



PLANKTONIC DIVERSITY IN *EUGLENA* INFESTED PONDS IN HILLS OF HIMACHAL PRADESH, INDIA

Ankit Kumar¹, Rani Dhanze² and Indu Sharma³

¹Deptt. of Biology and Environmental Science, COB, CSKHPKV, Palampur

²Deptt. of Fisheries, COVAS, CSKHPKV, Palampur- 176062 (H.P.)

³Zoological Survey of India, High Altitude Regional Centre, Solan (H.P.)-173212

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The planktonic diversity of *Euglena* infested ponds in Himachal Pradesh have been monitored for the present study to observe the affect of *Euglena* bloom on pond productivity. A total of 24 genera of plankton belonging to class bacillariophyceae (nine genera), euglenophyceae (one genus), chlorophyceae (seven genera), cynophyceae (four genera), rotifera (two genera) and copepoda (one genus) were identified. The physico-chemical parameters particularly low dissolved oxygen and high value of free carbon dioxide, total dissolved solids, and nitrate were found to favour the production of *Euglena* bloom and total plankton population u/l remained high in *Euglena* infested ponds. Moreover, the planktonic diversity was also comparatively more in *Euglena* infested ponds.

Plankton abundance and distribution are strongly depended on factors such as nutrient concentrations, availability of light and the state of water. Phytoplankton is the basic member in the aquatic ecosystems and hence changes in phytoplankton population have a direct link with the change of water quality in any aquatic medium. Further, it has been observed that the growth and abundance of plankton varied in different months and also in various depths range depending on meteorological and water properties¹. The relationship between the physico-chemical parameters and plankton production of pond water is of great importance to enhance the fish production. Fishes are more dependent on water temperature, pH, dissolved oxygen, free carbon dioxide, alkalinity, total hardness, total dissolved solids, chloride, nitrate and some other salts for growth and development as these parameters also affect the abundance and diversity of plankton. Thus it becomes necessary to study the planktonic diversity of water body to evaluate the production potential in terms of aquaculture. However, in hills the *Euglena* bloom is main problem in aquaculture as it directly affects the pond's productivity, water quality as well as oxygen balance. A perusal of literature revealed that meagre work has been done on limnology of pond in sub temperate zone². Thus, the present investigation is an attempt to provide vital information regarding planktonic diversity in stagnant water body which would help in proper management of fish culture in the ecosystem.

MATERIALS AND METHODS

The study was conducted at the CSKHPKV fish farm

from March, 2009 to February, 2010. Water samples were collected fortnightly from the *Euglena* free and *Euglena* infested ponds for the analysis of different physico-chemical and biological parameters such as air temperature, water temperature, transparency, pH, dissolved oxygen (DO), free carbon dioxide, total alkalinity, and total hardness, total dissolved solids (TDS), nitrate, chloride and planktons. The plankton was collected by filtering fifty liters of water through the bolting silk no.40 plankton net and fixed in 4% formalin on the spot for detailed study. The procedure for collection, storage and analysis of samples were followed as described in standard methods^{3,4}. The correlation between different abiotic and biotic parameters was calculated and student t-test was applied to find out the statistical significance at 5% level.

RESULTS AND DISCUSSION

Aquatic environment: The physico-chemical parameters such as dissolved oxygen, free carbon dioxide, total dissolved solids and nitrate affects the plankton diversity. Dissolved oxygen (Fig.1) was comparatively high in *Euglena* free pond (15 mg/l) through out study period as compared to *Euglena* infested pond (12 mg/l) and maximum value was noticed in April in both types of pond. The low content of oxygen in *Euglena* infested pond proved that *Euglena* bloom is responsible for the oxygen depletion as it consume oxygen in night also as a result directly affects the survivability as well as growth of aquatic fauna and is in concurrence with erstwhile worker⁵. The dissolved oxygen has a positive and statistically significant correlation ($r=0.2,0.1$) with water temperature in

Euglena free and *Euglena* infested ponds respectively. The level of free carbon dioxide (Fig. 1) was high in *Euglena* infested pond (20.50 mg/l) as compared to that of *Euglena* free pond (18.50 mg/l) and high value of free CO₂ in *Euglena* infested pond is considered to be detrimental to aquatic animals⁶. Further, the high free carbon dioxide content during summer months was due to the high temperature which was also observed by earlier worker⁷ and confirmed the present observation. It exhibited a positive and statistically significant correlation with pH in both types of ponds ($r=0.3, 0.1$). The total dissolved solids (Fig. 1) in *Euglena* infested pond (252.50 mg/l) were high as compared to that of *Euglena* free pond (206.51 mg/l) and its value was found high during the month of June in both types of pond. However, in both types of pond total dissolved solids showed a direct relationship with water temperature and free carbon dioxide but indirect relation with chloride and bicarbonate. The present observation is in confirmation with the findings of previous workers⁸. Further, it showed a positive and statistically significant correlation with water temperature ($r=0.8, 0.9$) but negative and statistically significant correlation with alkalinity ($r=0.6$). Nitrate (Fig. 1) was comparatively high in *Euglena* infested pond (109.32 mg/l) than that of *Euglena* free pond (107.31 mg/l) and its peak value was reported during September in both types of pond. The value of nitrate depicted a direct relation with water temperature but indirect relation with dissolved oxygen, free carbon dioxide, chloride and alkalinity and relate with the findings of earlier work². Based on present observation it may be inferred that high level of nitrate was due to influx of allochthonous materials during rainy season and responsible for the luxuriant growth of *Euglena* bloom and confirmed the view of prior authors⁹. It has positive and statistically significant correlation with water temperature and alkalinity ($r= 0.2, 0.4$ and $0.1, 0.01$) but negative and statistically significant correlation with free carbon dioxide and chloride ($r=0.3, 0.5$ and 0.6).

Planktonic diversity: The planktonic diversity of *Euglena* free and *Euglena* infested ponds revealed the presence of 24 genera belonging to class bacillariophyceae (nine genera), euglenophyceae (one genus), chlorophyceae (seven genera), cynophyceae (four genera), rotifera (two genera) and copepoda (one genus). The total number of plankton u/l depicted that the plankton population remained high in *Euglena* infested pond (3374.32u/l vs. 721.54u/l) due to the abundance of *Euglena* (Fig. 2). It exhibited single peak in winter with

occurrence of euglenophyceae but summer peak in *Euglena* free pond. Bacillariophyceae was found to be high in *Euglena* free pond as compared to that of *Euglena* infested pond (Fig. 2). The highest value was observed in December (39.73%) in *Euglena* free pond due to high transparency, dissolved oxygen and chloride content. The similar observations were reported by others^{2,10}. However, in *Euglena* infested pond highest value was observed in June (27.45%) due to high content of free carbon dioxide, temperature, transparency, and total dissolved solids. It has also reported that presence of high dissolved oxygen and total dissolved solids enhance the growth of bacillariophyceae⁹. Further, it was observed that the planktonic diversity in terms of abundance was more in *Euglena* free pond due to low organic matter and high content of dissolved oxygen. The abundance of only two genera i.e. *Cymbella* and *Synedra* was recorded in *Euglena* infested pond (Table 1). The absence of *Cymbella* in *Euglena* free pond and *Tabellaria* in *Euglena* infested pond was also noticed (Table 1). Bacillariophyceae exhibited positive and statistically significant relationship with chloride ($r=0.4$), euglenophyceae ($r=0.2$) and copepoda ($r=0.9$) in *Euglena* free pond but in *Euglena* infested pond a positive and statistically significant relationship with free carbon dioxide ($r=0.5$), total dissolved solids ($r=0.1$), chlorophyceae ($r=0.5$), rotifers ($r=0.9$) and copepoda ($r=0.1$) was noticed.

Euglenophyceae was comparatively high in *Euglena* infested pond (Fig. 2) and mainly dominated by genus *Euglena* and its two peaks was observed that is May (90.17 %) and October (96.82 %) which was favoured by high concentration of free carbon dioxide, total dissolved solids, nitrate and total hardness. It has also been reported that high temperature, free carbon dioxide, alkalinity and nitrate were responsible for the luxuriant growth of *Euglena*⁹. However, in *Euglena* free pond only one peak was observed that is in July (17.51%) when low dissolved oxygen and total hardness were reported but temperature, free carbon dioxide, transparency and the concentration of nitrate were high and coincide with the observation of others¹¹. Euglenophyceae showed positive and statistically significant relationship with transparency ($r=0.3$), dissolved oxygen ($r=0.1$), total hardness ($r=0.1$), cynophyceae ($r=0.3$) and total plankton ($r=0.01$) in *Euglena* free pond but positive and statistically significant relationship with water temperature ($r=0.1$), nitrate ($r=0.5$), chlorophyceae ($r=0.08$) and total plankton ($r=0.9$) in *Euglena* infested pond which is supported by the view of formers⁹.

Chlorophyceae was high in *Euglena* free pond as compared with that of *Euglena* infested pond (Fig. 2) due to high dissolved oxygen and total hardness. Its maximum density was recorded during April (97.98%) in *Euglena* free pond but during January (50.02%) in *Euglena* infested pond due to low temperature and high concentration of total dissolved solid and alkalinity and supported the view of former¹². Further, the presence of genus *Ankistrodesmus* was noticed in latter one though genus *Mesotaenium* was observed only in *Euglena* free pond (Table 1). The abundance of four genera was noticed i.e. *Ankistrodesmus*, *Scenedesmus*, *Spirogyra* and *Volvox* in *Euglena* infested pond but only two genera viz. *Closterium* and *Pediastrum* in *Euglena* free pond (Table 1). Chlorophyceae executed a positive and statistically significant relationship with dissolved oxygen ($r = 0.9$), total hardness ($r=0.7$), rotifers ($r=0.4$) and total plankton ($r=0.9$) in *Euglena* free pond but with rotifers ($r=0.4$) and total plankton ($r=0.08$) in *Euglena* infested pond and in confirmation with others⁸.

Cyanophyceae was comparatively high in *Euglena* free pond (Fig. 2) during August (60.94%). In *Euglena* infested

pond maximum value of cyanophyceae was noticed in two different months that is January (14.77%) and August (14.91%). Though abundance of only one genus i.e. *Agmenellum* was recorded in *Euglena* free pond where as rest three genera i.e. *Anabaena*, *Gomphospheria*, *Synechocystis* showed their abundance in *Euglena* infested pond (Table 1). Cyanophyceae showed positive and statistically significant relationship with nitrate ($r=0.09$) and copepoda ($r=1$) in *Euglena* free pond. Though in *Euglena* infested pond it executed positive and statistically significant relationship with nitrate ($r=0.6$) only which confirmed the view of formers¹³.

Rotifer showed high percentage in *Euglena* infested pond (Fig.3) as compared to that of *Euglena* free pond. The maximum density of rotifers was noticed in June (3.78%, 2.65%) in *Euglena* free and *Euglena* infested pond respectively. Further, the abundance of *Brachionus* and *Keratella* was reported from *Euglena* infested pond but *Keratella* was absent in *Euglena* free pond which is an indicator of polluted water. Rotifers exhibited positive and statistically significant

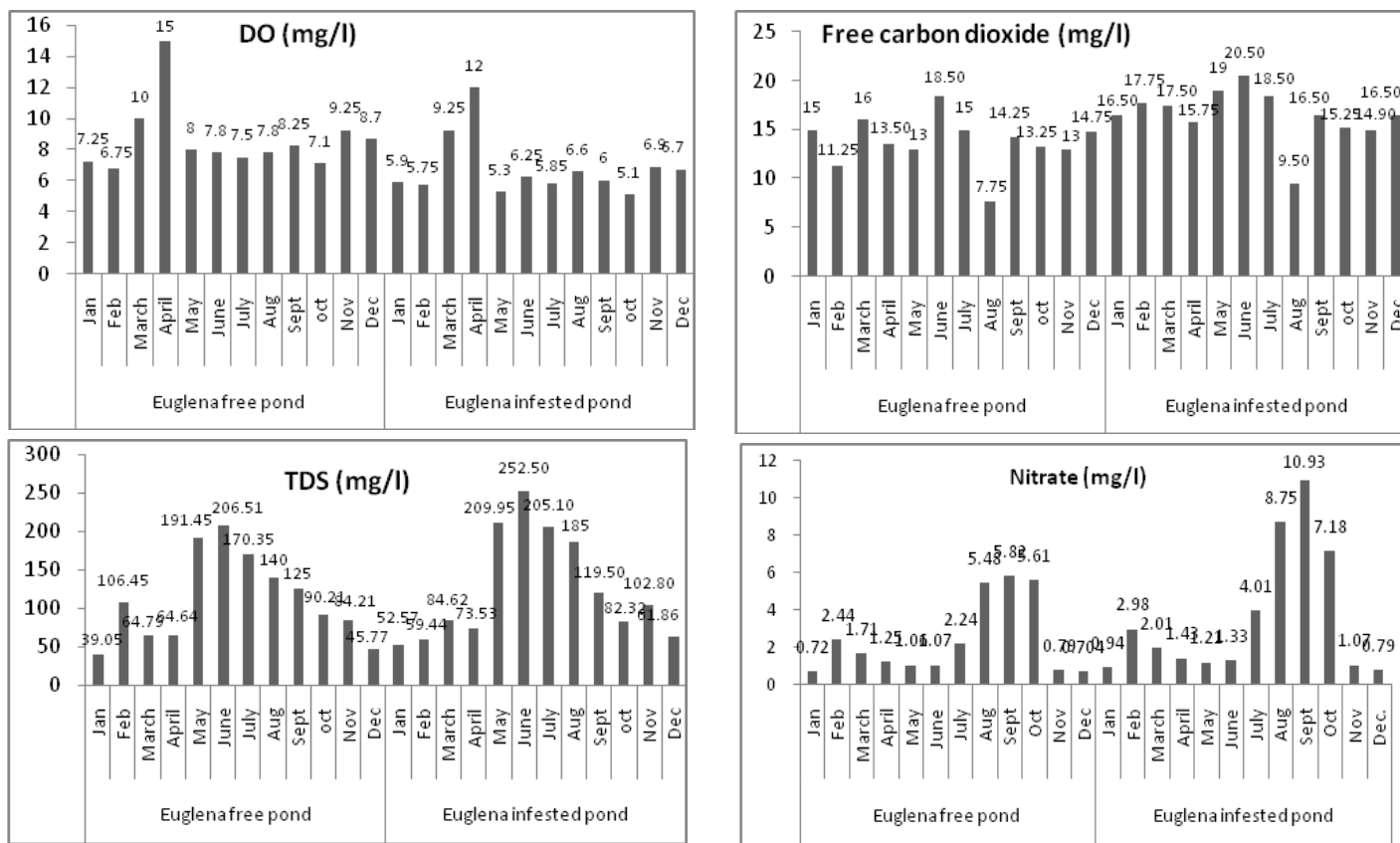


Fig.1. Comparative account of some physico-chemical parameters

Table 1. Comparison of plankton diversity and abundance in *Euglena* free and *Euglena* infested ponds.

	<i>Euglena</i> free pond	<i>Euglena</i> infested pond
Bacillariophyceae		
<i>Amphora</i>	+++	++
<i>Coconeis</i>	+++	++
<i>Cymbella</i>	-	+++
<i>Diatoma</i>	+	+
<i>Fragilaria</i>	+++	++
<i>Gomphonema</i>	+++	++
<i>Navicula</i>	+++	++
<i>Synedra</i>	++	+++
<i>Tabellaria</i>	+++	-
Euglenophyceae		
<i>Euglena</i>	+	+++
Chlorophyceae		
<i>Ankistrodesmus</i>	-	+++
<i>Closterium</i>	+++	++
<i>Mesotaenium</i>	++	-
<i>Pediastrum</i>	+++	+
<i>Scenedesmus</i>	++	+++
<i>Spirogyra</i>	++	+++
<i>Volvox</i>	++	+++
Cynophyceae		
<i>Agmenellum</i>	+++	++
<i>Anabaena</i>	++	+++
<i>Gomphospheria</i>	++	+++
<i>Synechocystis</i>	++	+++
Rotifera		
<i>Brachionus</i>	++	+++
<i>Keratella</i>	-	+++
Copepoda		
<i>Cyclops</i>	++	+++

- Absent + Present ++ Common +++ Abundance

relationship with total dissolved solids ($r=0.6$) and free carbon dioxide ($r=0.5$) in *Euglena* free pond as such confirmed the view of previous author¹⁴. Though in *Euglena* infested pond it showed positive and statistically significant relationship with total dissolved solids ($r=0.6$), free carbon dioxide ($r=0.5$) and copepoda ($r=0.1$). Copepoda has been observed comparatively high in *Euglena* infested pond (Fig.3) in the month of April

(1.82%). In *Euglena* free pond the peak value was reported in the month of June (3.78%) and July (4.04%). Copepoda revealed a negative and statistically non significant relationship with dissolved oxygen ($r=-0.09$), but statistically significant relationship with total hardness ($r=-0.09$), total plankton ($r=-0.9$) in *Euglena* free pond. In *Euglena* infested pond copepoda exhibited positive and statistically significant relationship with

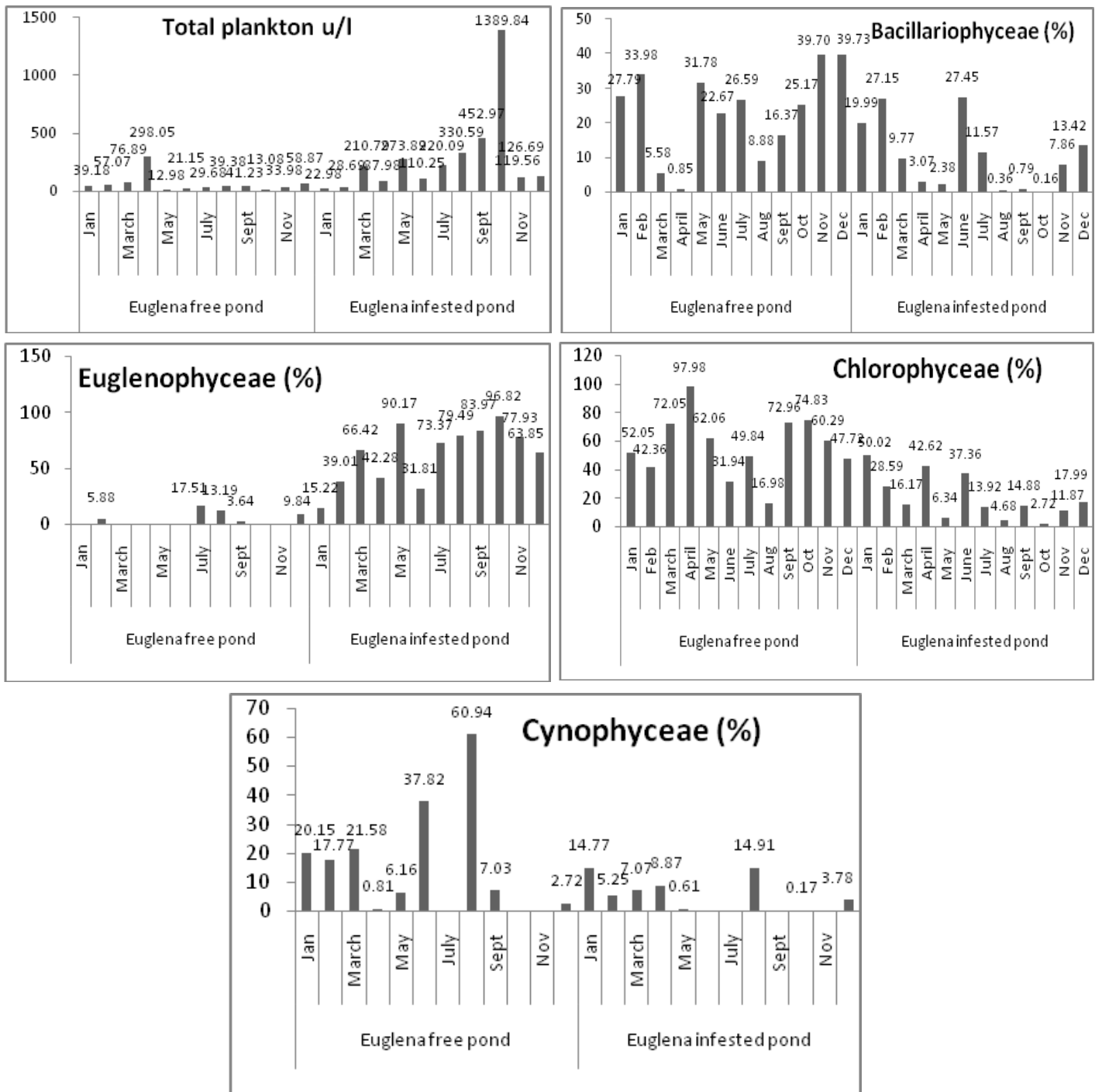


Fig. 2. Comparative account of the total plankton production and phytoplankt in *Euglena* free and *Euglena* infested pond.

dissolved oxygen ($r=0.6$) and total hardness ($r=0.4$) and negative and significant relationship with total plankton ($r=-0.5$). Similar observations were reported by other¹⁴.

The results of this study inferred that the physico-chemical parameters particularly low dissolved oxygen and high value of free carbon dioxide, total dissolved solids, and

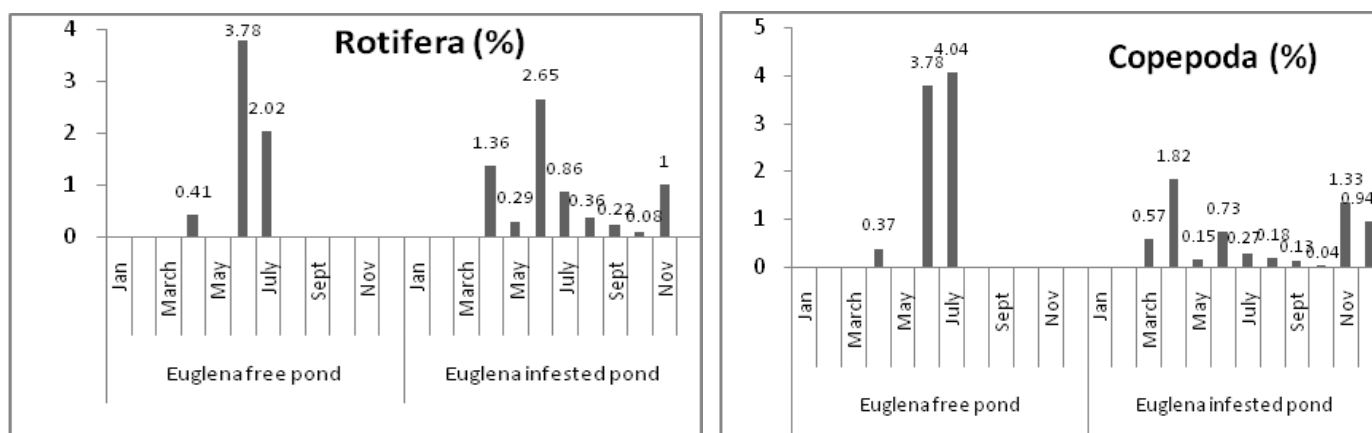


Fig. 3. Comparative account of the zooplankton in *Euglena* free and *Euglena* infested pond.

nitrate favoured the production of *Euglena* bloom as a result the population of plankton unit per litter increased and suppressed the growth of other plankton liked by fishes. Further, the planktonic diversity of *Euglena* infested pond differs from *Euglena* free pond. The biological productivity of *Euglena* infested pond is less than that of *Euglena* free ponds. Thus it may be concluded that the *Euglena* bloom directly affects the pond's productivity, water quality and oxygen balance and the impact of these resulted in terms of low production and survivability of fishes.

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