CHAPTER - IV

COMPOSITION AND SEASONAL ABUNDANCE OF THE MACROBENTHOS IN JARI TANK

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1. INTRODUCTION

Macrobenthos

Benthos includes all those organisms which inhabit the bottom of an aquatic body. Like periphyton, it is a collection of heterogeneous organisms invariably consumed by fish as food. Hutchinson (1967) has suggested the following terminology for benthic communities based on the niches they occupy in an ecosystem. These are: (a) Rhizobenthos rooted in the substratum but well extended into the aqueous phase, (b) Haptobenthos or Periphyton - attached to an immersed solid surface, the term epiphyton (Aufwuchs), epilithon, and lasion (Bewuchs) are often used as informal sub-division, (c) Herpobenthos - growing on moving through mud, (d) Psammon - growing on moving through sand, (e) Endobenthos - boring in solid substrate. The benthos are also divided on the nature of their composition viz. (1) Zoobenthos - contributing animal communities, and Phytobenthos - consisting plant communities.

The pond include the surface water area and the marginal area which are rich in dissolved oxygen. But, however, in the mud at the bottom conditions are quite different from aquatic zone. There is a great accumulation of decaying plant and animal matter. This means that oxygen is used up in the process of decay and where there are heavy deposits there may be a complete lack of oxygen. Even under such conditions there are a few animals which have been able to utilise these areas
for their propagation. The degree of specialization required to inhabit this zone amount to limited number of species.

For instance the larvae of chironomid midges are found usually in mud, often rich in decaying organic matter where oxygen is not so plentiful. The annelid worms, belonging to the genus Tubifex, are also inhabitants of the mud. Their blood, like that of Chironomus contain haemoglobin, which is capable of combining with oxygen to form oxyhaemoglobin, in this way augment the oxygen carrying capacity of the blood. This enables the organisms to live in mud, often rich in decaying organic matter in almost anaerobic conditions. Certain molluscs are also partially aquatic, visiting the surface at intervals to breath air taken into a chamber beneath the mantle through a breathing aperture. The lining of the mantle in such molluscs is richly supplied with blood vessels and functions as a kind of Lung (hence they are known as pulmonate). Many pulmonates, however, live in stagnant water containing little or no dissolved oxygen. Planorbis can exist in concentrations of oxygen which are much lower than that required by most freshwater molluscs.

The importance of bottom fauna in relation to their role in the trophic cycle of a water body is well-recognised. The importance of such studies cannot be overstressed as most of the benthic animals form essential food items of cultured fishes (Van and Van Van Oven 1959). The abundance and the
distribution of the bottom living animals have a bearing on
the fisheries potential also. Fundamental importance of these
benthic organisms in the economical utilization of natural
water has led a large number of investigators to study the
qualitative and other ecological aspects of this biota.
However, knowledge on the trophic dynamics of benthic
communities is extremely meagre compared to that of plankton.
Far too little is known concerning the seasonal fluctuations
of benthic organisms in trophical waters. Our knowledge on
the ecology of benthic organisms lags behind that of plankton
in freshwater impoundments (Buscemi, 1961). A review of
limnological investigations conducted in freshwater in India
reveals that this particular aspect of the problem has almost
been neglected. The present account is based on the data
obtained during a period of two years (Sept. 1976 – Aug.’ 1978)
on the bottom fauna of Jarki tank, in which detailed
planktological investigations were also made (Chapter I).
The studies were made by demarcating the tank bottom in two
different regions and their species composition has been
recorded in. In the following paragraphs an attempt has been
made to present the seasonal abundance of macrobenthic fauna
of Jari tank.

2. REVIEW OF LITERATURE

Most of the earlier works on the subject have been
confined to larger bodies of waters. Muttowshi (1918), worked
on the bottom fauna of lake Mentodo and observed regular
seasonal succession of species and also periods when certain organisms were entirely absent. Annandale and Sewell (1921) worked on the bionomics of the pond snail *Vivipara bengalensis* and stated that each year a heavy mortality occurred in the molluscan fauna of the ponds towards the end of rainy season. The deeper parts of the lake Mentoda was found to be composed of oligochaetes, chironomids and *Pisidium* (Judy, 1922). The bottom fauna of lake *Simcoe* and its influence on the ecology of the lake was studied by Rawson (1930), Berg (1938) who worked on the European lakes pointed out that each lake has its own individuality as to its faunistic composition. Miyadi (1931) studied the bottom fauna of Japanese lakes, Moor (1939) made a limnological investigation of microscopic benthic fauna of Douglas lake of Michigan. The benthic communities in lake Beppi, was observed by Asahina (1942, 1943), wherein he recorded that 11.5% of the benthos was composed of chironomid larvae, Kurasawa (1947) elucidated that the two molluscan populations in the littoral zone of lake Suwa showed a seasonal change in productivity and net increase of standing crop. The richness of bottom fauna was attributed to the copious nourishment available in the form of detritus in the Susaa river system (Jonasson, 1948). The researches of Ball (1948) on the relationship between available fish food, feeding habits and total fish production in a Michigan lake revealed that the decrease in number of invertebrates in a lake was due to decrease in the agitation covering the bottom. In Minnesota lakes,
Moyle (1949) found that quantitative bottom samples are unsatisfactory as productivity indices. The oligochaetes and chironomids dominated the bottom fauna in low-lying lakes near Stockholm, Sweden (Böe, 1949). Wohlschlag (1950) investigated the invertebrate life in a Marl lake and demonstrated that the quantity of animal life is roughly proportional to the weight of vegetation present. During his studies on the food relationship of spotted Gar, *Lepidosteus platyrhincus*, Hunt (1952) gave attention to the bottom fauna in the Pamiami canal, Florida. Carl (1953) recorded very meagre quantities of bottom fauna in the characteristic oligotrophic lake Cowichann, British Columbia. The investigations of Henson (1954) showed that the macroscopic profoundal benthos of Cayuga lake, New York differed considerably from year to year in their population structure.

Nelder and Pennak (1955) have shown that the tendipedid larvae and the bivalve *Pisidium* were the most abundant forms in the bottom of a Colorado Alpine pond. The sand and gravel bottom produced the largest number (4108/sq m) of the bottom organisms in a shallow eutrophic lake, in Iowa (Tebo, 1955). The population densities of the important groups of bottom fauna vary in different seasons and depths as shown by Lenz (1955). It has been suggested that with increase of total dissolved solids contents of lake waters, bottom fauna also increases (Northcote and Larkin, 1956). The predation by fish could minimise the abundance of standing crop of bottom fauna, has been demonstrated in two ponds, in South Michigan (Hyne and Ball,
1956). In lake Shira, the chief benthic organisms was found to consist of tendipedids (Platanova, 1956). The seasonal abundance and production of littoral bottom fauna in a southern Michigan lake was found to show large annual fluctuation in the volume (Anderson and Hooper, 1956). Labyanov (1956) described the seasonal changes in the benthic fauna of ponds in the Ukrainian Steppe.

The ecology of the macroscopic bottom fauna in lake Texoma was studied by Sublette (1957). The maximum density in winter and minimum in summer were noticed in the bottom fauna of ponds studied by Lellak (1958), who also found an abundance of larvae belonging to chironomidae and ceratopogonidae. No relationship between benthic tendipedidae and season or temperature could be demonstrated by Kajak (1958). But Gaufin (1959) was able to find that uniformly alkaline and the high carbonate content of water was associated with high productivity of the bottom fauna. From a study of certain aspects on the ecology of lake Macquarie, Macintyre (1959) concluded that each depth zone had its typical fauna. Mundic (1959) found that many benthic animals are less static in their distribution than is commonly accepted. The studies of Ruggles (1959) on the standing crop of bottom fauna showed that the average number of animals per square foot of bottom varied from year to year.

The presence of coprogenic sediments were found to be produced by the action of bottom fauna or due to settled
planktogenic sediments (Schmitz 1959). Clampitt et al. (1960) investigated the fauna in a Bay of lake West Okoboji, Iowa found chironomid to be the dominant forms. Considerable annual variation was seen in chironomid larval population in Lac La Ponge, Saskatchewan (Oliver 1960). The bottom fauna of the lake Huron was investigated by Teter (1960). Pennak (1960) described the freshwater invertibrates of United States. In Girni reservoir, chironomid larvae were found to dominate in the benthos by Verigin (1960). The possibility that movement of larvae of chironomidae into deeper layers of bottom decrease their accessibility to fishes has been suggested by Assman (1960). Dunn (1961) correlated the depauerate conditions of molluscan forms in lake Bala to the very low calcium content of the water. In the determination of age of lakes, it was suggested that evidence could be gathered from dead shells by using radio carbon dating method (Holme 1961). Hunter (1961) showed that population of Ancylus fluviatilis, Physa fontinalis and Lymnaea perogra varied from year to year in mean size and density. Buscemi (1961) studied the ecology of bottom fauna of parvin lake, Colorado and observed that the highest total biomass occurred within the 0.6 metre to 1.0 metre benthic interval. Heard (1962) concluded that the occurrence of sphaeriidae of north American great lakes, varied with depth and nature of substratum. Ghabbour (1966) studied the importance of oligochaetes in fish culture. Ferraris Carl and Jerry Wilhm (1977) studied the distribution
of benthic macroinvertebrates in an artificial destratified reservoir. Gore (1977) worked on the reservoir manipulations and benthic macroinvertebrates in a prairie river. Maciorowski et al. (1977) worked on species composition, distribution and abundance of oligochaetes in the Kanawha river, West Virginia. Sala et al. (1977) studied the physico-chemical condition and benthic macroinvertebrates of a tertiary sewage treatment system, while Woff et al. (1977) studied the development of a benthic ecosystem on a sandy bottom.

The studies on benthic organisms of freshwater in India, however, have been made by Hora (1936), Srivastava (1955, 1956, 1958 and 1959) reported on the bottom fauna of some ponds of Lucknow and stated that it exhibited seasonal fluctuations, its total volume being highest during monsoon months attributable to the dominance of molluscs and oligochaetes. Fresh water oligochaetes (e.g. Deronaia, Chaetogaster and Aeolosaoma) constituted the bulk, especially during monsoon and summer months. George Michael (1964), who studied the bottom fauna of a perennial tank at Barrackpore in West Bengal, divided the bottom into shore zone and middle zone. The shore bottom was dominated by molluscs, whereas the middle zone contained oligochaetes. Most of the organisms occurred in maximum densities during the period January to April. Krishnamurthy (1966) made a preliminary studies on the bottom macrofauna of the Tungabhadra reservoir, Moitra and Bhowmick (1968) reported that
the volume of bottom organisms in a pond of Kalyani fish farm in West Bengal showed a unimodal pattern of distribution during the year with a single broad peak spread over winter and early summer months (January to March) and single trough during autumn (September to October). The winter early summer peak was constituted mainly by chironomids. However, in numerical abundance benthic fauna, represented by oligochaetes and crustaceans, was at its peak of its abundance during monsoon. Govind (1969) studied the bottom fauna and macrovegetation in Tungabhadra reservoir. While Raman et al (1975) studied the macrobenthic fauna of lake Pulicat. Gupta (1976) studied the macrobenthic fauna of the Loni reservoir and found abundance of molluscs in the shallower depths and chironomids and oligochaetes in deeper areas.

The present investigations were carried out in a freshwater irrigation tank at Jari village near Allahabad (U.P.), for the purpose of giving a detailed qualitative and quantitative picture of the benthic organisms and their seasonal fluctuations during the period of two years.

3. MATERIAL AND METHODS

The community of organisms living on the bottom has been usually divided by Limnologists as belonging to littoral, sublittoral and profundal zones. In tank taken up for the present investigation, only two zones could be clearly demarcated.
because of its smaller size. Macro-benthic samples were collected from three different areas of the tank. Area A and C represents the littoral or shore bottom zones as these extend from the tank margin to a depth which usually makes the limit of the rooted vegetation and is up to 3 to 4 metres from the shore. The profoundal or middle zone (Area B) represents the area of the bottom beyond the littoral zones. After a preliminary survey of the fauna sampled from the different regions of the tank, three points (A, B and C) for collection were fixed for the subsequent regular sampling. For samples from the littoral zone two dredgings from opposite sides were taken at a time. For the middle zone, one dredging was done at the centre of the tank. The dredge was operated at three chosen spots in each area of A, B and C.

The benthic organisms were collected monthly by employing Ekman's dredge with a transverse area of 529 cm² (Welch, 1948). The collections were always made at 9.00 a.m. The closed dredge was hauled to the surface and the contents then transferred carefully to a bucket and brought to the shore. The material was taken in a sieve of 40 meshes per linear inch or 2.5 cm and washed thoroughly so that only the finest sand grains and mud were strained. The samples then brought immediately to the laboratory in wide-mouthed bottles and stored in large white enamel trays. In the free condition the animals retained their natural colour which helped quick and effective sorting. All
the organisms collected were preserved in 5% formalin. A hand lens was used whenever necessary. The different animals were counted species-wise whenever possible and their abundance was calculated as number of organism per square metre of the tank bottom. For quantitative enumeration the method indicated by Jhingran et al. (1969) was follows:

\[ N = \frac{a}{ah} \]

where,

\[ N = \text{number of macro-organism in 1 sq m} \]
\[ n = \text{number of macro-organism per sample area} \]
\[ a = \text{area of Ekman's dredge in sq m} \]
\[ h = \text{number of hauls} \]

4. RESULTS

The composition of bottom material in the various zones consisted mainly pebbles, sand, roots and sometimes, clumps of aquatic weeds mixed up with soft clayey soil. Dead shells of Molluscs, were also seen in various stages of decomposition. Oligochaetes, molluscs and chironomid larvae were the major groups of bottom biota available in the Jari tank.

Numerical abundance of the various macrobenthic organisms in the tank during the two years of study period (September, 1976 to August, 1978) are given groupwise in Table XXV, while Table XXVI give percentage composition of three major groups of animals. Further, the density of benthos during the same period
in the successive years was not the same in respect of the three groups of organisms. Generally, the abundance during the second year was comparatively less except the molluscs, their number was higher when compared to the previous year.

4.1. Seasonal fluctuations of total macrobenthos population

The total macrobenthic organism per square metre as shown in Table XXV and Fig. 46 indicated a trend of marked fluctuations during both the years (1976-77 and 1977-78).

In the first year the total macrobenthic population was found to be in the range of 285 units/m² in November to 3135 units/m² in December. It showed two peaks, first minor peak in September and second major peak in December. The macro-benthic population showed high density (1691 units/m²) in September which suddenly decreased in November and reached the minimum (285 units/m²). But it suddenly increased in December and there was a sporadic rise to the major peak of the year (3135 units/m²). Subsequently the population again showed a gradual decline and reached to a very low density of 304 units/m² in April. From May onward again the population started to rise and in August touched a density of 1396 units/m².

During the second year concentration of macrobenthos was comparatively lower on most of the sampling dates when compared to the previous year. The maximum concentration was observed (1387 units/m²) in December, while the minimum
### TABLE XXV

Monthly fluctuations of Macrobenthos in Jari Tank

(Sept. 76 - Aug.' 78)

<table>
<thead>
<tr>
<th>Months</th>
<th>Oligochaetes</th>
<th>Chironomids</th>
<th>Molluscs</th>
<th>Total Macrobenthos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>76-77</td>
<td>77-78</td>
<td>76-77</td>
<td>77-78</td>
</tr>
<tr>
<td>September</td>
<td>1406</td>
<td>665</td>
<td>285</td>
<td>228</td>
</tr>
<tr>
<td>October</td>
<td>798</td>
<td>875</td>
<td>95</td>
<td>38</td>
</tr>
<tr>
<td>November</td>
<td>209</td>
<td>817</td>
<td>-</td>
<td>114</td>
</tr>
<tr>
<td>December</td>
<td>3040</td>
<td>1102</td>
<td>95</td>
<td>209</td>
</tr>
<tr>
<td>January</td>
<td>2527</td>
<td>627</td>
<td>57</td>
<td>114</td>
</tr>
<tr>
<td>February</td>
<td>1938</td>
<td>380</td>
<td>190</td>
<td>95</td>
</tr>
<tr>
<td>March</td>
<td>323</td>
<td>285</td>
<td>57</td>
<td>95</td>
</tr>
<tr>
<td>April</td>
<td>247</td>
<td>152</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>May</td>
<td>418</td>
<td>152</td>
<td>76</td>
<td>57</td>
</tr>
<tr>
<td>June</td>
<td>361</td>
<td>114</td>
<td>57</td>
<td>38</td>
</tr>
<tr>
<td>July</td>
<td>418</td>
<td>209</td>
<td>76</td>
<td>95</td>
</tr>
<tr>
<td>August</td>
<td>1111</td>
<td>570</td>
<td>285</td>
<td>285</td>
</tr>
</tbody>
</table>

### Annual Average

|            | 1066 | 495 | 110 | 118 | 25 | 63 | 1202 | 677 |
FIG. 46. MONTHLY FLUCTUATIONS IN TOTAL BENTHIC POPULATION
### TABLE XXVI

Percentages of Macrobenthos in Jari Tank
(Sept. 1976 - August, 1978)

<table>
<thead>
<tr>
<th>Months</th>
<th>Oligochaetes</th>
<th>Chironomids</th>
<th>Molluscs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>76-77</td>
<td>77-78</td>
<td>76-77</td>
</tr>
<tr>
<td>September</td>
<td>83.2</td>
<td>73.0</td>
<td>16.8</td>
</tr>
<tr>
<td>October</td>
<td>82.0</td>
<td>88.0</td>
<td>10.0</td>
</tr>
<tr>
<td>November</td>
<td>73.0</td>
<td>84.0</td>
<td>-</td>
</tr>
<tr>
<td>December</td>
<td>97.0</td>
<td>80.0</td>
<td>3.0</td>
</tr>
<tr>
<td>January</td>
<td>97.8</td>
<td>78.5</td>
<td>2.2</td>
</tr>
<tr>
<td>February</td>
<td>91.0</td>
<td>71.0</td>
<td>9.0</td>
</tr>
<tr>
<td>March</td>
<td>85.0</td>
<td>65.2</td>
<td>15.0</td>
</tr>
<tr>
<td>April</td>
<td>81.0</td>
<td>53.3</td>
<td>19.0</td>
</tr>
<tr>
<td>May</td>
<td>79.0</td>
<td>53.3</td>
<td>14.0</td>
</tr>
<tr>
<td>June</td>
<td>76.0</td>
<td>46.3</td>
<td>12.0</td>
</tr>
<tr>
<td>July</td>
<td>76.0</td>
<td>48.0</td>
<td>14.0</td>
</tr>
<tr>
<td>August</td>
<td>80.0</td>
<td>64.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

**Annual average**

|           | 83.4    | 68.5   | 10.4   | 17.5   | 5.3   | 15.4   |
(247 units/m²) was recorded in June. The benthic population showed a gradual increasing trend from September (912 units/m²) to December (1387 units/m²) constituting the major peak of the second year. From December onward there was a gradual decrease reaching to the minimum (247 units/m²) of the year in June. From July again the density increased and touched the second peak (893 units/m²) of the year in August. The total macrobenthic population was higher in density during post-monsoon and in winter months, in both the years, but was usually low in abundance during late winter and summer months. The average macrobenthic population was found to be low during the second year. Its density decreased from 1202 units/m² of the first year to 677 units/m² in the second year. In the following paragraphs the behaviour of three major constituents of benthos are discussed.

4.2. Seasonal fluctuation in oligochaeta

Oligochaetes were observed to be the most dominant group of macrobenthos. Their abundance during the two years of study is shown in Table XXV and Fig. 47 and 48. The abundance of oligochaetes was very high in the samples collected from mid-bottom zone or profoundal zone of the tank.

In first year average oligochaetes population ranged between 209 units/m² in November to 3040 units/m² in December. In the second year their density was in the range of 114 units/m² in June to 1102 units/m² in December,
FIG. 47. MONTHLY FLUCTUATIONS IN PERCENTAGE OF MACROBENTHIC GROUPS IN JARI TANK
FIG. 48. MONTHLY FLUCTUATIONS IN GROUP OLIGOCHAETA
In both the years oligochaetes showed major peaks in the month of December while minimum were recorded differently in November in the first year and June in the second year. In both the years monsoon and the winter months, gave higher concentration against summer months when their concentration was poor.

The annual average population was found to be 1066 units/m² and 425 units/m² in the first and the second year respectively.

The group oligochaeta was represented by a single dominating genus *Tubifex tubifex*. This genus constituted 83.4% and 68.5% of total benthos in first and second year respectively.

4.3. Seasonal fluctuation in Mollusea

The molluscan population was confirmed to the marginal areas of the tank bottom which provided shelter and comparatively less water movements undisturbed. Molluscs were second in dominance among the macrobenthos and their seasonal abundance in two years is shown in Table XXV and Fig. 49a. It is evident from Fig. 49a that molluscs were recorded irregularly in the first year but in the second year their presence was recorded in all the months.

The molluscan population was found to be in the range of 38 units/m² in May to 76 units/m² in October and November
FIG. 49. MONTHLY FLUCTUATIONS IN

a. MOLLUSCA

b. CHIRONOMIDS
during first year, while during second year it was in the range of 19 units/m² in September to 95 units/m² in June and July. The average number was 25 units/m² and 63 units/m² in the first and second year respectively. Their concentration was usually higher in summer and monsoon months as compared to winter months, during both the year of present investigations.

The molluscs constituted 5.3 and 15.4% of total macrobenthos in first and second year respectively (Table XXVI and Fig. 47). Their population was constituted by *Viviparus bengalensis* great pond snail *Limnaea stagnalis* great ramshorn snail, *Planorbis corneus* and Bivalvia like *Lamellibranchia*, *Lamellidens corinus* (LEA) and *Pisidium clarkeanum* (NEVILL).

### 4.4. Seasonal fluctuation in Chironomids

The Chironomids showed a variable seasonal fluctuation during both the years (Table XXV and Fig. 49b). In the first year chironomid larval population ranged from 57 units/m² to 285 units/m² corresponding to minima each in January, March, April and June and maximum in September and August. These organisms were totally absent from the samples of November of the first year. In second year density of chironomid was recorded throughout the year. Their population ranged between 38 units/m² to 285 units/m² corresponding respectively to minima in October and June and maximum in August. The population was
usually poor from March to July in both the years. Average chironomid number showed a slight increase from 110 units/m² recorded in the first year to 118 units/m² in the second year and contributed 10% and 17% of the total macrobenthic population during the two years respectively (Table XXVI, Fig. 47). Chironomidae was represented mainly by the tendiped larvae in the present work.

5. DISCUSSION

Analysis of benthic organism shows that the organisms belong to the groups oligochaeta, Chironomidae and Mollusca. Similar conditions were observed in other temperate and tropical waters (Judson, 1922, Puke, 1949, Dunn, 1961 and Michael, 1964). Although species composition of benthic organisms and their densities between the shore and middle-bottom zones could not be made separately for quantitative analysis. Yet tank bottom was arbitrarily divided into two separate zones viz., marginal and middle-bottom.

The density of oligochaetes was high in the middle-bottom zone. The occurrence of soft clayey soil with decaying leaves and detritus in the middle-bottom layer serves as most suitable niche for the growth and propagation of oligochaetes (Adamstone, 1924).

Abundance of molluscs both in species and number in the shore or marginal zone may be attributed to high percentage
of lime available in shallow waters as pointed out by Adams et al. (1924), Michael (1964) also observed high density of molluscs in the shore bottom area of fish pond in West Bengal. The presence of large number of dead shells in the shore bottom zone supports this conclusion in the present investigations also.

Usually chironomid larvae were found to be maximum in number in the shore zone samples. Since these larvae are mostly dependent upon algal growth for food (Kajak, 1956), the bottom zone with submerged vegetation evidently provided a suitable medium for their abundance. The submerged vegetation consisted of Ceratophyllum and Myriophyllum on the marginal areas.

The species composition observed has certain similarities to that recorded from lake Bala (Dunn, 1961) and certain other ponds (Warwick, 1949), and a rice pond of West Bengal, India (Michael, 1964).

Considering the density of macrobenthic biota, most of the species occurred mainly between November-February with few exception when their density was high in other months. Several factors like intensity of sunshine (Hunter, 1961), quantity of dissolved calcium (Asahina, 1943), and importance of vegetation (Muttowski, 1918, Lundbeck, 1926, Rawson, 1930, Juday, 1942, Ball, 1948 and Dimitrov, 1959) have been attributed to increase in number of benthic communities. During the
period of maximum abundance of benthos (December and January) water temperature and total alkalinity were low showing an inverse relationship with the benthic population. The water transparency reading on the other hand showed a direct relationship with the benthic population. The high values of water transparency during peak of benthos help in maximum penetration of sunlight. Thus enhancing the growth of submerged vegetation. Thus a combination of optimum condition with regards to the various factors enumerated above would have resulted in the abundance of benthos.

The density of oligochaetes per square metre of bottom area of Jari tank (irrigation tank) was comparatively low than recorded by Jonasson (1948) and Michael (1964), but were definitely higher than in the temperate waters (Nelder and Pennak, 1955). Michael (1964) in a fish pond recorded high numbers of organisms/m² area (3242/m²). This compares well with Jari tank than some of the temperate water bodies studied by Nelder and Pennak (1955), and Oliver (1960). Chironomid larvae and molluscs were recorded to be low in abundance as compared to others observations (Table XXVIII and XXIX). Jonasson (1948) recorded a higher density of *Pisidium clarkeanum*. The density recorded by Jonasson was more than that described by Belder and Pennak (1955). Table XXX shows the average values of the maximum numbers recorded in the present study as compared to other water bodies.
TABLE XXVIII

Showing Average population densities of Macrobenthos in Jari Tank

(September, 1976 - August, 1978)

<table>
<thead>
<tr>
<th>Months</th>
<th>Oligochaetes</th>
<th>Chironomidae</th>
<th>Molluscs</th>
<th>Total Macrobenthos population</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>1035.5</td>
<td>256.5</td>
<td>9.8</td>
<td>1301.5</td>
</tr>
<tr>
<td>October</td>
<td>836.5</td>
<td>66.5</td>
<td>76</td>
<td>978.5</td>
</tr>
<tr>
<td>November</td>
<td>513</td>
<td>57</td>
<td>57</td>
<td>627</td>
</tr>
<tr>
<td>December</td>
<td>2071</td>
<td>152</td>
<td>38</td>
<td>226.1</td>
</tr>
<tr>
<td>January</td>
<td>1577</td>
<td>85.5</td>
<td>28.5</td>
<td>1691</td>
</tr>
<tr>
<td>February</td>
<td>1159</td>
<td>142.5</td>
<td>28.5</td>
<td>1330</td>
</tr>
<tr>
<td>March</td>
<td>304</td>
<td>76</td>
<td>28.5</td>
<td>408.5</td>
</tr>
<tr>
<td>April</td>
<td>199.5</td>
<td>57</td>
<td>38</td>
<td>294.5</td>
</tr>
<tr>
<td>May</td>
<td>285</td>
<td>66.5</td>
<td>57</td>
<td>408.5</td>
</tr>
<tr>
<td>June</td>
<td>327.5</td>
<td>47.5</td>
<td>76</td>
<td>361</td>
</tr>
<tr>
<td>July</td>
<td>313.5</td>
<td>85.5</td>
<td>76</td>
<td>475</td>
</tr>
<tr>
<td>August</td>
<td>840.5</td>
<td>285</td>
<td>19</td>
<td>1144.5</td>
</tr>
</tbody>
</table>

Average in two years (Annual) 788.5 114.2 44.1 946.8
TABLE XXIX

Showing comparative abundance of Macrobenthic organisms for a square metre of bottom

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligochaetes 783.5/m²</td>
<td>Oligochaetes 1910/m²</td>
<td>Tubificids 168/m²</td>
<td>—</td>
<td>Oligochaetes 2640/m²</td>
</tr>
<tr>
<td>Chironomidae 114/m²</td>
<td>Chironomide 4200/m²</td>
<td>Tendipedidae 1904/m²</td>
<td>Chironomidae 742/m²</td>
<td>Chironomidae 258/m²</td>
</tr>
<tr>
<td>Molluscs 44/m²</td>
<td>Unio sp. 101/m²</td>
<td>—</td>
<td>—</td>
<td>Lamellidens corrianus 257/m²</td>
</tr>
<tr>
<td></td>
<td>Pisidium sp.</td>
<td>Pisidium sp.</td>
<td>—</td>
<td>Pisidium clarkeanum 2120/m²</td>
</tr>
</tbody>
</table>
### TABLE XXX

Average number of organisms/m² of bottom of different inland waters as compared with present observations

<table>
<thead>
<tr>
<th>Place of study</th>
<th>Bottom fauna organisms/m²</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul Lake</td>
<td>1363</td>
<td>Rawson (1930)</td>
</tr>
<tr>
<td>British Columbia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue Lake</td>
<td>2267</td>
<td>Calhoun (1944)</td>
</tr>
<tr>
<td>Sierra Nevada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oligotrophic lakes</td>
<td>2000</td>
<td>Brundin (1949)</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shallow entrophic lakes</td>
<td>4108</td>
<td>Tebo (1955)</td>
</tr>
<tr>
<td>Iowa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloverleaf lake</td>
<td>4674</td>
<td>Raimers et al. (1955)</td>
</tr>
<tr>
<td>California</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish Pond</td>
<td>3242</td>
<td>Michael (1964)</td>
</tr>
<tr>
<td>West Bengal, India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present Study</td>
<td>946.8</td>
<td></td>
</tr>
<tr>
<td>Irrigation tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uttar Pradesh, India</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A lake bed producing 1000 individuals or less per metre square is usually regarded as poor productive, while a density of 2000 organisms per metre square is considered highly productive Thienomann (1925). The maximum average (Table XXVII) obtained viz., 3135 organisms/m², indicates a high productive rate of the Jari tank. Evidences are available to show that large and deep lakes are not on the average as productive as small shallow pond (Hayes, 1957). Low water level may create optimum conditions for higher productivity due to super imposition of photosynthetic zone over the zone of decomposition (Wilson, 1958).

The variety and abundance of various benthic organisms have shown that a continuous food supply is generally available in the tank bottom for bottom feeding fishes. The bulk of benthias was composed of molluscan species, which evidently consumed much of organic matter in converting themselves into organic production (Hunter, 1956). But their values as fish food organisms have not yet been completely established at least with regard to the common major carps in India. *Pangasius pangasius* (Ham.), however, has been reported to consume the molluscs in large quantities (Hore, 1952). Further, detailed studies on the bottom feeding properties of cultivable fishes will be of interest.
TABLE XXVII

Showing Maximum and minimum densities of total number of macroorganisms/\text{m}^2, \text{ in Jari Tank}.

(Sept. 76 - August, 78)

<table>
<thead>
<tr>
<th>Period</th>
<th>Total numbers per square metre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>September, 1976 - August, 1978</td>
<td>3135</td>
</tr>
<tr>
<td>September, 1977 - August, 1978</td>
<td>1387</td>
</tr>
</tbody>
</table>
6. **SUMMARY**

1. Quantitative dredge samples collected from Jari tank bottom during a period of two years, were studied with regard to population densities and seasonal abundance of the macrobenthic fauna present in them.

2. Three different zones representing marginal and middle bottom zones with their species composition could be distinguished. Usually the marginal bottom zone was dominated by molluscs, whereas oligochaetes were predominant in the middle bottom zone.

3. Most of the organisms occurred in maximum densities during the months of December to February. While minimum abundance was recorded during April to June.

4. The seasonal variations of the standing crop of bottom fauna during both the years have been found to be influenced by fluctuations in the Molluscan population.

5. The availability of sufficient amount of macrobenthic fauna for consumption by bottom feeding fishes has been indicated.
7. REFERENCES


* Not Consulted in original.