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A Study of Plankton Diversity of Some Ponds of Bankura Town, West Bengal, India

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ABSTRACT

Fish is a substantial element of both culture and emotion of Bengalis. Unfortunately, fish production does not reach the limit of its requirement in West Bengal, so we have to import fish from different states like Andhra Pradesh, Bihar, Karnataka, Tamil Nadu. The Bankura district of West Bengal is full of static water bodies like ponds, reservoirs. Recently a breakthrough fishery project has been initiated at Ramsagar, a small village of Bankura and it is giving commendable fish yield as well as competition to well-known pisciculture hubs of India. The Bankura town also has a lot of water bodies with standard health, which is left unproductive. Ramsagar, being only 30 km away from Bankura town has almost identical environmental conditions with Bankura, but still pisciculture in Bankura town has been left unattended for years now. To understand the reason of unproductivity of ponds of Bankura a quantitative study of plankton diversity in four ponds of Bankura town was carried out through the year 2018. Most of these water bodies are used by the local residents for both household and economic purposes. As a result ponds get moderately to highly polluted. Zooplanktons, mainly the Rotifers play an important role (as bio-indicators) to known the water quality of the studies water bodied. The main four groups of zooplankton (Rotifera, Copepoda, Caldocera and Ostracoda) and the main four classes of phytoplankton (Bacillariophyceae, Chlorophyceae, Cyanophyceae, Charophyceae) were recorded from all of the ponds during the study period. The main aim of the study was to have a basic understanding of the productivity status of these ponds and observing the population and diversity of the plankton community and presenting it in a graphical and tabular form.

Keywords Plankton diversity, Bankura town, Bio-indicator, Productivity status.

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INTRODUCTION

Water is doubtlessly the elixir of life. During the last several decades, the water quality of the Indian water bodies has been deteriorating, due to continuous discharge of industrial, agricultural and domestic

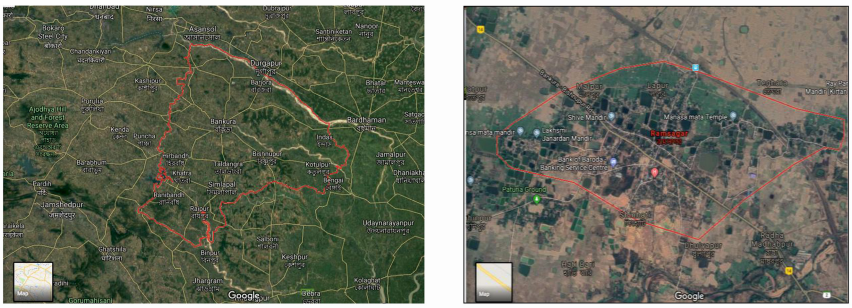

Fig. 1. Map of Bankura and satellite view of Ramsagar, respectively.

sewage (Majumder and Dutta 2014). Both lentic and lotic inland freshwater ecosystem are being subjected to constant environmental stress (Patra et al. 2010). Ponds are useful in many ways, including the common source of open freshwater in land. It is one of the methods of artificial infiltration of underground water (Smitha and Sajitha 2015). Freshwater zooplankton is an important component of an aquatic ecosystem and plays a critical role for maintaining the ecological chain of the ecosystem as they maintain the link between the producer and primary consumer. The very basis of nutritional cycles of an aquatic ecosystem is constituted by phytoplanktons (Goswami et al. 2017). They are not only the primary food for many organisms, such as fish, crustaceans and shellfish but can also function as indicators of trophic status of water bodies. Their distribution and the level of abundance are useful for estimation of the fishery potential of a water body. The knowledge of their abundance, species diversity and spatial distribution is important in understanding trophodynamic and trophic progression of water bodies.

Ramsagar is a place very close to Bankura town and has almost identical climatic conditions with Bankura town but shows comparatively a very high range of fish production. This is mainly due to initiation of a fishery project in Ramsagar which has shown its success through increase in fish yield. While, the town of Bankura also shows a lot of small and large water bodies, which cannot be used properly for fish production, due to lack of proper knowledge and initiative. The project work was carried out in four different ponds of Bankura district. Study related to plankton diversity status from this municipal area in Bankura town, West Bengal is very rare. For that reason the present study was undertaken, in selected ponds from the municipal area, to know the present plankton diversity statuses of these urban ponds.

MATERIALS AND METHODS

The total study was carried out consecutively for a year from January to December, 2018 at four different sites of Bankura town. The water bodies selected for

Fig. 2. Map of Ramsagar showing Fishery Project and satellite view of Bankura showing an abundance of ponds.

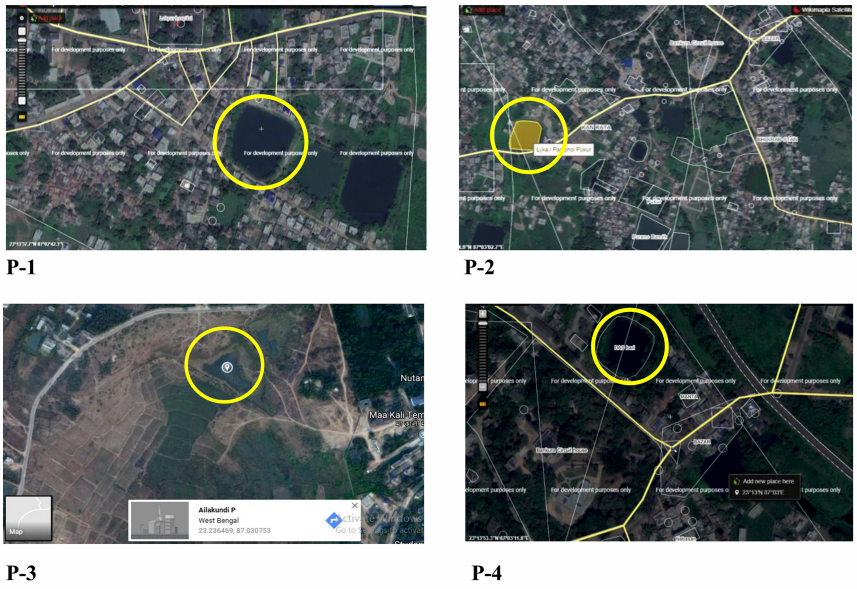

Fig. 3. Map showing satellite view with co-ordinates of the ponds : P-1 (Had pukur), P-2 (Lyka pukur), P-3 (Sarbagan pukur) and P-4 (Pond behind Pushpa Mistanna Vandar).

the present study are situated within the Bankura I and Bankura II block. First pond (P-1)-Had pukur, situated in the Lokepur region of Bankura town, is mainly used by local people for household purposes. Second pond (P-2) Lyka pukur situated in the Vairabsthan-Lokepur main road, is also generally used for household purposes. Third pond (P-3)-Sarbagan pukur is situated near the SBSTC Depot of Bankura, in the outskirt of the township, just beside the Bankura sammilani Medical College, as a result, we can visualize a huge dump of biomedical wastes at its sides, all over the year. The last pond (P-4) -behind the Pushpa Mistanna Vandar, Bhairabsthan is situated in a relatively populated area, besides household purposes and washing utensils of the sweet shop, it is also used for pisciculture purposes.

The phytoplankton and zooplankton from the surface water of four ponds were collected, each day in the morning (between 6-8 am) by filtering 50 l of water through a modified Heron Tranter net, a round frame of 0.625 sq m area. The filtering cone was made up of Nylon bolting silk plankton net (No.25, mesh size-50 micron) was used for collection of zooplankton. Collected samples were transferred to the labeled vials containing 5% formalin. Sedgwick Rafter Counter was used for Quantitative analysis and identification by taking 1mL sample on counter. The plankton was studied and documented using Magnus Trinocular Microscope (Model-MLX TR) attached with Nikon Coolpix Camera. Detailed taxonomic identification was done following Needham and Needham (1962) and Hosmani et al. (2014).

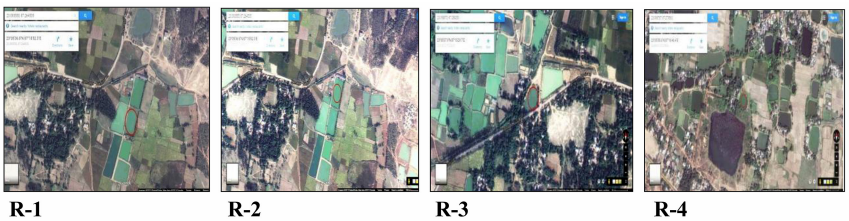

Fig. 4. Satellite view of R-1 (Hati bari-1) R-2 (Hati bari-2) R-3 (Hati bari-3) and R-4 (Rakshit pukur). All these four productive ponds are situated at Ramsagar village of Bankura district.

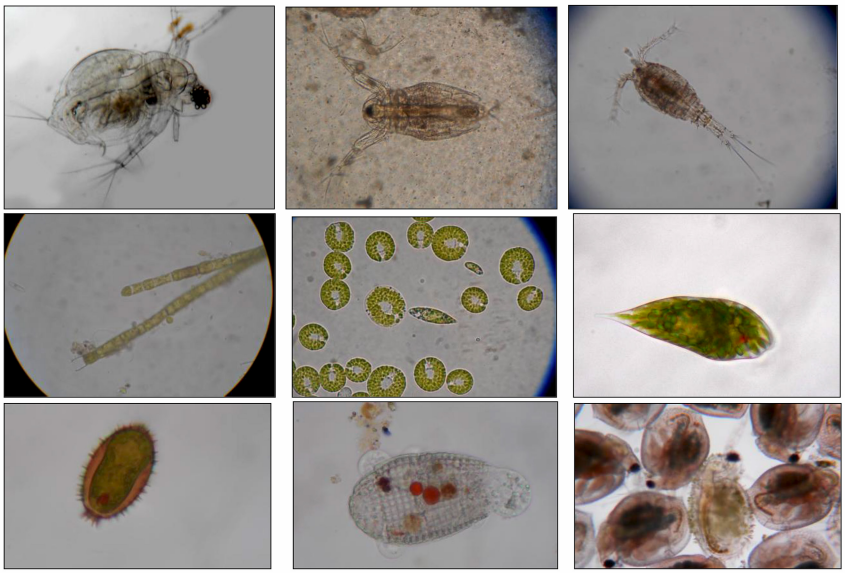

Fig. 5. Different specimen of phytoplanktons and zooplanktons collected from the ponds during the study at two different magnifications.

Four ponds of Ramsagar region were subjected to extensive study, as a comparison parameter for the relatively unproductive ponds of Bankura town. First pond of Ramsagar (R-1)-Hati bari-1 is large and situated far away from locality beside a poultry farm, the color of water is greenish and used for fish culture. Second pond (R-2)-Hati bari-2 is situated just beside the R-1, almost of same size as R-1, well manicured and water color is greenish. Third pond (R-3)-Hati bari-3 is not so large; it is used for regular household purposes but mainly for seasonal fish culture. All three ponds are used for fish culture strictly and maintained by fish farmers. The fourth pond (R-4)-Rakshit pukur is also large, water color is greenish and situated amidst the locality. All the ponds are used for local activity and to some extent for seasonal fish culture.

RESULTS AND DISCUSSION

Zooplanktons are heterotrophic planktonic animals floating in surface of water. They are delicate aquatic

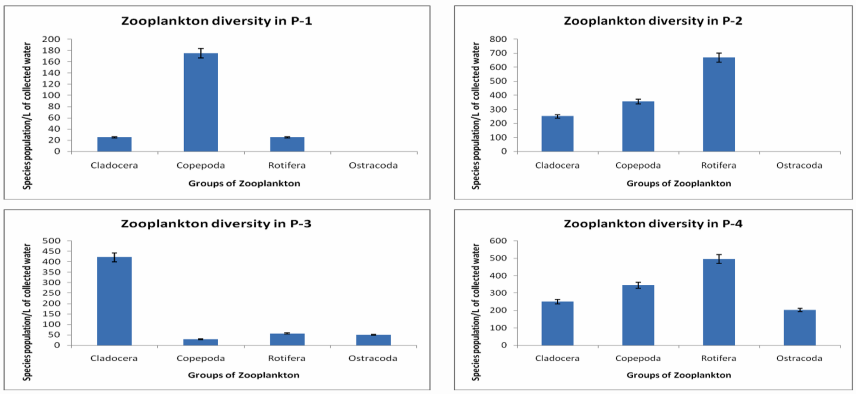

Fig. 6. Graphs showing variation of species population of each group of zooplankton in the four ponds, during the study.

Table 1. The physico-chemical and hydro-biological parameters of the four ponds of Bankura district of WB, India, where sampling was carried out throughout the year 2018 are being summarized here. The values of different physico-chemical parameters are Mean ± SE.

Sampling sites → / Parameters observed ↓	Pond 1 of Bankura town Had pukur (P-1)	Lyka pukur (P-2)	Sarbagan pukur (P-3)	Pond behind Pushpa Sweets of Bhairabsthan, Bankura (P-4)	BSI standard
Latitude	23°22′69.918′′N	23°22′89.143′′N	23°23′59.831′′N	23°13′51.1′′N	—
Longitude	87°04′50.64′′E	87°04′75.96′′E	87°03′00.007′′E	87°03′14.4′′E	—
Air temp (°C)	34 ± 4.0	32 ± 5.2	36 ± 3.2	35 ± 4.1	—
Water temp (°C)	30 ± 1.5	30 ± 1.2	32 ± 1.4	31 ± 1.8	<40°C
pH	7.50 ± 0.5	7.60 ± 0.6	7.50 ± 0.5	7.60 ± 0.71	6.5–8.2
Dissolved O_2 (mg/L)	4.25 ± 0.25	2.3 ± 0.25	3.75 ± 0.25	1.74 ± 0.25	Upto 6.0
Free CO_2 (mg/L)	210 ± 23.8	325 ± 23.8	295 ± 23.8	365 ± 23.8	—
Dissolved CO_2 (mg/L)	573 ± 34.6	435 ± 34.6	478 ± 34.6	398 ± 34.6	—
Quantitative analysis phytoplankton (Nos/L)	775 ± 34	1218 ± 29	959 ± 23	1744 ± 52	—
Quantitative analysis of zooplankton (Nos/L)	225 ± 16	1273 ± 42	556 ± 18	1293 ± 35	—

animals which are very weak swimmers. They may exist in a wide range of environmental conditions and are also very good bio indicators to access the pollution of any freshwater body (Dutta and Patra 2013). They contribute significantly to biological productivity of freshwater ecosystem Majumder et al. 2018). The freshwater zooplankton constitutes protozoans, Rotifers, Cladocerans, Copepods and Ostracods. We observe mainly four groups of zooplankton (Tables 1 and 2). (Figs. 1—8.).

The highest zooplankton number (1293 Nos/L) in P-4, followed by P-2 (1273 Nos/L) and P-3 (556 Nos/L) and the minimum zooplankton number in P-1 (225 Nos/L). Mostly four groups of zooplankton are observed in this area, i.e., Cladocera (represented by *Daphnia* sp., *Bosmina* sp., *Moina* sp., and *Ceriodaphnia* sp., Copepoda (represented by *Cyclops*

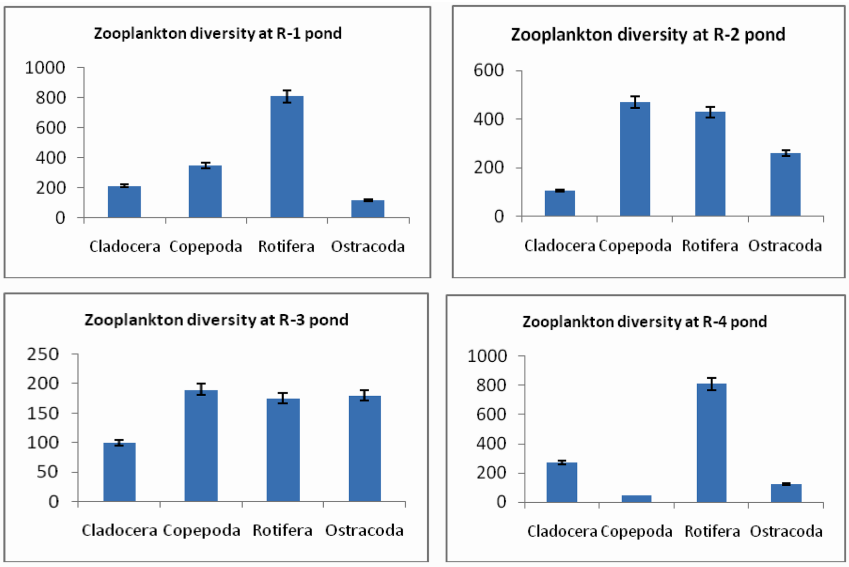

Fig. 7. Graphs showing variation of species population of zooplankton in the four ponds of Ramsagar. The values at Y-axis shows the species population/L of collected water.

Table 2. The physico-chemical and hydro-biological parameters of the four ponds of Ramsagar zone of Bankura district of WB, India, where sampling was carried out throufghout the year 2018 are being summarized here. The values of different physico-chemical parameters are Mean ± SE.

Sampling sites → / Parameters observed	Pond 1 of Ramsagar (Hati-bari-1) or R-1	Pond 2 of Ramsagar (Hati bari-2) or R-2	Pond 3 of Ramsagar (Hati bari-3) or R-3	Pond 4 of Ramsagar (Rakshit pukur) or R-4
Latitude	23°05'34.7" N	23°05'36.8" N	23°05'37.9" N	23°05'55.6" N
Longitude	87°15'53.4" E	87°15'52.3"E	87°15'29.7" E	87°16'46.4" E
Air tem (°C)	20 ± 2.3	30 ± 3.1	20 ± 2.4	24 ± 2.7
Water temp (°C)	16 ± 1.7	22 ± 2.1	18 ± 1.9	20 ± 2.4
pH	7.64 ± 0.9	8.6 ± 1.2	7.54 ± 0.9	7.4 ± 0.7
Dissolved O_2 (mg/L)	7.5 ± 0.65	4.5 ± 0.43	5.0 ± 0.45	3.6 ± 0.43
Free CO_2 (mg/L)	216 ± 21.2	133 ± 13.2	250 ± 26.5	287 ± 19.6
Quantitative analysis of zooplankton (Nos/L)	1495 ± 21 / L	1265 ± 18 / L	645 ± 8 / L	1250 ± 11 /L

sp., *Mesocyclops* sp., and *Diaptomus* sp.), Rotifera (represented by *Brachionus bidentata , Brachionus diversicornis, Brachionus quadridentata, Keratella tropica*) and Ostracoda (represented by *Cypris* sp. ,and *Stenocypris* sp.).

Cladocerans are useful components of micro-faunal food webs, e.g., as grazers of phytoplankton or as food supplements for macro-invertebrates. This cladoceran group undergoes a rapid increase in ponds, lakes and reservoirs. Coastal cladoceran gathering is commonly dominated by Chydoridae, Macrothricidae and occasionally Daphniidae and Hyocryptidae. Planktonic cladocerans are subordinated by four families : Bosminidae, Daphniidae, Moinidae and Sidiidae, although some taxa from other families were also observed seasonally. This group feeds on smaller zooplankton, bacterioplankton and algae; and they are highlyresponsive against pollutants, this group also reacts against low concentration of contaminants. P-3 pond showed very high population of Cladocera, wherein P-2 & P-4 exhibit moderate population and P-1 exhibits very low population of Cladocera.

The sub-class Copepoda is the largest class of Sub-phylum Crustacea and is pre-dominantly marine, with a large species population. Copepoda constitutes the third most abundant group of zooplankton . In fresh water, two orders : Caligoidia and Lernacopodida are primarily parasitic. There are three free-living

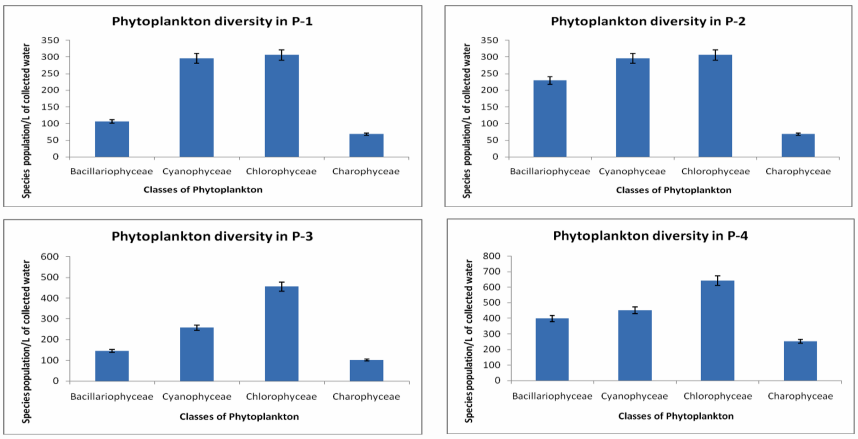

Fig. 8. Graphs showing variation of species population of each group of phytoplankton.

orders, all of which have freshwater intermediaries : Calanoida Cyclopoida and Harpacticoida. Copeponds of the order Cyclopoida are the most important food items in freshwater aquaculture and their nauplii are especially valuable for feeding fry. Copepods as natural food are either cultivated or collected from the wild. They are also intermediary hosts for important fish parasites, including tapeworms and nematodes. Damage from these parasites may lead to fish fatalities or decrease the market value of the fish yields. Finally copepods serve as intermediate hosts for parasites that infact humans and can serve as vectors of human diseases like cholera. Feeding habits differein three orders of Copepods. Cyclopoid, Copepods are commonly carnivorous though they also feed on algae, bacteria and detritus. The Calanoid Copepods are generally omnivorous (feed on ciliates, rotifers, algae, bacteria and detritus).

Rotifers are soft-bodied metazoans and is a prominent group among the zooplanktons irrespective of the trophic status of the water body (Majumder et al. 2016). The rotifers are a diverse population of pseudo-coelomate plankton. They are identified by the presence of an anterior ciliary organ (the corona) used in locomotion and collection of food, a specialized apparatus (mastax) containing a complex set of jaw-like structure, called trophi and a tegumental skeletal lorica which, (in many species) forms a hard and protective coating. Rotifers are the prominent group among the zooplanktons of a water body. This may be due to the less specialized feeding parthenogenic treproduction and high fertility. Rotifers occasionally become plenty in population when sufficient food is available and can obtain population densities of over 5000 individuals/L. In some unusual water bodies, excessively large populations can develop. Their population can be identified by 8 species belonging to 6 genera and 5 families; namely Brachionidae, Asplanchnidae, Trichocercidae, Lecanidae and Testudinellidae. Quantitative exploration during the period of study showed that the family Brachionidae exhibit maximum diversity of species. Increase in number of *Brachionus* sp., indicates that the pond is organically polluted and is approaching eutrophication (Ahmad et al. 2012). It is illustrated by 4 species, among the *Brachionus bidentata* was found to be predominant species.

There are reasonably good number of regional reports including those primarily on the family. Studies, shows that DDT, Dicophol, Estradiol and other pesticides do had a direct impact on growth, fertility and survival of rotifers. Overall study indicates that the rotifer population is lower in P-1 and P-3 pond and the population increase in P-2 and P-4 pond.

In addition to rotifers, a low consistence and diversity of Copepods in the water body provides additional record of the presence of strong amount of organic components. In present study in P-2 and P-4 Copepods shows the majority and P-1 pond showed a moderately high population of Copepodian compared to other ponds. Copepoda domination may also be due to their feeding on diatoms, Rotifera and Cladocera and high reproduction capacity. Zooplankton diversity in four ponds of Ramsagar zone was studies in the year 2018. The sampling was done from months of January to November. The average phytoplankton diversity in the pond of Bankura town is 836.75 but the average diversity of phytoplankton is 1163.75 in the pond of Ramsagar town, which is much higher than the ponds of Bankura town. The ponds of Ramsagar town shows higher production of freshwater aquaculture than the ponds of Bankura town. As the production of the freshwater aquaculture is directly proportional to the number of the plankton, is inferred by the presence of the higher number of the plankton in the pond of the Ramsagar. Our country needs more freshwater aquaculture production. But it was shown that the fresh water aquaculture production is very much diversified in both the studied towns of the Bankura District of West Bengal. The plankton diversity of the two different sites also varies. This study may help to increase the production of the freshwater aquaculture by increase in the production of the phytoplankton.

Ostracods are small, poorly-segmented Crustacea in which the body parts are enclosed within a calcareous bivalved carapace. Ostracoda constitutes of the minimum abundant group of zooplankton and this group is illustrated by *Cypris* sp. and *Heterocypris* sp. These organisms serve as food for fish and benthic macro-invertebrates. During the present study, P-4 shows the maximum population where as in P-1 and P-2 Ostracodan population is absent.

Phytoplanktons are important indicators of ecological status of water bodies (Mili et al. 2017). The species composition, biomass, relative abundance, spatial and temporal distribution of phytoplankton are an expression of the environmental health or biological integrity of a particular water body. The occurrence and abundance of phytoplankton is correlated to all environmental and physico chemical parameters of the pond (Nandigam et al. 2016). Here we identify four major phytoplankton groups.

The highest phytoplankton number (1744 Nos/L) in P-4, followed by P-2 (1218 Nos/L) and P-3 (959 Nos/L) and the minimum phytoplankton number in P-1 (775 Nos/L). Mostly four phytoplankton groups are observed in this area, i.e., Bacillariophyceae (represented by *Navicula* sp., *Synedra* sp., *Lyngbya* sp., *Diatom* sp.), Cyanophyceae (represented by *Peridinium* sp., *Ceratium hirundinella*), Chlorophyceae (represented by *Oedogonium* sp., *Schizochlamys* sp., *Asterococcus* sp.) and Charophyceae (represented by *Chara* sp., *Staurastrum* sp., *Micrasterias* sp.).

Among phytoplankton, Chlorophyceae was the dominant class. The occurrence of Chlorophyceae was highest in P-4 pond (642 Nos/L), and lowest in P-1 pond (306 Nos/L). The commonly occurring green algae were *Oedogonium* sp., *Schizochlamys* sp., *Mougeotia* sp., *Asrerococcus* sp., were dominantly occuring genera. *Schizochlamys* sp., *Oedogonium* sp., *Mougeotia* sp., was found all over the year (Gulecal and Temel 2014).

Navicula sp., *Synedra* sp., *Lyngbya* sp., *Diatom* sp., was the dominant genera under the class Bacillariophyceae. The occurrence of Bacillariophyceae was highest i. e., 398 Nos/L in pond P-4, and lowest i.e. 106 Nos/L in pond P-1.

In the present study, we observed a few phytoplanktons such as *Peridinium* sp., *Ceratium hirundinella,* which are known as indicators of mesoeutrophic waters. Cyanophyceae was one of the major groups of phytoplankton.

The highest number of Cyanophyceae i.e., 452 Nos/L was observed in pond P-4 and lowest number of Cyanophyceae i.e. 257 Nos/L was observed in P-3 pond. The representatives of Charophyceae were *Chara* sp., *Staurastrum* sp., *Micrasterias* sp. and *Netrium* sp. The highest number of Charophyceae i.e., 252 Nos/L was observed in pond P-4 and lowest number of Charophyceae i.e. 68 Nos/L was observed in P-1 pond.

CONCLUSION

Both the qualitative and quantitative abundance of plankton in a water body vary from location to location and also in aquatic systems within the same location even with similar ecological conditions, thus are of great importance for imposing sustainable management policies to maintain the health of water bodies (Chopra et al. 2013). The productivity of species, its composition and abundance is highly interrelated to the physico-chemical properties such as light, dissolved oxygen, pH, dissolved carbon dioxide, temperature (Bera et al. 2016). Zooplanktons are connecting links between autotrophs and heterotrophs. The density of phytoplankton is directly proportional to pisciculture potentiality of the pond. In rural area the drinking water, agricultural practices, pisciculture are based on different ponds and reservoirs. It is necessary to maintain proper zooplankton community to draw out the pond condition in relation with particular nature of work on the pond. Density of zooplankton is directly correlated with fishery potentiality. The pond water is controlled by different factors such as heat, light, humidity and contamination from different effluents in the pond water. Contamination of water through domestic sewage was also noticed which is having a huge toll on the pond productivity status. Proper biological and chemical treatments of domestic sewage need to be done before discharge to the ponds for long run sustainable of the resources. The present study gives information on diversity and distribution of plankton. The present basic information of the plankton distribution and abundance would form a beneficial tool for further assessment and monitoring of the ecosystem of these four ponds in Bankura town, West Bengal.

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