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Rotifers in Dhanras Fly Ash Discharge Water Pond

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Abstract

Korba is power hub of Chhattisgarh as contributes maximum to the state power share. As coal is the major source of power generation, it also leads to the generation of huge amount of fly ash, which is disposed in ash dykes. Excessive water from these ash dykes are further collected into fly ash discharge water pond for further settlement. Present study was done in fly ash discharge water pond made for such purpose in Dhanras, Korba distritc, India. For study fly ash discharge water pond was divided into four stations and samples were collected respective stations. It was found that fly ash discharge water supports the growth of few rotifers at all stations except the point of entry of discharge water into the pond from ash dykes. Six different rotifers were isolated from the fly ash discharge water pond: Eosphora sp., Proalinopsis sp., Philodina sp., Keratella sp., Epiphanes sp., Lecane sp.. Philodina sp. was found to be the dominant one followed by Lecane sp., Prolinopsis sp. was the least abundant one.

Keywords: Fly ash discharge water, rotifer, physicochemical, dominant.

Introduction

Fly ash dyke is an embankment, a dumping yard of hot ash slurry produced as a by-product of coal combustion, which is a combination of dried fly-ash and water in ratio of 1-4 part fly ash and 4-20 part water. Fly ash particles are spherical in shape and reported as spheroid carbonaceous particle (SCP)[1]. Size of these particles ranged between 1µ-100µ[2]. The constituents were found mostly in their oxide form while their quantity and composition depends on the type of coal burned at thermal power plant. Chemically it is composed of oxides- SiO_2, Al_2O_3, TiO_2, Fe_2O_3, MnO, MgO, CaO, K_2O, Na_2O, some micronutrients- Cu, Zn, Mn, Fe, B, Mo and heavy metals- Se, Cr, Pd, Co, Ni, Cd, As, Hg available in trace amounts[3] . The excess water from dyke goes in fly ash discharge water pond where fly ash makes bottom mud and fly ash constituent are present in soluble and non soluble form. Thus it provides a substratum for survival for incoming life form, which comes through different sources as wind, rain water, anthropogenic activities and other contaminations.

Rotifers are important and commonly found soft bodied invertebrates. They are numerous in all freshwater habitats and are capable of tolerating a wide range of ecological conditions. They exhibit striking array of adaptive behavior[4]. Like other organisms of aquatic medium, rotifer population is also affected by the physiochemical conditions of water-body. These physiochemical parameters are not only affected by the contaminations, but are also regulated by the seasonal changes, and diurnal fluctuations of particular area[5,6]. Through these regulating processes physiochemical parameters of water-body works as controlling factor and regulates the population of inhibiting zooplanktonic population including rotifers. Zooplankton diversity on many water reservoirs[7,8] , lake[9] and pond[10,11] has already been studied. Fluctuation of physiochemical properties and variations in zooplanktonic population in river water after industrial contamination of fly ash was reported in many previous studies[12,13]. Invertebrate fauna in fly ash discharge water pond has been recently done by Shrivastava and Shrivastava[14]. As fly ash discharge water is different from above mentioned water bodies, present study of rotifer occurrence and survival in it water will be helpful to explore this ecological niche for commercial use.

Study area: Korba is the largest fly ash producer in Chhattisgarh state, India as it has maximum number of thermal power plants operating in the state[15]. Fly ash discharge water (FAD) pond in the present study is situated in Dhanras village of Korba district, India. It is connected from ash dyke through inlet pipelines and thus receives discharge water from the ash dyke in the form of low concentrated slurry. Four sites selected for the present study were Station A-Inlet of the FAD pond from where the slurry containing water and fly ash from ash dyke enters in the pond, Station B-Left bank of the FAD pond, Station C-Right bank of the FAD pond and Station D - Outlet of the FAD pond from where excess of water is released to the canal leading to nearby river.

Material and Method

Physiochemical parameters of water such as temperature, pH and dissolved oxygen (DO) were tested on the spot. Color of water samples was recorded by visual observation. Temperature was taken with mercury filled glass thermometer pH, and DO through water testing kit and other parameters such as COD, BOD, chloride, phosphates and sulphates were measured in

laboratory according to standard methods given in APHA[16] and Adoni[17].

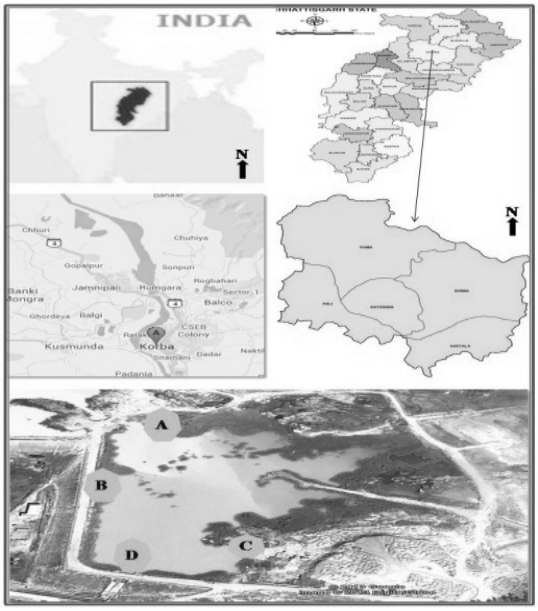

Figure-1
Showing map of study area, C.G state, followed by block map of Korba dist., Google map of site and Fly ash discharge water pond indicating all four stations

To study rotifers, ten liter of water from all four stations were filtered through plankton net and taken to the laboratory for further study. Samples were studied in cavity slides for their observation in live condition and some samples were preserved in 4% formalin and Lugol's solution[18] for further studies. All observations were made using binocular research microscope and identification of rotifer was done using standard key given in Edmondson[19] and Adoni[17].

Table-1
Physiochemical properties of fly- ash discharge pond

S. No.	Parameters	Station A	Station B, C and D
1.	Colour	Grey	Grey
2.	Odor	Pungent	Pungent
3.	Temperature(^{0}C)	33	30
4.	pH	7.8 (8.8-13)	7.4
5.	Hardness (mg/l)	169	167
6.	Turbidity NTU	145	126
7.	BOD (mg/l)	4.85	4.85
8.	COD (mg/l)	2.3	2.2
9.	DO (mg/l)	4.34	4.34
10.	Sulphate (mg/l)	13.00	11.95
11.	Phosphate (mg/l)	1.8	1.8
12.	Chloride (mg/l)	27.99	26.49

Table-2
Distribution of Rotifer from all four stations of Fly-ash discharge water pond

S. No.	Rotifers	No. of rotifers from stations			
		A	B	C	D
1.	*Eosophora* sp.	0	15	60	10
2.	*Proalinopsis* sp.	0	08	16	0
3.	*Philodina* sp.	0	50	110	20
4.	*Keratella* sp.	0	21	36	24
5.	*Epiphanes* sp.	0	10	28	18
6.	*Lecane* sp.	0	30	47	21
7.	**Total**	0	129	297	93

Results and Discussion

In India water bodies of different types such as estuary[20] and groundwater[21] has already been studied, but study of flyash discharge water is one of its kinds. Every time discharge from ash dykes imparts characteristic pungent odor, turbid grey appearance, high pH, high chloride content to the water in discharge water pond. Physicochemical analysis of water from fly ash discharge pond was done as by Rajagopal *et al.* had reported in their study that physicochemical conditions directly affects the inhabiting fauna[22], given in table-1. Sharma has reported physio-chemical status of water directly affects the richness and diversity rotifer population[9]. Station A- which is the inlet of the pond as totally different physicochemical properties during the discharge from ash dykes, which leads to sudden increase in the temperature to 43^{o}C from 33 ^{o}C indicates the thermal effects of ash bunds and pH in the range of 8.8 to 13.0 in the alkaline scale which normally remains near to 7.8. This station has very strong pungent odor and has grey turbid appearance throughout. The elevated temperature and pH level remains till active discharge continue and for few more time after end of discharge. Considering other three Stations B, C, D has stable temperature and pH throughout. Other factor such as turbidity of water sample from Station A was found to be 145 NTU and 126 NTU at remaining three stations. Water at station A was more turbid (145 NTU) due to more concentration of fly ash comparing with other stations. Hardness of discharge water pond was found to be 167-169 mg/l, BOD of all four stations was observed to have same reading of 4.85mg/l; COD 23 mg/l at station A and 22 mg/l at other stations. DO of all station was found to be 4.34 mg/l, which due to depletion of oxygen due to ash content in it. BOD and COD were found to be very lower as that was observed in study of fly ash contaminated Kanhan river[23]. The value of COD does not indicate any organic pollution. Ionic concentrations of Sulphate was found to be 13.00 mg/l at station A and 11.95mg/l in all other stations, Phosphate was found to be 1.8mg/l in all study stations and Chloride was found to be in range of 26.49mg/l at station B,C, D and 27.99 mg/l in Station A. High chloride ion levels may be attributed to the bleaching treatment of during the processing before disposal.

Rotifers belonging to six different genus were encountered by microscopic observations of water samples from fly ash discharge water pond, during present study (table-2) namely

Eosphora sp., *Proalinopsis* sp., *Philodina* sp., *Keratella* sp., *Epiphanes* sp., *Lecane* sp.. Considering station wise distribution, no rotifer was observed from station A, while from all other stations all six of the rotifers were isolated. This station wise distribution is given in table-2 and figure-1. Considering the table-2 maximum number of rotifers was observed in station- C (297) which included all six isolated species. This station is far from the inlet point and had vegetation at littoral zone which provided shelter and food for rotifers, Sharma reported 36 genera of that phylum dominated by littoral periphytonic monogont species[9] , followed by station- B with 129 rotifers and the station-D with total of 93 rotifers excluding *Proalinopsis* sp. Station-D which is outlet of the pond and thus there is discharge of excessive water from this point time to time, makes it quite unstable for rotifers and other zooplankton to get stabilize and hence comparatively less population of rotifer was isolated from this point. At station-A no rotifer was observed may be due to fluctuating physiological conditions at this station.

Considering the dominance according to table-2 and figure-2 *Philodina* sp. was emerged as the most dominant one as it was isolated from all the three stations and also maximum in number. This study was in accordance with the study conducted by Shrivastava and Shrivastava[14]. Considering station wise dominance at Station C- order of dominance was *Philodina* sp.> *Eosphora* sp.> *Lecane* sp.> *Keratella* sp.> *Epiphanes* sp.> *Proalinopsis* sp. At station B- *Philodina* sp.> *Lecane* sp.> *Keratella* sp.> *Eosphora* sp.> *Epiphanes* sp.> *Proalinopsis* sp. At Station D- *Keratella* sp. > *Lecane* sp.> *Philodina* sp.> *Epiphanes* sp. > *Eosphora* sp.

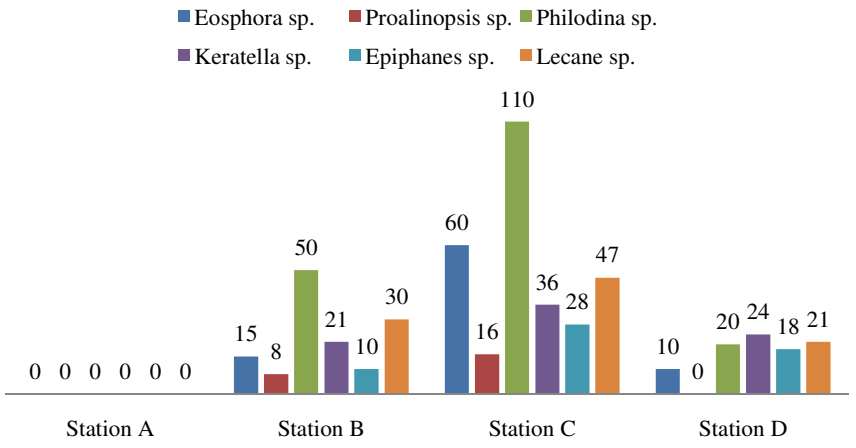

Figure-1
Distribution of Rotifers In Four Stations

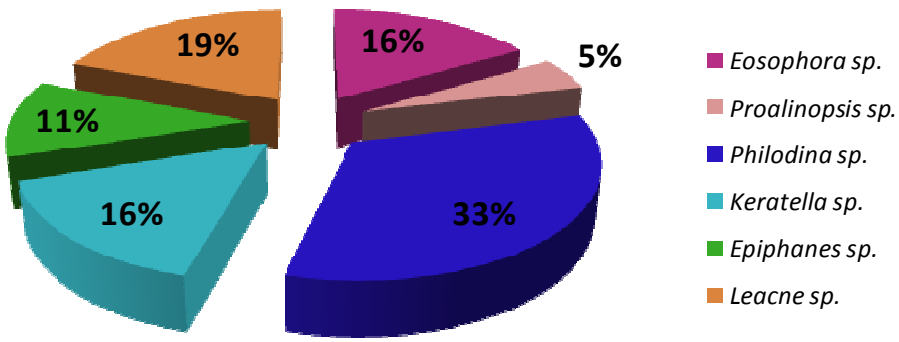

Figure-2
Rotifer Dominance

Considering percent dominance *Philodina* sp. was the most dominant species with 33%, followed by *Lecane* sp. 19%, *Keratella* sp. and *Eosphora* sp. both 16%, *Epiphanes* sp. 11%, *Proalinopsis* sp. 5%. Shrivastava and Shrivastava had also reported *Philodina* sp. as dominant rotifer in their study[14]. Rehman *et al*. has studied survival growth and heavy metal processing efficiency of rotifers and observed that *Philodina roseola* has capability to survive in the environment loaded with heavy stresses of metals[24]. *Lecane* sp. was observed as the second dominant specie in the present study. Amsha and Suresh identified 40 different rotifers from tropical reservoir Kullurchandai, and found *Lecane* sp. and *Branchionus* sp. as the dominant one[25]. Vaishali *et al.* has reported *Keratella* sp. and *Branchionus* sp. as abundant rotifer at lake Kacharali, during their bioremediation study[26]. *Lecane* sp., *Eosphora* sp. and *Epiphanes* sp. has been previously reported as eutrophic species[27, 28,29]. Karuthapandi *et al*. reported that different members of genus Lecane have wide adaptation to survival with physic chemical factors of the temporary water habitat[30]. *Proalinopsis* sp. was least encountered during the study and was about 5% of total rotifer population isolated and hence can be considered as less adaptive one. Balkhi *et al.* categorized *Proalinopsis* sp. as eurythermal species in their detailed hydrobiological study of Anchar lake[31]. Sharma had studied the rotifer diversity of Loktak Lake at Manipur and reported that richness was inversely correlated with pH, water temperature, rainfall, hardness, nitrate, chloride and total dissolved solids but positively correlated with DO[9]. Similarly Shayestehfar and Abdovis studied the diurnal fluctuation in population density of rotifers in Karun river water at Iran with special reference to physiochemical properties of water. He found that physiochemical factor as temperature, water current, and dissolved oxygen affected the population density and maximum population density[5].

During the study it was observed that station-C is the most habitable part fly ash discharge water pond for rotifer, from were all six species are isolated while the inlet of discharge water supports no rotifer when study was conducted which is in accordance with the findings of Shrivastava in published in 2006 that no life form has been yet reported in hot slurry[32].

Conclusion

Isolation of six different rotifer from the fly ash discharge water pond indicates that it supports their growth though not luxuriantly. All six rotifers have ability to adapt themselves in such fluctuating physiological conditions. The point of addition of hot discharge water (Station-A) form ash dyke supports no rotifer population. *Philodina* sp. has come out as the most adapted rotifer from Dhanras fly ash discharge water pond. *Keartella* sp. was dominant at Station D which is the outlet. Presence of eutrophic species indicates that constituents of fly ash discharge water somewhere support the rotifers and other members of zooplanktons. Thus it can be looked forward to use fly ash discharge water for culturing rotifers but a more detailed study is needed for this purpose, which will be a part of our further study.

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