Assessment on the physico-chemical parameters and biodiversity of copepods and rotifers in Muthannan pond wetland, Coimbatore, Tamil Nadu, India

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Abstract: The interdependence between man and wetlands is ancient, with the earliest of civilizations originating in close proximity of wetland habitats. Wetlands, providing very important ecosystem services that benefit humankind, are also called as the kidneys of a landscape. Wetlands, the most fertile ecosystems, are becoming most threatened nowadays . The continuous abuse of the wetland resources has lead to extinction of several valuable nutrient , organisms in different trophic level of the ecosystem, as well as pollution of various kinds. Wetlands contribute significantly to the biodiversity and being among the most productive life-support systems, they have immense social, economic and ecological importance to humankind.

Keywords: Interdependence, wetlands, ecosystem services, Physico-chemical, biodiversity, resources ,pollution, ecological importance and biodiversity.

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1.INTRODUCTION

The open-access to nature and public, characteristics of wetlands is being undervalued in decisions related to their use and conservation. Wetlands occupy the transitional zone between permanently wet and generally dry environments. Wetlands include mangroves, swamps and marshes, rivers, lakes, flood plains and flooded forests, rice-fields, and even coral reefs. Aquatic invertebrates play very important role in wetland food chains both in terms of recycling nutrients and providing food for larger animals. Some of them are Snails, Mussels, Insect larvae, copepods, crabs, Leeches etc., The invertebrates that inhabit the benthonic zone are highly dominated by small species and the species are compared to the zooplankton of the open water. They include Molluscs (e.g. clams and snails), Crustaceans (e.g. crabs, crayfish, and shrimp), and numerous types of insects (Brönmark and Hansson, 2005). Aquatic invertebrates can be found in any habitat from small temporary pools to large lakes and small springs to large rivers. Some of the more extreme habitats include highly saline waters (e.g., Great Salt Lake), pools of petroleum, sewage treatment, plant lagoons, and hot springs. Within a water body, aquatic invertebrates inhabit a variety of habitats. In standing waters(lentic), aquatic invertebrates occur at the bottoms of deep lakes, along vegetated margins, and in open water. In flowing waters(lotic), aquatic organisms occur under stones or woody debris, buried in sand or sediment, and crawling or sprawling on rocks, leaf packs, and snags. The greatest diversity of aquatic invertebrates is found in medium-sized, forested streams with cobble and gravel substrates. Fresh water zooplankton plays a key role in preservation and sustaining of ecological balance and a study on its basic aspects is absolutely necessary. The seasonal fluctuations of the zooplankton exhibit a bimodal oscillation with a spring and autumn phenomenon in the temperate lakes and reservoirs (Wetzel *et al,* 2001). This fluctuation is greatly influenced by the variations in the temperature along with many other factors.

2. MATERIALS AND METHODS

The pond selected for the investigation is Muthannan Pond (Kumarasamy lake). It is situated on the left side of the Coimbatore to Thondamuthur road and eastern side of Selvampathy lake and receives excess water from the Selvampathy lake and drains its surplus water to Selvachintamani lake. This wetland is located at the latitude of 10° 59.457' N and longitude of 76° 56.701' E

Water samples are taken from the lake at early morning at 10m depth for laboratory analyses. Water was filtered through a 50-µm mesh to remove zooplankton and placed into the container 2.5X1 lit. Polythene carboy. The study to assess the P^H, Total suspended solids, Total dissolved solids, Chloride, Sulphate, BOD, COD, Dissolved oxygen, Nitrite Nitrogen, Nitrate Nitrogen, Alkalinity, Total hardness, Calcium hardness, Magnesium hardness, Phosphate. The experiments were carried out using the standard methods (Standard analytical procedures for water Analysis, Government of India, 1999.

P^H

Remove electrodes from storage solution, rinse, blot dry with soft tissue, place it in an initial buffer solution and standardize ***P^H*** meter according to manufacturer's instructions. Remove electrodes from the first buffer, rinse thoroughly with distilled water, blot dry and immerse in second buffer preferably of ***P^H*** within 2 ***P^H*** units of the ***P^H*** of the sample. Read ***P^H***, which should be within 0.1 unit of the ***P^H***of the second buffer. Determine ***P^H*** of the sample using the same procedure as in (b) after establishing equilibrium between electrodes and sample. For buffered samples this can be done by dipping the electrode into a portion of the sample for 1 min. Blot dry, immerse in a fresh portion of the same sample, and read ***P^H***. With dilute poorly buffered solutions, equilibrate electrodes by immersing in three or four successive portions of the sample. Take a fresh sample to measure ***P^H***. Stir the sample gently while measuring ***P^H*** to insure homogeneity.

Total suspended solids-TSS (mg/l)

Wash filter paper by putting it on filtration assembly and filtering 3 successive 20 ml portions of distilled water. Place filter in an aluminium dish and dry in oven at 104 ±1^{o} C for 1h. If a Gooch crucible is used, dry filter and crucible combination together. Cool in desiccator to balance temperature and weigh. Assemble filtration apparatus with the washed, dried and weighed filter paper. Wet filter paper with a small amount of distilled water to seat it. Stir sample with a magnetic stirrer and while stirring pipette a measured volume on to the filter using a wide bore pipette. Choose sample volume to yield between 10 and 200 mg dried solids. Wash with 3 successive 10 ml volumes of distilled water. Continue suction for about 3 min after filtration is complete. Carefully remove filter and transfer to the aluminium-weighing dish. Dry, cool and weigh.

Total Dissolved Solids-TDS (mg/l)

Wash filter paper by inserting it in the filtration assembly and filtering 3 successive 20 ml portions of distilled water. Continue suction to remove all traces of water. Discard washings. Dry evaporating dish at 104 ± 1^{0}C for 1 h, cool and store in desiccator. Weigh immediately before use. Stir sample with a magnetic stirrer and while stirring pipette a measured volume on to the filter using a wide bore pipette. Choose sample volume to yield between 10 and 200 mg dried residue. Wash with three successive 10 ml volumes of distilled water. Continue suction for about 3 min after filtration is complete. Transfer total filtrate with washings to a weighed evaporating dish and evaporate to dryness in an oven at 104 ±1^{0}C. If necessary add successive portions to the same dish after evaporation in order to yield between 10 and 200 mg dried residue. To prevent splattering oven temperature may be lowered initially by 2^{0}C below boiling point and raised to 104 ^{0}C after evaporation for 1h. Cool in a desiccator and weigh.

Chloride (mg/l)

Use a 100 ml sample or a suitable portion diluted to 100 ml. If the sample is coloured or turbid, add 3 ml Al (OH) 3 suspension, mix, let settle and filter. Add 1 ml K_2CrO_4 indicator solution; titrate with $AgNO_3$ titrant to a pinkish yellow end point. Repeat the titration with distilled water blank. A blank of 0.2 to 0.3 ml is usual.

Sulphate(mg/l)

Standardize nephelometer following manufacturer's instructions. Measure the turbidity of sample- blank, a sample in which no $BaCl_2$ is added. Measure 100 ml sample or a suitable portion made up to 100 ml, into a 250 ml conical flask. Add 20 ml buffer solution and mix. While stirring add a spoon of $BaCl_2$ crystals. Stir for 60 ±2 s. Measure turbidity of the sample at 5±0.5 min after stirring ended Prepare SO4 2- standards at 5 mg/l increments in the range of 0- to 40 mg/l SO42- Develop BaSO4 turbidity for the standards as above. Determine turbidity of the standards using procedure as above and draw calibration curve between turbidity and SO42- concentration, mg/l.

Biochemical Oxygen Demand (BOD) (mg/l)

Prepare required amount of dilution water at the rate of 1000 to 1200 ml per sample per dilution. Bring the diluted water temperature to 27°C. Saturate with air by shaking in a partially filled bottle, by bubbling with organic free filtered air or by storing in cotton-plugged bottles for a day. Some samples do not contain sufficient microbial population (for example, some industrial wastes, high temperature wastes, or wastes with extreme ***P^H*** values). For such wastes, the dilution water is seeded using effluent from a biological treatment system processing the waste. Where this is not available, use supernatant from domestic wastewater after settling for at least 1 h but not more than 36 h. Seed from a surface water body receiving the waste may also be suitable. Add enough seed volume such that the DO uptake of the seeded dilution water is between 0.6 and 1.0 mg/l. For domestic wastewater seed, usually 4 to 6 ml seed / l of dilution water is required. Surface water samples usually do not require seeding.

Dilution of the sample. Dilutions must result in a sample with a residual DO (after 3 days of incubation) of at least 1 mg/l and a DO uptake of at least 2 mgl/l. Make several dilutions using the Table and experience with the particular sample source. Polluted surface waters may have 5 to 25 mg/l BOD.

Dilution of water blank. Find the DO consumption of unseeded dilution water by determining initial and final DO. It should not be more than 0.2 mg/l Seed control. Determine the DO uptake by seeding material according to the above procedure.

Chemical Oxygen Demand(COD) (mg/l)

Add 50 ml of sample or an aliquot diluted to 50 ml with distilled water in a 500 ml refluxing flask. Add 1g HgSO4, few glass beads, and 5 ml sulphuric acid reagent, mix, cool. Add 25 ml of 0.0417M $K_2Cr_2O_7$, mix. Connect the flask to the condenser and turn on cooling water, add additional 70 ml of sulphuric acid reagent through open end of condenser, with swirling and mixing. Reflux for 2 hours; cool, wash down condenser with distilled water to double the volume of contents, cool. Add 2 drops of Ferroin indicator, titrate with FAS the remaining

potassium dichromate, until a colour change from bluish green to reddish brown. Also reflux and titrate a distilled water blank with reagents. Use standard 0.00417M $K_2Cr_2O_7$, and 0.025M FAS, when analysing very low COD samples. Evaluate the technique and reagents by conducting the test on potassium hydrogen phthalate solution. Do not add grease at the Leibig jacket to prevent jamming, use water instead.

Dissolved Oxygen (mg/l)

Drain any liquid in the flared lip of the BOD bottle containing the sample. Remove stopper and add 1 ml of MnSO4 followed by 1 ml alkali-iodide-azide reagent. Hold the pipette tip just below the liquid surface touching the side of the bottle. Wash the pipette before returning to the reagent bottles. Stopper used carefully to exclude air bubbles. Mix by inverting the bottle a few times. Allow the brown manganese hydroxide floc (white floc indicates absence of DO) to settle approximately to half the bottle volume, add 1.0 ml conc. $H_2SO_4$and re-stopper. Mix by inverting several times until dissolution is complete. Titrate 201 ml with standard $Na_2S_2O_3$as for standardization procedure.

Nitrate nitrogen(mg/l)

Transfer 10 ml of 1.0 mg NO_3--N/L standard to a 50 ml beaker, add 10 ml buffer and stir with magnetic stirrer. Stop stirring after mixing and immerse electrodes. Start stirring again. Take mill volt reading when stable (after about 1 min).Repeat with 10 and 50 mgNO_3-N/L standards. Plot is done on a semi logarithmic graph paper potential measurement of the standards in mV, on arithmetic scale, vs. NO_3 – N concentration on logarithmic scale. The calibration curve should be a straight line with a slope of +57 ±3/ decade at 25^{o}C. Recalibrate the probes and the instruments several times every day using the 10 mg NO3--N/L standard. Transfer 10 ml sample to a 50 ml beaker, add 10 ml buffer and stir with magnetic stirrer. Stop stirring after mixing and immerse electrodes. Start stirring again. Take millivolt reading when stable (after about 1 min). In case of direct reading ion meters, follow manufacturer's instructions to set up and calibrate the ion meter using standards in the prescribed range. Standards already diluted with the buffer may have been supplied with the meter.

Nitrite nitrogen (mg/l)

Add 2 ml colour reagent to 50 ml sample, or to a portion diluted to 50 ml, and mix. Measure absorbance at 543nm. Wait between 10 min and 2h after addition of colour reagent before measurement Prepare standard curve by diluting 1, 2, 3, 4 and 5 ml of standard nitrite solution to 100 ml to give 5, 10, 15, 20 and 25 µg/l concentration, respectively.

Alkalinity (mg/l)

Add 2 to 3 drops of bromcresol green indicator. Titrate until change in colour (blue to yellow, pH 4.9 to 4.3) is observed. Record total mL titrant used.

Total hardness (mg/l)

Dilute 25 ml sample to 50 ml with distilled water. Add 1 to 2 ml buffer to give a pH of 10.0 to 10.1. Add 1 to 2 drops of indicator solution and titrate with EDTA titrant to change in colour from reddish tinge to blue. Select a sample volume that requires less than 15 Ml EDTA titrant and complete titration within 5 min after buffer addition.

Calcium hardness (mg/l)

Take 50 ml sample or an aliquot diluted to 50 ml such that the calcium content is not more than 10 mg. Samples which contain alkalinity greater than 300 mg/l should be neutralised with acid, boiled for 1 min and cooled before titration. Add 2 mL NaOH solution or a volume sufficient to produce a pH of 12 to 13. Start titration immediately after addition of the alkali. Add 0.1 to 0.2 g indicator mixture. Titrate with EDTA solution, with continuous mixing, till the colour changes from pink to purple. Check end point by adding 1 to 2 drops excess titrant to make certain that no further colour change occurs.

Magnesium hardness (mg/l)

The values for Total Hardness and Ca Hardness determined by EDTA were calculated for Mg hardness.

Sampling analysis of fresh water invertebrates

Water samples was collected from the Muthannan pond wetland during morning session (6.00 to8.00 am). Qualitative sampling of zooplankton was done with the aid of plankton net of mesh size 60 - 75µ by sweeping it through the weeds in the littoral zone and by towing it through the water in the limnetic zone from boat. Quantitative samples were collected by filtering 100 litre of water. Collected specimens were transferred carefully to a tube and narcotized with 5% formalin and preserved in 5% buffered formalin and added a few drops of Rose Bengal solution which colours the zooplanktons and make them conspicuous.(Datta,2011).

3. RESULT AND DISCUSSION

The physico-chemical parameters of water of this lake have been given in the Table 1. Low value of dissolved oxygen, and high levels of dissolved solids, chloride, total hardness, BOD, Alkalinity, Calcium hardness and low value of COD indicated the poor quality of water. Zooplankton species survive under a wide range of environmental conditions and their growth and intensity totally depend on physical, chemical and biological factors. Zooplankton consists of copepods (38%), and rotifers (10%) and both the two groups contributed to richness in the pond and copepod formed the dominant group over rotifer. In the present study, copepods recorded were *Mesocyclops aspericornis, Thermocyclops hyalinus, Cyclops vicinus and* Nauplius larva. The rotifers recorded were *Branchionus angularis, B. quadrientatus* and *B. caudatus.* Survival of bio indicators like zooplanktons showed poor water quality.

Table 1 Physico-chemical parameters of water of Muthannan kulam

S.No	Parameters	Values
1	pH	8.75
2	TSS *(mg/l)*	280.0
3	TDS *(mg/l)*	836.0
4	Chloride *(mg/l)*	41.28
5	Sulphate *(mg/l)*	58.0
6	BOD *(mg/l)*	40.0
7	COD *(mg/l)*	160.0
8	Dissolved Oxygen *(mg/l)*	2.0
9	Nitrate nitrogen *(mg/l)*	6.65
10	Nitrite nitrogen *(mg/l)*	2.78
11	Alkalinity *(mg/l)*	532.5
12	Total hardness *(mg/l)*	384.0
13	Calcium Hardness *(mg/l)*	197.0
14	Magnesium hardnes***(mg/l)***	185.2

Low values of dissolved oxygen and high values of dissolved solids,chlorides, total hardness, BOD, Alkalinity, Calcium hardness and high value of COD indicated the poor quality of water. Submerged and floating water plants serve a number of important functions. In wetlands, a well-developed macrophyte community provides shelter against predation for vulnerable prey species like small zooplankton (Batzer, 1998). In general, lakes with a well-developed macrophyte community are characterised by a more diverse community of zooplankton (Timms and Moss, 1984). Invasions of water hyacinth have become a nuisance worldwide. It is now considered as a threat to biological diversity, affecting fish faunas, plant diversity and other freshwater life and the food chains, which depend upon it (Luken and Thieret, 1997). The absence of a well developed macrophyte community and the decreased levels of oxygen under the canopy of water hyacinth (Rommens. 2003) may be adverse for zooplankton richness and abundance.

4.CONCLUSION

Present study indicated that during May – November period of Muthannan pond wetland experienced most of the water covered area with full of water hyacinth and the plankton population of pond is highly influenced by water floating vegetations and also contamination of discharge of domestic waste, floral offerings, washing clothes, cleaning vehicles, bathing and other anthropogenic activities. Thus, the shift in the zooplankton community dominance of pollution tolerance forms indicated decline in the quality of the water in the Muthannan pond.

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