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Research Article

PROTOZOAN FAUNA OF FRESHWATER HABITAT IN WATER BODY ON AJINKYATARA FORT, DIST. SATARA, MAHARASHTRA, IN DECEMBER 2017

Ravindra Bakare*[1] and Savita Nalawade[2]

[1]Department of Zoology, Kisan Veer Mahavidyalaya, Wai, District: Satara, 412803
[2]Department of Zoology, Y. C. I. S. Satara, (Dist-Satara), Pin 415002

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ABSTRACT

Protozoa are highly abundant in all aquatic habitats, agricultural soil and wetland habitats and they are greatly involved in food chain. In India and most specifically in Maharashtra protozoan species diversity has been rarely studied by limnologists for several reasons. In present investigation the species composition population and diversity of protozoa in water body of Ajinkyatara fort of Dist. Satara, Maharashtra, during the year 2017 is studied. When studied on annual mean basis the total number of protozoan species estimated was to be 41. It seems that if the species variety at given time is considered the ciliates count approximate 61 %, flagellates about 19.5% and rhizopods are 19.5% of total protozoan population. Throughout the year ciliates dominated the total number and in number of varieties. The average density of total protozoa found minimal in February and peak in December. The maximum concentration of protozoa was found at a region influenced by organic waste.

INTRODUCTION

Protozoa are highly abundant in all aquatic habitats, (Finlay, 1998) agricultural soil (Bakare and Nalawade, 2014) and wetland habitats and they are greatly involved in food chain. In India and most specifically in Maharashtra protozoan species diversity has been rarely studied by limnologists for several reasons. As far as the aquatic ecosystem is concerned details about diatoms, phytoplankton and zooplanktons are abundantly available, surprisingly showing very less data about protozoa. If we start our review on the data published by the Government of India in "Overview of Biodiversity: Status, Trends and Threats" (Source: National Biodiversity Action Plan, 2008) the number of protista (protozoa) given in the world it is 31250 and in India it is 2577, comprising about 8.24 % of total protozoan diversity. When it comes to the Annual Report of Ministry of Environment 2013-14 under the forests and climate change, it is stated about the percentage endemism in the Indian faunal groups for protozoa, the total endemic number is 48.54% in which free living protozoa are 7.21% and parasitic are 41.33%. State wise endemic number is also given. It is Andhra Pradesh-6, Arunachal Pradesh-6, Assam-30, Himachal Pradesh- 12, Tamil Nadu-20. The total 74 species stated without names given. No endemic species have been shown in front of Andman and Nicobar, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Maharashtra, Meghalaya and Punjab. Free-living protozoan diversity in Indian wetlands is studied by Bindu L. from the Zoological Survey of India. He mentions about the present (2000) estimate of 1247 species from marine, estuarine and freshwater systems. Wetland displayed from Bharatpur, Rajasthan and Chilka Lake, Orissa representing 117 and 61 species respectively. From Kolkata wetlands West Bengal represent about 102 species comprising of flagellates 4 species, rhizopods 15 species and ciliates 83 species. Mini Mohandas *et al* (2013), Bakare and Nalawade (2014) are most successful workers in the studying biodiversity of free living protozoa finding about 96 varieties (21 varieties of Phytomastigophora, 36 varieties of Rhizopoda and 39 varieties of Ciliata) from soil and aquatic habitat around Wai Dist. Satara, Maharashtra respectively. Dr. U. A. Kamble (2012) has described 8 varieties of free living protozoa from Mumbai region. He also has given methods of preservation and staining of protozoan specimen. While studying diversity of phytoplankton from three water bodies of Satara district; Pawar and Sonawane ((2011) mentioned 10 species of Euglenidae. Kamble *et al* (2013) have studied seasonal diversity of protozoa from Krishna River near Miraj, Maharashtra and found 11 different species almost throughout the year 8 of Ciliata and 3 of Rhizopoda. Sharma and Sharma (2011) interestingly investigated 21 varieties of

Corresponding author:* **Ravindra Bakare
Department of Zoology, Kisan Veer Mahavidyalaya, Wai, District: Satara, 412803

only testate amoeba from Deepor Beel (Ramsar site), Assam and North Eastern India. It is to be noted that Bakare and Nalawade (2014) also has investigated about 9 varieties of testate amoeba. Kamble (2012) studied free living protozoa from Pawai Lake, Mumbai and found 10 species of protozoa and their prevalence only 1 species of Rhizopoda, 2 species of Flagellates and 7 species of Ciliata was found during the year. The prevalence noted was 63.11%. Bhat *et al* (2014) studied zooplankton species diversity along with other zooplankton and found 8 varieties. J. Chitra (2014) studied Protozoan Fauna of Freshwater Habitats in South Dum Dum, Kolkata. Eight species of rhizopoda belonged to 4 genera, 4 family (Pelomyxidae, Arcellidae, Centropyxidae and Difflugiidae) and 2 order (Pelobintida and Arcellinida), Four species of flagellate belongs to 2 genera, 1 family (Euglinidae) and 1 order (Euglenida), 4 species of ciliate belongs to 4 genera, 4 family (Colepidae, Vorticellidae, Euplotidae and Paramaeciidae), 2 order (Prorodontida and Peritrichida) and 2 suborder (Sporadotrichinia and Peniculina). Kailash Chandra *et al* (2017) in 'Current Status of Freshwater Faunal Diversity in India' published by Zoological Survey of India it is stated that total in the world about 33400 species of free living protozoa occur from which 2390 are freshwater species and in India total number of protozoan varieties are discovered is 3510 out of which only 291 varieties are freshwater. Protozoan population plays a significant role on the microbial food webs from the soil and water ecosystems. Their predatory activities on bacteria and thus reduce their numbers in environments rich in organic matter. They also feed voraciously on phytoplankton. These activities are also involved in shaping the bacterial and phytoplankton distribution and composition as it has been reported in different aquatic environments Protozoan population plays a significant role on the microbial food webs from the soil and water ecosystems. Their predatory activities on bacteria and thus reduce their numbers in environments rich in organic matter. They also feed voraciously on phytoplankton. These activities are also involved in shaping the bacterial and phytoplankton distribution and composition as it has been reported in different aquatic environments.

The present investigations were undertaken with the objectives of describing the diversity, abundance of protozoa in the zone of a freshwater eutrophic lake on plateau of Ajinkyatara fort near Satara in Maharashtra state. The water bodies on the fort Ajinkyatara have been excavated and cleared recently to make the water available for public use. The location of Ajinkyatara fort is 17°24′N 73°35′E, Hill fort, 1010 meters (3,360 ft) ASL

Sampling and Identification

Suitable sites for sample collection from Ajinkyatara Lake were identified, having fewer disturbances of the tourists and local people. Freshwater samples along with some waterweeds, algae, bottom ooze and flocculent matter arising out of washing waterweeds and aquatic plants from littoral zone was collected and brought to the laboratory; stored in wide mouthed specimen glass jars. Temperature and pH of water at the collection site was recorded. Then observed for occurrence of protozoon under low and high power of compound microscope. It is necessary to keep the collected sample in laboratory under diffused light conditions for at least fifteen days so as to allow less populated protozoan to increase its number by division and to study progressive and retrogressive changes in varieties due course. Frequent observations from the collection time were made to ensure coverage of most of the varieties under observation. Some of the ciliate and flagellate varieties are so fast moving that it becomes very difficult to chase them under view. To minimize their movement 1% Methyl cellulose solution is used. Photographs and videos of movements and binary fission and conjugation were recorded with Abbot digital eyepiece 5 MP as per required by magnification of 10X, 40X. Protozoan observed were identified using taxonomic criteria given by Hyman (1940), Westphal (1976), Jahn (1979) and Kudo (1977) and online references.

RESULTS AND DISCUSSION

Table 1 Different protozoan varieties and their relative abundance at selected collection spots on Ajinkyatara fort, Satara during 2017.

Sr. No.	Variety	Relative abundance
	Flagellata	
1	*Spondylomorum quaternarium* Ehrenberg	P++
2	*Eudorina elegans*	P
3	*Euglena acus* Ehrenberg	P+++
4	*Euglena spirogyra*	P++
5	*Euglena anabaena*	P+
6	*Peranema trichophorum*	P +++
7	*Palmella stage of flagellates*	P +
8	*Chilomonas paremecium*	P ++
	Rhizopooda	
1	*Amoeba proteus*	P ++
2	*Amoeba radiosa*	P ++
3	*Arcella vulgaris*	P ++
4	*Arcella megastoma*	P ++
5	*Difflugia oblonga*	P ++
6	*Actinophrys sol*	P +++
7	*Actinosphaerium eichhorni*	P +++
8	*Astrodisculus radians*	P +
	Ciliata	
1	*Prorodon ovum*	P +
2	*Coleps hirtus*	P +++
3	*Lacrymaria olor*	P +++
4	*Coleps octospinus*	P ++++
5	*Didinium nasutum*	P ++++
6	*Litonotus fasciola*	P ++
7	*Trachelius ovum*	P +
8	*Loxodus rostrum*	P ++
9	*Chilodonella cucullulus*	P ++
10	*Paramecium caudatum*	P +++
11	*Paramecium multimicronucleatum*	P +++
12	*Paramecium aurelia*	P +
13	*Paramecium bursaria*	P ++
14	*Spirostomum intermedium*	P +
15	*Oxytricha fallax*	P +
16	*Stentor coeruleus*	P ++++
17	*Stentor polymorphus*	P ++++
18	*Stylonychia mytilus*	P +++
19	*Stylonychia pustulata*	P +++
20	*Stylonychia notophora*	P +++
21	*Euplotus patella*	P +++
22	*Euplotes eurystomus*	P +++
23	*Euplotes aediculatus*	P +++
24	*Vorticella campanula*	P ++++
25	*Vorticella microstoma*	P ++++

These are diatoms; phytoplankton, unicellular and multicellular algae and mixotrophic flagellates flourish and give green appearance to the water body. Only flagellates which are generally described as phytomastigophorans have been discussed here. As the water body has limited area it is cannot

be categorized as pond or lake but as it has been rejuvenated and constructed by nature lovers from Satara it is big artificial tank maintained by natural water source. However water is available throughout the year as there is consistent rainfall in the region.

Out of 41 varieties observed so far only 8 species of flagellates are seen. So out of 100 it comprises about 19.5%. The green appearance of water is due to heavy growth of algae and not due to green flagellates. One more interesting thing about them is presence of a prominent red spot called as chromatophore towards the anterior side. It is said to be photosensitive and seldom labeled as eyespot. Majority of euglenoids are more or less spindle shaped. *Spondylomorum quaternarium* is from Genus *Spondylomorum;* 16 cells in a compact group in 4 transverse rings; each with 4 flagella, asexual reproduction by simultaneous division of component cells. It shows movement like a football. Dark green in appearance. Persists only for about 2-3 days after collection of sample. *Eudorina elegans* is like a jelly capsule enclosing colony of cells 10-24µ in diameter; colony 40-150 µ in diameter; in ponds, ditches and lakes. Movements like a rolling ball. *Euglena acus* is with long swift body, spindle or cylinder with a sharply pointed posterior end; flagellum short about $1/4^{th}$ the body length; spiral striation of pellicle very delicate; numerous discoid chromatophores; rod form and 12-20µ long, nucleus central, stigma distinct, movement sluggish but straight. *Euglena spirogyra* is *s*imple fusiform shaped pellicle is with spiral rows of tubercles the body is flexible showing role in movement sluggish. *Euglena anabaena* is profoundly spindle shaped sluggish mover while *Peranema trichophorum* is straight and swift runner with axial movement of flagellum. *Palmella* stage is a jelly capsule in which asexually reproduced flagellates like *Chromulina* are seen in colony. Movement of palmella is like amoeba and often misunderstood like amoeba engulfed unicellular algae in its endoplasm. *Chilomonas paramecium* always have been seen in the samples collected in freshly formed temporary water body and in unpolluted water when brought in the laboratory in the initial stage. They disappear within 2-3 days. It is observed that all euglenoids disappear from the collected sample within 2-3 days except *Euglena acus* which persists for several days.

Rhozopods are also in the same number of variety viz. 8; comprising 19.5% of total species discovered in the given water body. *Amoeba proteus* and *Amoeba radiosa* are cosmopolitan in distribution and are seen with irregular and radiated pointed pseudopodia respectively. *Arcella vulgeris* is testate amoeba with height of test about ½ of the diameter, dome of hemispheral test evenly convex. Aperture circular, central; colourless, yellow or brown; protoplasmic body confirms with the shape of but does not fill. Several contractile vacuoles are seen. *Arcella megastoma* is bigger in size and with many gaseous vacuoles is seen. It is because CO2 filled vesicles are used in floating. *Difflugia oblonga* is the swift runner of the rhizopods. It is with pyriform test, flask shaped or ovoid; neck variable in length; fundus roundedwith occasionally1-3 conical processes; aperture terminal, typically circular; test composed of angular sand grains, diatoms; bright green with chlorophyllous bodies; 60-580 µ X 40-240 µ; in the ooze of fresh water ponds, ditches and bogs also in moist soil. *Actinophrys sol* is Spherical; ectoplasm vacuolated ectoplasm granulated with numerous small vacuoles; a large central nucleus; solitary but may be colonial when young; diameter variable, average being 40-50 µ; among plants in still fresh water. *Actinospherium eichhorni* is with numerous nuclei; scattered in the periphery of endoplasm; 2 or more contractile vacuoles, large; axial filaments arise from a narrow zone of dense endoplasm at the borderline between endoplasm and ectoplasm; body large, diameter 200-300 µ sometimes up to 1mm, nuclei12-20 µ in diameter; among vegetation in freshwater bodies.

It is as usual ciliates dominate by number and types. Out of 41 varieties ciliates are 25 i. e. 61%. Major varieties seen are *Paramecium caudatum* 180-300 µ long; with a compact micronucleus, a massive macronucleus; two contractile vacuoles on aboral surface; posterior end bluntly pointed; in fresh water. *Paramecium multinucleatum* is the largest species 200-330 µ long; three to seven contractile vacuoles; four or more vesicular micronuclei; a single macronucleus; in fresh water. *Paramecium aurelia* is 120-180 µ long; two small vesicular micronuclei; a massive macronucleus; two contractile vacuoles on aboral surface; posterior end more rounded; in fresh water. *Paramecium bursaria* having foot shape, somewhat compressed; about 100-150 µ X 50-60 µ; green with Zoochlorellae as symbionts; a compact micronucleus; a macronucleus; two contractile vacuoles; in fresh water.

Spirostomum intermedium is Slender, 400-600 µ long, macronucleus chain form; fresh water. *Coleps hirtus* is 40-65 µ long; 15-20 rows of plates; 3 posterior processes; fresh water. *Didinium nasutum* is 80-200 µ long; endoplasm highly granulated; with two girdles of pectinelles; feeds on Paramecium; spherical cysts with three walls, 60-80 µ in diameter; fresh water. *Litonotus fasciola* is elongated flask in form; hyaline; with flattened neck and tail both of which are moderately contractile; posterior end bluntly rounded; without trichocysts; neck stout, bent toward the dorsal side; cytostome is a long slit; contractile vacuole posterior; 2 spherical macronuclei between which a micronucleus is located; 100 µ long fresh water and probably also in salt water. *Euplotes eurystomus* is Elongated ellipsoid; length 100-195 µ; average dimentions 138 µ X 78 µ; 9 frontal-ventrals; no aboral ridges, but 7 rows of bristles; peristome wide, deep; peristomal dipression sigmoid; membranellae forming sigmoid curve; macronucleus near flattened and anterior corner of macronucleus; fresh and brackish water. *Euplotes aediculatus:* Elliptical; length 110-165 µ, average dimentions 132 µ X 84 µ; 9 frontal- ventrals; aboral surface usually without ridges, but with about 6 rows of bristles; peristome narrow, peristomal platelong triangular, drawn out posteriorly, macronucleus band like. *Euplotes patella* having 9-10 cirri at the front and 9-10 cirri at the back in addition to the adoral zone; including 4 marginal cirri at the back; in standing water among plants. *Vorticella campanula* usually in groups; endoplasm filled with refractile reserve granules; vestibule very large with an outer pharyngeal membrane. Micronucleus band form. *Vorticella microstoma* 35-83 µ X 22-50 µ; peristome 12-25 µ wide, stalk 20-385 µ X 1.5-4 µ; common in fresh water infusion, macronucleus band form. *Stentor coeruleus* fully extended body 1-2 mm long; anterior end greatly expanded; the beautiful blue color is due to pigment stentorian; macronucleus moniliform. *Stentor polymorphus* Colourless with symbiotic chlorella1-2 mm long when extended beaded macronucleus and

anterior end is well expanded. *Stylonychia mytilus* 100-300 µ long; sharply tapering and posterior cilia long. *Stylonychia pustulata* About 150 µ long, comparatively oval in shape. *Stylonychia notophora* about 125 µ long. *Oxytricha fallax* About 150 µ long. Posterior region broadly rounded. Prorodon ovum the ciliates is 85-135 µ long, and 75-110 µ, and with 43-53 somatic kineties. The structure of the brosse is variable, formed by three or four oblique rows of kinetosomes that do not reach the cell equator. The number of nuclei is also variable. *Lacrymaria olor* is elongate, highly contractile can extend upto 1.2mm; with 2 micronuclei; two contractile vacuoles are present. *Coleps octospinus* is 80-100 µ long, eight posterior spines are present. 24 rows of platelets are seen. *Trachelius ovum* sphiroidal to ellipsoid; right side flattenedand with longitudinal groove; left side convex; proboscis about 1/4 -1/2 of the body length. Cilia short and closely set. Numerous contractile vacuoles; macronucleus short divided into two spherules. *Loxodus rostrum w*ith an anterior beak usually with excretory vacuoles, cytostome with peristome like groove. Two diploid macronuclei; preying on algae on the surface of stagnant water. *Chilodonella cucullulus* is about 100-300 µ long; 19-20 ventral ciliary rows seen. Oral basket is with 12 rods and with three pre-oral membranes. Macronucleus oval; micronucleus small.

Population ecology of protozoa has been widely studied in different parts of world, while the protozoan data from Indian region and Western Ghats is very sparse. Aquatic biologists and limnologists have ignored the occurrence and diversity of protozoa in different aquatic bodies they have studied. It is because they were interested on studies on phytoplankton and zooplankton which were submicroscopic, and for which collection methods had been established, availability of ample reference and comparatively simple methods of quantitative estimations. The authors of present research article have set up a different method of their own to collect and observe protozoan diversity. The selected spot for the biodiversity study comes in the region of Western Ghats of India which is rich in flora and fauna on land as well as in water resources. Hundreds of workers in the field have worked on terrestrial and aquatic ecosystems, and they could mention only a few varieties of Protozoa while when only the population and types of Protozoa was studied some interesting results were obtained. Still comprehensive studies on Protozoa on various water bodies are lacking. In addition to their ecological role in different habitats, they are also been studied for bioindicator species, biomonitoring agents and in the experiments of biotechnology.

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