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BIOMONITORING OF WATER FOR FISH CULTURE IN KHOP TAAL, DISTRICT CHHATARPUR (MP)

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ABSTRACT

Good water quality is very essential for survival of aquatic organisms. The best possible fish production is entirely dependent on the physical, chemical & biological conditions of water to the most extent. Therefore, successful pond management is required to consider good water quality. Water quality is determined by variables like turbidity, temperature, DO, COD, transparency, TDS, pH, alkalinity, nitrate, BOD, Phosphates and microphytes population etc. as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals.

The present study was carried out in the Khop taal for the assessment of fish diversity, macrophytes and microphytes in relation to water quality of the pond. At present, water to Chhatarpur town is being supplied mainly from Khop taal Tank which is managed by Public Health Department and Nagar Palika Parishad. The relationship analysis between two variables fish species and water quality parameters was carried out through Canonical Correspondence Analysis. CCA biplot indicates that the fish species as Puntius sarana, Hypophthalmichthys molitrix, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, C. striatus and C. ranga show positive correlation with the water quality parameters like Nitrates, BOD, DO, pH, turbidity and phosphates and the negative correlation with water temperature. However the fish species Chanda ranga, Puntius chola, Cyprinus carpio, Notoptrus notopterus and Channa marulius show negative correlation with Nitrates, Phosphates BOD and turbidity.

***Keywords**: Physico-Chemical & Biological, Water quality, Production of fish, Macrophytes, Microphytes etc.*

INTRODUCTION

Water is the precious gift of Mother Nature to earth, which is abundant available on the planet of earth. Water is the most utilized natural resources in our daily life after the oxygen. Human beings are using water resources to fulfill their needs. The quality of water is vital factors to maintain the biodiversity of aquatic ecosystem and main component in the evolution of universe. The ponds are significant habitat of water for domestic uses and have developed for inland fishes. The pond in an ecological point of sources and pond fishes play a helpful role in the socio-economic importance of the country. The fish diversity is fundamental requirement for stabilization of ecological unit, protection of environmental feature for considerate intrinsic significance of all species on the earth.

Aquatic organism's life directly or indirectly depends on the water quality of ecosystem. Millions of the years ago the origin of aquatic species was reported and its biodiversity is rich and harbors diversity of flora & fauna from primary producer to tertiary consumers including algae, fishes, insects and amphibians. Poor water quality on respect of both physico-chemical & biological also lead to the reduction of number of fishes from the fresh water body.

Aquatic plants play a major role in ecological balance and help in maintaining environmental productivity of the aquatic habitat. Macrophytes are large aquatic visible plants with their vegetative reproductive part growing periodically or permanently. Macrophytes are especially sensitive to water pollution and used as bio-indicator of water quality. Macrophytes are essential food source used for aquatic invertebrates; they are also efficient heavy metals accumulator of the water ecological unit (Devlin, 1967). Biological organisms especially flora & fauna are long term bio-indicators of environmental quality for aquatic ecosystem which is more helpful than substance process for detecting non-point pollution source. Macrophyte is one of the clues for the improvement of aquatic biodiversity, which enables to identify interactions and understand the pattern of changes in the regional species pool. Aquatic submerged plants develop low bottom sediments and low sunlight environments of which negatively effects of growth in plants (Scheffer, 1998; Chambers and Kalff, 1985). Macrophytes help to stabilize underwater slopes, anchor soft sediments and remove nutrients and suspended particles (Madsen *et.al.,* 2001; Doyle, 2000; Barko *et.al.,* 1986).

Microphytes are found in aquatic ecosystems which cannot be seen by eye. They are unicellular species that exist individually or in chain or groups. Plant communities that are attached to the stones are called periphytons microphytes and it may be joined by bacterial and protozoans like amoeba. Small suspended organism in the pelagic zone of water bodies of primary producers is known as phytoplankton (microphytes) similarly, a large organism observed in littoral zone is called hydromacrophytes.

Fishes are important food resources and invariable living organisms of aquatic system as well as it is also a good quality of indicator for ecological health in water body. Fishes contribute approx. 21,723 living species out of 39, 900 genera of the vertebrates are recorded i.e. half of the vertebrates species in the world (Jayaram, 1991). Currently approx. 2,200 fish variety are known to human out of which nearly 40% are found in fresh water and inland water habitats. In India 20 orders, 100 families and 300 genera of fishes are distributed in freshwater ecosystem (Daniels, 2000).

MATERIALS AND METHODS

Chhatarpur district located at latitudes 24º06' to 25º20' N and longitude 78º59' to 80º26' E on the North-East border of Madhya Pradesh and height above mean sea level 387 above mean sea level – 369 (AMSL). The district surrounded by Uttar Pradesh, East side by Mahoba and west in Tikamgarh and Sagar (M.P.) in South East. Water quality parameters were analyzed in the laboratory as per standard methods (APHA, 2005). The water quality parameters such as water temperature, transparency, electrical conductivity, turbidity, pH, TDS, Dissolve oxygen (DO), Biological Oxygen Demand (COD), Chemical Oxygen Demand (COD), alkalinity, phosphate and nitrate was estimated seasonally to assess the pollution level of water body. In the most cases the specimen was collected with the help of different kinds of fish catching appliances and devices identified up to genus level with the help of available standard books and monographs (Srivastava, 1968; Gupta and Gupta, 2006; Talwar and Jhingran, 1992; Day, 1989 and Jayaram, 2010). The relationship analysis between abiotic and biotic variables was carried out through Canonical Correspondence Analysis.

RESULTS AND DISCUSSION

The physico-chemical attributes of Khop taal water have been analyzed in the present work and the annual deviation is mentioned in table 1 & 2.

PHYTOPLANKTONS

Phytoplanktons are the diverse species assemblage of algal groups (Sandgren, 1988). Structure and composition of the phytoplankton community may be determined through the colonization, speciation,

predation, competition and such environmental conditions as light availability, temperature, nutrient conditions, and meteorological condition in any aquatic ecosystem (Chalar, 2009). It plays key role as a water pollution indicator. Total 21 species were identified belonging to 18 families and 8 classes during June, 2016 to May, 2018. Among all the identified phytoplankton, Bacillariophyceae and Chlorophyceae classes were represented the highest number of 6 genera, Cyanophyceae (3 genera) Zygnematophyceae (2 genera), Ulvophyceae (1 genus), Hormogoneae (1 genus), Euglenophyceae (1genus) and Trebouxiophyceae (1 genus).

Identified 21 species of phytoplanktons viz. *Navicula gracilis, Frustulia, Diadesmis, Stauroneis phoenicenteron, Pinnularia nobilis, Nitzschia palea, Oscillatoria limosa, Oscillatoria tenuis, Lyngbya digueti, Oedogonium suecicum, volvox aureus, pediastrum simplex, Pediastrum tetras, Scenedesmus quadricauda, Chlamydomonas reinhardi, Spirogyra condensata, Closterium moniliferum, Ulothrix aequalis, Anabaena planctonica, Euglena gracilis* and *Chlorella pyrenoidosa* belonging to eight classes are Bacillariophyceae, Cyanophyceae, Chlorophyceae, Zygnematophyceae, Ulvophyceae, Hormogoneae, Euglenophyceae and Trebouxiophyceae recorded from the sampling sites. Bacillariophyceae and Chlorophyceae recorded the highest 28.57% with six species, class Cynophyceae recorded in 14.29% with three species and lowest four classes namely Ulvophyceae, Hormogoneae, Euglenophyceae and Trebouxiophyceae were identified with single species contributed 4.76% .

Phytoplanktonic families' perencetage contributions in different taxonomic divisions and species perencetage contribution in different phytoplanktons classes are graphically represented in figure 1.

ZOOPLANKTONS

Zooplanktons are the aquatic organisms that consume phytoplankton & small fishes i.e. planktivorus and micro-invertebrates, which are producer, trapped sun light and produce food with the help of atmospheric CO2. Zooplanktons are the organisms that convert phytoplankton into foods, fish existence, determining the population densities and understanding the life process of aquatic ecosystem as well as trophic link between primary producer and secondary trophic level in the ecosystem.

Zooplanktons community in the ecosystem depends on various environmental factors like physical, chemical as well as biological attributes. It can be determined as free floating microscopic animals as protozoa, copepods and rotifer etc. in the aquatic ecosystem. There were 13 species identified belonging to 8 classes during June, 2016 to May, 2018 at Khop taal. Among all the identified zooplankton, Maxillopoda class was represented highest number with three genera, Branchiopoda (two genera), Monogononta (two genera), Oligohymenophorea (two genera), Tubulinea (one genus), Hexanauplia (one genus) Crustacea (one genus) and Eurotatoria (one genus).

Identified zooplanktons species are *Diaptomus, Calanoid copepoda, Cyclops bicuspidatus, Ceriodaphnia dubia, Bosmina longirostri, Brachionus sp, Keretella, Vorticella campanula, Paramoecium, Arcella dentate, Copepod, Daphnia sp and Cephalodella sp belonging from eight classes as Maxillopoda, Branchiopoda, Monogononta, Oligohymenophorea, Tubulinea, Hexanauplia, Crustacea and Eurotatoria observed from all sampling sites. The Class wise i*dentified zooplanktons species are mentioned in Fig. 2 as follows:

The maximum zooplanktons was 23.08% Maxillopoda *followed by 15.38% & 7.60%*, Branchiopoda, Monogononta, Oligohymenophorea, Tubulinea, Hexanauplia, Crustacea *and* Eurotatoria *respectively.*

MACROPHYTES

Macrophytes are the large photosynthetic plants (aquatic weeds) visible to naked eye, which are

growing with roots in water as well as soil and having vegetative parts periodically or permanently. Macrophytes are the secondary producer in the aquatic ecosystem. Macrophytes help in nutrient cycling, maintaining water quality and river bank stabilization. The ponds having moderate nutrient loading increase the proportion of macrophyte's biomass and after that fill the entire water body. Macrophytes disappearance in the ponds can lead the major changes in the lake ecosystem. It also helps in the determination of physiology of aquatic ecosystem. Macrophytes are observed growing in the ponds with high nutrient loads. Macrophytes constitute more diverse group as submerged, floating unattached, floating attached, emergent plants etc. with considerable economical as well as ecological significance in ecosystem (Vyas et.al., 2012). Identification of macrophytes was done in each quadrat at every sampling site seasonally during the sampling (Table 3).

FISH DIVERSITY

In the present scenario it is a big issue of habitat management to monitor the change detection before and after change occurred in the fishes (Dudgeon et.al., 2006). Fishes are widely used as a bio indicator to evaluate the level of degradation, level of water pollution, nutrient loading and health condition of water body. Sampling site wise occurrence of fish species diversity and their classification & identification is represented in table 4. In this study during June 2016 to May, 2018, a total of 31 species representing 22 genera, 11 families and 7 orders of the fishes were collected from the defined sampling stations at Khop taal, Chhatarpur. Four families were recorded widely distributed and common in each sampling sites; Cyprinidae, Siluridae, Ophiocephalidae and Centropomidae.

The family Cyprinidae, of whom 16 species dominate in all the sites, was representing around 52% of the fish fauna. Order Cypriniformes consists of 20 genera (65%) under one family 55% representing the highest contribution and lowest percentage was found Symbranghiformes, Anabantiformes and Clupiformes with one genus (4%) each in this period. The highest 20 species (65%) was found under the genus Cypriniformes). However fig. 3 representing the percentage composition of genera and species in identified fish family. Family Cyprinidae consists of 10 genera (45%), family Siluridae and Centropomidae showing 9% each contribution of genera and other family was observed with 4 and 5 % each. However, family Cyprinidae consisting of 52% species i.e. the highest contribution and lowest 3% was obeserved by the five families; Heteropneustidae, Clariidae, Nandidae, Amphipnoidae and Anabantidae.

The relationship analysis between two variables fish species and water quality parameters was carried out through Canonical Correspondence Analysis.

The turbidity values estimated in this study in water is mainly caused by sand, silt, clay, phytoplankton, microorganisms or organic material suspended or dissolved in it. Turbidity indicated that the fish species as *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda ranga* were positively correlation. Turbidity is negatively correlated with fish species *Chanda ranga, Puntius chola, Cyprinus carpio, Notoptrus notopterus* and *Channa marulius*.

pH:

pH affects the metabolism and other physiological processes of culture organisms. It can create stress, enhance the susceptibility to disease, lower the production levels and cause poor growth and even death. Signs of sub-optimal pH are besides others increased mucus on the gill surfaces of fish, unusual swimming behavior, fin fray, harm to the eye lens as well as poor phytoplankton and zooplankton growth. Optimal pH levels in the pond should be in the range pH was observed from 6.9 – 8.9. pH indicate that the Positive correlation with fish species as *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius,*

Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus and *Chanda ranga.*

Dissolved Oxygen

Maintaining good levels of DO in the water is essential for successful production since oxygen (O_2) has a direct influence on feed intake, disease resistance and metabolism. A sub-optimal level is very stressful for fish and shrimp. DO indicate that the Positive correlation with fish species as *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda ranga.*

Biochemical oxygen demand

Biochemical oxygen demand of the pond can affect the oxygen cycle and thus, the oxygen balance. The BOD of pond aquaculture effluents usually ranges from 5 to 20 mg/l. The greater the BOD, the more rapidly oxygen is depleted during present work BOD showed positively with fishes are *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda ranga.* BOD is showed negatively correlated with fish species *Chanda ranga, Puntius chola, Cyprinus carpio, Notoptrus notopterus* and *Channa marulius*.

Temperature

Temperature affects fish and shrimp metabolism, feeding rates and the degree of ammonia toxicity. Temperature also has a direct impact on biota respiration (O_2 consumption) rates and influences the solubility of O_2 (warmer water holds less O_2 than cooler water). Temperature cannot obviously be controlled in a pond. Aquatic animals modify their body temperature to the environment and are sensitive to rapid temperature variations. For each species, there is a range of temperature conditions. It is therefore important to adapt fish and shrimp progressively when transferring them from tank to pond. During present work temperature showed are negative correlation with fishes are *Puntius sarana, Hypopshalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda ranga.*

Chemical Oxygen Demand

COD test is helpful in determining the present of toxins and biological resistant organic substance in water. COD does not different the stable organic matter from unstable form, hence the COD values are not directly comparable to that of BOD values, in general COD values is more than the BOD values.

Nitrate

Important source of nitrate is biological oxidation of organic nitrogenous matters. During present work nitrate showed positively with fishes are *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda rang* and negatively correlated are showed nitrate with fish species *Chanda ranga, Puntius chola, Cyprinus carpio, Notoptrus notopterus* and *Channa marulius*.

Phosphate

Phosphate content of natural fresh water is low. It is also formed during certain biological process of transformation of organic substances to inorganic phosphate. Phosphate once being introduced in to aquatic habitat it have been continually recycled between algae, aquatic plants and biotic factors. Phosphate indicate that the positively correlated with fish species as *Puntius sarana, Hypopthalmic molitric, Rasbora daniconius, Ctenopharyngodon idella, Clarias batrachus, Channa punctatus, Channa striatus* and *Chanda ranga.* Phosphates are showed negatively correlated with fish species *Chanda ranga, Puntius chola, Cyprinus carpio, Notoptrus notopterus* and *Channa marulius.*

Abbreviations: -***Water quality Parameters:*** - WT- Water Temperature, T- Turbidity, N- Nitrogen, P- Phosphorus, DO and BOD. ***Fish Species*:-**P1- *Catla catla*, P2- *Cirrhinus mrigala*, P3- *Labeo bata*, P4- *Labeo calbasu*, P5- *Labeo gonius*, P6- *Labeo rohita*, P7- *Rohtee cotio*, P8- *Puntius sarana*, P9- *Puntius sophore*, P10- *Puntius ticto*, P11- *Puntius chola*, P12- *Rasbora daniconius*, P13- *Ctenopharyngodon idella*, P14- *Cyprinus carpio*, P15- *Hypophthalmic molitrix*, P16- *Notoptrus notopterus*, P17- *Oxygaster bacaila*, P18- *Ompok biamaculatus*, P19- *Wallago attu*, P20- *Heteropneustus fossilis*, P21- *Clarias batrachus*, P22- *Channa marulius*, P23- *Channa punctatus*, P24- *Channa striatus*, P25- *Ambassis nama*, P26- *Chanda ranga*, P27- *Nandus nandus*, P28- *Mastacembelus armatus*, P29- *Mastacembelus puncalus*, P30- *Amphipnous cuchia* and P31- *Anabas testudineus*.

CONCLUSION

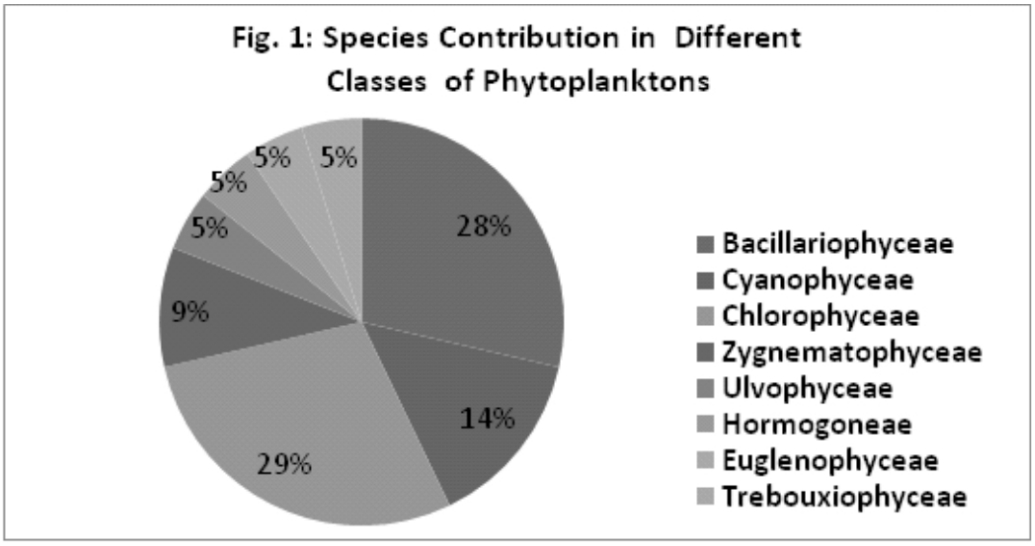
Careful monitoring of water quality parameters is important to understand the interactions between parameters and effects on microphytes, phytoplankton, macrophytes and fish feeding, their growth and health. Each water parameter alone may not tell much, but several parameters together can reveal dynamic processes taking place in the pond. Water quality records will allow farmers to note changes and make decisions fast so that corretive actions can be taken quickly.

Table 1: Annual mean Deviation in Physico-chemical attributes of Khop taal during 2016-17

Parameters	Mean	SD Error	Min.	Max.
Transparency	[illegible]	4.60E+00	115.67	140
Water Temperature	26.97±0.93	4.20E-01	25.67	27.83
Turbidity	30.67±3.886	1.70E+00	26.67	36
Electrical Conductivity	7.53±0.157	7.00E-02	7.37	7.73
TDS	273.73±4.89	2.20E+00	266.33	280
pH	6.28±0.717	3.20E-01	5.4	7.07
Dissolved Oxygen	3.29±0.29	1.30E-01	2.83	3.6
BOD	94.12±4.91	2.20E+00	88.73	102
COD	242.47±17.45	7.80E+00	221.67	261.33
Total Alkalinity	520.6±64.412	2.90E+01	451	589
Nitrates	27.78±3.838	1.70E+00	22.8	32.57
Phosphate	1.48±0.38	1.70E-01	1.15	2.14

Table 2: Annual mean Deviation in Physico-chemical attriutes of Khop taal during 2017-18

Parameters	Mean	SD Error	Min.	Max.
Transparency	130.87±11.233	5.00E+00	117.33	146
Water Temperature	26.07±0.329	1.50E-01	25.53	26.33
Turbidity	31.15±1.144	5.10E-01	29.33	32.17
Electrical Conductivity	7.61±0.13	5.90E-02	7.3967	7.73
TDS	365.93±26.737	1.50E+00	11.08	19.26
pH	3.53±0.304	2.20E+00	14.89	25.91
Dissolved Oxygen	3.72±0.5	1.30E+00	16.75	24.8
BOD	94.82±3.638	1.50E+00	11.29	19.37
COD	206.43±23.272	1.50E+00	12.46	20.49
Total Alkalinity	540.96±73.511	2.00E+00	13.01	23.73
Nitrates	25.42±4.511	1.40E+00	14.89	21.49
Phosphate	1.8±0.267	1.60E+00	12.68	21.42



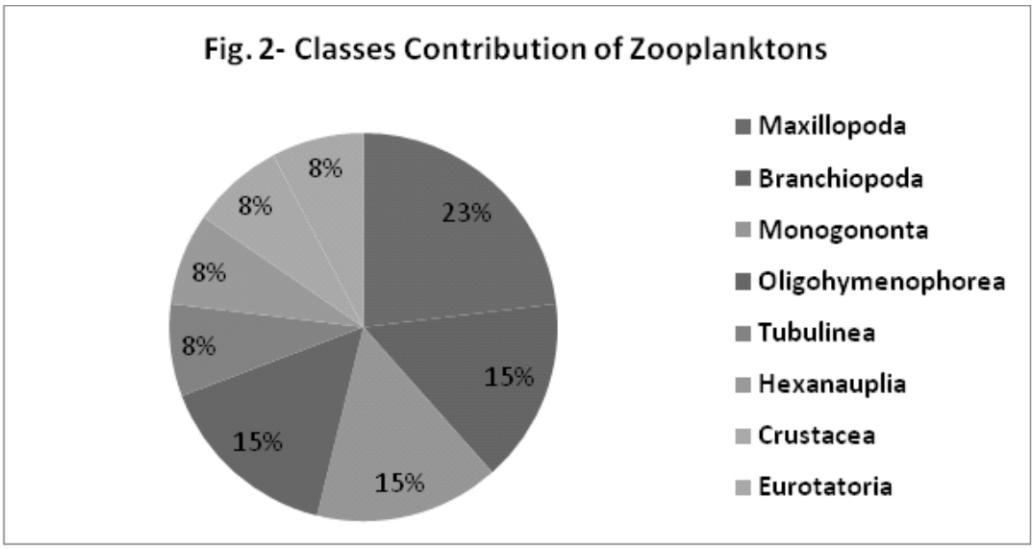
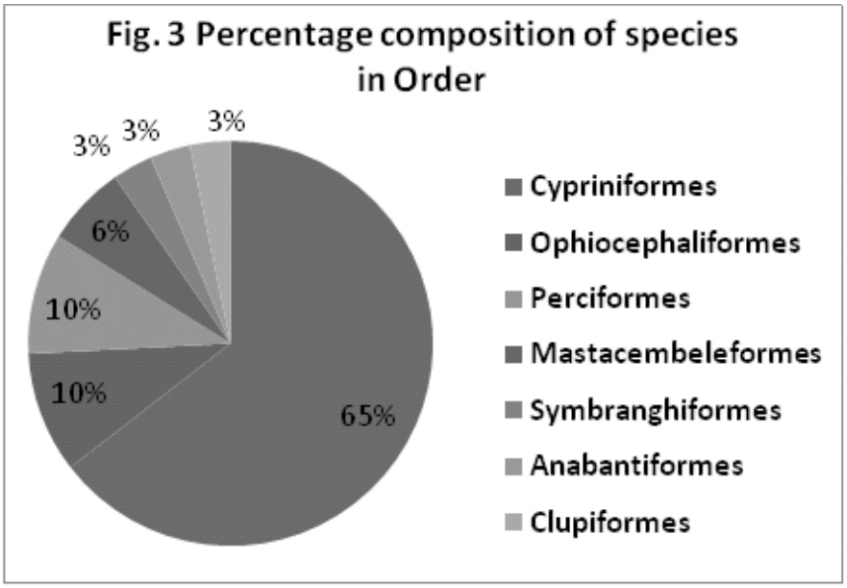


Table 3: Occurrence of Macrophytes in Khop taal at Chhatarpur

Sl. N0.	Scientific Name	Family	Common name	Habitat
1	***Cyperus rotundus***	Cyperaceae	Nut grass, Java grass	Emergent anchored
2	***Spirodela polyrhiza***	Araceae	Duckweed	Floating
3	***Alocasia macrorrhizas***	Araceae	Giant alocasia	Emergent anchored
4	***Pistia sratiotes***	Araceae	Water cabbage	Floating
5	***Ceratophyllum demersum***	Ceratophyllaceae	Hernwart	Submerged
6	***Trapa bispinosa***	Lythraceae	Singhada	Floating leaved anchored
7	***Ipomoea aquatica***	Convolvulaceae	NariBhazi,Kalmi Sage, Water Morning glory	Floating leaved anchored
8	***Ipomoea carnea***	Convolvulaceae	Besharam, Pink morning glory	Emergent anchored
9	***Persicaria glabra***	Polygonaceae	Patharlea	Floating laved anchored
10	***Persicaria barbata***	Polygonaceae	Bon-Ghehy, Water milk wort	Floating laved anchored
11	***Nymphaea pubescens***	Nymphaceae	Kumda, Pink water lily	Floating laved anchored
12	***Nelumbo nucifera***	Nymphaceae	Kamal, Lotus	Floating laved anchored
13	***Nymphoides indica***	Nymphaceae	Waterlily	Floating laved anchored
14	***Azolla pinnata***	Salviniaceae	Masquito fern, Water fern	Floating
15	***Digitaria sanguinalis***	Poaceae	Large crabgrass	Emergent anchored
16	***Hygroryza aristata***	Poaceae	Niwar	Emergent anchored
17	***Panicum repens***	Poaceae	Torpedograss	Floating anchored
18	***Typha angustifolia***	Typhaceae	Cat Tail , Mothitrina	Emergent anchored
19	***Alternanthera philoxeroides***	Amaranthaceae	Alligator weed	Floating laved anchored
20	***Phyla nodiflora***	Verbenaceae	Jalbuti	Emergent anchored
21	***Hydrilla verticillata***	Hydrocharitaceae	Hydrilla	Submerged anchored

Table-4: Fish species in Khop taal

Zoological name	Common Name	Family
Ctenopharyngodon idella	Grass Carp	Cyprinidae
Cyprinus carpio	Common Carp	Cyprinidae
Hypophthalmichthys molitrix	Silver Carp	Cyprinidae
Oxygaster bacaila (Ham)	Chalhawa	Cyprinidae
Catla catla (Ham)	Catla	Cyprinidae
Cirrhinus mrigala (Ham)	Nain	Cyprinidae
Labeo bata (Ham)	Bata	Cyprinidae
Labeo calbasu (Ham)	Karaunt	Cyprinidae
Labeo gonius (Ham)	Khursa	Cyprinidae
Labeo rohita (Ham)	Rohu	Cyprinidae
Rohtee/ Osteobrama cotio (Ham)	Gurda	Cyprinidae
Puntius sarana (Ham)	Putiyah	Cyprinidae
Puntius ticto (Ham)	Khabdi	Cyprinidae
Puntius sophore (Ham)	Khadiyah/Puti	Cyprinidae
Puntius chola (Ham)	Sidhri/Putiyah	Cyprinidae
Rasbora daniconius (Ham)	Anjra	Cyprinidae
Ompok bimaculatus (Blo)	Pabda	Siluridae
Wallaga attu (Blo)	Padhin	Siluridae
Heteropneustes fossilis (Blo)	Singhi	Heteropneustidae
Clarias batrachus (Lin)	Magur	Clariidae
Channa marulius (Ham)	Saur	Ophiocephalidae
Channa punctatus (Ham)	Sauri/Girai	Ophiocephalidae
Channa striatus (Ham)	Kuddha/Saur	Ophiocephalidae
Ambassis nama (Day)	Chanari	Centropomidae
Chanda/Ambassis ranga (Ham)	Chanari	Centropomidae
Mastacembelus armatus (Lac)	Bam	Mastacembelidae
Mastacembelus pancalus (Ham)	Bam	Mastacembelidae
Amphipnous cuchia (Ham)	Bam	Amphipnoidae
Nandus nandus (Ham)	Chamariya	Nandidae
Notopterus notopterus (Pal)	Patola	Notopteridae
Anabas testudineus (Blo)	Kabai/Jalebi	Anabantidae



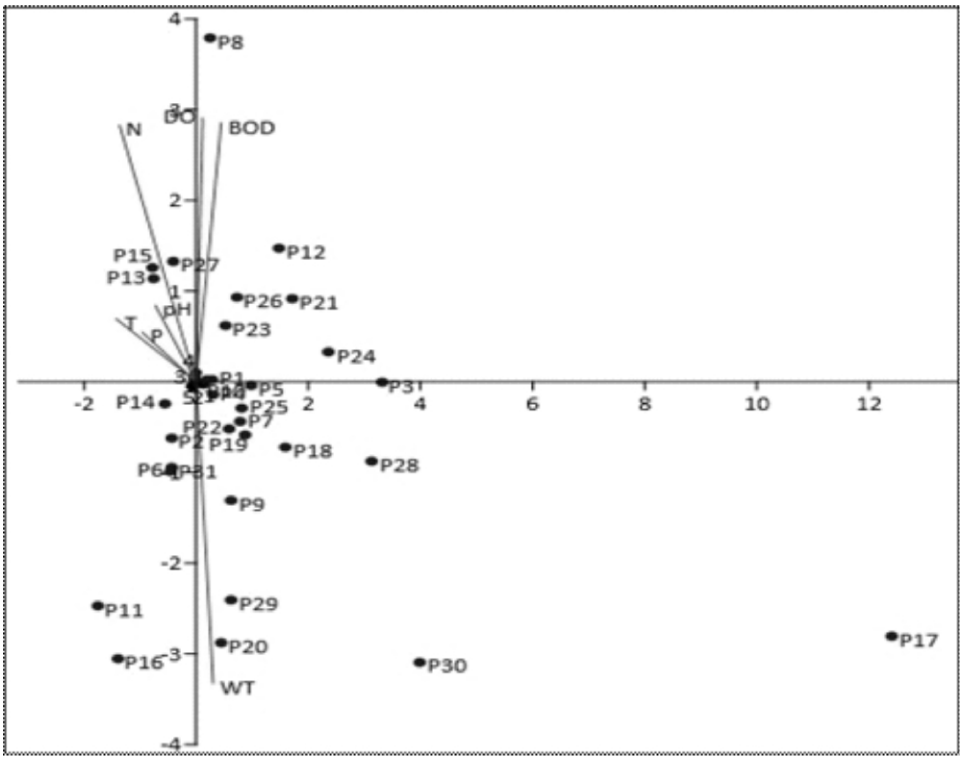


Fig.4: Canonical Correspondence Analysis (CCA) showing the relationship between Water Quality Parameters and fish Species.

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