*Bulletin of Pure and Applied Sciences.*
*Botany, Vol.41 B, No.2.*
*July-December 2022: P.94-101*
*Original Research Article*

*Print version ISSN 0970 4612*
*Online version ISSN 2320 3196*
*DOI: 10.5958/2320-3196.2022.00011.8*
*Available online at www.bpasjournals.com*

# Diversity of Zooplankton in the Paddy Fields of Imphal West District

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Received on 30.06.2022
Revised on 05.10.2022
Accepted on 31.10.2022
Published on 15.12.2022

**Keywords:**
Paddy fields, Zooplankton, Imphal West.

**Abstract**

*Diversity of zooplankton was studied in three selected paddy fields (PF) of Imphal West District in Manipur namely, Wangoi ($PF_1$), Hiyangthang ($PF_2$), Mayang Imphal ($PF_3$) during August to October, 2020. The study revealed that altogether 55 taxa comprising of 44 rotifera, 8 cladocera and only 3 copepoda (fig2) had occurred in the three studied paddy fields. The highest number of zooplankton taxa (rotifer) was observed at $PF_1$followed by (cladocera) at $PF_3$ and (copepoda) at $PF_2$. Nine physico-chemical parameters of water in the three study areas was also analysed The $P^H$ value ranged between 6.0 and 8.0, Temperature between 27 and $30^0$C, Dissolved oxygen between 2.0 and 6.0mg/l, Free Carbondioxide between 3.0 and 11.0 mg/l, Chloride between 3.0 and20.0 mg/l, Acidity between 5.0 and 18.0 mg/l, alkalinity between 22.0 and 95.0 mg/l, Nitrate between 0.03 and 0.06mg/l, and Nitrite between 0.01 and 0.05 mg/l. as observed during the investigation period (Table -3).*

**How to cite this article:** Th. Rajen Singh, Dr. N. Mohendra Singh, Dr. Kh. Rajmani Singh (2022). Diversity of Zooplankton in the Paddy Fields of Imphal West District. *Bulletin of Pure and Applied Sciences-Botany,* 41B(2), 94-101.

## INTRODUCTION

The present study is to investigate zooplankton diversity in the paddy fields of Imphal West District, Manipur. The samples were collected from the study areas namely $PF_1$, $PF_2$ and $PF_3$ respectively, during the period from August to October 2020. Physico-Chemical parameters such as temperature, $P^H$, dissolved oxygen, carbon dioxide, acidity, alkalinity, chloride, nitrate, nitrite etc. were also measured. Zooplankton diversity richness were calculated by using Sedgwick Rafter Counting Cell (SRC).

The zooplankton community play fundamental role in trophic networks (Jernberge *et al*., 2017) by cycling nutrients and stabilizing aquatic ecosystems. It is sensitive to environmental fluctuation, species-specifically responding to it, which results in to difference dominance between species (Adamczuk *et al.,* 2015).

There are several field studies that analysed the zooplankton community in relation to agricultural practices (Dodson *et al.,* 2007, Ituburu *et al.,* 2019; Regaldo *et al.,* 2018). Though, the community responds to several environmental factors, which it is difficult for the species to relate its response to pesticide

contamination in the paddy field. With this view three paddy fields belonging to the same district were selected to observe agro-chemical effects on zooplankton communities of the paddy fields. Due to its importance in aquatic communities, the reduce of zooplankton species by exposure to pesticides can alter top-down and bottom-up mechanisms and modify the structure and function of biological communities (Carpenter and Kitchell, 1996). Plankton are the indicator of pollution, they have been used for the conservation of biodiversity in the paddy field (Ueno, 2013). Although zooplankton are the key component of the aquatic community of the paddy field (Lim *et al.,* 1984) only few countries such as Italy and Southeast Asian countries used as a bio indicator in the paddy field. In developing countries control policies are limited. So it is important to conduct an assessment of paddy field water based on the site specific by measured environmental concentrations (MECs) to identify the possible risk to aquatic organisms (Stadlinger *et al.,* 2018). The knowledge about relevant ecological aspects of the paddy fields are still scantyin Manipur. Moreover, no work has been done on the diversity of zooplankton communities in the paddy field. Most of the agricultural practices are converted to conventional crop with the application of more pesticides, from the agro ecological crop. At this present scenario, there is high risk of reducing zooplankton in the paddy fields. Thus the present work was established.

## MATERIALS AND METHODS

The study area is located in the central portion of the Imphal West District. The rice fields are mainly located at the flood plain areas of Nambul and Imphal rivers. The total agricultural area of Imphal West District is 60616.8hact. (Manipur Remote Sensing Application Centre (1990). In the area native grasslands and natural wetlands co-exist with land used for intensive farming, cattle rearing, piggery etc. Paddy fields require irrigation during some of its growth stages. There are no proper irrigation systems for agricultural practices. The paddy fields are fed with rain water. The sowing season extends from August to October 2020 and harvest takes place during November and December. The climate is moderate with rainfall 1467.5mm (average) per year (ICAR-Lamphel).

The sampling was carried out between August to October 2020 during the rice growing season. The management practices with the use of pesticides in conventional crops are common observation in the production process. In the three paddy fields at Imphal West District, water and zooplankton samples were collected simultaneously during investigation period.

Water samples of each paddy field were collected for physico-chemical determination which was done at the laboratory of D.M. College of Science, (Fishery section) D.M. University, Imphal. The parameters were analysed in mg/l. dissolved oxygen, carbon dioxide, acidity, alkalinity, chloride nitrate and nitrite etc. after APHA, (2012). Physical parameter like, temperature, turbidity measured at the field on the same day. Zooplankton were analysed after authentic literature.

Zooplankton sampling in rice fields was carried out during the 3 cycles of the growing season. The first cycle was taken after 15 days of seeding, the second cycle was taken at the time of flowering paddy plant and third cycle was taken when the paddy is ready for harvest. The second and third samples were taken in the mid-cycle i.e. in the pre-harvesting period just before the water was drained drain out.

On the sampling date from each rice field, a quantitative sample of zooplankton was taken with a plankton net having 45µ and determined the species richness. Three quantitative samples (replicates) of 100ml were taken for the quantitative analysis of zooplankton community by filtering 15 L. of water each time.

All the plankton samples were preserved with 4% formalin also added 2 drops of lugol solution to prevent the shrinkage of cells. A total of 55 zooplankton samples were analysed (Table – 1). The taxonomic identification was made with a binocular microscope (Motic SMZ-168), an optical microscope (Olympus CX 31) and specific keys for each of the main taxa: cladocera, capepoda and rotifera (Ahlstrom, 1940 1943; Koste & Shiel, 1989: Lopretto & Tell,

1995; Paggi, 1995; Ringuilet, 1958). The quantitative samples were sub-sampled using 1ml of pipette and transferred to a Sedgewick Rafter counting chamber. The mean of three sub-samples were used to calculate the abundance of zooplankton in 1 L water sample replicate from the paddy field.

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The richness, abundance, diversity and dominance of species for each sampling site of the paddy fields were calculated with data obtained during investigation period.

**MAP OF STUDY AREA**

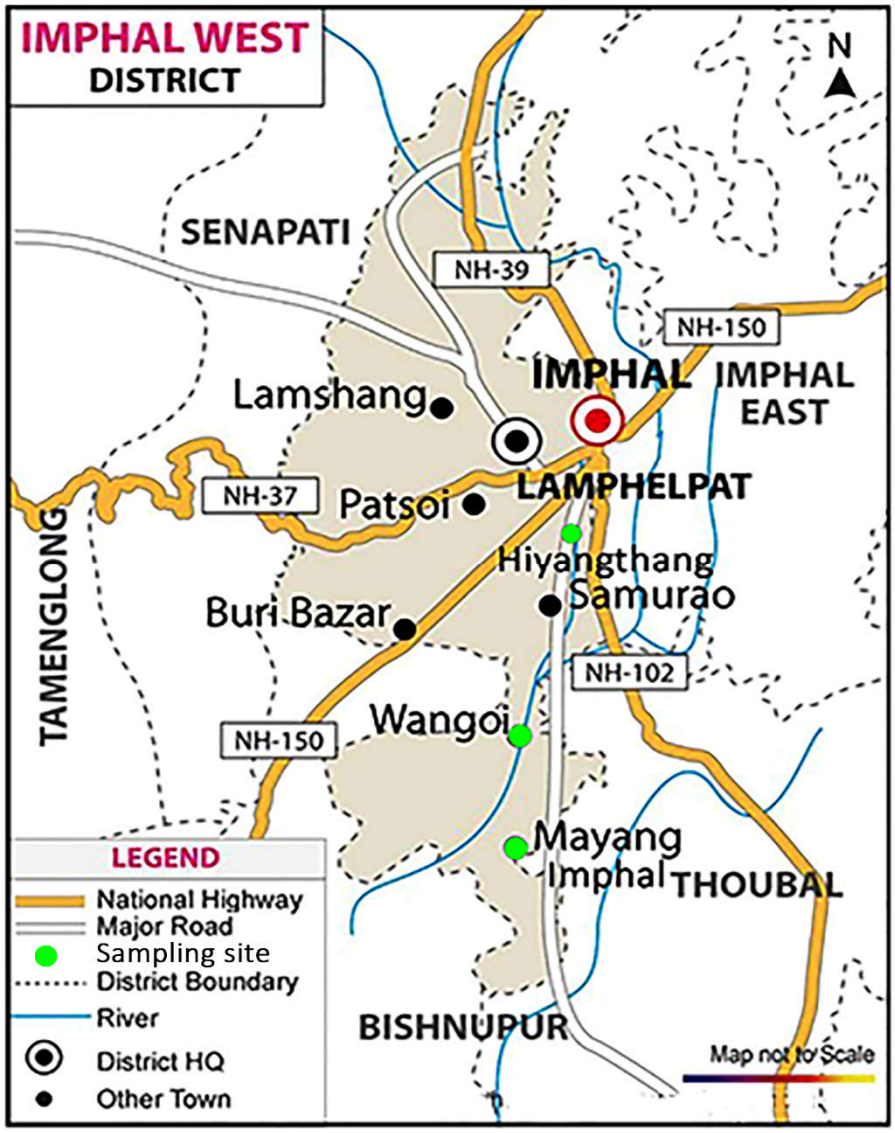


**Figure 1:** Study Area

## RESULT AND DISCUSSION

The average depth of the paddy fields was recorded from 18 to 22 cm (Table – 2) with a mean of 19.2cm. Average $p^H$ recorded during monsoon and post monsoon may be influenced by run-off water entering into the water bodies, The $p^H$ was near neutral but slightly alkaline during summer and during post monsoon which may be due to dumping of garbage and inflow of sewage water. The desirable limit of $p^H$ recommended by Drinking water Specification Indian Standard – IS 10500, 1991 is 6.5-8.5 (BIS, 1992). The present study recorded $p^H$ was within the permissible level of BIS 1992.

The dissolved oxygen (DO) value ranged between 2-6mg/L with a mean value of 5mg/L at $PF_2$. Considerable amount of variation in D.O was observed in the three water bodies of the paddy fields with higher values recorded during post-monsoon at all sites. Dissolved oxygen is an important aquatic environmental factor, which influences the health of an aquatic ecosystem. The higher values of D.O may be due to the influence of run-off water from monsoon rain. Lower level of DO was recorded during pre-monsoon at the three paddy fields. Atmospheric observation and photosynthetic production of oxygen by phytoplankton may be low during pre-monsoon and higher during post monsoon. DO levels between 5.3 and 8.0 mg/L are satisfactory for survival and growth of aquatic organisms.

The total alkalinity value range 24-90 mg/L at $PF_1$ and 23-95mg/L at $PF_2$ and 22-85mg/L respectively with the mean value of 86.6 mg/L. Excess alkalinity gives a bitter taste to water. Maximum values were recorded during summer at $PF_2$. Alkalinity prescribed for drinking water by Drinking Water Specification Indian Standard – IS 10500: 1991 is 200 mg/L whereas permissible limit goes up to 600mg/L in absence of alternate source. The present value of alkalinity registered below the permissible level of IS. An increase in the free carbon dioxide may result in the increase in alkalinity (Singhal *et al.*, 1986). The higher alkalinity value may be due to the discharge of municipal sewage, domestic sewage and urban wash off into the fresh water bodies. The total hardness (TH) value ranged between 10 to 65mg/L with a mean of 61 mg/L. The minimum value recorded as 10mg/L at $PF_2$ while maximum value recorded as 65 mg/L at $PF_1$ total hardness of water is due to the concentration of salts. In particular, it is due to the concentration of multivalent metallic ions of calcium and Magnesium. Any increase of hardness causes scale deposition and scum formation. The desirable limit of TH is 300mg/L. The present study recorded less than the desirable value. Acidity ranged between 5 to 18 mg/L with a mean of 15mg/L. Acidity decreased and DO increased, chlorinity value varied between 3 to 26 mg/L with a mean of 17mg/L. Chloride concentration was higher during post-monsoon. High chlorinity would reduce the D.O content in water which turns harmful for aquatic organisms. Chloride content increases in rainy season and decreases in winter season and again increases during summer season. Increase in chloride during rainy season may be due to incoming organic wastes of human origin with rain water in to the paddy fields during summer season. It is effected due to evaporation, according to WHO maximum permissible limit for chloride is 500mg/L, but the present data is less than the permissible level of WHO. Increase in concentration of nitrate and nitrite during rainy season may be the result of incoming water from the catchment area of human settlements and entry of domestic sewage.

In the present study 55 members of zooplankton were observed (Table-1) in the paddy field of Imphal West District, comprising of 44 rotifers, 8 cladocera and 3 copepods during the study period (Fig. 1). It has been observed that some parameters, like, D.O, $CO_2$ acidity, hardness, nitrate and nitrites favoured the growth of zooplankton. But the higher diversity of rotifer indicates the presence of high amount of suspended materials in the water body of the paddy fields which may lead to eutrophication of the water body. Thus, from the present investigation, it is obvious that measures should be taken up immediately for the preservation and sustainability of the water body in the paddy field.

**Table 1:** List of Zooplankton species during a crop cycle of three paddy fields in Imphal West District, 2020

| **Rotifera** |
|---|
| *Anuraeopsis navicula,* (Rousselet, 1911) |
| *Brachionus angularis* (Gosse, 1851) |
| *B. caudatus* (Barrois and Daday ,1894) |
| *B. diversicornis,* (Daday ,1883) |
| *B. falcatus,* (Zacharias, 1898) |
| *B. forficula,* (Wierzejski, 1891) |
| *B. rubens,*( Ehrenberg,1831) |
| *B, urceolaris,* (Muller, 1773) |
| *Coluerella calurus* (Ehenberg 1830) |
| *Cephalodella sps.* |
| *C. uncinata* (Muller, 1773) |
| *Dicranophorusepicharis* (Ehrenberge, 1800) |
| *Epiphans sps.,* |
| *Filiniacamasecla* ( Myers,1983) |
| *F. longiseta* (Ehrenberg, 1832) |
| *Keratilla lenzi* (Hauer, 1953) |
| *K. tropica* (Apstein, 1907) |
| *Lecane bulla* (Gosse, 1851) |
| *L. closterocerca* (Schmada, 1939) |
| *L. curvicornis* (Murray, 1913) |
| *L. lateralis* (Sharma, 1972) |
| *L. leotina* (Turner, 1892) |
| *L. luna* (Muller, 1976) |
| *L. pyriformis* (Daday, 1905) |
| *L. quadridentata* (Ehrenberg, 1830) |
| *L. signifera* (Jennings, 1896) |
| *L. ungutata* (Fadeev, 1935 ) |
| *Lepadella acuminata* (Ehrenberge, 1834) |
| *L. ovalis* (Muller 1786) |
| *L. patella* (Muller, 1773) |
| *Lophochariss alpina* (Ehrenberg, 1834) |
| *Mytilina bisulcata* (Lucks, 1912) |
| *M. ventralis* (Ehrenberge, 1838) |
| *Platyias quadricornis* (Ehrenberge, 1832) |
| *Pomphalyx complanata* (Gosse, 1851) |
| *Sinantherina spinosa* (Thorpe, 1833) |
| *Testudinella patina* (Hermann, 1783) |
| *T. tridentate* (Smirnov, 1981) |
| *Trichocerca braziliensis* (Murray, 1913) |
| *T. insulata (Hauer,* 1937) |
| *T. pusilla* (Jennings, 1903) |
| *T.similisgrandis* (Haurer, 1965) |
| *Trichosphaeraacquatoriatis* (Semper, 1872) |
| **Cladocera** |
| *Alonacastata* (Sar, 1862) |

| |
|---|
| *A. puchella* (King, 1855) |
| *Ceriodaphnia cornută* (Sars, 1885) |
| *Diaphanosoma excism* (Sars, 18850) |
| *Euryalona orientalis* (Daday 1888) |
| *Kurzia longirostris* (Day Day 1898) |
| *Macrothrix spinosa* (King 1852) |
| *SeapholeberisKingi* (Sars, 1903). |
| **Copepoda** |
| *Phyllodiaptomus praedictus* (Dumount and Reddy 1994) |
| *Mesocyclops thermo cyclopoidess priden* (Herda 1931) |
| *Thermocyclop decipiens* (Keifer, 1928) |

**Table 2:** Environmental variables among the three paddy fields

| Study area | Depth of Water (cm) | PH | Temp Oc | Do (mg/l) | Acidity (mg/l) | Alkalinity (mg/l) | Chloride (mg/l) | Hardness (mg/l) | Nitrate (mg/l) | Nitrite (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| $PF_1$-Wangoi | 22 | 6-8 | 27-30 | 2-4 | 5-18 | 24-90 | 3-12 | 12-65 | 0.04-0.07 | 0.01-0.06 |
| $PF_2$-Hiyangthang | 18 | 6-7 | 28-31 | 3-5 | 6-15 | 23-95 | 4-13 | 10-16 | 0.05-0.09 | 0.01-0.05 |
| $PF_3$-Mayang Imphal | 19 | 6-7 | 27-30 | 2-6 | 5-14 | 22-85 | 3-26 | 12-58 | 0.01-0.03 | 0.02-0.04 |

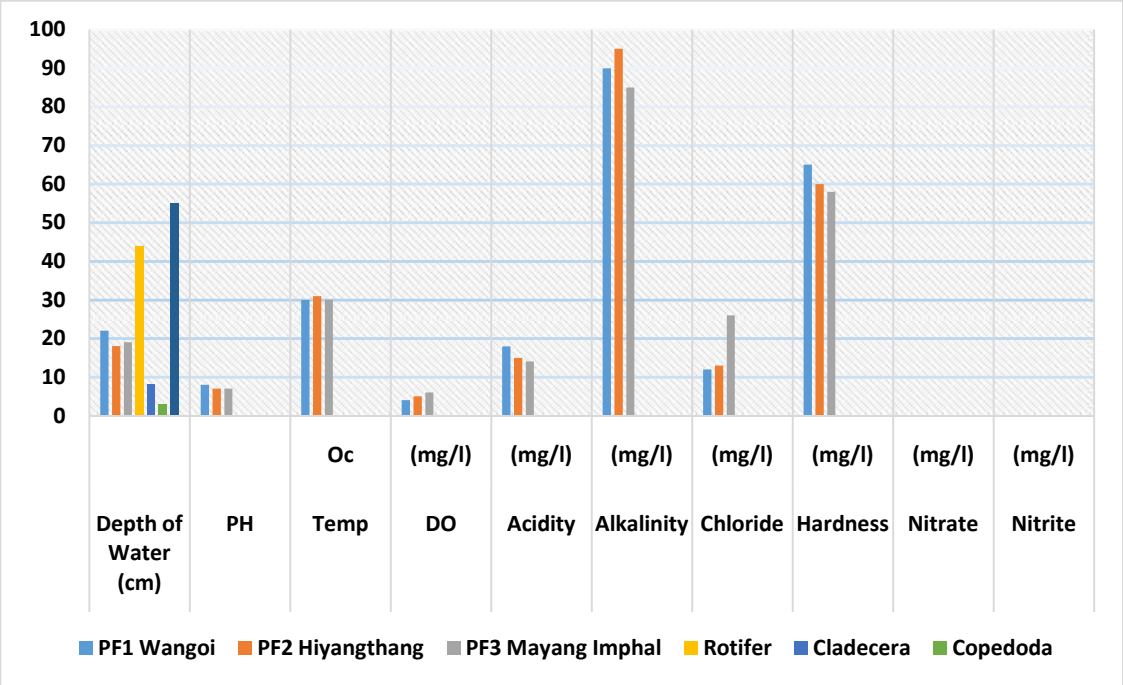


**Figure 2:** Zooplankton fluctuation in the paddy fields of Imphal West District.

**Table 3:** Average Physico – Chemical Parameters of water in (mg/l) at the paddy fields of Imphal West, District from August to October, 2020

| Parameters | August | September | October |
|---|---|---|---|
| Temperature | 27.1 ± 2.0 | 27.8 ±2.5 | 16.3 ± 1.3 |
| PH | 7.3 ± 0.3 | 7.1 ±0.1 | 6.1 ±0.5 |
| DO | 4.8±1.4 | 5.9±0.7 | 6.1±0.3 |
| Total alkalinity | 65.5±11.2 | 58±20.5 | 45±18 |
| Acidity | 13±1 | 8.5±2.5 | 9.6±1 |
| $CO_2$ | 8.4±2.5 | 8.6±0.9 | 16.0±4.2 |
| Chloride | 12.6±1.1 | 12.5±0.9 | 10.5±1.3 |
| Hardness | 30.0±20.0 | 33.0±18.2 | 33.5±29.1 |
| Nitrate | 0.04±0.03 | 0.09±0.05 | 0.08±0.09 |
| Nitrite | 0.05±0.02 | 0.01±0.16 | 0.01±0.13 |

## CONCLUSION

The overall view of the present investigation reveals that good diversity of zooplankton in the water of paddy field of Imphal West District. In the present investigation, rotifer group of zooplankton was found dominate population in the water body over cladocera and copepod.

**Acknowledgment**
Thanks are due to Prof. O. Aditya Kumar Singh HOD, Department of Zoology, D.M. College of Science, Dhanamanjuri University, Imphal for providing laboratory facilities during the work and all faculty members of the Department of Zoology (PG section) D.M. College of Science Dhanamanjuri University for their suggestion during the work.

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