (cfu/ml)				
	Theroor	Putheri	Chungankadai	Neduvali	Nalloor
Total coliforms	$24x10^2$	$31x10^2$	$18x10^2$	$29 x10^2$	$29 x10^2$
Faecal coliforms	$2 x10^2$	$17 x10^2$	$4 x10^2$	$11 x10^2$	$5 x10^2$
Streptococcus. faecalis	$14x10^2$	$16 x10^2$	$26 x10^2$	$13 x10^2$	47
Salmonella Species	21	17	6	4	NIL
Shigella Species	$43 x10^2$	$37 x10^2$	$21 x10^2$	$18 x10^2$	NIL

Chart: 1 Distribution of bacteria in pond waters du ing the month of January-2011

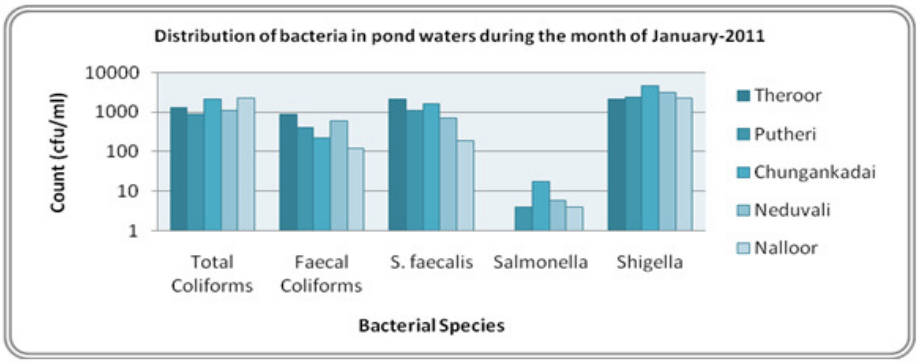


Chart: 2 Distribution of bacteria in pond waters during the month of February-2011

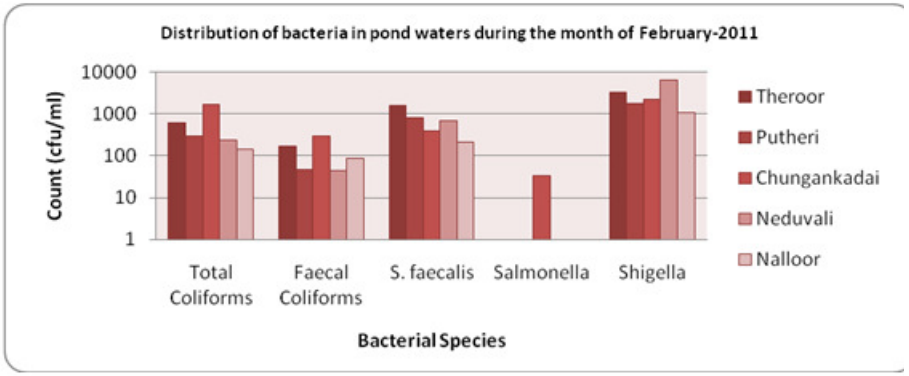


Chart: 3 Distribution of bacteria in pond waters during the month of March-2011

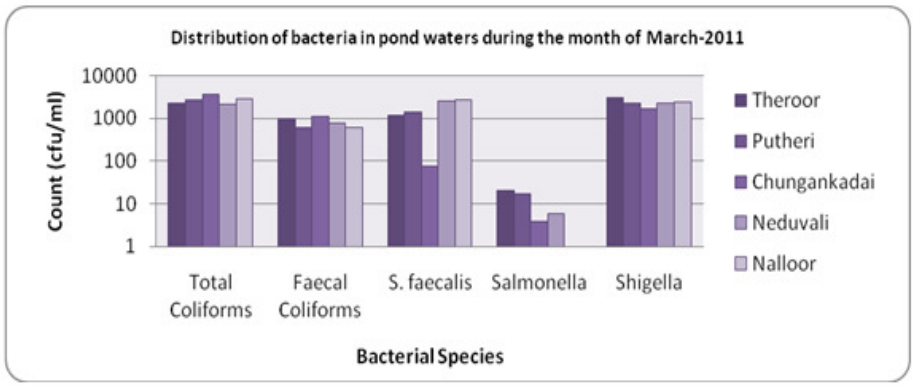


Chart: 4 Distribution of bacteria in pond waters during the month of April-2011

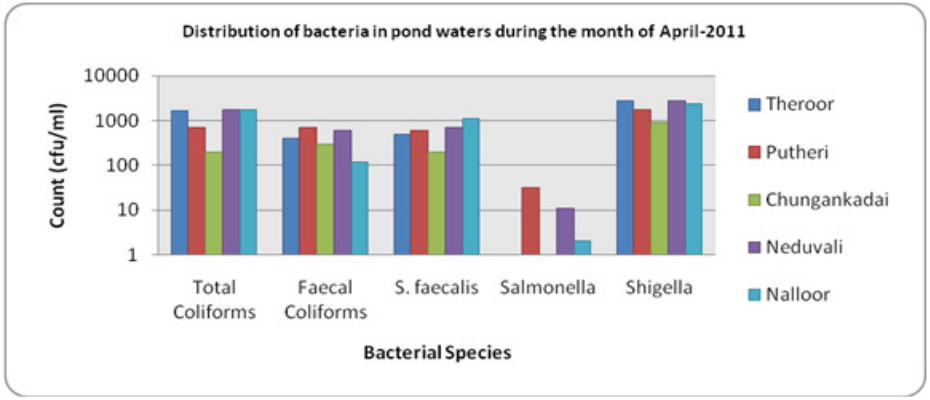
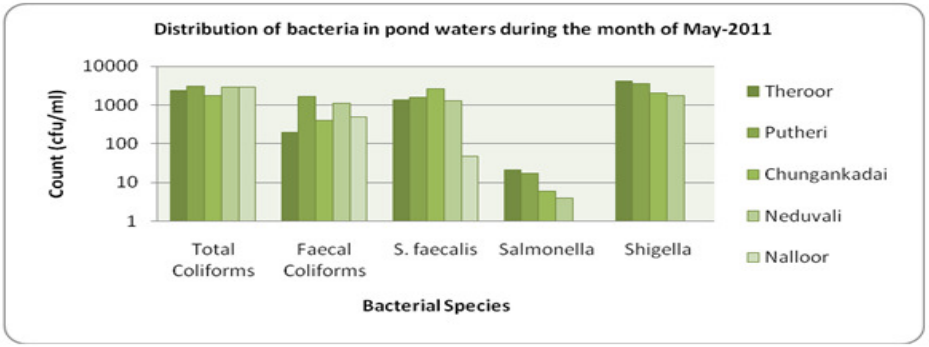


Chart: 5 Distribution of bacteria in pond waters during the month of May-2011



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Kanyakumari District map showing five ponds

Discussion

Total coliforms indicate degree of pollution and their higher density portrays the differences between clean and polluted water (Rai and Hill, 1978). Table 2 depicted that Nalloor pond possessed the maximum coliform density ($61x10^2$cfu/ml) while Neduvali pond showed the minimum count (146cfu/ml) though both exceeded the potable and recreational standards. (Clark and Pogel, 1977) considered coliforms as a reliable indicator of contamination of water since they indicate the possibility of simultaneous occurrence of human pathogens. Faecal coliforms should be used as the indicator organism for evaluating the microbiological suitability of recreation waters. As per the United States Environmental Protection Agency (USEPA,1976) direction of FC not to exceed a log mean of 200/100ml, nor more than 10 percent of total samples during any 30-day period to exceed 400/100 ml in primary contact recreation waters, only samples at Neduvali pond is fit for recreation in all the months. Possibility of entropathogenic strains in these sources cannot be ruled out. Since large number of people use the ponds for bathing and recreation, their epidemiological significance needs special attention. Also they may gain entry to humans through the food web through fish as reported from fresh water fishes of Thirichirapalli, Tamilnadu (Sivakami et al., 1996. In Namakal district, Tamilnadu also E. coli a prominent member of fecal coliform group is identified from water Thenmozhi, 2010. In the present analysis, they varied from 44cfu/ml to $21x10^2$cfu/ml.

Streptococcus faecalis varied from 47cfu/ml to $31x10^2$cfu/ml, *Salmonella* like organisms, which may include *S. typhi* the causative agent of typhoid is an inhabitant of intestine of warm blood animals. The maximum *Salmonella* count ($12x10^2$cfu/ml) was noticed from Nalloor in the month of March and the minimum count at Neduvali (2cfu/ml) in the month of April. Being a member of coliform group, *Shigella* causes shigellic dysentery, its maximum count was obtained in Chugankadai ($65x10^2$cfu/ml) in February and minimum in Putheri ($9x10^2$cfu/ml) in April. In general, the results pointed out that the chance of epidemic could not be ruled out these pond waters were used for drinking.

Conclusion

The study comprehensively showed that lentic system around Marthandam and Nagercoil town was anthropogenically polluted. Considering the density of population settled around the ponds and their continuous usage of water from the ponds, very huge bacterial counts noted was clearly an indication of possible epidemics. Especially important to be noted was the high counts of *Salmonella* noted at Nalloor and Putheri which needed immediate attention.

Bibliography

Ahalya, N. and Ramachandra, T.V. 2002. Wetland restoration and conservation, what, how and why. *Proc. Of the Environ. 2001.* National conference control of pollution and environment degradation, Sept. 14-15, 2001.

APHA (American Public Health Association) 1998. Standard Methods for the Examination of Water and Sewage. 20th edition, Washington DC: American Public Health Association.

Clark, J. A and Pogel, J.E. 1977. Pollution indicator bacteria associated with municipal raw and drinking water supplies. *Can. J. Microbiol.*, 23: 465-470.

Constanza, R., dArge, R., deGroot, R., 1997. The values of the world's ecosystem services and natural capital. *Nature,* 387: 253–260.

Goldman, Charles R. and Alexander, H.J. 1983. Limnology. International Student Edition. McGraw-Hill Book Company Japan, Ltd., Tokyo.

Prasad, S.N., Ramachandra, T.V., Ahalya, N., Sengupta, T., Alok Kumar, Tiwari, A.K., Vijayan V.S. and Lalitha Vijayan, 2002. Conservation of wetlands of India – a review, *Tropical Ecology*, 43 (1): 173-186.

Rai H. and Hill, G. 1978. Bacteriological studies on Amazoni, Mississippi and Nile water. *Arch. Hydrobiol.* 81(4): 445-461.

Ramachandra, T.V., Ahalya, N. and Murthy, R. 2005a. Aquatic Ecosystems: Conservation, Restoration and Management, Capital Publishing Company, New Delhi.

Ramachandra, T.V., Rajinikanth, R. and Ranjini, V.G. 2005b. Economic valuation of wetlands, *Journal of Environmental Biology*, 26(3): 439-447.

Rapport, D.J., Costanza, R., McMichael, A.J. 1998. Assessing ecosystem health. *Trends Ecol. Evol.* 13(10): 397–402.

Sivakami, R., Premkishore, G. and Chandran, M. R. 1996. Occurrence and distribution of potentially pathogenic Enterobacteriaceae in carps and pond water in Tamil Nadu, India , *Aquaculture Research,* 27 (5): 375–378.

Thenmozhi, M. 2010. Isolation of potentially pathogenic *Escherichia coli* O157:H7, from the water sources, *International Journal of Pharma and Biosciences,* 1(4): 84-88

U.S. EPA (Environmental Protection Agency), 1976. Quality Criteria for Water. U.S. Environmental Protection Agency, Washington, DC.

Wetzel, Robert G. and Likens. 1991. Limnological Analysis, Second edition. Springer-Verlag, New York, Inc., New York.