“Zooplankton Diversity and their Seasonal Variations of Londhare dam Shahada Taluka District Nandurbar (M.S.) India”.

Patil Ravindra D1. And Patil Rajendra D2.


Abstract:-Zooplanktons are the microscopic animals that act as a primary and secondary links in the food webs of all aquatic ecosystem. Zooplankton diversity is one of the most important ecological parameters in water quality assessment. Zooplankton is good indicators of the changes in water quality because they are strongly affected by environmental conditions respond quickly to changes in water quality. The present paper focused on the zooplankton abundance and diversity of Londhare dam, Shahada Taluka, District Nandurbar, (M.S.) during the period June 2012 to May 2014. A total of 42 species of zooplankton were recorded belonging to 27 general which divided into four groups. Among these Rotifera comprise of 24 species (35.61%), Cladocera 08 species (32.74%), Copepoda 06 species (25.42%) and Ostracoda 04 species (6.23%). Numerically Rotifera was dominant group throughout the study period. The season wise zooplankton analysis showed that the number of population was maximum in summer, moderate in monsoon and lowest during winter.

Keywords:-Londhare dam, Zooplankton, Seasonal variation, diversity.

Introduction:-Aquatic ecosystem are known to support work to range of organism. Among these zooplanktons are the free floating and microscopic animal found in aquatic ecosystem. Ecologically Zooplanktons are one of the most important biotic components influencing all the functional aspects of an aquatic ecosystem such as food chain, food webs, energy flow and cycling of matter (Dadhick and Saxena, 1999, Park and Shin, 2007). Zooplankton plays a key role in transferring energy from one tropic level to other in the aquatic habitat (Goswami, 2004). The zooplankton which plays a role of converting phytoplankton into food, suitable for fishes and can be used as indicator of the trophic status of a water body (Verma and Munshi, 1987).

According to Trope and Corich, 1991, Carriack and Schelske, 1997, the nutrient status and the physico-chemical parameters of water body plays vital role in governing the production of plankton. The study freshwater fauna especially zooplankton in a particular area is extensive and complicated due to environmental, physical. Chemical and geographic variations involving ecological, extrinsic and intrinsic factors (Majagi and Vijaykumar, 2009). Zooplankton acts as main source of food for many fishes and plays an important role in early detection and monitoring the pollution of water (Shivshankar P and Venkataramana G. V, 2013).
The variability observed in the distribution of zooplankton is due to abiotic parameters either climatic or hydrological limitations or biotic parameters such as predation, competition or combination of both (Escribano and Hidalgo, 2000 and Beyst et al., 2001). The study of zooplankton has been fascinating subject for long time. The zooplanktons are classified in various groups viz. Rotifera, Cladocera, Copepoda and Ostracoda. The biodiversity of phytoplanktons and zooplanktons are also rich in nature (Kangasabapathi and Rajan, 2010). A number of studies has been carried out on the condition of ecology and freshwater bodies in various parts of India (Sinha B and Islam M. R, 2002 and Singh S.P et al., 2002, Smith P. G et al., 2007), but in Northern part of Nandurbar district in Maharashtra the ecological studies of freshwater bodies especially zooplankton studies is very scanty. So that the present investigation made an attempt to study the zooplankton population along with composition and abundance in Londhare dam.

**Materials and Methods:-**

**Study area:-**

Londhare dam is one of the water bodies selected for study purpose. Londhare reservoir is the medium projects which is build up during the decade of 1990 near the Londhare village in Shahada Taluka of Nandurbar district (Maharashtra). This project (dam) is constructed on Mhais River which originates from Satpuda mounatain range and flows towards south and merges to the Tapi River. The geographical location is 21°31’ North latitude and 74°36’ East longitude. The project was completed in 1988 and stores 3.05 Mcum water. The catchment area of Londhare dam is 21.00 Sq.miles. This dam is 646 metres long earthen embankment and maximum height is 20.48 metres. It has spillway having one gate at right side. The length of main canal is 3.12 Km. The gross command area of this water body is 1450 acres and this area is irrigated by canal. The available water source is 2.74 Mcum. This dam helps to increase underground water level of surrounding area. Hence M. I. T water dam is beneficial for multiple uses. The gross culturable area is 588 hectares. The villages under command of dam are Londhare and Dhandre of Shahada Taluka. (Fig.1 and 2).

![Satellite view of Londhare dam.](image)

*Fig. 1:- Satellite view of Londhare dam.*
Zooplankton Sample collection, Preservation, Identification:-

The study area Ranipur dam was visited at monthly intervals during the two years period from June 2012 to May 2014. The water samples collected from three sampling stations were considered for sample collection mean/average of the three stations was considered for results and discussion. The samples were collected in between 8 am to 10 am. According to Edmonson (1963) ten liters of water was filtrated through the plankton net No. 25 of bolting silk with mesh size 64 micrometer. The collected samples were taken in separate vials and preserved by 1ml of 4% formalin and 1ml of Lugol’s iodine was added to it for further qualitative and quantitative studies. The qualitative and quantitative analysis of zooplankton was carried out in the laboratory with the help of Sedgewick Rafter Cell counting chamber. To calculate density of plankton the averages of 5 to 10 counts were made each samples and the results were expressed as the number of organisms per liter of collected sample water. Qualitative study of zooplankton was carried out up to the genus/species level using the standard and by observing photographs according to keys given by Welch(1952), Tonapi (1980), Trivedy(1998), Edmondson(1963), Battish(1992), Sarode and Kamat(1984), Kodarkar(1998) and Dhanpathi(2000). The two year study data (June-2012 to May-2014) were pooled for four months and three seasons and analyzed for seasonal changes, with respect to monsoon (June, July, August and September), Winter (October, November, December and January), Summer (February, March, April and May). Further the means, standard error of mean(SEM) were calculated for each season and one way ANOVA with no post test for various parameters for three seasons was performed using graph pad prism version 3.00 for windows (Graph pad software, San Diego California, USA). The correlation between the physicochemical parameters and the zooplankton density was calculated. The Pearson correlation was calculated by keeping plankton as dependent variable and other abiotic and biotic factors as independent variables with the help of SP557.5 for windows. The P value for ANOVA is non significant if P> 0.05 (ns). Significant if P< 0.05(*) significantly significant (**) if P< 0.001 and highly significant if P< 0.0001.

Result and Discussion:- A total 42 species of zooplankton were recorded from Londhare dam. Among 42 species Rotifera was dominant with 24 species followed by 08 species of Cladocera, 06 species of Copepoda and 04 species of Ostracoda (Table 1). Seasonal variation in density of different groups of zooplankton (No/L) population is depicted in Table-1.

The abundance of total zooplankton includes four quantitative components and their abundance show significant seasonal variation. The sequence of abundance of various zooplankton groups
in decreasing order were recorded as Rotifera (35.61%) > Cladocera (32.74%) > Copepoda (25.42%) > Ostracoda (6.23%). The structure of zooplankton communities is influenced by climatic and physiochemical parameters as well as biological interactions. Some species are therefore found in wide range of environmental conditions while others are limited by many physicochemical factors (Ganon et al., 1978 and Nerves, 2003).

Table: -1 Seasonal variations in density of different groups of Zooplanktons (No/L) with two years mean percentage density at Londhare Dam during June 2012 to May 2014.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>F- value</th>
<th>Monsoon</th>
<th>Winter</th>
<th>Summer</th>
<th>Two years %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Zooplankton</td>
<td>F_{221} 31.4</td>
<td>2111±108.3</td>
<td>1399±52.46</td>
<td>2549±133.2</td>
<td>-</td>
</tr>
<tr>
<td>Rotifera</td>
<td>F_{221} 17.74</td>
<td>772.5±62.36</td>
<td>398.8±34.04</td>
<td>986.2±99.52</td>
<td>35.61%</td>
</tr>
<tr>
<td>Cladocera</td>
<td>F_{221} 26.15</td>
<td>665±25.28</td>
<td>551±26.32</td>
<td>803.8±32.57</td>
<td>32.74%</td>
</tr>
<tr>
<td>Copepoda</td>
<td>F_{221} 47.86</td>
<td>503.8±18.89</td>
<td>406±15.69</td>
<td>630±13.63</td>
<td>25.42%</td>
</tr>
<tr>
<td>Ostracoda</td>
<td>F_{221} 46.01</td>
<td>169.4±8.26</td>
<td>78.25±3.50</td>
<td>129.4±7.34</td>
<td>6.23%</td>
</tr>
</tbody>
</table>

Table: -2 Pearson correlation of total Zooplankton density along with individual group with Abiotic parameters of Londhare Dam during June 2012 to May 2014.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameter</th>
<th>Total Zooplankton</th>
<th>Rotifera</th>
<th>Cladocera</th>
<th>Copepoda</th>
<th>Ostracoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Atmospheric Temperature (AT)</td>
<td>-.219</td>
<td>-.212</td>
<td>-.204</td>
<td>-.043</td>
<td>-.543**</td>
</tr>
<tr>
<td>2)</td>
<td>Water Temperature (WT)</td>
<td>-.181</td>
<td>-.158</td>
<td>.194</td>
<td>-.021</td>
<td>-.523**</td>
</tr>
<tr>
<td>3)</td>
<td>Water Cover (WC)</td>
<td>.857**</td>
<td>.898**</td>
<td>.670**</td>
<td>.716**</td>
<td>.685**</td>
</tr>
<tr>
<td>4)</td>
<td>Transparency (Trans)</td>
<td>-.368</td>
<td>-.304</td>
<td>-.476’</td>
<td>-.526**</td>
<td>.273</td>
</tr>
<tr>
<td>5)</td>
<td>Total Solids (TS)</td>
<td>-.008</td>
<td>-.041</td>
<td>.048</td>
<td>.215</td>
<td>-.491’</td>
</tr>
<tr>
<td>6)</td>
<td>Total Dissolved Solids (TDS)</td>
<td>-.763**</td>
<td>-.704**</td>
<td>-.798**</td>
<td>-.669**</td>
<td>-.560**</td>
</tr>
<tr>
<td>7)</td>
<td>Total Suspended Solids (TDS)</td>
<td>.643**</td>
<td>.562**</td>
<td>.726**</td>
<td>.775**</td>
<td>.013</td>
</tr>
<tr>
<td>8)</td>
<td>pH</td>
<td>-.896**</td>
<td>-.838**</td>
<td>-.881**</td>
<td>-.911**</td>
<td>-.450’</td>
</tr>
<tr>
<td>9)</td>
<td>Dissolved Oxygen (DO)</td>
<td>.487</td>
<td>.497</td>
<td>.367</td>
<td>.285</td>
<td>.835**</td>
</tr>
<tr>
<td>10)</td>
<td>Free Carbon Dioxide (CO₂)</td>
<td>-.496’</td>
<td>-.488’</td>
<td>-.413’</td>
<td>-.309</td>
<td>-.808’</td>
</tr>
<tr>
<td>11)</td>
<td>Total Hardness (TH)</td>
<td>-.854**</td>
<td>-.848’</td>
<td>-.777</td>
<td>-.751’</td>
<td>-.582’</td>
</tr>
<tr>
<td>Sr.No</td>
<td>Season</td>
<td>Rotifera</td>
<td>Cladocera</td>
<td>Copepoda</td>
<td>Ostracoda</td>
<td></td>
</tr>
<tr>
<td>-------</td>
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<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>2)</td>
<td>Winter</td>
<td>398.8±34.04</td>
<td>515±26.32</td>
<td>406±15.69</td>
<td>76.75±13.50</td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td>Summer</td>
<td>986.3±99.52</td>
<td>803.8±32.57</td>
<td>630±13.63</td>
<td>129.4±7.34</td>
<td></td>
</tr>
</tbody>
</table>

**Rotifera:** Rotifera are microscopic aquatic animals occurring in almost all types of fresh water habitats and have an important role in many fresh water ecosystem considered as water quality indicator and nature purifier (Ganon et al; 1967 and Sladecek, 1983). Rotifers play a major food of fishes. In rotifiers like Brachionus species are common in temperate and tropical water (Hutchinson G. E.1967). Rotifers play vital role in the trophic tiers of freshwater impoundments and serve as living capsule of nutrition (Sureshkumar et al., 1999). In the present study the Rotifers dominated with 24 species as compared to other groups of zooplankton. In the Londhare dam density of Rotifers is maximum in summer, moderate in monsoon and minimum in winter. More work is still required to designate regional indicator species from different parts of India.

**Cladocera:** Cladocera commonly known as water fleas, constitute one of the major zooplankton communities occurring in all types of water bodies. In the present study the cladoceran formed second dominant quantitative components with the two years average density of 32.74% and showed significant seasonal variation. The maximum density of Cladocera was recorded in summer and minimum in winter. Maximum density of cladoceran recorded in summer was due to the rise in the temperature. The temperature is the main physical parameter which shows effect on distribution, abundance of Cladocera population (Quadri and Yusuf, 1980). In the present study the cladoceran density is positively significant correlated with WC, TSS, NO_3^- and PO_4^-, while negatively significant correlation with TDS, pH, TH, Cl, SO_4^-, Mg^{2+} and Ca^{2+} indicates...
variable influence of biotic and abiotic factors on cladoceran density. (Table 2) This are found to be proliferate of higher rate in water bodies, and consist of 08 species of 07 genera in Londhare dam. Most abundance species observed were *Diaphanosoma* species, *Ceriodaphnia cornuta*, *Moina micrura* and *Moina branchiata*, while three taxa *Moina ceriohaphnia* and *Diaphanosomo* are predominantly herbivores typically found in tropical water bodies (Dodson and Frey, 2001).

**Copepods:** Freshwater copepods constitute one of the major zooplankton communities occurring in all types of water bodies, which serve food for many fish and play major role in ecological pyramids. Copepod is also an ecologically and economically important group of zooplankton. Copepod prefer more stable environment and generally are regarded as pollution sensitive taxa (Das et al., 1996). Copepods are also known as significant for primary and secondary consumer in the aquatic food web. Gajanan Sontakke and Satish Mukashe (2014), Ahmed U, et al., (2011) and Bhaswarajewari Indur (2015) have recorded copepod as the zooplankton community to occupy third position in the Dekhu reservoir from Aurangabad (M.S.), sewage fed pond of Aligarh (A.P.), India and freshwater reservoir of Yadigir district, Karanataka respectively. Similar result is observed in recent investigation at Londhare dam. The seasonal changes in Zooplankton species are clearly related to the physicochemical and biological parameters of aquatic environments. In Londhare dam copepod consist of 06 species belonging to 05 genera. Among these 06 species such as *Rhinediaptomus indicus*, *Diaptinus species*, *Cyclops ladakanus*, *Mesocyclops hyalinus*, *Mesocyclops leuckarti* and *Microcyclopes bicolor*. *Mesocyclops* being most dominant species. In the present study the copepods population density were higher in summer season and lower winter season. In the present study copepods also showed positively significant correlation with WC, TSS, NO$_3$ and PO$_4$ at 0.01 levels (Table.2) It concluded that Londhare dam water supports good density and diversity of zooplankton that can maintain the balanced ecosystem.

**Ostracoda:** Ostracoda is one of the most diverse group of crustaceans living in all aquatic ecosystem. The body of Ostracoda is laterally compressed and protected by a bivalve like such as chitinous or calcareous valve or “shell”. Ostracods occur in lentic as well as lotic water. The water temperature and availability of food are affecting the population of ostracods. According to Kaushik and Sharma (1994) reported that ostracods occur in greater number when the temperature of the reservoir is 20$^0$ C. At Londhare dam average water temperature around 21.4± 0.46$^0$C in monsoon while 22.4± 0.42$^0$C in summer which is favorable for plankton. In the present investigation the maximum density of ostracoda was recorded in monsoon (169.4± 8.36 No/L) and minimum recorded in winter (78.75± 3.50 No/L) Patil (2008) recorded the maximum population of ostracods during the monsoon season. Pejawar and Gurao (2008) observed them only during monsoon and stated that these are pollution sensitive species. During the present study the ostracod was occupied last position in terms of population and lowest quantitative components 6.23% (Table 1). Species richness of ostracoda at Londhare dam was very low with only four species. Similar type of observations is reported by many researchers. Yashwant Lake at Toranmal (M.S.), Agale M. C (2013) reported 04 species of ostracod were distributed in a freshwater of Budki dam at Shirpur, District Dhule (M.S.). Pawar Rajkumar T (2016) observed 02 species of ostracod from Majalgaon reservoir Maharashtra state (India). Patel Y.E et al., 2015 reported 03 species of ostracoda at Waghur dam near Jalgaon (M.S.), India. The
Ostracods are known to grow well in hard water. Total hardness of Londhare dam water ranged between 4.87±1.72 and 20.0±7.07 which is considered as soft water which may be attributed to lower density of ostracods. At the Londhare dam the ostracods and the total hardness are negatively significant correlation at 0.01 levels (Table. 2). During the present study at Londhare dam only 04 species of ostracods were recorded. These are Cyprissubglobosa, Standesia labiate, Hemicyprisanomala and Indiacypridispar. At noted ostracoda density is also positively correlated at the level of 0.01 with WC, DO and PO4 and it is negatively significant correlation with AT, WT, TDS, CO2, TH, Cl, Mg2+ and Ca2+ at 0.01 levels. (Table.2)

Checklist of Zooplankton from Londhare Dam

A) Rotifera
1. Brachionous caudatus (Barrois and Daday, 1894)
2. Brachionous plicatilis (Muller, 1786)
3. Brachionousbidentata (Anderson, 1889)
4. Brachionous quadridentatus (Hermann, 1783)
5. Brachionous fulcatus (Zacharias, 1898)
6. Brachionous diversicornis (Daday, 1883)
7. Brachionous forficula (Wierzejski, 1891)
8. Brachionouscaliciflorus (Pallas, 1776)
9. Brachionoushavanaensis (Illinois)
10. Brachionousurceolaris (Muller, 1773)
11. Keratellaprocurva (Thorpe, 1891)
12. Keratellatropica (Apstein, 1907)
13. Platyiasquadricorniz (Ehrb., 1832)
14. Lapadella ovalis (Muller, 1786)
15. Lacana luna (Muller, 1776)
16. Monostyla bulla (Gosse, 1851)
17. Monostylalunaris (Ehrb., 1832)
18. Trichocera cylindrical species
19. Asplanchna priodonta (Gosse, 1850)
20. Filinaopaliensis (Zach, 1898)
21. Filinalogesita (Ehrb., 1834)
22. Testidunella mucranata (Gosse, 1886)
23. Rotariarotatoria (pallas, 1776)
24. Rotarianeptunis (Ehrb., 1832)
B) Cladocera
1. Diphanosomasarsi (Richard, 1895)
2. Ceriodaphniacornuta (Sars, 1888)
3. Simocephalusespinosus (Koch, 1841)
4. Moina micrura (Kurz., 1874)
5. Moina brachiata (Jurine, 1820)
6. Bosminalongirostris. (Muller, 1776)
7. Alonarectangula (Sars, 1862)
8. Indialonaganpati (Petkovaski, 1966)

C) Copepoda
1. Rhinediaptomus indicus (Kiefer, 1936)
2. Diaptmus species (Westwood, 1836)
3. Cyclops ladakanus (Kiefer, 1936)
4. Mesocyclops hyalinus (Rehberg, 1880)
5. Mesocyclops leuckarti (Claus, 1857)
6. Microcyclops bicolor (Sars, 1863)

D) Ostracoda
1. Cyprissubglobosa (Sowerby, 1840)
2. Standesialabiata (Hartmann, 1964)
3. Hemicyprisanomala (Klie, 1938)
4. Indiacyprisdispar (Hartmann, 1964)

Conclusion:- The present investigation on the zooplankton composition, seasonal variation in the diversity and distribution of zooplankton in Londhare dam at Shahada Taluka district Nandurbar (M. S.) India is helpful to investigate the status of this reservoir. In all 42 species of zooplankton were identified from Londhare dam during the course of study of two years. All four groups of zooplankton were recorded throughout the study period. The number was highest during summer and lowest during winter except ostracoda. Ostracoda is maximum in monsoon to the study area. The study indicates that temperature plays an important role in the distribution of zooplankton in a fresh water habitat. The abundance of zooplankton from this Londhare reservoir followed a sequence as under: Rotifera > Cladocera > Copepoda > Ostracoda.

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Reference:-


