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Quantitative Analysis of Plankton in the Paddy Fields of Kakching District, Manipur

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ABSTRACT:
The Plankton analysis along with physico-chemical characteristics of water was carried out on the four sampling sites in the paddy fields of Kakching District. Temperature, transparency, pH, dissolved oxygen, chloride, total alkalinity, acidity, hardness, nitrate and nitrite etc. were analysed and observed in favour on plankton in the paddy fields of the study areas. Phytoplankton recorded as increase during rainy season while decrease in zooplankton during the last part of October. Total 870 plankton, comprising 627 phytoplankton and 243 zooplankton were listed during the investigation period, July to October 2021.

Keywords:
Biological, Physico-Chemical, Plankton, Kakching.

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INTRODUCTION

Water quality is dynamic in nature, many times monitoring fails to detect occasional changes as intermitted pulses of pollution EPA (1998). But biological monitoring involves sampling plankton and benthic organisms give an indication of the health of the paddy field basin as a whole.

The present selected study sites are paddy fields within the Kakching District is one of the newly bifurcated from Thoubal District, Manipur, on the 8th December, 2016 (*Manipur Extraordinary Gazette No. 408 of 9/12/2016*), which is located in the southern part of Manipur with a distance of 45.1km from the capital city of Imphal. The district occupies a large portion of south eastern half of the valley in the state between 24.64'N and 24.23'N latitude and 94.97'E and 93.82'E longitude. The Sekmai River is a major source of

water which is used for drinking purposes as well as water is also used for irrigation in the paddy fields in and around the kakching and also its neighbouring paddy fields of Palel, Keirak and Wabagai. The Sekmai River makes the paddy fields fertile. The south-west monsoon begins around the starting of June and feeds down by the end of September or October, including the first parts of winter covered the study periods. The current driven by monsoon are powerful physical forces Hwang et al. 2010; Tseng et al, 2008 states that wind play a vital role in shaping the species richness and diversity of plankton. In fact, the present study area is poor mineral resources but the mineral found in the district brine springs are significant. The water from the spring are boiled and extracted in the form of cake and are considered to have a good medicinal property and also used in ceremonial purposes. Those springs are found along the foothills on the eastern side of the valley around Waikhong, Thongjao, Chairen etc. within the jurisdiction of Kakching District. Some qualities of low grade iron ore are also obtained at Kakching District. These minerals do not influence to the water of paddy field may be the result of occurring low amounts.

From evolutionary point of view the present study was selected for the study of plankton in the paddy fields of Kakching District. Plankton, Biologically indicates the degree of imbalance that has been caused, while chemical measure shows the concentration of pollutants in the paddy field water. Biota can integrate the environmental effects of water chemistry and aquatic communities like plankton reflects the average of ecological conditions and therefore plankton may be used as indicator of water quality – Batt et al, (1999).

Agriculture is main sources of livelihood for the people of Kakching District. More than 70% of the total population of the District is directly or indirectly depended on agricultural activities. The valley is fertile alluvial soil and topography of the district provides good opportunity for nature as well as artificial irrigation. The production of rice is above 90% of the land area under cultivation (Economic survey, Manipur-2008). The production of rice in the paddy field is related with the distribution of total export of rice to other places. So it may be termed as the **"Rice basket of Manipur"**. Thus, the present work is established and selected this particular district of Kakching. A total 870 plankton comprising 627 phytoplankton and 243 zooplankton were listed (Table 2).

MATERIALS AND METHODS

The present study was carried out for a period of four months starting from July to October 2021 covering the monsoon and winter season during one crop cycle of paddy. The first reading was taken after fifteen days of plantation because during these time plants start getting food form soil. The 2nd reading was taken when paddy plants matured i.e. time of flowering. The 3rd reading was taken when harvesting is ready. The characteristics and biological analysis of water in the paddy were performed. The study sites are marked within the municipality boundaries of Kakching town. The marked first paddy field (PF_1) on the Asian high way No. 1 (AH_1) namely Leingang near Kakching Lamkhai, the second selected paddy field (PF_2) on the same route near the Pallel Lamkhai namely Heikakpokpi the third (PF_3) paddy field is on the way of inter village road (IVR), Tekcham by pass Kakching Wairi. The fourth sampling site of paddy field (PF_4) was slightly stretches from Kakching on the Burma Sugunu Road (BSR) near Wabagai Lamkhai Bazar namely Keirak.

The phytoplankton and zooplankton on the surface water of the four paddy fields were collected from photic zone of 5-15cm depth by filtering 60 liters capacity of water through a plankton net made by nylobolt with 60 µ mesh size fitted with a metallic frame. After collection of the plankton from the respective study sites were brought to the laboratory at D.M. College of Science (Fishery lab.) Dhanamanjuri University, for identification. At the laboratory, a few drops of Lugol solution was added to the collected plankton to prevent the shrinkage of cells. Identification of plankton were done after Ward and Wipple (1959) and other authentic literatures. At the same time water were collected from the respective sampling paddy fields. The oxygen of the sampling water was fixed with Manganese sulphate and Alkaline

iodide on the spot itself. The other parameters like dissolved oxygen, free carbondioxide, chloride, acidity, alkalinity, hardness, nitrate and nitrites etc. were analysed after APHA (2005). pH and temperature were measured on the spot during the investigation period.

The collected plankton were analysed and counted after Sidgwick Rafter Counting Cell (SR -Cell). A Sidgwick Rafter counting cells are divided into 100 equal squares made to hold 1ml. of the plankton sample was used. The phyto and zooplankton present in the squares in the vertical row and 10 squares in the horizontal row were counted at random.

The percentage of the dominant group and other members of phyto and zooplankton were separated. The seasonal changes in physico-chemical characteristics (Table-1) and planktonic activities/distribution (Table-2) in the water of paddy field in Kakching district are interrelated and interdependent each other. The changes in the concentration of some chemical constituents were observed during the investigation period. This may be the result due to the entrance of rain water into the paddy fields.

Figure 1: Map of Study Area (Kakching District)

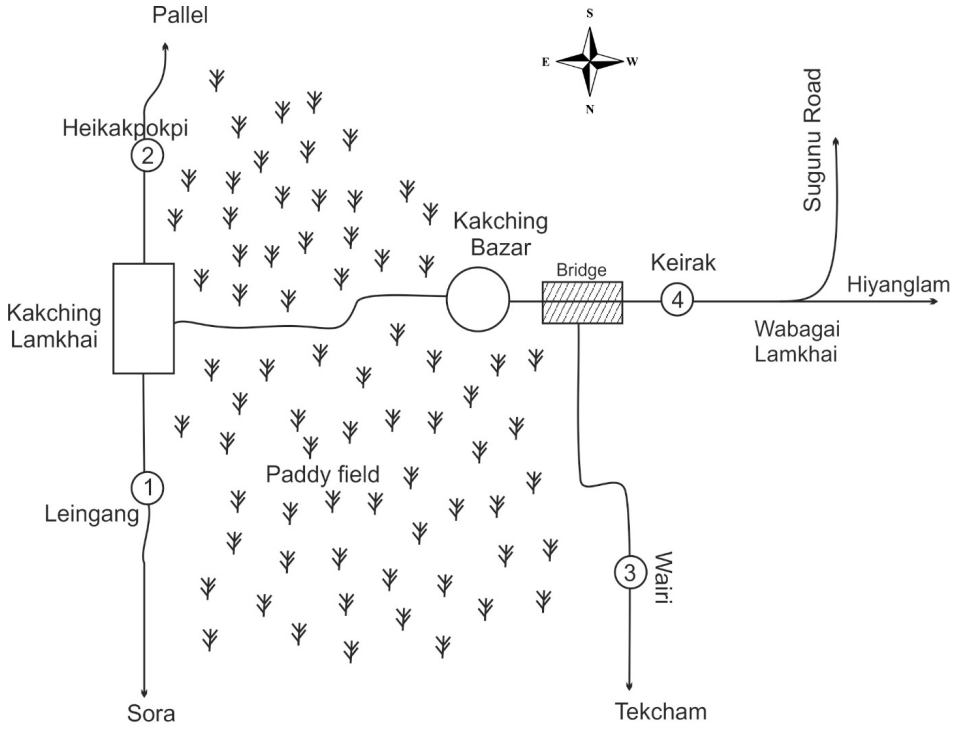


Figure 2: Sketch map of study sites. Kakching District

RESULTS AND DISCUSSION

The variation in phytoplankton and zooplankton distribution and abundance were influenced by seasonal change in environmental characteristics. Temperature, pH, dissolved oxygen, carbon dioxide, alkalinity, acidity, hardness, chloride, nitrate and nitrite etc. are important to study the physico-chemical parameters to distinguish the differences between the plankton and seasonal scale in fresh water ecology.

Temperature is a key factor for aquatic environment as it influences the aquatic life and physico-chemical parameters (Sukumaram et al., 1989), seasonal variations in temperature may attribute with the force of wind influx of fresh water and atmospheric temperature. The present study recorded 27^0C as minimum and 32^0C as maximum. Hydrogen ion-concentration varied from 6.8 to 8.0. Thus, maximum value was observed during August and minimum value was observed during the month of October 2021 decline upto monsoon and remained alkaline during post monsoon. The carbon dioxide by photosynthesis through which bicarbonate degradation occurred. The freshwater influx, reduction in salinity, temperature and decomposition of organic matter (Rajagopal et al., 2010). Higher pH obtained during post monsoon might be due to influx of fresh water along with local waste materials. The present study revealed that higher value of pH recorded in some paddy fields favour the production of plankton.

Dissolved oxygen is a major component in the aquatic ecosystem which determine the quality of water and also support aquatic life. During the investigation period dissolved oxygen recorded at the range between 4.31 to 8.6 mg/L, in the month of September and minimum value registered during the month of August (Table - 1). The lower value of dissolved oxygen during the day time may be due to higher catabolic rate of aquatic organisms, accelerated decomposition and decrease in oxygen solubility at higher temperature. Thus, seasonal variations of dissolved oxygen were observed during the study period. This occurring value could be due to higher temperature and biological activity. The phenomena were analogo used by Davis, 1975, Levinton, 2001. Higher concentration of

dissolved oxygen during monsoon and post-monsoon is attributed to high in fresh water input and evidenced by maximum occurrence of phytoplankton species (Morgan et al., 2006).

The water body in the paddy field of Kakching district is deficient in all nutrients. It may be more absorption of nutrition from water by plants. The nutrients such as nitrate and nitrite in the paddy field would exhibit substantial variations which depends on rainfall, input of water and consumption of nutrients by autotrophs. Concentration of nitrate in the paddy field ranged from 0.02 to 0.06 mg/L during the month of August and October respectively. Higher concentration of nitrate was recorded during summer and monsoon. It could be due to inflows of fresh water, terrestrial run off and higher rate of biological production, oxidation of ammonia, reduction of nitrate by recycling of nitrogen and also by degradation of planktonic detritus present in the environment (Govinda Sagar et al., 2009; Hutchinson, 1957) Lower concentration of nitrate registered during non-monsoon period. It might be due to higher consumption of nitrate by photosynthetic organisms and incursion of neritic water which constitutes only small amount of nitrate (Das et al., 1997; Govinda Swamy et al., 2000).

The total alkalinity registered during investigation period was ranged of 30 to 35 mg/L. The present data was supported by Hedge and Bharti, 1985, the minimum value recorded during in the month of October as 30 mg/L and maximum as 35mg/L during the monsoon season of the study period. The increase of alkalinity could be due to mixing with the amount of water coming from municipality areas of Kakching town enter to the water of paddy fields. It makes the low quality of water in the paddy field and also lead to high evaporation rate. Such changes in alkalinity may be due to the decomposition of local solid waste which is dumping to the paddy fields with water. Acidity ranged from 3-21.6 mg/L. This range of data recorded from the paddy fields was supported by Singh (2018). Acidity is related with temperature and dissolved oxygen in the paddy field. Minimum acidity was observed in the month September at Heikakpokpi on the way of AH_1 and maximum value was recorded in the last part of October 2021 at Keirak on the way of BSR. Less number of zooplankton were registered at the paddy field PF_4 of AH_1. Chloride content in water of the paddy fields of Kakching District ranged from 4-12.5 mg/L. The higher chloride content may be due to higher amount of sewage effluent of domestic and municipal waste discharged in the paddy field during rainy season. During the investigation period higher value of chloride obtained with less zooplankton distribution was observed. (Table- 1, 2)

Hardness of water was due to the concentration of salt particles, the concentration of metallic ions of calcium and magnesium increases in hardness causes decomposition of scale and also scum formation on the water surface of the paddy field. The present study recorded 46mg/L as maximum in the month of October while minimum value was recorded as 27mg/L in the month of July 2021. The data obtained during the study period was within the permissible limit of ICMR (WHO). The increase in calcium and magnesium hardness in the paddy field's water towards winter and summer may be attributed to the steady state of hardening of water due to evaporation of the surface water and addition of calcium and magnesium salts from detergents and soaps used for washing and bathing places near the mouth of the paddy fields, whereas excessive dilution by heavy rain are also important factors for lowering hardness of water in the paddy fields.

Aquatic life depends on physico-chemical characteristics of water. The plankton distribution in the paddy fields of Kakching District influence by the combination of several physical, chemical factors. Most of the phytoplankton are floating on the water surface influencing the colour, test and odour while zooplankton is wandering animals living in darken and cold area of the water body. Among phytoplankton community, the present study revealed that
Chlorophyceae>Cyanophyceae>Bacillariophyceae>Euglenophyceae (Table-2)
while among zooplankton community Ostracode>Rotifera>Cladocera>Copepoda (Table-2).

Table 1: Average physico-chemical parameters of water in (mg/L) at different paddy fields of Kakching District, during 2021-2022

Parameters	July				August				September				October			
	PF_1	PF_2	PF_3	PF_4	PF_1	PF_2	PF_3	PF_4	PF_1	PF_2	PF_3	PF_4	PF_1	PF_2	PF_3	PF_4
Temp. 0^0C	27±1.4	23±2	21±1.4	20±2	24±1.3	25±1.3	24±2	23±1	24±1.6	25±1.7	24±1	35±2	25±2	26±2	23±1.7	25±1.4
Transp. (Cm)	3±1.4	3.5±2.2	4±1.3	5±1.4	5±1.5	4±1.3	3±1.4	3±1.5	3±1.3	2±1.6	4±1.6	4±1.2	3±1.3	4±1.7	3.1±1.5	4±1.2
pH	6.8±0.2	7.0±0.6	7.1±0.7	6.6±1.6	6.3±1.5	6.1±1.6	7.0±2.5	8.0±1.5	8.0±1.5	9.2±1.3	8.6±1.2	6±1.3	8±1.4	7±1.6	9.0±1.3	8.5±1.2
DO	4.6±1.6	5.0±1.2	6.0±1.5	6.2±1.2	7.2±1.4	7.1±1.4	7.2±1.3	7.6±0.7	8.6±1.4	8.6±1.2	9.2±1.6	8±1.7	9±1.6	10±1.4	21±1.2	25±1.6
T/A	30.0±2.8	30±3.2	29.6±1.4	30±1.0	29±1.6	28.2±1.1	29±1.6	30±1.6	32.0±1.2	32±1.5	30±1.3	29±1.7	27±1.3	26±1.3	19.1±1.6	19±1.6
Acidity	12±1.2	11±2.3	12±3.3	14±2.1	15.0±1.4	16.3±1.6	17±1.3	19±1.2	20±2.1	23±1.6	20±1.7	19±1.0	20±1.3	16±1.7	13.0±1.8	6.0±1.8
CO_2	3.0±1.4	5.0±1.6	4.27±1.7	4.6±1.2	5±1.2	4.8±1.3	4.2±2.8	5±1.0	4.9±1.5	5±1.3	6.1±1.2	7.1±1.2	8.6±1.5	9±1.4	10±1.7	9±1.4
Chloride	7.3±1.4	7.0±1.3	6±1.6	6±1.6	4.0±1.1	45±1.4	5.0±1.3	6.0±1.4	6.1±1.0	5.8±1.2	7.2±1.3	7.0±1.5	6±2.1	7±1.0	7.5±1.8	8±1.2
Hardness	44.0±1.2	45±0.2	46±1.5	46±1.6	57±1.2	55.0±1.6	56±1.2	54±1.8	58±0.4	57.0±1.3	57.0±1.3	60±1.0	67±0.3	70±1.3	69.0±1.2	.72±3.0
Nitrate	0.08±0.03	0.09±0.04	0.07±0.06	0.09±0.01	0.06±0.01	0.07±0.04	0.06±0.05	0.08±0.06	0.04±0.01	0.03±0.06	0.03±0.06	0.07±0.02	0.04±0.03	0.06±0.01	0.07±0.01	0.09±0.02
Nitrite	0.02±0.01	0.05±0.02	0.07±0.03	0.08±0.04	0.09±0.03	0.08±0.06	0.06±0.04	0.08±0.03	0.09±0.04	0.07±0.04	0.07±0.03	0.07±0.03	0.08±0.04	0.08±0.06	0.03±0.07	0.06±0.04

Table 2: Plankton variations in the paddy field of Kakching District, during one crop cycle-2021

Class	Biological Name	PF_1	PF_2	PF_3	PF_4	Total	% Composition
Chlorophyceae 223	*Spirogyra maxima*	10	08	06	12	36	11.1
	Spirogyra sps.	08	12	07	13	40	10
	Desmidium vulgaris	12	15	10	08	45	8.8
	Scenedesmus dimorphus	05	10	13	10	38	10.5
	Cosmarium sps.	15	12	06	08	31	12.9
	Closterium sps.	11	10	08	16	43	9.3
Cyanophyceae 212	*Nostoc sphericum*	13	10	10	06	39	10.2
	Anabaena ballygunlii	09	10	09	05	31	12.9
	Oscillateriaamphibia	12	08	10	12	42	9.5
	Fragilaria construens	07	13	10	07	37	10.8
	Synedra ulna	11	12	09	06	38	10.5
	Nitzschia closterium	08	05	02	10	25	16.0
Bacillariophyceae 123	*Cymbela sps.*	15	12	03	-	30	10.0
	Navicula viriduloides	13	-	14	16	43	6.9
	Navicula sps.	12	13	-	-	25	8.0
	Pinnularia sps.	-	-	13	12	25	8.0
Euglenophyceae 69	*Trachelomonas sps.*	-	10	20	13	43	6.9
	Phacus sps.	03	02	05	-	10	30
	Euglena viridis	04	-	10	02	16	18.7
Copepode 45	*Calanoid copepod*	08	-	02	01	11	27.2
	Cycloid copepod	05	06	02	03	16	25.0
	Nauplii	-	-	10	08	18	11.1
Rotifer 67	*Branchionus sps.*	10	12	-	13	35	8.5
	Lacanesps.	-	17	13	02	32	9.3
Ostracods 74	*Crustacean sps.*	08	07	02	03	20	20.0
	Decapoda sps.	10	05	04	06	25	16.0
	Prawn	-	05	-	06	11	18.1
	Mysis	03	05	04	06	18	22.2
Cladocera 57	*Daphnia sps.*	06	08	04	-	18	16.6
	Moina sps.	05	10	02	06	23	17.3
	Bosminia sps.	03	06	-	07	16	18.7

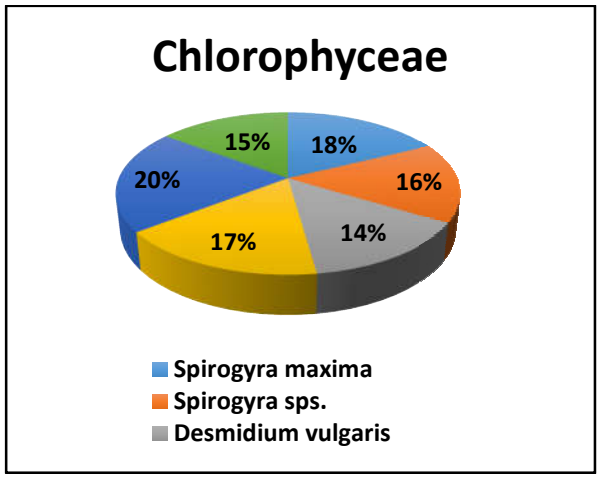
The distribution pattern of phytoplankton and zooplankton are shown in Fig. 3. Plankton are essential link in food chain in the aquatic ecosystem, zooplankton is good indicators for changing of water quality and also change in environmental quality.

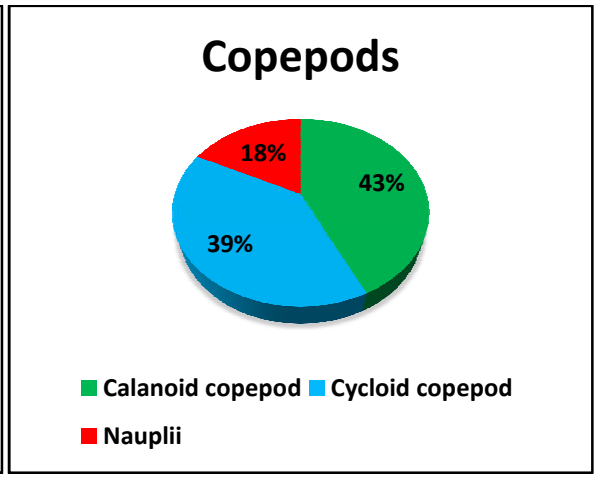
A total 870 plankton species were listed during investigation period. Member of chlorophyceae were recorded as highest population during the post monsoon in the paddy fields of Kakching district on average of each study sites. Similar observation was given by (Affan et al., 2005). Dominance of diatoms over the chlorophyceae in stagnant water was reported by (Vaisali et al.), 2007). Analogous was the present data obtained in the paddy field. Plankton community is regarded as dynamic role as a biomonitoring tool of water quality.

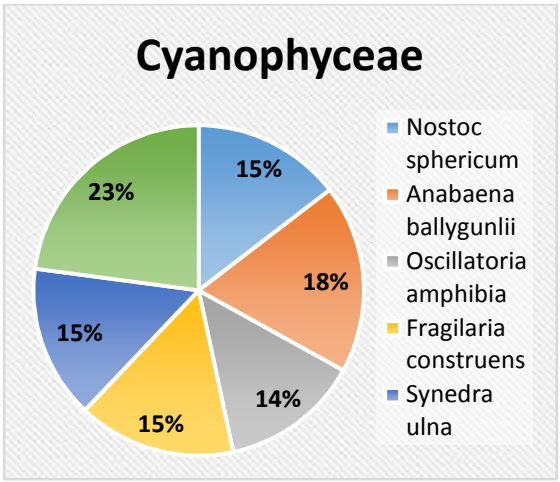
The aquatic environment is an area controlled by the change in factors such as light, heat, humidity and contamination of various effluents in the water body of paddy fields. Contamination of water through domestic sewage was also observed gradually reducing

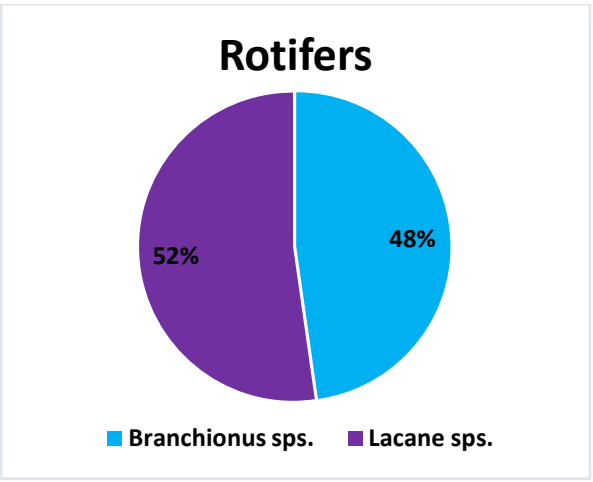
the productivity status of the paddy fields during the investigation period. Proper biological and chemical treatment of domestic sewage analysis to be done before discharging to the paddy fields for agricultural sustainable resources.

To sum up, the present study is limited and preliminary study of qualitative and quantitative analysis of the paddy fields in Kakching district. But data of the present study will provide useful information of the composition and ecology of plankton. The present basic information would form a very useful tool for ecological assessment and monitoring the ecological status in the paddy field in Kakching district as well in the paddy field in Manipur.









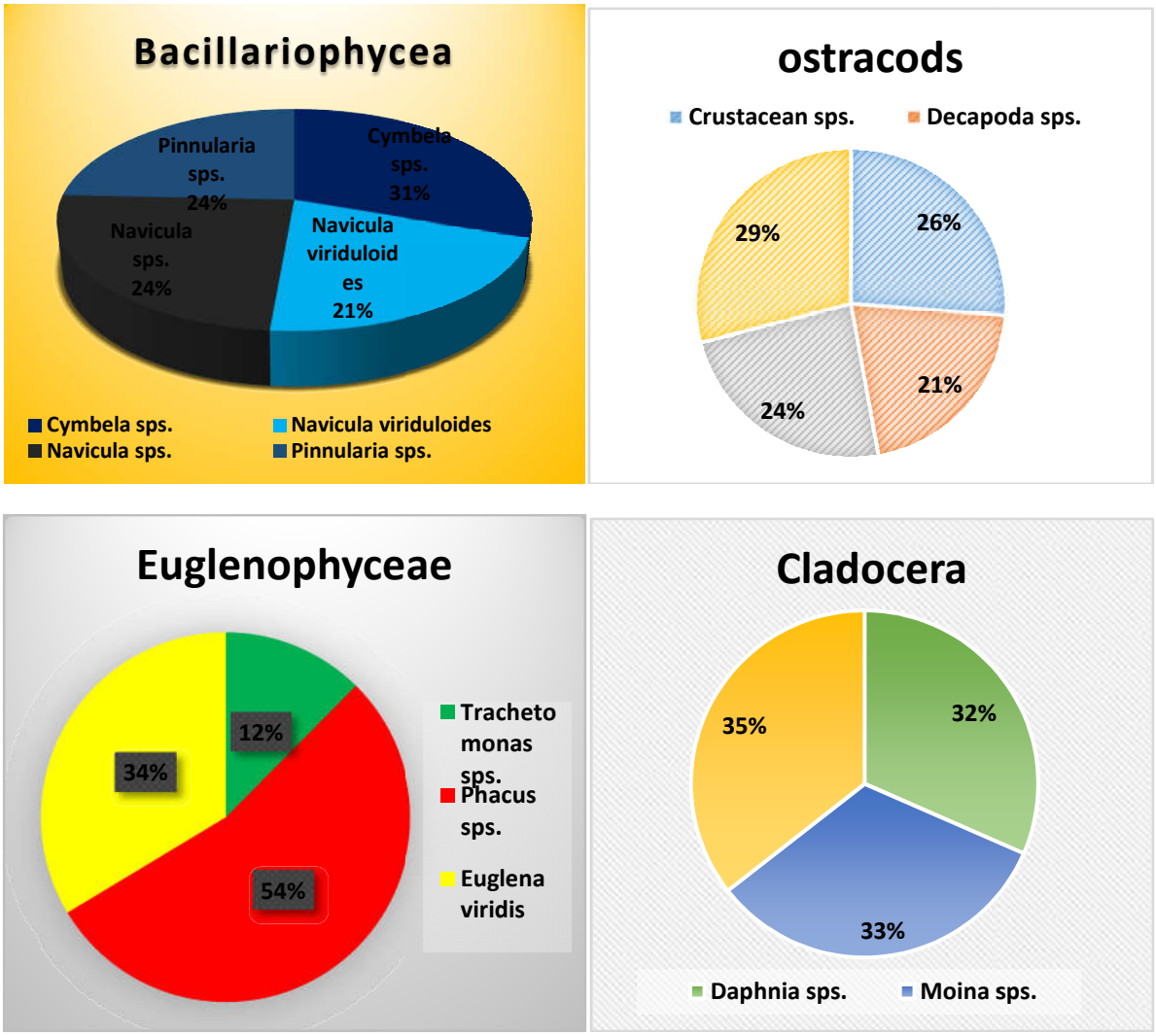


Figure 3: Distribution pattern of phytoplankton and zooplankton in the paddy fields of Kakching District

CONCLUSION

The overall views of the present investigation revealed good diversity of plankton in the water of paddy field of Kakching District. In the present investigation, rotifer group of zooplankton was found dominant population in the water body over cladocera and copepod. While phytoplankton chlorophyceae are dominant and followed by cyanophyceae, bacillariophyceae and euglenophyceae.

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