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RESEARCH ARTICLE

Hydrobiological characteristics of Freshwater Habitats of South Dum Dum Municipality, North 24 Parganas District, West Bengal, India

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Abstract

The hydrobiological characteristics of freshwater habitats of South Dum Dum municipality, North 24 Parganas District, West Bengal is explored and reported in the present study. The surface water samples were collected from 37 freshwater habitats during December 2012. The collected water samples were analyzed for their physico-chemical characteristics like pH, alkalinity, hardness, chloride, TDS, dissolved oxygen, fluoride, iron, ammonia, nitrite, nitrate and residual chloride. Algal blooming of *Microcystis aeruginosa* is noticed at Kachhari bari Tank, Motijheel Avenue pond and Hazarapara pond.

Keywords: Hydrobiological characteristics, freshwater habitats, physico-chemical parameters, algal blooming**.**

Introduction

The main surface water resources such as lakes, ponds, tanks are copious in North 24 Parganas district. Mainly local people depend on pisciculture and domestic activities like bathing, washing clothes and other rituals which show the high involvement of human society. The demand for freshwater is however increasing at a faster pace with passing time and living beings are compelled to survive in a water-stressed condition (Rudra, 2007). Water condition changes greatly with the influence of physico-chemical composition and the biological resources altered due to the variability of lithology, climate, vegetation and other anthropogenic inputs (Hamed, 2008; Chennakrishnan *et al.,* 2008). The physico-chemical parameters of an aquatic body not only reflect the water quality which also relates to the diversity, abundance of aquatic biota and the pollution status (Mir *et al.,* 2004). The nutrients status of water plays an important role in governing the production of plankton or the primary production in ponds (Banerjee, 1967). A regular assessment of water quality is therefore significant. In the present study, various physicochemical characteristics of 37 freshwater habitats (lakes, ponds and tanks) in South Dum Dum municipality, North 24 Parganas district (WB) has been undertaken and first hand information is provided.

Materials and methods

Study area: South Dum Dum municipality is located at 22.61° N; 88.40° E' in North 24 Parganas district, West Bengal, India. The climate is mostly tropical. Summer months are mostly hot and humid while the winter season is moderate and pleasant. A total of 37 different sites were randomly selected and both surface water and plankton samples were collected during Dec 2012 at 10 am to 11.30 am.

The collected water samples of respective localities are assigned as L1-Harihar Nagar Pond No. 1, Shyamnagar; L2-Harihar Nagar pond No. 2, Shyamnagar; L3-Harihar Nagar pond No. 3, Shyamnagar; L4-Nilachal complex tank, R.A.K road; L5-Swami Vivekananda road pond, Jessore road; L6-Baghabathi Nagar tank No. 1; L7-Baghabathi Nagar tank No. 2; L8-Bapuji Nagar Tank No. 1; L9-Bapuji Nagar No. 2; L10-Bapuji Nagar Tank No. 3; L11-Bapuji Nagar tank No. 4; L12-Bapuji Nagar tank No. 5; L13-Clive house pond, Nager Bazaar; L14-Motijheel Avenue pond No.1; L15-Motijheel avenue pond No. 2; L16-Motijheel old quarter pond; L17-Telipukur lake; L18-Amarpalli Block- B pond; L19-Devendra Nagar Tank, Jessore Road; L20-Rangpara pond, Nayapatti Road; L21-Kachhari bari Tank, Shyamnagar; L22-Mallibagan pond, Shyamnagar road; L23-Dum Dum park tank No. 1; L24-Dum Dum park tank No. 2; L25-Dum Dum Park, Tank No. 3; L26-Dum Dum park Tank No. 4; L27-Dum Dum Park Tank No. 5; L28-Bangur Block B tank, L29-Bangur Block C tank; L30-Lake Town lake; L31-Vidyapara tank, Lake Town; L32-Hazrapara pond Lake Town; L33-Digirpara pond, Patipukur; L34-Kothpol pond Patipukur; L35-Seth colony pond Dum Dum; L36-Tanawar Colony tank No. 2, Dum Dum; L37-Japur tank No.4, Dum Dum.

Collection of water samples: The water samples were collected in pre-cleaned polypropylene bottles (1000 mL). The chemically preserved samples (3-5 mL of HNO_3 added per litre) were brought to the laboratory for chemical analysis within 6 h of collection. Physical parameters like surface water temperature, colour, odour and turbidity were determined immediately at the site. Samples for dissolved oxygen were collected in BOD bottle (250 mL) and fixed by Winkler's 'A' and Winkler's 'B' solution at site.

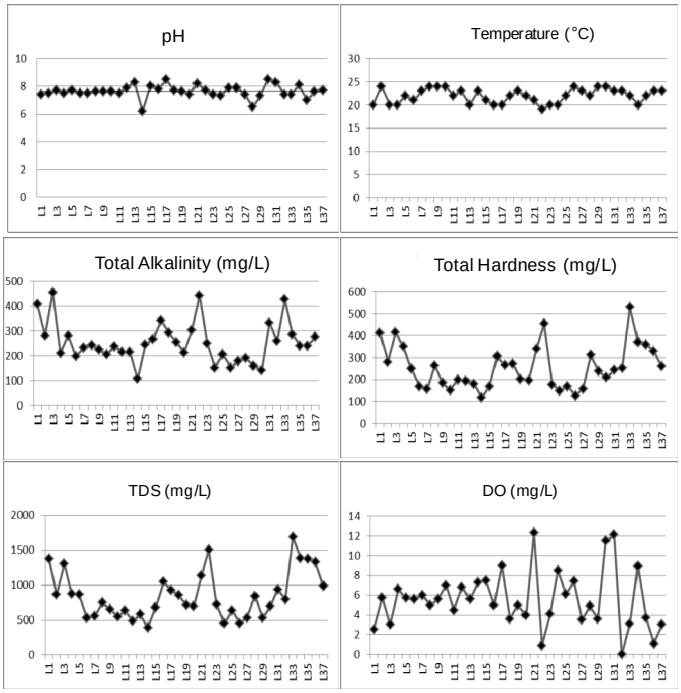
The biological samples (planktons) were collected in 100 mL polypropylene bottles by filtering surface water through 100 µm mesh size of plankton net and preserved in 4% formaldehyde for further analysis.

Parameters studied: The physical characteristics like colour, odour, temperature and turbidity were analyzed at the site. The collected samples were taken to the laboratory to analyze the chemical parameters (APHA, 1998). The parameters include total alkalinity (TA), total hardness (TH), chloride, total dissolved solids (TDS), fluoride (Fl^-), iron (Fe), ammonia (NH_3), nitrite (NO^{2-}), nitrate (NO^{3-}), residual chlorine (RC) and dissolved oxygen (DO). The pH of all the water samples was determined using a digital pH meter (Model no. 335, Systronics). Preserved biological samples identification was performed for phytoplankton (Anand, 1998, 1999).

Results and discussion

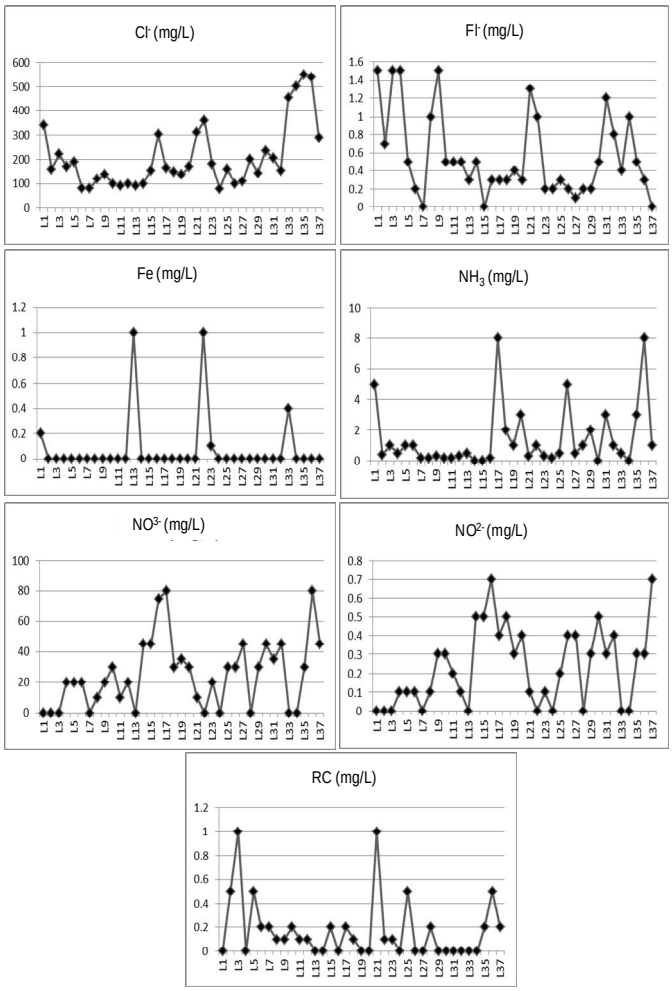
Physico-chemical parameters: The analytical results of the present investigation indicate that the quality of water considerably varies from location to location. Temperature of the water at different sites varied between 19ºC and 24ºC. The water samples were observed to be colourless or unclear or hazy; slightly greenish, yellowish or yellowish green in appearance. Most of the samples exhibited agreeable odour and some showed algal smell. Water sample from site L1 and L22 exhibited soil and site L32 and L33 exhibit stinking smell, respectively. The reason for their colour, turbidity and odour may be due to the presence of natural metallic ions, humus, plankton, weeds, algal blooming, industrial and domestic wastes. The pH of the collected freshwater samples is within the acceptable range of 6.5-8.5. The pH value of some samples (L13, L17, L21, L13, L31 and L34) were found to be in the range between 8.2 and 8.5 indicating alkalinity dominance which may be attributed to the free availability of heavy metals as result of their precipitation in hydroxide form. Water samples collected from site L14 showed a minimum pH value of 6.2 is due to low dissolved solids which may consequently have low buffering capacity (EPA, 2001). TA and TH of water of different locations varied from 107 to 455 mg/L and 116 to 529 mg/L, respectively. Beyond 400 mg/L of TA and TH indicates the unpalatability and high hardness of the water (EPA, 2001), respectively. Further alkalinity is involved in the consequential effects of eutrophication (over-enrichment) of waters. Sampling sites L1, L3, L16, L21, L22, L33, L34, L35 and L36 exhibited very high TDS value of 1049 to 1692 mg/L which is well above the desirable limit of 1000 mg/L for fresh waters. The high TDS values can cause water balance problems for aquatic organisms and decrease DO level in water (Environmental Service Program, 2013) as in the case of L1, L3, L22, L33, L35, L36 and L37. Water samples from L21, L30 and L31 showed DO values above 10 mg/L which may be lethal to fishes during the rearing of spawn in nursery ponds (Alikunhi *et al.,* 1951). DO content with 0 mg/L was recorded for sample L32 (Fig. 1).

Fig.1. Physico-chemical parameters observed during the study.



Samples L33, L34, L35 and L36 showed chloride concentration above 400 mg/L. The high concentration of chloride may be due to anthropogenic activities, sewage contamination and deposition of organic wastes. High chloride concentration in freshwater can harm aquatic invertebrates by interfering with osmoregulation (Hunt *et al.,* 2013) and reduce DO content of water (L1, L3, L16, L22, L28, L33, L35, L36 and L37). Fluoride ion concentration of different locations is observed to be within the desirable limit of 1.5 mg/L. Generally, iron concentrations in natural freshwaters do not exceed 1 mg/L (Xing and Liu, 2011) and the study result revealed that iron content is within the acceptable limit (Fig. 2). Studies on ammonia concentration showed a maximum of 8 mg/L was recorded for L17 and L36. High level of ammonia in water can cause gill damage and reduce DO level (Isyagi *et al.,* 2009**)** as reflected in the case of samples L1, L20, L29, L35 and L36. In the present study, nitrite concentration of samples of different sites varied from 0 to 0.7 mg/L. Nitrite is extremely toxic to aquatic life than ammonia and any reading should be cause for concern. Nitrate concentration ranged between 0 and 45 mg/L is observed for almost all the samples except L17, L16 and L36. Fairly high concentrations of nitrate pose less serious environmental problem since it is relatively non-toxic to aquatic organisms. When nitrate concentrations become excessive, however and other essential nutrient factors are present, eutrophication and associated algal blooms can be become a problem (Environmental Service Program, 2013). Residual chlorine concentration varied from 0 to 1 mg/L (Fig. 2).

Fig. 2. Physico-chemical parameters analyzed during the study.



Biological analysis: From the present investigations 25 species of phytoplankton were registered belonging to 3 family; 19 genera. Among chlorophyceae, *Pediastrum duplex, P. simplex, P. tetras, Scenedesmus armatus, S. arcuatus, S. obliquus, S. dimorphous, Coelastrum* sp., *Selanastrum gracile, Kirchneriella* sp., *Ulothrix* sp. were found. Among Bacillariophyceae, *Closterium ehrenbergii, C. tumidum, Closterium* sp., *Synedra* sp., *Netrium* sp., *Navicula* sp., *Cymbella* sp. were registered. Among Cyanophyceae, *Merismopedia minima, Chroococcus minutus, Aphanocapsa* sp., *Anabaena* sp., *Spirogyra* sp., *Oscillatoria* sp. were recorded. Phytoplankton showed higher population at L9, L16, L22, L31 and L34. Algal bloom of (cyanophyceae–blue green algae) *Microcystis aeruginosa* was noticed at L32, L21 and L14 (Fig. 3 and 4). *Oscillatoria* sp. bloom was noticed at L22 (Fig. 5). Naturally ponds appear to be green in colour may due to algal deposition on the stones, pebbles or the substratum and on walls of the tank namely periphyton and decayed vegetation settlement. But the surface water collected does not shown the green colour during the study. It is said that phytoplankton flourish well either in nutrient rich and warm water or at times in water with apparently low nutrient concentrations subjected to higher temperature and bright light conditions (Ganapathi, 1940; Palmer, 1969; Munawar, 1970; Fogg, 1975; Somasekhar and Ramaswamy, 1983). The occurrence of algae in polluted water is also reported (Tarar *et al.,* 1998). Few submerged macrophytes can have an effect on the planktonic food web by allelopathy and effects on aquatic biota (Scheffer *et al.,* 1993; Nakai *et al.,* 1999; Van Donk and Van de Bund, 2002). In the present study, plankton distribution occurred almost in all the selected sites.

Fig. 3. Algal blooming (*Microcystis aeruginosa*) observed at L32.

Fig. 4. *Microcystis aeruginosa* observed at L32 (x 100).

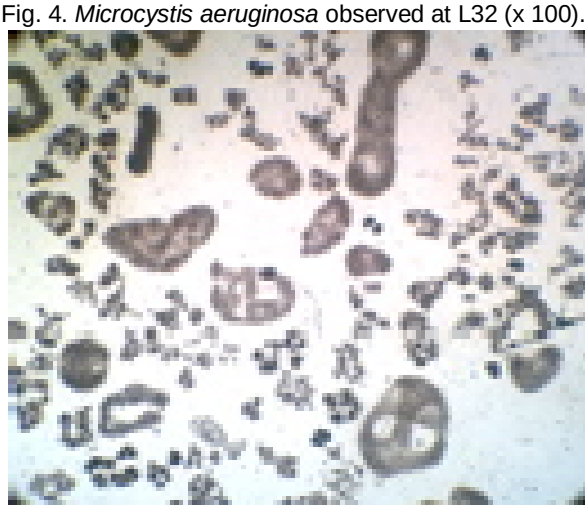
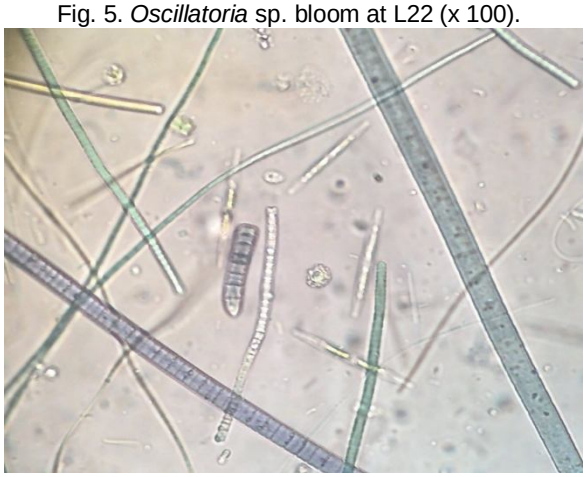


Fig. 5. *Oscillatoria* sp. bloom at L22 (x 100).



Conclusion

The physico-chemical and biological characteristics of freshwater samples from thirty seven locations of the study area revealed that there were considerable variations in the examined samples from different source. The rapid urbanization has led to increased anthropogenic pressure on most of the water bodies. The dumping of solid wastes and discharge of sewage has deteriorated the quality to a great extent. It may cause a variety of health problems to humans as well as to other organisms dependent either directly or indirectly on this ecosystem. Periodic determination of physico-chemical and biological characteristics of such important water bodies is essential for assessing the suitability of water for human and animal use as well as for the aquatic biota. The present study explicates the actual status of freshwater habitats of South Dum Dum municipality and therefore urges for the restoration of some of the deteriorating water bodies. Maintenance of a healthy aquatic environment and production of sufficient fish food organisms in ponds are the two factors of primary importance.

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