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# Diversity of Plankton in the Paddy Fields of Thoubal District, Manipur

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**Abstract**
*The physico-chemical and biological analysis of water in the paddy fields of Thoubal District with reference to phytoplankton Zooplankton, fish fauna and benthic macro invertebrate is reported. The dynamic structure and composition of the biota in different seasons is regarded as a key to the prevailing ecological and environmental condition of the water body. It is observed that the water in the paddy fields in the study area receive more stress from sewage and organic effluents since no proper irrigation system in the paddy field. The present study revealed more anthropogenic impacts by the biota in the paddy field of Thoubal district.*

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## 1. INTRODUCTION

Analysis of the physico-chemical characteristics of water samples generally provides a picture of environmental status during the period of sample collection. It provides chemical quality but do not necessarily reflect the ecological state of the system (Karr et. al 2016) water quality is a dynamic in nature, many items, monitoring may fail to detect occasional changes as intermittent pulses of pollution (EPA, 1998). Biological monitoring involves sampling plankton and benthic organisms which give an indication of the health of the paddy field basin as a whole. Since water pollution is essentially a biological phenomenon, degree of pollution can be estimated either from physical and chemical properties or from biological characteristics of water. Biota can integrate the environmental effect of water chemistry, aquatic communities like phytoplankton reflects the average ecological condition and therefore may be used as indicators of water quality (Batt et al, 1999). Even though the ecological requirement of aquatic flora and fauna are so broad that their used as biological indices is limited (Friedrich, 1992). They could reflect the degraded quality of water (Hynes, 1962).

The basic principal followed in bio-monitoring is that nutrient level of water determines the occurrence of individual algal groups and their numerical abundance. Manipur is a land of biodiversity, luxuriant habitat types, land locked topography, high rain fall and large number of water bodies. Paddy fields are the lungs of land with cultural, economic as well as ecological significance and monitoring and maintenance of health of the paddy fields is of primary importance. Strategies for management and performing for the assessment of water quality in the paddy field

is the need of the hour. The present study is an to evaluate the quality of water in the paddy fields of Thoubal district in accordance with different strata of aquatic biota pertaining in the paddy field. The selected study area in Thoubal District includes, Heirok, Wangjing and Khangabok respectively, comprising 15 sampling sites in the three villages. Some paddy field is being utilized for rabi crop. The present paper includes biological estimates, their taxonomic composition along with chemical assessment in the paddy fields of Thoubal District.

## 2. MATERIAL AND METHODS

Paddy/Rice (*Oriza sativum*) is one of the important cereal crop mainly grown in Kharif season and also play a significant role in food security in the state Manipur. The present works on analysis of plankton and fish fauna in relation with its physico–chemical characteristics in the paddy field, Thoubal District, Manipur selected three villages i.e. Heirok, Wangjing and Khangabok as well as five sampling areas/sites were made in each village altogether fifteen sampling sites were established. The observations were taken in three in one cycle. The 1st cycle for observation was taken after 20 days of plantation. The second and third cycle observations were taken at the time of matured/flowering time and ready for harvesting paddy crop respectively starting from August to October 2020. Observation depends on the monsoon rain because there is no proper irrigation system in the study area. Paddy field fed water only rain water, temperature, transparency, dissolved oxygen free carbondioxide, alkalinity, acidity, chloride hardness, nitrates and nitrites etc. were analysed after APHA (1995). Phytoplankton were collected from the water surface while zooplankton were collected at the depth of 15 – 20 cm. from water surface by filtering water samples using plankton net with mesh size 60µ and preserved in 100 ml of plastic bottle with 4% formalin and three drops of lugol solution was also added and kept in dark place for 24 hours and decantation and estimated the volume of the rest water. The collected plankton were analysed after Sedgwick Rafter Counting cell (SR-Cell) and identified by a phase contrast light Olympus microscope Japan with the help of Edmondson, (1992) most of the plankton are identified by CIFRI, Barrackpore, Calcutta, Fishes were collected randomly with the help of local fisher women by using scoop net basket net (lohng) basket trap, deep net (Nupi il), conical trap (Sora lu), Khoi (stick hook), tubular trap (Kabolu) rectangular trap (Taijeb) etc. collected fishes were preserved in 4 to 6 % formaldehyde were analysed after Sherstha (1985) Jhingran V.G. (2002), Vishwanath (2002).

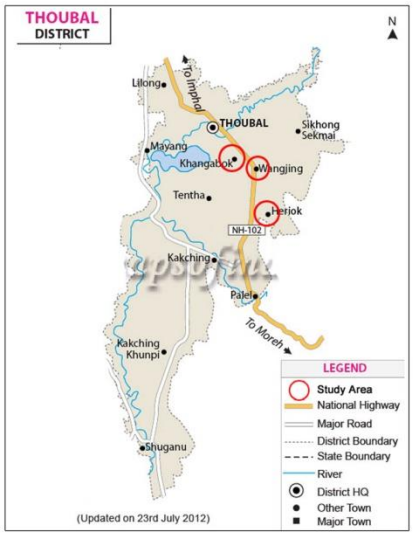


**Figure 1:** Map showing study area in Thoubal District

## 3. RESULT AND DISCUSSION

The water bodies in the paddy fields were observed as contaminated which are exposed to domestic and other local effluents. The water quality data presented in (Table – I) revealed that water temperature ranged between 27°C to 31°C. Generally, higher temperature recorded during summer. Temperature is also a key factor for seasonal variation of plankton as observed during the study periods. Paddy fields having water temperature more than 23°C is suitable for phytoplankton reported by Bhosale, Sabale and Mulic (1994), supported the temperature of the present works, Transparency recorded low during summer and rainy seasons. While high in summer due to high planktonic and increase in concentration due to high evaporation rate whereas during rainy season it was observed as suspended particles brought through the surface run off. The present study recorded as 2cm, during September at wangjing Loukon while 5.6 cm was recorded during the month of October at Khangbok (Komjao Loukon). Results were suitable for plankton as they live on the water surface; analogous was supported by Mishra et al. (1998).

PH value ranges from 6.5 to 7.6 showed the medium of productive in nature for plankton community. The lowest pH value was recorded during monsoon and post monsoon season in the month of September and October 2020. Which implies the influences of run-off water entering to the paddy field. During this period *Cypriniformes* recorded was higher, pH was slightly alkaline during summer (hot day) and pre-monsoon which may be due to dumping of garbage and inflow of sewage water from the surrounding villages to the paddy field but the present data recorded within the range of IS (Indian Standard), Value: 6.5 to 8.5 BIS (1992). During the study flowering of the paddy possess numerous nectar on the bunch of paddy crop more plankton were collected from all the study area of paddy fields. The higher rate of organic matter decomposition increase influx of free carbondioxide, higher temperature during September make slightly acidic but more number of fishes were collected. The present study recorded low range of carbon dioxide between 1-4.6 mg/L at Heirok and Wangjing areas as minima and maxima respectively. pH of water in the paddy field is important factor that affect thefish fauna. The collected fishes in the net beg and *Mystussps*, *Clarius* cought usually small economic fishes like *Puntius sps, Channa sps, Heteropneustes, Anabus, Colisa*, *sps* etc. The maximum value recorded in monsoon was enlarge decomposition of organic matter from domestic and municipality effluents. Lower values of free carbon dioxide increase the value of dissolved oxygen is related to the decrease in temperature or decrease in dissolved oxygen is possible because of higher temperature in solubility of oxygen decrease with increase in temperature the higher value of dissolved oxygen may be due to influence of runoff water from monsoon rain. Lower value of dissolved oxygen was recorded during pre-monsoon most of the paddy field during the investigation period. Atmospheric aeration and photosynthetic production of oxygen of phytoplankton may be low during pre-monsoon and higher during post-monsoon. Monthly variations of dissolved oxygen recorded on the surface water ranged from 4.0 to 8.0 mg/L. Data is satisfactory for the survival and growth of aquatic organisms. Maximum value recorded as 8.0mg/L during the month of October at Heirok (Lairam Loukon) and minimum value recorded as 4.0 mg/L during the month of August 2020 at Khangabok (louhonbi Loukon). This might be due to the fluctuation in temperature which alter trurbidity and also reduce photosynthetic activities as well as the establishing principles of low temperature and increase in solubility of gases, Rao et al (1993). The total alkalinity recorded during the study provide at the ranged of 29 to 35 mg/L. Less than 100 mg/L is suitable for plankton and fish, Benerjee (1967). Data was suppoted by Singh (2019). Minimum value was recorded in the month of October at wangjing and Khangabok Kaklou and Umurokloukon respectively. Maximum value recorded as 35 mg/L during monsoon rain at Heirok (Musalman Loukon). This increase value may be due to accidental mixing with sewage/waste materials and low lying area of paddy fields and also high evaporation rate change in alkalinity is also one factor of increasing decomposition. Similar result was also reported by Hedge and Bharathi (1989). The present data was found less than the permissible value of WHO (1991), Acidty ranged from 4-25 mg/L. Result was

supported by Singh (2018). Minimum acidity recorded at wangjing (yumkha) while maximum recorded at the same (Kaklou Loukol). Chloride content in water may be due to higher amount of sewage effluent and domestic waste discharged in the paddy field. The present study recorded 4mg/L and 35mg/L as minimum and maximum during the month of September and October. The present data was supported by Ongley (1996). Chloride content in water is also observed as discharge of human excreta. Phenomena were also reported by Saxena (1990). Minimum value of chloride recorded at Khangabok (Komjao Loukon) as 4mg/L and maximum as 35 mg/L recorded at wangjing (Sangaibi Loukon).Hardness of water was due to the concentration of salts of calcium and magnesium. Increase in hardness causes scale decomposition and scum formation on the surface water of paddy field. The present value recorded as 47mg/L maximum in the month of October while minimum recorded 33 mg/L during the month of August at Wangjing and Khangabok respectively. The maximum and minimum values of hardness depend on human disturbance in the paddy field. The present work hardness recorded lower than the permissible value of ISI (75 mg/L). Thus the water in the paddy field favour for fish but is less economic and also for plankton communities. The concentration of nitrate and nitrites are the indicator of organic pollution and eutrophication. The present work recorded ranged from 0.02 to 0.04 mg/L and 0.03 to 0.05mg/L respectively. Minimum value recorded in the month of August and maximum recorded in September.

The value above 0.05 to 10 mg/L of nitrate and nitrites are toxic to fish and other aquatic organisms, Day (1889). The present data recorded below the toxic level. The higher value of nitrite and nitrates was observed as man-made domestic activities like fertilizers, pesticides, hervicides etc. used in higher level by farmers reduces loss of ammonium fertilizers and enhances of availability of nutrients follows the reduction quality of soil. Excess amount of chemical fertilizers used in paddy field by farmer were also observed during study period. It makes soil very hard reported by local farmers. Aquatic life depend on the physico chemical characteristics of water, plankton and fish fauna in the paddy field were found distributed but influence by several physical and chemical factors. Most of the phytoplankton are floating while zooplankton are wandering drifting and living in darken and cold area of the water body. Early morning fishes were observed playing on surface water and hiding after 9 a.m. was observed at the bottom may be increase in temperature on the surface water. Among the phytoplankton community recorded *Cyanophyceae> Chlorophyceae> Bacillariophyceae > Euglenophyceae* (Fig. 4) while Zooplankton recorded *Rotifers> Copepods (Fig. 2)* same result was reported by K.P. Sreejith (2008) Fishes recorded *Cypriniformes> Siluriformes> Perciformes* etc. A total 5547 phytoplankton were collected. Members of *Cyanophyceae* was recorded as maximum (Table – 3) while 124zooplankton and only 16species of fish were identified. (Table – 3) during the study period in the paddy field of Thoubaldistrict, Planktonic organisms in the aqua system are essential link in food chain. The present study explores plankton and small economic fish community in the paddy field of Thoubal District. Phytoplankton plays a phenomenon of organic materials while zooplankton is one important of secondary producer in aquatic ecosystem. Zooplankton and fish are good indicator in changing the water quality to change in environmental quality. Plankton community dynamic is regarded as a biomonitoring tool of water quality. Fluctuation between the plankton and fish fauna revealed the degree of pollution and caused the grazing of consumers like carp fishes. Thus, the need of the hour is to stop dumping the sewage in the paddy field and also in fresh water and realized the excess application of chemical fertilizers in the paddy field as it harm to our soil as well as to health. Paddy field was rich in diversity of plankton. Thus the present study is limited to the quantitative observation from the Thoubal District even though it will provide some information of the composition and seasonal water quality revealed the maximum diversity of phytoplankton present in the paddy field is and around the Thoubal District.

**Table 1:** Average physico-chemical characteristics of water in (mg/L) at different paddy fields of Thoubal District, 2020

| | **AUGUST** | | | | | **SEPTEMBER** | | | | | **OCTOBER** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **S1** | **S2** | **S3** | **S4** | **S5** | **S1** | **S2** | **S3** | **S4** | **S5** | **S1** | **S2** | **S3** | **S4** | **S5** |
| Temp 0°C | 27±1.3 | 23±1.6 | 22±1.5 | 21±1.7 | 20±1.8 | 25±1.3 | 24±1.4 | 23±2.0 | 22±1.6 | 23±1.7 | 24±1.6 | 23±1.7 | 25±1.3 | 25±1.2 | 23±1.3 |
| Transparency (Cm) | 3±1.3 | 3.5±2.3 | 1.1±1.0 | 4.2±1.0 | 3.5±1.2 | 5±1.2 | 5±1.3 | 5±1.5 | 5±1.6 | 4±1.5 | 3+1.6 | 2.1+1.3 | 3±1.5 | 4±1.7 | 5±1.2 |
| pH | 6.7±0.2 | 6.8±0.7 | 6.5±0.6 | 6.5±1.6 | 6.3±1.6 | 6±1.6 | 6.2±1.0 | 6.3±1.7 | 7±0.2 | 8±0.5 | 8.3±1.2 | 8.2±1.2 | 8.3+1.2 | 7.5±1.2 | 7.6±1.3 |
| DO | 6.0±1.3 | 5.7±1.5 | 6.0±2.0 | 6.3±1.2 | 7.2±1.3 | 7.5±1.4 | 7.1±1.5 | 6.8±.6 | 6.4±.2 | 8±1.2 | 7.1±1.4 | 8.1±0.7 | 8.3±1.6 | 8.0±1.2 | 8.3±0.5 |
| Total Alkalinity | 30±3.1 | 28±2.0 | 29±1.5 | 28±1.5 | 28±2.0 | 30±1.2 | 29±1.2 | 28±1.5 | 30±1.6 | 31±1.5 | 29±1.2 | 30±1.5 | 28±1.2 | 30±1.2 | 29±1.5 |
| Acidity | 12±1.4 | 11±2.8 | 12.6±.12 | 12.6±.6 | 15±1.2 | 14±1.7 | 11.1±0.5 | 16±1.7 | 19±2.6 | 18.1±.6 | 19.2±1.2 | 20±.5 | 20±1.7 | 24±1.2 | 16±1.2 |
| $CO_2$ | 3.2±.2 | 5±1.4 | 4.0±1.3 | 4.2±1.6 | 5±1.4 | 4.9±1.4 | 38±1.9 | 5±1.0 | 1.9±1.1 | 6±1.1 | 5.6±1.1 | 5.7±1.4 | 7.3±1.3 | 8±1.6 | 8.1±1.0 |
| Chloride | 7.3±1.7 | 6.8±1.7 | 6.0±1.4 | .8±1.7 | 5±1.8 | 4.6±1.2 | 5±1.7 | 5.2±1.5 | 5±1.6 | 6.0±1.0 | 7.3±1.3 | 6.8±1.7 | 7.0±1.2 | 7.6±1.2 | 6.6±.7 |
| Hardness | 44.0±08 | 44±1.7 | 46±1.4 | 45±1.0 | 44±0.9 | 50±1.1 | 42±2.1 | 44±22 | 50±1.9 | 48±0.8 | 52±1.3 | 47±1.6 | 49±1.6 | 50±1.6 | 50±0.9 |
| Nitrate | 0.07±0.03 | 0.07±0.04 | 0.08±0.02 | 0.09±0.03 | 0.08±0.04 | 0.09±0.05 | 0.06±0.06 | 0.07±0.04 | 0.08±0.03 | 0.07±0.04 | 0.08±0.05 | 0.06±0.04 | 0.07±0.07 | 0.08±0.04 | 0.07±0.07 |
| Nitrite | 0.02±0.03 | 0.06±0.02 | 0.09±0.03 | 0.09±0.05 | 0.07±0.01 | 0.08±0.01 | 0.07±0.02 | 0.08±0.04 | 0.06±0.03 | 0.07±0.06 | 0.06±0.07 | 0.08±0.06 | 0.09±0.07 | 0.06±0.05 | 0.08±0.07 |

| Heirok Area | Wangjing Area | Khangabok Area |
|---|---|---|
| S1 = KangdabiLoukol | S1 = SangaibiLoukol | S1 = ThajakhongLoukon |
| S2 = LairamLoukol | S2 = YumkhaLoukol | S2 = UmurouLoukon |
| S3 = MusalmalLoukol | S3 = UningkhongLoukol | S3 = LouhonbiLoukol |
| S4 = Sari Labuk | S4 = MahaLoukol | S4 = KomjaoLoukol |
| S5 = MayangambiLoukol | S5 = Kaklou | S5 = AngomKhongLoukol |

**Table 2:** Diversity of phyto and zooplankton in the paddy field of Thoubal District

| Station | **Phytoplankton** | **Heirok** | | | | | **Wangjing** | | | | | **Khangabok** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | Total |
| Cyanophyceae | Oscilltoria sp | 600 | - | - | 450 | 350 | 440 | - | - | - | - | - | 330 | - | - | 340 | 2510 |
| | Anabaena sp | - | 80 | - | - | 160 | - | - | - | - | - | 120 | - | - | 130 | - | 490 |
| | Microcystis sp | - | 60 | - | - | - | - | - | - | - | - | - | 80 | - | - | - | 140 |
| | Phormidium | 260 | - | - | - | - | 260 | - | - | - | - | 170 | - | - | 120 | - | 810 |
| | Pediastrum sp | 10 | - | - | - | 5 | - | - | - | - | 10 | - | - | - | - | 12 | 37 |
| | Oedugonium sp | - | - | 60 | - | 50 | 50 | - | - | 40 | 50 | - | - | - | - | - | 250 |
| | Scenedesmus sp | - | - | 40 | - | - | 20 | - | - | 10 | 20 | - | - | - | - | - | 90 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chlorophyceae | Mougeotia sp | 40 | - | - | - | - | 50 | - | - | 210 | - | - | - | 50 | 60 | 40 | 450 |
| | Coelestrum sp | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Cosmarium sp | 12 | 24 | - | 14 | - | - | 15 | 13 | 16 | 14 | 13 | - | 14 | - | - | 135 |
| | Desmidium sp | - | 13 | - | 13 | - | - | 14 | 14 | - | - | 14 | 16 | 13 | 17 | - | 114 |
| | Micrasterias sp | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 2 | 7 |
| | Spiprogyra sp | 20 | - | 14 | - | - | 30 | - | 20 | - | - | - | - | - | - | - | 84 |
| Bacillariophyceae | Cymbella sp | 20 | - | - | - | - | 15 | - | - | - | - | 20 | - | - | - | - | 55 |
| | Gyrasigma sp | - | - | - | - | 14 | - | - | - | - | - | - | - | - | 10 | - | 24 |
| | Aulasiera sp | - | - | - | - | - | - | - | - | 20 | - | - | - | - | 10 | - | 30 |
| | Fragilaria sp | - | - | - | - | - | - | - | - | - | - | - | - | - | 12 | - | 12 |
| | Navicula sp | - | - | - | - | - | - | 14 | 15 | 13 | 16 | 12 | 14 | - | - | - | 84 |
| | Nitzschia sp | 13 | - | 14 | - | - | 16 | 12 | - | 20 | 12 | - | - | - | - | - | 87 |
| | Synedra sp | | 14 | 14 | - | - | - | - | - | - | - | - | - | - | - | - | 28 |
| | Pinnularia sp | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 4 |
| Euglenophyceae | Trachelomonas | - | - | - | - | - | 54 | - | - | - | - | - | - | - | - | 28 | 82 |
| | Phacus sp | - | - | - | - | - | - | - | - | 31 | 1 | - | - | - | - | - | 4 |
| | Euglena | - | - | - | - | - | 4 | - | - | - | - | - | - | - | - | 16 | 20 |
| **Total abundance (Cells/10ml)** | | **977** | **191** | **144** | **477** | **579** | **393** | **60** | **62** | **332** | **123** | **349** | **440** | **77** | **359** | **438** | **5547** |

| Station | **Zooplankton** | **Heirok** | | | | | **Wangjing** | | | | | **Khangabok** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | Total |
| Copepoda | Calanoid Coepod | - | - | - | - | 8 | - | - | - | - | - | - | - | - | - | - | 8 |
| | Cyclopoid copepod | - | 3 | - | - | 6 | 2 | - | - | - | - | - | - | - | 3 | 3 | 17 |
| | Naupii | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| Rotifer | Brachionus sp | - | 14 | - | - | 12 | - | 13 | - | - | - | 10 | - | - | - | 10 | 59 |
| | Lecanesp | - | - | - | - | 13 | - | - | - | - | - | 15 | - | - | - | 10 | 38 |
| **Total abundance (individual/10ml)** | | - | **17** | - | - | **39** | **2** | **13** | - | - | - | **25** | - | - | **3** | **25** | **124** |

* Data analysis from CIFRI, Barrackpore, Kolkata

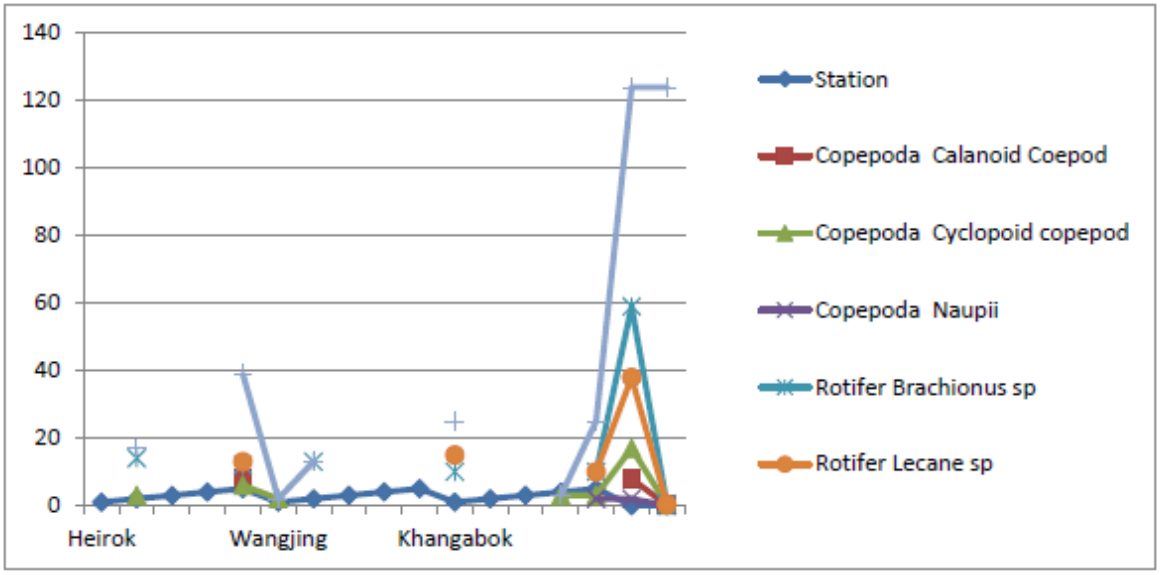


**Figure 2:**

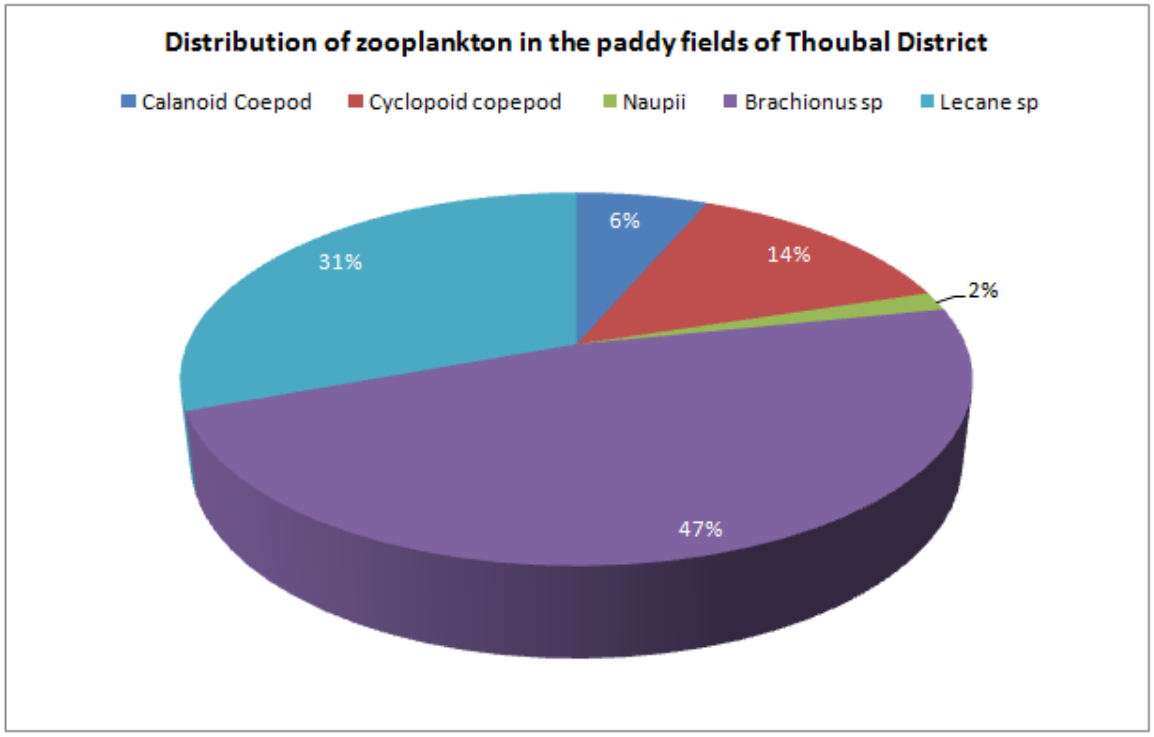


**Figure 3:** Distribution of zooplankton in the paddy fields of Thoubal District

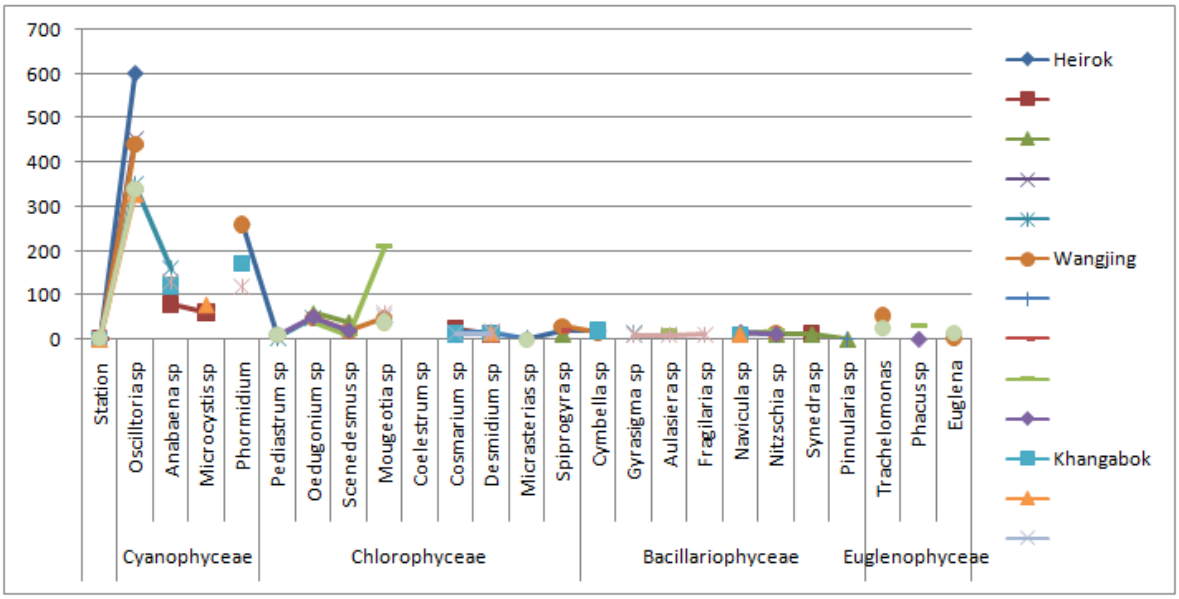


**Figure 4:**

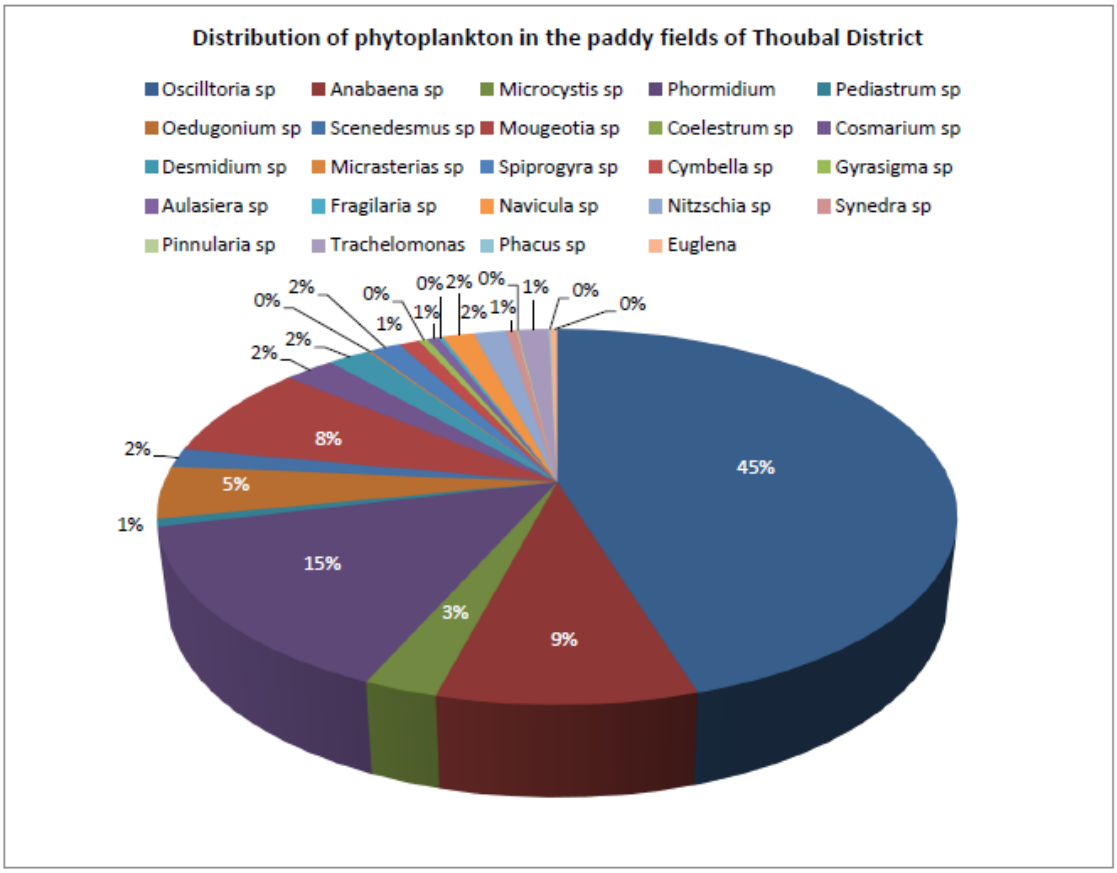


**Figure 5:** Distribution of phytoplankton in the paddy fields of Thoubal District

**Table 3:** Check list of collected fishes in paddy field of Thoubal District during August to October, 2020.

| Order | Scientific Name | Local Name |
|---|---|---|
| **Cypriniformes** | *Amblypharyngodon mola* (Hamilton) | Muka Nga |
| | *Danio devario* (Linnaeus) | Ngasang |
| | *Esomus danricus* (Hamilton) | Phabounga |
| | *Puntius conchonius* (Hamilton) | Phabounga |
| | *Puntius chola* (Hamilton) | Phabounga |
| | *Puntius ticto* (Ham, Buch) | Phabounga |
| | *Puntius sophore* (Ham, Buch) | Phabounga |
| **Siluriformes** | *Mystus bleekery* (Day) | Ngasep |
| | *Heteropneustes fossilies* (Block) | Ngachik |
| | *Clarius batrachus* (Linnaeus) | Ngakra |
| **Perciformes** | *Anabus testudineus* (Bloch) | Samjet/ukabi |
| | *Channa punctatus* (Bloch) | Ngamubogra |
| | *Channa striatus* (Bloch) | Porom |
| | *Chanda nama* (Ham Buch) | Ngamhai |
| | *Colisa lalia* (Scheider) | Phetin |
| | *Colisa fasciatus* (Scheider) | Ngabema |

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