Aquatic Biodiversity Documentation and Suggesting Measures for their Conservation in Rivers and Ponds of MP

Final Report

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CONTENTS

List of tables

List of figures

List of photographs

List of maps

1. Background and present status

As identified by **Convention on Biological Diversity** (Anon 2003), data and information is needed on the following issues at global as well as local level to protect Freshwater Biodiversity.

- Habitat Inventory and Indicators of Condition and Change
- Species Information
- Water Resource Information
- Socio-Economic data

According to the report of CBD entitled "Status and Trends of Biodiversity of Inland Water Ecosystems" (Technical Series no. 11) in absence of this information and data, proper planning of freshwater biodiversity conservation can not be done.

In the backdrop of this gap in information, it essential to assess the situation of aquatic biodiversity in Madhya Pradesh region

Madhya Pradesh is rich in aquatic resources. Entire state drain in to four major river system of India, mainly Ganga, Narmada, Tapti and Godawari. Major portion of the state fall under Ganga River system and Chambal, Parvati, Kalisindh Betwa, Ken and Dhasan are main rivers of the region. Narmada and Tapti are two west flowing river system and southern part of the state drains in to Godawari system through Pench and Wainganga rivers.

These aquatic resources give support to a rich aquatic biodiversity. Unfortunately systematic study of aquatic biodiversity has been neglected in the state for decades and the information on these aspects are either very old or not available in the most of the cases.

Studies of fish biodiversity dates back to 1941 when Hora and Nair first reported forty one species of fishes in hill stream of Satpura ranges, which are part of the Narmada river system. First detailed survey of the river was conducted by CICFRI, Barackpore between 1958-66 and recorded 77 species of fishes. Fisheries department of MP conducted another survey in 1967-71 and 46 fish species were recorded. Almost after two decades another survey was conducted in the Western Zone of the river by Rao (1991) and recorded 84 species. Recently Vyas (2006) has reported 47 species of fishes in the 22 km stretch of the central Narmada Covering 9 protected area under a study commissioned by MP State Biodiversity Board.

Tapti river is west flowing river originates from Southern M.P. and enters Maharashtra. Fish faunal survey of this river was first conducted by Karamchandani and Pisolkar (1967) and reported 52 species in Tapti. Under All India Coordinated Project a survey

was conducted in 1977 and 27 species were recorded from this river. Nimbalkar (1974, Unpublished data) recorded 20 species in the river after construction of Ukai Dam in Maharashtra.

Chambal river, which also has its origin in Madhya Pradesh, was first surveyed by Dubey and Mehra (1959) before construction of Gandhi Sagar dam and recorded 71 species of fishes from this stretch of the river. In 1977 Dubey and Chatterjee again surveyed the important river and recoded 41 species of fishes. Kartha and Rao (1992) also recoded 41 species of fishes in Ganghi Sagar reservoir.

Betwa is also major river of MP drains in to Ganga basin. Pertinent literature indicates that 55 species were recorded from Betwa River by Adholia (1977). No other record on this river is available till date after this study. However fish biodiversity of impoundments in Betwa basin has been subject to interesting studies. Halali reservoir in Vidisha District harbours plenty of ***Notopterus chitala*** in commercial catch, which has been declared critically endangered fish in other rivers of the state. The reservoir catch is also dominated by cat fishes mainly *Mystus* sp. Similarly the fishery of Upper Lake also depended on cat fish as they dominated commercial catch. Ratapani reservoir, which is now a part of Ratapani wildlife Sanctuary, has been a productive reservoir and Mahseer population has been main feature of this reservoir

Southern and southeastern part of the state consisting partly Betul Chhindwada Seoni and Balaghat districts form northern watershed of Godawari river system. Pench and Wainganga area main river of this region. Totladoh reservoir constructed of Pench river was once known for its Mahseer fishery apart from its commercial fisheries. After notification of Pench Tiger reserve fishing has been prohibited in this reservoir. It can be assumed that this reservoir may have well protected gene pool but this aspect has not been studied till now. Wainganga river in the region is known for its fresh water prawn population. *Macrobrachhium sp.* Overexploitation of Prawn and disruption of breeding cycle has resulted in reduced population of this commercially important fresh water arthropod.

2. Information Gaps

On the basis of above observations it can be concluded that

- Information of aquatic biodiversity is very old and not been updated for decade
- Information is scattered in reports, research papers and thesis
- Related socio-economic and other secondary information is lacking can not be collated on a single platform to draw up any conservation action plan.

3. Objective

It is therefore proposed to conducted a study with the following objectives

- To document current biodiversity profile in the water bodies of MP.
- To collect available records of fish biodiversity with current biodiversity profile.
- To assess the role of fishery resources in livelihood.
- To address the factors adversely affecting aquatic biodiversity including threats to dolphins and crocodile by fishing nets and to give necessary recommendations to mitigate this threat.
- To integrate all the information as geospatial scale using GIS.
- To prepare a management plan for conservation of endangered species.

4. Study area

Madhya Pradesh has been divided in to 6 ecoregions from biodiversity point of view. **Malwa Ecoregion** covers western part of M.P. Major Waterbodies of Malwa ecoregion are

- Chambal River
- Kshipra River
- Mahi River
- Kalisindh River

This ecoregion also harbour several reservoirs. **Gandhisagar** is the largest reservoir in this region and its fisheries is a major sources livelihood for number of fisherman families. **Gambhir and Undasa** in Ujjain district are important reservoir from irrigation water supply and fisheries aspects. Seasonal reservoir of Rajgarh districts are also rich

sources of fish fauna for livelihood of fisherman families. **Kalisindh** river is small tributary of **Chamba**l River and dry-up in summer months. Fish fauna gets refuge in pools found in mid river courses.

For the present study we identified **Chambal** river as major river from Malwa ecoregion as it represent almost all rivers of this region and a series of reservoir is present in this river in MP and Rajasthan having direct impart on its biodiversity

Seasonal reservoir of Rajgarh districts will also be taken during the study

Chambal ecoregion will also be represented by **Chambal** river. **Kalisindh, Parvati** and **Kunwari** are also important rivers in this area. As far as reservoirs are concerned **Matatila, Harsi, Tigara, Motijheel and Pagara** are main reservoirs. For the present study we have identified **Chambal river** and **Pagara** reservoir. This reservoir is reported to have abundance of catfish population.

In **Central Ecoregion**, **Betwa** and **Parvati** are main rivers, **Kaliasot Patra** and **Halali** area small rivers, which join Betwa river in Vidisha District. **Upper lake** of Bhopal **Ratapani**, **Halali** and **Kerwa** area important reservoir in this area. We have identified **Betwa** river because it's proposed to link it Ken River and **Upper Lake** of Bhopal for dominance of cat fishes in commercial catch. Attempts will be made to study **Halali** reservoir, which support *Notopterus chitala* which is declared critically endangered.

In **Satpura Ecoregion Pench** and **Wainganga** area main rivers which drain in to Godawari basin. Some parts of this ecoregion drain in to Narmada through its tributaries like Sher Shaker etc. Narmada river is not being covered under this study we have taken **Wainganga** river for its precious Prawn population. Apart from this **Totladoh** reservoir will also be taken up on account of its notification in Tiger reserve area and commercial fishing prohibited on this reservoir.

Tapti River is another important river in Satpura Ecoregion. These rivers originate from Betul district and flow western through Burhanpur district before entering Maharashtra. This river will also be studied in this project.

Bundhelkahnd Ecoregion Ken and **Dhasan** area two important rivers forming a part of Indo-Gangetic system. **Ken** river is a very important river as it has good population of Mahseer fish. Ken Ghariyal Sanctuary has also been established here which also has

significant contribution in conservation of aquatic biodiversity. We have identified **Ken** River for detailed study in this region

In **Vindhyan Ecoregion Govindgarh** lake has been identified from the present study biodiversity of some river and **Bansagar** will also be studied during the project.

Table 1. Ecoregion of Madhya Pradesh

Ecoregion	**District**	**River/reservoir**
Malwa	Mandsour,Ratlam,Nemach, Ujjain,Dhar,Indore,Dewas, Shajapur,Jhabua and Rajgarh	Chambal and seasonal reservoir of Rajgarh
Chambal	Morena, Gwalior, Datia, Shivpuri, Guna, Bhind, Seopur.	Chambal
Bundhelkahnd	Ticumgarh, Chattarpur, Panna.	Ken river
Vindhyan	Satna, Rewa, Sidhi, Shadol,	Son,Govindgarh lake
Satpura	Hoshangabad,Betul,Khandwa,Khargone, Chhindwada,Narsinghpur,Jabalpur, Mandla,SEoni,Balaghat,Barwani, Dindori,Harda, Katni	Tapti, Wainganga and Pench Rivers
Central	Bhopal,Sehore,Raisen,Sagar,Damoh,Vidisha	Betwa river,Upper lake, Halali Reservoir

Table 2. River and Tributaries of M.P along with reservoir and district wise

River	**District root**	**Tributaries**	**District root**
Chambal	Indore –Dhar–Ujjain-Ratlam–Mandsore–Nimach– Seopur–Murana - Bhind–**U.P.** (Reservoir on Chambal R. -**Gandhi Sagar**)	Shipra	Indore – Dewas – Ujjain - Ratlam - Chambal R.
		Choti Kalisindh	Dewas – Ujjain - Chambal R
		Gambhir (Reservoir on Gambhir R. – Yaswant sagar and Gambhir Dam)	Dewas – Ujjain - Chambal R
		Kalisindh	Dewas – Shajapur – Rajgarh – **Rajasthan** - Chambal R
		Parwan	Rajgarh – **Rajasthan** - Chambal R
		Newaj	Sehore - Shajapur – Rajgarh – **Rajasthan** - Chambal R
		Parwati	Sehore-Bhopal-Rajgarh-Guna-**Rajsthan**- Chambal R

		Ship	Sheopur-Chambal R
		Param	Sheopur-Chambal R
		Kanu	Guna-Shivpuri- **Rajsthan**-Shivpuri- Sheopur- Chambal R.
Ken	Panna –Chattarpur– **U.P.** (Reservoir on Ken R– **Bariyarpur Dam**)	Sonar	Sagar-Dhamoh-Panna- Ken R.
		Urmal	Chhatarpur- Ken R.
		Kutni	Chhatarpur- Ken R.
		Shyamri	Chhatarpur- Ken R.
		Mirhasan	Panna- Ken R.
Sone	Shadol–Sidhi-**U.P.** (Reservoir on Sone R– **Ban sagar**)	Banas	Shahdol-Sone R.
		Johil	Shahdol-Sone R.
		Mahanadi	Jabalpur- Sone R.
		Tipan	Shahdol-Sone R.
		Keani	Shahdol-Sone R.
		Kanak	Shahdol-Sone R.
		Gopat	Shidhi- Sone R.
Narmada	Dindori –Mandla– Jabalpur– Narsinghpur– Hoshangabad–Sehore-Harda–Dewas– khandwa – Khargone– Dhar– Barwani– Jhabua-**Gujrat** **(**Reservoir on Narmada R**. - Bargi, Indira sagar, Omkareshawar, Sardar sarivar)**	Silgi	Mandla -Narmada R.
		Burhaner	Mandla -Narmada R.
		Banjer	Balaghat-Mandla -Narmada R.
		Temar	Sivni-Jabalpur- Narmada R.
		Gaur	Mandla –Jabalpur-Narmada R.
		Hiran	Jabalpur- Narmada R.
		Sher	Sivni- Narsinghpur- Narmada R.
		Shakkar	Chhindwada- Narsinghpur-Narmada R
		Dudhi	Chhindwada- Hoshangabad-Narmada R
		Tendoni	Raisen- Narmada R
		Tawa (Reservoir on Tawa R.-**Tawa reservoir**)	Betul- Hoshangabad- Narmada R
		Barna (Reservoir on Barna R.-**Barna reservoir**)	Raisen- Narmada R
		Kolar (Reservoir on Kolar R.-**Kolar reservoir**)	Sehore- Narmada R
		Chandrashawar	Dewas- Narmada R
		Chhota tawa	Burhanpur-Khandawa-Narmada R
		Kanar	Indore-Dewas -Narmada R

		Kunda	Khargone-Dhar- Narmada R
		Moi	Khargone - Narmada R
		Hatni	Jhabua- Narmada R
		Kharner	Dhindhori- Narmada R
		Hather	Hoshangabad -Narmada R
		Ganjal	Harda- Narmada R
		Ajnal	Harda- Narmada R
		Machak	Harda- Khandwa-Narmada R
		Kaveri	Khandawa- Narmada R
		Kharkia	Khargone- Narmada R
		Khari	Indore- Narmada R.
		Deb	Barwani- Narmada R.
		Man	Dhar- Narmada R.
		Goi	Barwani- Narmada R.
		Uri	Dhar- Narmada R.
Tapti	Betul – Burhanpur – **Maharashtra** (Reservoir on Tapti R.- **Chhanora Dam**)	Purna	Betul- Tapti R.
		Mona	Burhanpur - Tapti R.
		Aner	Khargone-**Maharashtra-**Tapti R**.**
		Gonai	Khargone-**Maharashtra-**Tapti R**.**
Betwa	Raisen – Vidisha – Sagar - Guna – Shivpuri – **U.P.**	Godar	Raisen- Betwa R.
		Kaliyasot (Reservoir on Kaliyasot R.- **Kaliyasot reservoir**)	Bhopal-Raisen- Betwa R
		Ajnar	Bhopal-Raisen- Betwa R
		Halali (Reservoir on Halali R.-**Halali reservoir**)	Bhopal-Vidisha- Betwa R
		Base	Vidisha- Betwa R
		Bina	Raisen-Sagar-Vidisha- Betwa R
		Baha	Vidisha- Betwa R
		Sagar	Vidisha- Betwa R
		Naren	Vidisha- Betwa R
		Parasari	Vidisha- Betwa R
		Newan	Vidisha- Betwa R
		Kethan	Guna- Betwa R
		Ore	Guna- Betwa R

4.1 Description of different river basins of Madhya Predesh

4.1.1. Betwa River Basin

The Betwa or Vetrawati is a river of great antiquity and immense mythological and religious values for the people of the Malwa region of Madhya Pradesh for hundreds of years. This third largest river of the Malwa region is not only important from the geo ecological point of view but also has a significantly potent socio- economic impact on the area through which it flows. Viewing from another angle, Betwa is an, Betwa is an important tributary of the Yamuna which in turn is a tributary of the river Ganga. This makes the Betwa as an important river of sacred gangetic river system. The River Betwa rises from the main Vindhyan range in the extreme south west of the Raisen district at Jhirri village. It flows for an estimated total length of 573 kms of which 216 kms in Madhya Pradesh and 98 kms. in Uttar Pradesh & finally joins the river Yamuna at Hamirpur in Uttar Pradesh. The river has a huge catchments area of around 46580 sq.k.m. During the course of its flow Betwa receives 14 tributaries of which as many as 11 are located in the Madhya Pradesh. After a course of 96 kms. From Jhirri it enters Vidisha district and flows in it for a course of about 112 kms. The important tributaries of the Betwa include Kaliasot, Godal, Baha, Newon, Parasari, Sagar, Naren, Kaithan, Bina, Jamni and Ore river. Among these, Baha, Newon, Kaithan and Bina flows in the Vidisha district.

4.1.2. Tapti River Basin

The Tapti River originates in the Betul district from place called Multai of Madhya Pradesh at an elevation of about 760 m. above mean sea level and at latitude 21^0 04’ and longitude 78^0 21' . The river flows for 188 Kms in Betul district of Madhya Pradesh and runs along the common border of Madhya Pradesh and Maharashtra for a length of 58 Kms. At 246 Kms from the source the Tapti River leaves, the border of Maharashtra and Madhya Pradesh, and enters Khandwa district of M.P. and flowing 86 kms, re-enters Maharashtra. The length of Tapti River from its source to sea is about 724 Kms. Out of which it flows through Madhya Pradesh for a length of about 332 kms. & 217 Kms. in

Maharashtra and for about 175 Kms. in Gujarat before joining the Arabian Sea near Surat.

The River Tapti is an inter-state river flowing through Madhya Pradesh, Maharashtra and Gujarat. The total length of the river is 724 Kilometers with drainage area of 64874 Sq. Kms. Out of this 9804 Sq. Kms. Lie in Madhya Pradesh and 51100 Sq. Kms. lie in Maharashtra and 3970 Sq.K.m. in Gujarat. The main tributaries of Tapti River are Mona, Purna, Aner and Gomai in Madhya Pradesh.

4.1.3. Chambal Basin

River Chambal, a principal tributary of river Yamuna, originates in the Vindhyan ranges near Mhow in Indore District of Madhya Pradesh, at an elevation of 354 m, at latitude 22º27’ and longitude 73º20'. The river flows through the states of Madhya Pradesh, Rajasthan and Uttar Pradesh.

The basin is roughly rectangular in shape, with a maximum length of 560 km in a northeast- southwest direction. The river flows for some 320 km in a generally northerly direction before entering a deep gorge in Rajasthan at Chourasigarh, about 96 km upstream of Kota. The deep gorge extends up to Kota and the river then flows for about 226 km in Rajasthan in a north-easterly direction, and then forms the boundary between MP and Rajasthan for about 252 km. Thereafter, the river forms the boundary between MP and UP for about 117 km, enters UP near Charak Nagar village and flows for about 40 km before joining river Yamuna. The main tributaries of river Chambal are Siwana, Chambal are Siwana, Retam, Shipra and Choti Kalisindh in MP, Kalisindh, Parwati, Parwan and Banas in Rajasthan.

4.1.4. Ken Basin

The Ken River has its origin from the Ahirgawan village on the north-west slopes of the Kaimur hills in the Jabalpur district of Madhya Pradesh at an elevation of about 550 meters above mean sea level. The Ken is an interstate river between Uttar Pradesh and Madhya Pradesh. The total length of the river from its origin to confluence with the river Yamuna is 427 km, out of which 292 km lies in Madhya Pradesh, 84 km in Uttar Pradesh and 51 km forms the common boundary between Uttar Pradesh and Madhya Pradesh. The river joins the Yamuna river near village Chilla in Uttar Pradesh at an elevation of about 95 m. The river is the last tributary of Yamuna before the Yamuna joins the Ganga.

The river basin lies between the latitudes of $23^0$12' N and $25^0$54' N and the longitudes of $78^0$30' E and $80^0$36' E. The total catchment area of the basin is 28058 sqkm, out of which 24472 sqkm lies in Madhya Pradesh and the remaining 3586 sqkm in Uttar Pradesh. The basin covers the areas of Jabalpur, Sagar, Damoh, Panna, Satna, Chhatarpur and Raisen districts of Madhya Pradesh and Hamirpur and Banda districts of Uttar Pradesh. It is bounded by Vindhyan range in the south, Betwa basin on west, free catchment of Yamuna below Ken on east, the river Yamuna on north. The important tributaries of Ken are Alona, Bearma, Sonar, Mirhasan, Shyamari, Banne, Kutri, Urmil, Kail and Chandrawal. Out of these, Alona, Bearma, Sonar, Mirhasan and Shyamari join Ken river upstream of the project site. River Banne, on which the Rangawan dam is constructed, joins river Ken between proposed Daudhan dam site and the existing Bariarpur P.U.W., while Kutri, Urmil, Kail and Chandrawal join downstream of Bariarpur P.U.W. Urmil and Kail rivers have part of their catchments in Uttar Pradesh, while river Chandrawal has maximum catchment area in Uttar Pradesh.

4.1.5. Son Basin

Sone River, the main southern tributary of the Ganges is a river of central India. It originates from the Amarkantak hills of Madhya Pradesh at an elevation of about 1127 m. above mean sea level at latitude 22^0 42’ & longitude 81^0 59’ and flows north-west through hills and reaches the Kaimur range, which forms the southern wall of the Gangetic plain (the flood-plain of the Ganges), the river turns east and continues its flow in that direction until it meets with the Ganges near Patna. The Son River at 784 kilometres (487 miles) long, is one of the largest rivers of India. Its chief tributaries in Madhya Pradesh are Juhil, Mahanadi and Banas.

A major reservoir Bansagar has been contructed in the river.Bansagar is a multipurpose river valley project on Son River situated in Ganga Basin in Madhya Pradesh, India envisaging both irrigation and hydroelectric power generation. The Bansagar Dam across Sone River is being constructed at village Deolond in Shahdol district on Rewa – Shahdol road, at a distance of 51.4 km from Rewa. Bansagar Dam is located at Latitude 24^0 11’ 30’’ N and Longitude 81^0 17’ 15’’ E.

4.2. Description of sampling sites in different river basin of Madhya Pradesh

4.2.1. Betwa basin

1. Bhojpur: This station is a pool habitat situated at 23^0 06'15.7''N latitude and 77^0 34'59.1" E longitudes near the Bhojpur temple. The site is an important tourist destination for the people of Bhopal city. Bed is a mixture of sand and clay over the hard rocks. Depth of this zone is about 7.0 meter. Vicinity of the zone is surrounded by hillocks hard rocks.

2. Near Pagneshwar: This station is a run habitat situated at 23^0 26'08.1''N latitude and 77^0 43'.49.3" E longitude on the Risen –Vidisha road in close proximity to the village Pagneshwar. Bed is a mixture of sand and clay over the hard rocks. Depth of this zone is about 3.5 meter. Vicinity of the zone is eroded and emergent macrophytes are found in large numbers on the either shores of the river.

3. Ramghat (Vidisha): This station is a pool habitat situated at 23^0 32' 9.8''N latitude and 77^0 47'45.8" E longitudes in the Vidisha town. This is the deepest pool observed during the course of the study with a depth of 14 meter. The left shore of the river has a ghat on the river with a temple while on the right shore, agricultural fields.

4. Halali reservoir: This station is situated in the Halali reservoir, which are situated at 23^0 29'9.32''N latitude and 77^0 33'11.6" E longitudes near the Vidisha town. The reservoir receives a massive amount of waste water generated in the city of Bhopal through Patra nala and along with the domestic sewage it receives the spill over of the Lower lake old Bhopal as well. This inflow of nutrient rich water makes the reservoir particularly productive one and therefore best suited for fish culture.

5. Upper Lake: the Upper Lake (Latitude 23^0 13'- 23^0 16' N and Longitude 77^0 18'– 77^0 24' E) of Bhopal is one of the most important water bodies of the central part of India, designated as the Ramsar site, making it the water body of global significance. The

highly productive water of the wetland makes it a very conducive environment for the growth of fishes.

4.2.2 Tapti basin

1. Parasdoh: This station is a pool habitat situated near Betul- Atner road situated at 21^0 40'55.9'' N latitude and 77^0 59' 44.2'' E longitudes. The max height of the water column is 11.5 meter, while the bed is of gravel and sand and the vicinity has large rocks.

2. Baralinga: This station is a run situated near Baralinga Shiv Temple on the Betul - Amravati road at 21^0 48'39.4'' N latitude and 77^0 47' 08.8'' E longitude .The bed at this station comprises of large boulders and cobbles. The right bank of the station has agricultural lands in the vicinity while the left bank is predominantly hillocks covered by forest cover. The max depth in the region ranges 2.5 meter. However stream width at this site is one of the maximum observed during the study.

3. Amarkash doh: This station is a pool habitat situated at 21^0 47'98.0'' N latitude and 77^0 25'68.9'' E longitudes near the Kunkhedi village. The bed of the river at this station is sandy and the shore of the river is infested with a high density of submersed weeds. The left bank of the river is hilly while the right bank of the river has agricultural fields in its vicinity and sand mining is also observed at this place. The max depth at this station is 6.0. meter.

4. Tedtali: This station is a run situated at 21^0 29'99.2'' N latitude and 77^0 44' 77.4'' E longitudes near the Tedtali village. The bed of the river is a mixture of clay and sand at this station and infested with weed growth. The max depth at the station 3-4 meter. Both the banks of the river have agricultural land in its vicinity and loose sand cliffs cover the vicinity of the banks of the river at this station.

5. Raitali: This station is a run situated at 21^0 28'05.2'' N latitude and 76^0 42'90.6'' E longitude Near Dhar village. The max depth at this station is 3-4 meter and has the same

conditions in vicinity as the previous station. The sampling reach has a riffle which is of utmost importance for some fish species like mahaseer (*Tor tor*) as this site presents the breeding site for these fish species.

6. Boat Ghat, Nepa Nagar: This station is a run situated at 21^0 25'94.0'' N latitude and 76^0 24'05.8'' E longitudes at Nepa Nagar. Water supplied to the Nepa mills in Nepa Nagar, and the sampling reach receives waste water from the Nepa mill and the township, degrading the water quality evident by the growth of algal blooms and prolific growth of aquatics macrophytes. The max depth of the river at this station is 2 .5 meter.

4.2.3. Chambal basin

1. Nagda: This station is a pool situated at 23^0 27'48.7" N latitude and 75^0 23' 55.0'' E longitudes at Nagda town. The water is present in this region perennially even if the water in the vicinity dries up. The riverbed at this station is hard rock with a max depth of 5.92 meter.

2. Basai village: This station is a pool situated at 24^0 04'32.1'' N latitude and 75^0 31'46.0'' E longitudes near Basai village at Suwarsa, Mandsore road. The site is the upstream of the Gandhisagar Dam and is the fish landing site of MPF. The max depth at this station is around 6.67 meter.

4. Gandhi Sagar: This sampling station is situated at 24^0 41'01.3'' N latitude and $75^0$33'55.8'' E longitudes in Gandhisagar reservoir. This is a irrigation reservoir constructed at the Chambal river on the MP- Rajasthan border. The most developed fisheries practices are observed at this station. The maximum depth at this station 22.5 meter.

5. Kimor ghat (Kshipra river): This station is a run situated at 23^0 13'18.9'' N latitude and 75^0 47' 06.3'' E, longitude near the Mangalnath temple in the historic city of Ujjain. The water at this station is almost stagnated and profuse algal growth at the station

represents the degraded water quality at this station. The max depth at this station is 2.0 meter.

6. Gambhir Dam: This sampling station is situated at the Gambhir reservoir at 23^0 12'32.1'' N latitude and 75^0 38'12.7'' E longitudes. The reservoir has a max depth of 32 mt and is being used as the main source of potable water for the city of Ujjain.

4.2.4. Ken basin

1. Sonar-Ken river confluence: This sampling station is situated near Singora village at 24^0 23'50.3'' N latitude and 79^0 56'18.3'' E longitude, at the confluence of the rivers Sonar and Ken. The shoreline of the station is infested with profuse growth of macrophytes and has a depth of 7-8 mt. The bed of the river at this station is loose silt that has entered as a result of the soil erosion from the adjoining agricultural fields. This is one of the more productive sites for the fishes.

2. Near Salaiya Village: This station is a run situated at 24^0 48'43.4'' N latitude and 80^0 05'19.1'' E longitudes at near the Salaiya village. The bed of river is black eroded stone with the maximum depth of 1-2 meter, with emergent macrophytes at both the shores. The right bank at this station predominantly has agricultural fields, while the left bank is wasteland.

3. Bariyarpur Dam: This station is a deep pool situated at 24^0 50'59.7'' N latitude and 80^0 5'46.3'' E longitudes at the Bariyarpur dam. It is an irrigation reservoir, the catchments and command of which are agricultural fields.

4.2.5. Son basin

1. Govindgarh: This is an artificial Lake in the Rewa district situated at 24^0 14'83.9'' N latitude and 81^0 19'53.4'' E longitudes near the Govindgarh town. The water body is used for partial water supply of the Rewa town. The water body is very rich in biodiversity. The water body has a max depth of about 22.5 meter.

2. (Deolond village): This station is a deep pool situated at 24^0 22’ 4.81’’ N latitude and 81^0 16’ 8.98’’ E longitudes near the Deolon village. The maximum depth of the water column at this station is 8.0 meter. The bed at this station is sandy and shoreline is infested with emergent macrophytes.

4.2.6. Rajgarh basin

1. Bandavedra pond: This is an artificial pond situated at 23^0 41’42.6’’ N latitude and 77^0 04’ 11.8’’ E longitudes on the Jaipur- Jabalpur National Highway NH 12, near the Narsingarh town. The pond is a seasonal pond, which is used as stocking pond for IMC, which is leased out by the Panchayat to the local fishermen. The local weed fishes are also reported in this pond along with the IMCs. The bed of the pond is black cotton soil.

2. Kudali pond: This is also a seasonal pond situated at 23^0 42’ 46.7’’ N latitude and 77^0 00’ 36.7’’ E longitudes on near the Kudali village. The pond is used for variety of secondary purposes including irrigation in the vicinity. The fish practices are capture fisheries other than culture fisheries.

3. Newaj River: This station is a pool situated at 24^0 0’ 24.2’’ N latitude and 76^0 44’28.4’’ E longitudes near Rajgarh town. The maximum depth at this station is 5.5 meter with a bed being mixture of sand and clay. The right bank of the river is sandy cliff while the left bank is flat agricultural fields

5. Methodology

5.1. Details of field survey techniques

Preliminary location of the River on Map- A survey of India map was obtained at the scale of 1:10, 00.000 to locate the river and reservoirs.

Listing of location from previous studies- We tried to identify location if they have been covered in earlier studies.

Accessibility to the sites-With the help of map and consultation with People, we tried to find out the accessibility to the location so that we can cover them during the study.

Pre field visit- preliminary field visit was carried to locate the sampling points.

GPS readings- GPS reading were noted for precise location of the sampling site.

Depth- Since deep areas are considered to be hotspots of aquatic biodiversity, we measured depth with the help of a graduated rope. Deeper areas were selected for study.

Table. 3. Sampling sites selection Criteria

River basin	Sites Name	Selection criteria	Location covered in earlier study
Betwa	Bhojpur	Pool Habitat	Adholia (1979), studies on Hydrobiology of the river Betwa and fishery Resources, P. hD Thesis, Vikram University.
	Near Pagneshwar	Run Habitat	
	Near Ramghat (Vidisha)	Pool Habitat / Harbours Endangered Species N. Chitala	
	Halali reservoir	Harbours Endangered Species N. Chitala	-
	Upper lake	Wetland of National Importance/ Ramsar site/ Migratory birds	Bhoj Wetland project (1996-2003)
Tapti	Parasdoh	Pool Habitat	-
	Baralinga	Run Habitat	-
	Amarkash doh	Pool Habitat	-
	Tedtali	Run Habitat/ (CIFRI,1967)	Karamchandani, (1967) Survey of fish and fisheries of Tapti river.
	Raitali (Near Dhar village)	Run Habitat/ CIFRI,1967)	
	Boat Ghat Nepa Nagar	Run Habitat	-
Chambal	Nagda	Pool Habitat	Dubey G.P. and Mehra R.K (1959). Fish and fisheries of Chambal river, Kartha and
	Basai village	Pool Habitat	
	Gandhi Sagar	Dubey and Mehra, 1959	

		Rao et al., (1988)	Rao (1992). Environmental status of Gandhi Sagar Reservoir.
	Kimor ghat (Kshipra river)	Run Habitat	-
	Gambhir Dam	Tributary of Kshipra	-
Ken	Sonar-Ken river confluence near Singora village	Pool Habitat	-
	Near Salaiya Village	Run Habitat	-
	Bariyarpur Dam	Deep pool	-
Son	Govindgarh lake	Wetland	-
	Son (Deolond village)	Deep Pool	-
Rajgarh	Bandavedra pond	Seasonal pond	-
	Kudali pond	Seasonal pond	-
	Newaj river	Pool Habitat	-

5.2. Physico-chemical estimation

Standard methods (APHA, 1998 Adoni, 1995) were followed for the estimation of the Physico chemical parameters viz., Temperature, Transparency, Conductivity, pH, TDS, Turbidity, Chloride, Alkanity, Free carbon dioxide, Dissolve oxygen, Total hardness, Calcium hardness and Magnesium hardness.

Temperature: - The air and water temperature at the sampling site were recorded with the help of Mercury Thermometer,. The results have been reported in degree Celsius (^oC).

Transparency:- Transparency was measured by Secchi disc (Secchi an Italian scientist deviced a method for studying the transparency of aquatic bodies)

pH: - pH was measured by digital portable pH meter, (Hanna, Italy). The instrument was standadarised with the help of buffer solution of 4.0, 7.0 and 9.2 pH, before operation.

Electrical Conductivity: - Electrical conductivity was measured by digital portable conductivity meter, (Hanna, Italy). The results have been recorded in μs/cm.

Turbidity: It is measured using a Nephlometric turbidity meter, which determines the turbidity of the sample by the scattering of light, which took place during the passage of light through it, gives the turbidity directly in NTU'S.

Total Dissolved Solids: - TDS was measured by digital portable TDS meter, (Hanna, Italy). The results have been reported in mg/l**.**

Chloride: - Chloride was determined by Mohar′s argentometric method. Five drops of pot. Chromate indicator was added to 50 ml of water sample. Once the yellow colour developed, and then titrated against silver nitrate titrant (0.0141N), till a faint brick red colour formed. Calculation was done with the formula as;

$$\text{'Cl' mg/l} = \frac{\text{vol.of titrant used} \times 35.46 \times N \times 1000}{\text{ml of sample used}}$$

Alkalinity: - Two drops of phenolphthalein indicator was added to 50 ml of water sample. Pink colour developed and then titrated with (0.02N) sulphuric acid titrant, until pink colour disappears. Then add 2-3 drops methyl orange indicator, the colour changes into yellow and then titrate with same titrant until colour changes from yellow to orange. Note the total volume used in two titrations. On the other hand when no pink colour develops after adding phenolphthalein indicator, then run the sample using same procedure followed by addition of methyl orange indicator mention above for total alkalinity. Then phenolphthalein alkalinity (p) and total alkalinity (t) were calculated by using the given formula as;

$$\text{Carbonate alkanity (p) as mg/l } CaCO_3 = \frac{\text{Vol. Of titrant used} \times 1000}{\text{ml of sample used}}$$

$$\text{Total alkalinity (t) as mg/l } CaCO_3 = \frac{\text{Total volume of titrant used} \times 1000}{\text{ml of sample used}}$$

Bicarbonate alkalinity (mg/l) = Total alkalinity - Carbonate alkanity

Free Carbon dioxide: - Free Co_2 content was determined by adding two drops of phenolphthalein indicator to 50 ml of water sample, if pink colour is not developed i.e. free Co_2 is present, then titrated with 0.027N sodium hydroxide (NaOH) titrant till the faint pink colour develops, which is the end point of the reaction. The free carbon dioxide was calculated by using formula as;

$$\text{Free carbon dioxide } (CO_2) \text{ mg/l} = \frac{\text{volume of titrant used} \times 1000}{\text{ml of sample used}}$$

Dissolved Oxygen: - Dissolved oxygen was analyzed by Winkler′s method with azide modification. 125 ml of sample was carefully taken without bubbling in B.O.D bottle and 1 ml each of manganous sulphate and alkaline iodide azide solution were added one after the other, with separate pipettes. The precipitate was dissolved by adding 1 ml concentrated sulphuric acid. Then 50 ml of aliquot was titrated with 0.025N sodium thiosulphate, using starch as an indicator. The colour change was noted from blue to colorless, which is the end point of the reaction. Total volume of titrant used was noted and put into formula as;

D.O as mg/l = (8 x N x 1000) v / V

Where 'V' is volume of aliquot used and

'V' volume of titrant used,

8 is the molecular weight of oxygen,

'N' is the normality of titrant = 0.025N

Total Hardness: - The hardness of sample was calculated by titrating it against 0.01M EDTA titrant in presence of ammonia buffer solution and eriochrome black-T as an indicator. Titration was continued till the colour changed from wine red to clear blue.

Formula used;

Total Hardness mg/l as $CaCO_3$ = volume $\frac{\text{of titrant used x 1000}}{\text{ml of sample used}}$

Calcium Hardness: - Water sample after treated with 1 ml of 8% NaOH followed by a pinch of muroxide indicator was titrated against 0.01M EDTA titrant until a colour change from salmon pink to purple. Calcium Hardness was calculated by using formula as;

Calcium Harness as mg/l as $CaCO_3$ = $\frac{\text{ml. of titrant used x 1000 x1.05}}{\text{ml of sample used}}$

Where 1.05 is the molecular weight of $CaCO_3$

Magnesium Hardness (mg/l): - Total Hardness - Calcium Harness

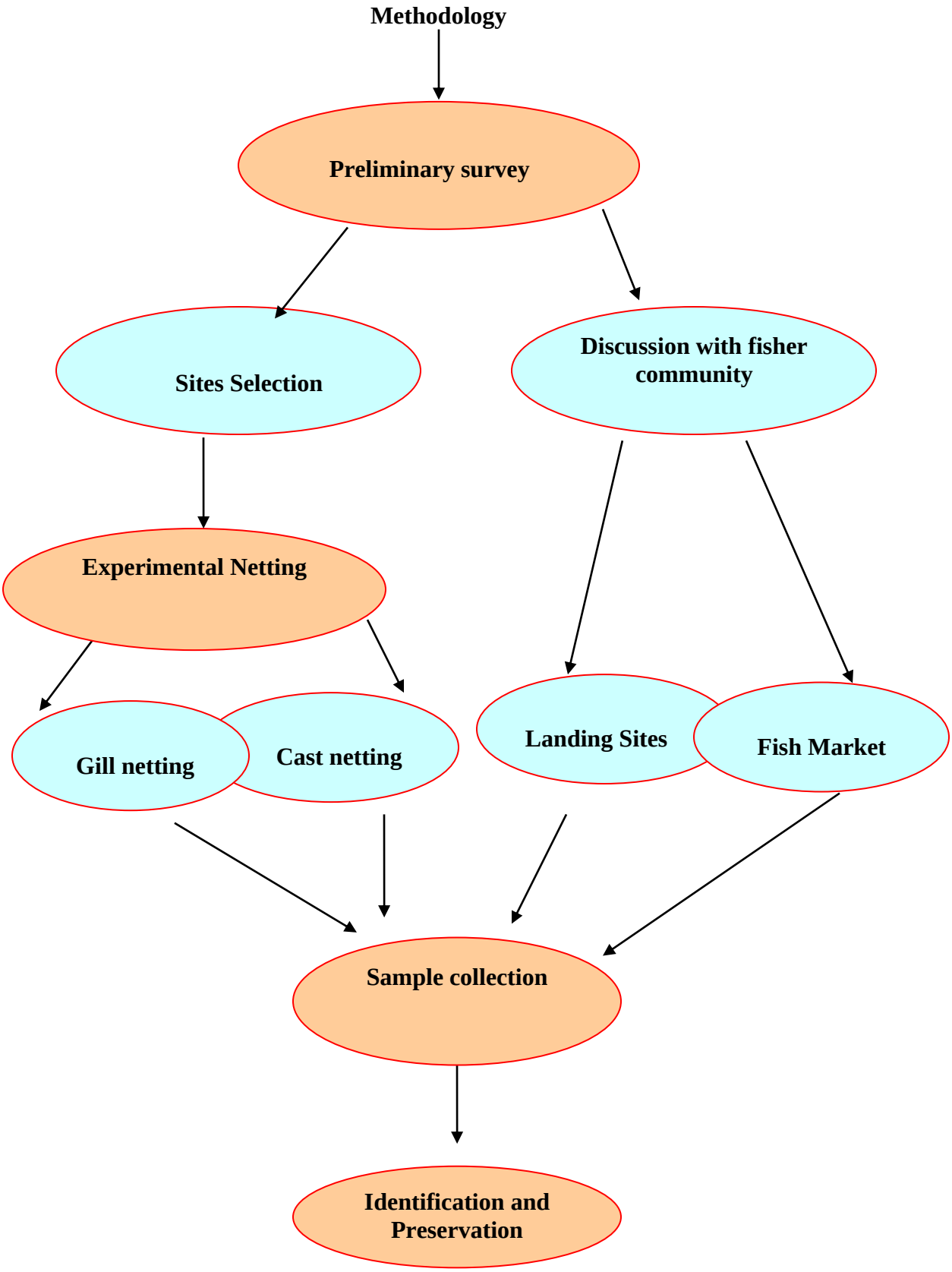
5.3. Fish collection, Preservation and Identification

The fishes were collected through experimental monofilamentous gillnets of different mesh sizes of 10, 20, 30,40,50,60,70,80,90,100 mm. (Arun, 1998; Mheen, 1995). Gill nets mostly fixed in the evening and hauled up next morning. The duration of operation varied between 10-12 hrs. In the morning the entire catch was brought to the landing centers.

Fish sample were collected in fresh condition from the fisherman in the morning from 6.00 am – 8.00am. Fish sample were also collected from with help of cast nets effort. Data was collected by interacting with the fisherman living adjacent to the landing sites and market survey has also done.

While collecting the fishes maximum care was taken to keep the external morphology and that for taxonomic studies. The sampling work was standardized to a constant time and number of fishing instrument employed at each sites. The gill nets were left submerged from the early evening to the following morning. The specimens retrieved from the nets were then placed in plastic containers containing 4 % formalin. Each container was labeled with the date and sampling site number. The fishes were identified using the standard keys of Qureshi & Qureshi (1983); Shrivastava (1998) and Jayaram (1999).

The specimens were counted and weighed, after that fish preserved in 4% formalin as describe in the “Wet preservation” of fishes by Aayappan and Satyamurti (1960). In care of bigger fishes, an incision was always made on the ventral side in front of the ventral (pelvic fine) before preservation. The preservation fluid was there injected in to the muscles with the help of a hypodermic syringe. The preserved fishes were transferable to the laboratory in sealed glass bottles go as to avoid the leakage of the formalin solution filter transporting to the laboratory; Preservative solution was changed as soon as possible. Changes of preservative solution made two to three times ensure complete dehydration and after that finally preserved in glass jar


Methodology
Preliminary survey
Sites Selection
Discussion with fisher community
Experimental Netting
Gill netting
Cast netting
Landing Sites
Fish Market
Sample collection
Identification and Preservation

5.3. Plankton collection and identification

Planktons have been collected along with water sample for qualitative studiy. Plankton samples were collected by standard plankton nets made of belting silk number 14 (120μ) and 25 (64μ) and preserved in 5% formalin. The systematic identification of zooplankton done by using standard literature keys like *viz.*, Needham and Needham (1962), Pennak (1978), Tonapi (1980), APHA (1998) and Adoni (1985).

5.4. Benthic collection and identification

The samples were collected with Surber samplers. Benthic macro invertebrate in Surber sampler were collected through washing of stone and pebbles in a sampler. Later their samples screened through 30 standard sieve (11.0/mesh /cm 0.589 mm opening) and organism were hand sorted and stored in an alcohol –formalin fixative. Benthic macro invertebrate were counted and identified to genus /species using keys provided by Pennak (1978), Needham and Needham (1974), Tonapi (1980), and Adoni (1985).

5.5. Macrophytes collection and identification

A wooden quadrate (50x50 cm) was placed at different river basin of Madhya Pradesh. The macrophytes sample was washed thoroughly to get rid of adhering material. The extra water of the plants was soaked with the help of filter paper and separates the plants of each quadrate, species wise. The samples were transported to the laboratory in polythene packets and sorted out for identification.

Identification of macrophytes were completed by using following keys and manuals like water plants of the world by C.D. cook (1974), Marsh plant of India and Burma by K. Biswas and C.C. Calder (1984), Adoni (1985).

5.6. Birds Identification

The present study was conducted on the different river basin of M.P. from November to December 2007. Water birds were identified and counted from vantage points on the boat and walking along roads in the around the study area. Field visit has done usually between 800 hrs to 1700 hrs. Observations were made from a distance not more than 500-600m without disturbing birds. A binocular (Nikon 7-15x 10 magnifications) was used for the study. Important morphological characters like colours of plumage and legs and shape of the bill were noted. Identification of these waterbirds has been done using standard taxonomic keys (Salim Ali, 1996 and Ali and Ripley 1975).

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6. Pert Chart

S.No	Task/Sub task	Year I											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Appointment of Staff Procurement of Material												
2	Preparation of base Maps												
3	Rapid Survey of Sampling Sites												
4	Market Survey												
5	Landing Site Survey												
6	Experimental Netting												
7	Ecological Conditions												
	Physico-chemical Properties												
	Phytoplankton												
	Zooplankton												
	Benthos												
	Macrophytes												
8	Socio-economic Studies												

Work to be Continued……

Target fixed for the month **Target achieved**

7. Survey of Pertinent literature

Extensive literature survey was conducted to collect information on previously available data and information on waterbodies of M.P and its Biodiversity. After going through the literature available following information was compiled.

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8. Fish biodiversity documentation

8.1. Fresh water Fish biodiversity of India

Ichthyodiversity refers to variety of fish species. Depending on context and scale, it could refer to alleles or genotypes within piscian population, to species of life forms within a fish community, and to species or life forms within a fish community and to species or life forms across aquaregimes (Burton et al., 1992). Biodiversity is also essential for stabilization of ecosystems, protection of overall environmental quality, for understanding intrinsic worth of all species on the earth (Ehrlich and Wilson, 1991).

Studies of freshwater fishes in the Indian subcontinent have been limited to scattered works on commercial fisheries and even these have been largely restricted to some of the major river systems like the Ganges and the Yamuna. Out of the 2,500 species of freshwater fishes that have been recognized in the Indian subcontinent, 930 are categorized as freshwater species (Jayaram 1999). 1570 are marine (Kar, 2003). Considerable studies on ichthyofaunal diversity have been carried out during the last few decades (Day, 1967; Jayaram, 1981; Menon, 1992; Shaji, 1995; Sarkar and Banerjee, 2000; Arunachalum, 2000; Daniel, 2001; Bhat, 2002; Mishra et al., 2003; Bossuyt, 2004; Rajalakshmi and Sreelatha, 2005).

Jhingran (1991) referred the important river system of India are Ganga river system having a stretch of 1600 km from Haridwar (U.P) to Lalgotoghat (West Bengal) giving place to 3382 species, Brahmaputra 126 species , Mahanadi, 99 species, Cauvery, 80 species, Narmada 95 species and Tapti 57 species.

8.1.1. Fish biodiversity of Betwa basin and their composition

During the study a total of 67 fish species belonging to 19 families were recorded in Betwa basin of Madhya Pradesh. The most dominant family was Cyprinidae having 33 species (49%) followed by Bagridae was contributed 5 species (9%) and rests of families were order of abundance. We have selected three water bodies in Betwa basin viz., Betwa river, Halali reservoir and Upper lake Bhopal. 60 species were recoded in Betwa river, 31 species encountered in Halali reservoir and 37 species were identified in Upper Lake.

Overall 67 fish species encountered throughout the study while the maximum 41 species were recorded in winter, 40 species were recorded in summer, 39 species were found in pre monsoon and 38 species were recorded in post monsoon.

8.1.2. Fish abundance of fishes in Betwa basin

The study a total of 1807 individuals were counted out of which 845 individuals were found in Betwa River, 507 individuals counted in Halali reservoir and 455 individuals were counted in Upper Lake. The most dominant family was Cyprinidae having 1244 individuals followed by Bagridae was contributed 80 individuals and rests of families were order of abundance.

8.1.3. Fish biodiversity of Chambal basin and their composition

We have includes five major water bodies in Chambal basin viz., Chambal river, Gandhi Sagar reservoir, Gambhir river, Gambhir reservoir and Kshipra river. The totals of 52 species belonging to 15 families were recorded. 51 species belonging to 14 families were recorded in Chambal river, 46 species were found in Gandhi Sagar reservoir, 30 species belonging to 12 families were recorded in Gambhir reservoir, 23 species belonging to 10 families were recorded in Gambhir river and 22 species belonging to 11 families were recorded in Kshipra river. The most dominant family was Cyprinidae representing 25 (47%) species followed by Bagridae was contributed 6 (11%) species.

During the period of study 52 fish species encountered while the maximum 36 species were recorded in summer, 33 species were recorded in post monsoon, 31 species were found in pre monsoon and 30 species were recorded in winter.

8.1.4. Fish abundance of fishes in Chambal basin

The study a total of 2179 individuals were counted out of which 679 individuals were found in Chambal River, 559 individuals counted in Gandhi Sagar reservoir, 363 individuals were counted in Gambhir reservoir, 294 individuals counted in Gambhir river and 284 individuals were counted in Shipra river. The most dominant family was

Cyprinidae having 1497 (69%) individuals followed by Schilbeidae family was contributed 128 (6%) individuals and rests of families were order of abundance.

8.1.5. Fish biodiversity of Tapti basin and their composition

During the study a total of 57 fish species representing 15 different families were recorded in Tapti River in Madhya Pradesh. The most dominant family was Cyprinidae having 28 species (48%) followed by Bagridae was contributed 5 species (9%) and rest of families was order of abundance.

Overall 57 fish species encountered in the different seasons out which the maximum 36 species were recorded in premonsoon, 35 species were recorded in post monsoon, 32 species were found in winter and 31 species were recorded in summer.

8.1.6. Fish abundance of fishes in Tapti basin

The study a total of 549 individuals were counted out of which 142 individuals were found in summer, 141 individuals counted in premonsoon and 115 individuals were counted in post monsoon. The most dominant family was Cyprinidae having 362(61.97%) individuals followed by Bagridae family was contributed 22 (4%) individuals and rests of families were order of abundance.

8.1.7. Fish biodiversity of Ken basin and their composition

A total of 43 species belonging to 14 families were recorded in Ken basin. Most dominant family was Cyprinidae contributed 20 (46%) species followed by Bagridae 5 (11.62%) species. Highest species diversity was recorded in winter, 27 species encountered in premonsoon, 25 species were found in summer and 24 species were recorded in post monsoon.

8.1.8. Fish abundance of fishes in Ken basin

The study a total of 316 individuals were counted out of which 95 individuals were found in premonsoon, 64 individuals counted in post monsoon, 91 individuals were counted in winter and 66 individuals were counted in summer. The most dominant family was

Cyprinidae having 209 (66.13%) individuals followed by Bagridae family was contributed 20 (6.32%) individuals and rests of families were order of abundance.

8.1.9. Fish biodiversity of Son basin and their composition

A total of 44 species belonging to 15 families were recorded in Son basin. The area covered under this study includes Govindgarh Lake and Bansagar reservoir. The total 24 species belonging to 11 families were indentified in Govindgarh Lake and 42 species belonging to 14 families were recorded in Bansagar reservoir.

Most dominant family was Cyprinidae contributed 20 (46%) species followed by Bagridae 5 (11.62%) species. Highest species diversity 28 species were recorded in winter, 27 species encountered in premonsoon, 25 species were found in summer and 24 species were recorded in post monsoon.

8.1.10. Fish abundance of fishes in Son basin

The study a total of 586 individuals were counted out of which 325 individuals counted in Govindgarh lake and 393 individuals were counted in Bansagar reservoir. The most dominant family was Cyprinidae having 388 (66.21%) individuals followed by Bagridae family was contributed 28 (7.67%) individuals and rests of families were order of abundance.

8.1.11. Fish biodiversity of Rajgarh District their composition

Present study includes three water bodies; two are ponds (Bandavedra and Kudali) one is Nawaj river in Rajgarh district. Overall 39 species belonging to 10 families recorded were recorded. The most dominant family was Cyprinidae having 22 (56.41%) species followed by Bagridae family was contributed 4 species and rests of families were order of abundance.

During the study period, maximum 26 species were recorded in winter, 25 species encountered in premonsoon, 21 species in post monsoon and 24 species were found in summer.

8.1.12. Fish abundance of fishes in Rajgarh District

The study a total of 393 individuals were counted out of which maximum 150 individuals counted in winter, 99 individuals were counted in premonsoon, 84 species were counted in summer and 60 species were recorded in post monsoon. The most dominant family was Cyprinidae having 270 (68.70%) individuals followed by Bagridae family was contributed 28 (7.12%) individuals and rests of families were order of abundance.

Table.4. Fish diversity of betwa basin in summer season

S. No	Species	Common Name	Betwa Basin		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	1		1
2	*Labeo dero*	Dudiya			1
3	*Labeo rohita*	Rohu		1	
4	*Labeo angra*	water	1		1
5	*Labeo fimbriatus*	-	1		
6	*Cirrhinus mrigala*	Naren	1	1	1
7	*Cyprinus carpio*	Common carp	1	1	
8	*Catla catla*	catla		1	
9	*Esomus danricus*	-			1
8	*Puntius conchonius*	Khardi	1		
9	*Puntius saphore*	Kharpata	1	1	
10	*Puntius dorsalis*	putty	1		
11	*Puntius ticto*	Kadita	1		1
12	*Puntius titius*	-	1		
13	*Danio davario*	Raiya	1		1
14	*Oxygaster bacaila*	Chal	1	1	
15	*Oxygaster clupeoides*	Chal	1		
16	*Rasbora elanga*	Darai	1		1
17	*Garra lamta*	Malya			1
18	*Barilius barila*	Fegata	1		
19	*Tor tor*	Badas	1		
	Family-Cobitidae				
20	*Lepidocephalichthys guntea*	Gunguch	1		1

	Family-Notopteridae				
21	*Notopterus notopterus*	Patola	1	1	1
	Family-Ambassidae				
22	*Chanda nama*	Kakhai	1		1
	Family-Gobiidae				
23	*Glossogobius giuris*	Gillu	1		1
	Family-Mastacembelidae				
24	*Mastacembelus pancalus*	Bam	1		1
	Family-Schlibeidae				
25	*Clupisoma garua*	Bekeri	1		
25	*Silondia silonia*		1		
	Family-Siluridae				
27	*Ompok bimaculatus*		1	1	1
28	*Wallago attu*	Padhin	1	1	
	Family-Bagridae				
29	*Mystus cavasius*	kittu	1		
30	*Mystus seenghala*	Sigad		1	
31	*Mystus bleekeri*	Kittu	1	1	1
32	*Rita rita*	Gagra	1		
	Family-Clupeidae				
33	*Gudusia chapra*	Chapra		1	
	Family-Belonidae				
34	*Xenentodon cancila*	Suza Bam	1	1	
	Family-Ophiocephalidae				
35	*Channa punctatus*	Karra	1		
36	*Channa striatus*	Kabra	1		1
	Family-Saccobranchidae				
37	*Heteropneustes fossilis*	Singhi	1		1
	Family-Claridae				
38	*Clarias batrachus*	Magur	1		
	Family-Mugilidae				
39	*Rhinomugil corsula*	Corsula	1	1	
	Family-Anabantidae				
40	*Colisa fasciatus*	Colisa			1
		Total-	**34**	**14**	**19**

Table.5. Fish diversity of betwa basin in Pre-monsoon season

S. No	Species	Common Name	Betwa Basin		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	1		1
2	*Labeo Bata*	Bata	1		
3	*Labeo gonius*	Khursa	1	1	
4	*Labeo rohita*	Rohu	1	1	1
5	*Labeo calbasu*	Kalot	1	1	1
6	*Labeo dero*	Dudiya			1
7	*Labeo angra*	water	1		1
8	*Labeo dussuniere*				1
9	*Catla catla*	Catla	1	1	1
10	*Chela laubuca*	Chalar	1		
11	*Puntius conchonius*	Khardi	1		1
12	*Puntius saphore*	Kharpata		1	1
13	*Puntius sarana*	Sikra	1	1	1
14	*Puntius ticto*	Kadita	1		1
15	*Danio davario*	Raiya	1		1
16	*Garra gotyla*	Malya	1	1	
17	*Oxygaster bacaila*	Chal	1	1	
18	*Oxygaster clupeoides*	Chal	1		
19	*Rasbora daniconius*	Darai	1		
20	*Osteobrama cotio*	Mohiya	1		1
21	*Barilius Bandelisis*	Fegata	1	1	
	Family-Cobitidae				
22	*Lepidocephalichthys guntea*	Gunguch	1		1
	Family-Notopteridae				
23	*Notopterus notopterus*	Patola	1	1	1
	Family-Ambassidae				
24	*Chanda ranga*	Kakhai	1		1
25	*Chanda nama*	Kakhai	1		1
	Family-Gobiidae				
26	*Glossogobius giuris*	Gillu	1		1
	Family-Mastacembelidae				
27	*Mastacembelus armatus*	Bam	1	1	1
	Family-Schlibeidae				

28	*Clupisoma garua*	Bekeri	1		
	Family-Siluridae				
29	*Ompok bimaculatus*		1	1	1
30	*Wallago attu*	Padhin		1	
	Family-Bagridae				
31	*Mystus cavasius*	Kittu	1		
32	*Mystus aor*	Diger		1	
33	*Rita rita*	Gagra	1		
	Family-Clupeidae				
34	*Gonialosa manmina*	Baroti	1		1
	Family-Belonidae				
35	*Xenentodon cancila*	Suza Bam		1	1
	Family-Nandidae				
36	*Nandus nandus*	Kabri	1		
	Family-Ophiocephalidae				
37	*Channa marulius*	Samal		1	
38	*Channa gachua*	Samal			1
	Family-Cichlidae				
39	*Tilapia mossambica*	Tilapia	1		
		Total-			
		Total-	**31**	**16**	**23**

Table.6. Fish diversity of betwa basin in post-monsoon season

S. No	**Species**	**Common Name**	**Betwa Basin**		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Labeo Bata*	Bata	1		
2	*Labeo gonius*	Khursa	1	1	
3	*Labeo boga*	Bhangan		1	
4	*Labeo rohita*	Rohu		1	1
5	*Labeo calbasu*	Kalot	1	1	1
6	*Labeo angra*	water	1		1
7	*Labeo fimbriatus*	-	1		
8	*Cirrhinus mrigala*	Naren		1	1
9	*Cyprinus carpio*	Common carp		1	
10	*Catla catla*	Catla		1	1
11	*Puntius saphore*	Kharpata	1	1	1

12	*Puntius dorsalis*	Putty	1		
13	*Puntius sarana*	Sikra	1	1	1
14	*Puntius titius*	-	1		
15	*Garra gotyla*	Malya	1	1	
16	*Oxygaster bacaila*	Chal	1	1	
17	*Rasbora daniconius*	Darai	1		
18	*Osteobrama cotio*	Mohiya	1		1
19	*Barilius Bandelisis*	Fegata	1	1	
	Family-Cobitidae				
20	*Lepidocephalichthys guntea*	Gunguch	1		1
21	*Nemacheilus botia*	Gunguch		1	1
	Family-Notopteridae				
22	*Notopterus notopterus*	Patola		1	1
	Family-Ambassidae				
23	*Chanda nama*	Kakhai	1		1
	Family-Gobiidae				
24	*Glossogobius giuris*	Gillu	1		1
	Family-Schlibeidae				
25	*Clupisoma garua*	Bekeri	1	1	
26	*Eutropiichthys vacha*	Vacha	1	1	
27	*Silondia silonia*		1		
	Family-Siluridae				
28	*Ompok bimaculatus*		1	1	1
29	*Wallago attu*	Padhin		1	1
	Family-Bagridae				
30	*Mystus cavasius*	kittu	1		
31	*Mystus bleekeri*	Kittu	1	1	1
32	*Mystus seenghala*	Sighad	1	1	1
33	*Mystus aor*	Diger	1	1	
	Family-Belonidae				
34	*Xenentodon cancila*	Suza Bam	1	1	1
	Family-Ophiocephalidae				
35	*Channa marulius*	Samal	1	1	
36	*Channa gachua*	Samal	1		1
	Family-Saccobranchidae				
37	*Heteropneustes fossilis*	Singhi	1		1
	Family-Cichlidae				
38	*Tilapia mossambica*	Tilapia	1		
			30	**23**	**20**

Table.7. Fish diversity of betwa basin in winter season

S. No	Species	Common Name	Betwa Basin		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	1		1
2	*Labeo Bata*	Bata	1	1	
3	*Labeo rohita*	Rohu		1	1
4	*Labeo calbasu*	Kalot	1	1	1
5	*Labeo fimbriatus*	-	1		
6	*Labeo gonius*			1	
7	*Labeo boga*	Bhangan	1		
8	*Cirrhinus mrigala*	Naren		1	1
9	*Cyprinus carpio*	Common carp		1	
10	*Catla catla*	Catla		1	1
11	*Chela laubuca*	Chalar	1		
12	*Puntius conchonius*	Khardi	1		1
13	*Puntius sarana*	Sikra		1	1
14	*Puntius saphore*		1	1	
15	*Puntius ticto*	Kadita	1		1
16	*Danio davario*	Raiya	1		1
17	*Oxygaster bacaila*	Chal	1	1	
18	*Oxygaster gora*	Chal	1		1
19	*Rasbora elanga*	Darai			1
20	*Rasbora daniconius*	Darai	1	1	
21	*Osteobrama cotio*	Mohiya	1	1	1
	Family-Cobitidae				
22	*Lepidocephalichthys guntea*	Gunguch	1		1
23	*Nemacheilus botia*	Gunguch	1		1
	Family-Notopteridae				
24	*Notopterus notopterus*	Patola	1	1	1
25	*Notopterus Chitala*	Chitala		1	
	Family-Sisoridae				
26	*Bagarius bagarius*	Andha	1		
	Family-Mastacembelidae				
27	*Mastacembelus pancalus*	Bam	1		1
28	*Mastacembelus armatus*	Bam	1	1	1

	Family-Schlibeidae				
29	*Clupisoma garua*	Bekeri	1	1	
30	*Silondia silonia*			1	
	Family-Siluridae				
31	*Ompok bimaculatus*		1	1	1
32	*Wallago attu*	Padhin		1	
	Family-Bagridae				
33	*Mystus tengra*	tengra	1		
34	*Mystus bleekeri*	Kittu	1	1	1
35	*Mystus seenghala*	Sighad		1	
	Family-Clupeidae				
36	*Gudusia chapra*	Chapra		1	1
37	*Gonialosa manmina*	Baroti	1		
	Family-Belonidae				
38	*Xenentodon cancila*	Suza Bam	1	1	1
	Family-Mugilidae				
39	*Rhinomugil corsula*	Corsula		1	
	Family-Anabantidae				
40	*Colisa fasciatus*	Colisa			1
	Family-Cichlidae				
41	*Tilapia mossambica*	Tilapia	1		
			27	**24**	**22**

Table.8. Overall fish diversity of betwa basin during the study

S. No	**Species**	**Common Name**	**Betwa Basin**		
			Betwa River	**Halali Reservoir**	**Upper Lake**
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	1		1
2	*Labeo Bata*	Bata	1	1	
3	*Labeo gonius*	Khursa	1	1	
4	*Labeo boga*	Bhangan	1	1	
5	*Labeo rohita*	Rohu	1	1	1
6	*Labeo calbasu*	Kalot	1	1	1
7	*Labeo dero*	Dudiya			1
8	*Labeo angra*	Water	1		1
9	*Labeo fimbriatus*	-	1		
10	*Labeo dussuniere*				1
11	*Cirrhinus mrigala*	Naren	1	1	1

12	*Cyprinus carpio*	Common carp	1	1	
13	*Catla catla*	Catla	1	1	1
14	*Chela laubuca*	Chalar	1		
15	*Esomus danricus*	-			1
16	*Puntius conchonius*	Khardi	1		1
17	*Puntius saphore*	Kharpata	1	1	1
18	*Puntius dorsalis*	Putty	1		
19	*Puntius sarana*	Sikra	1	1	1
20	*Puntius ticto*	Kadita	1		1
21	*Puntius titius*	-	1		
22	*Danio davario*	Raiya	1		1
23	*Garra gotyla*	Malya	1	1	
24	*Oxygaster bacaila*	Chal	1	1	
25	*Oxygaster gora*	Chal	1		1
26	*Oxygaster clupeoides*	Chal	1		
27	*Rasbora elanga*	Darai	1		1
28	*Rasbora daniconius*	Darai	1	1	
29	*Osteobrama cotio*	Mohiya	1	1	1
30	*Garra lamta*	Malya			1
31	*Barilius Bandelisis*	Fegata	1	1	
32	*Barilius barila*	Fegata	1		
33	*Tor tor*	Badas	1		
	Family-Cobitidae				
34	*Lepidocephalichthys guntea*	Gunguch	1		1
35	*Nemacheilus botia*	Gunguch		1	1
	Family-Notopteridae				
36	*Notopterus notopterus*	Patola	1	1	1
37	*Notopterus Chitala*	Chitala	1	1	
	Family-Ambassidae				
38	*Chanda ranga*	Kakhai	1		1
39	*Chanda nama*	Kakhai	1		1
	Family-Sisoridae				
40	*Bagarius bagarius*	Andha	1		
	Family-Gobiidae				
41	*Glossogobius giuris*	Gillu	1		1
	Family-Mastacembelidae				
42	*Mastacembelus pancalus*	Bam	1		1
43	*Mastacembelus armatus*	Bam	1	1	1
	Family-Schlibeidae				

44	*Clupisoma garua*	Bekeri	1	1	
45	*Eutropiichthys vacha*	Vacha	1	1	
46	*Silondia silonia*		1	1	
	Family-Siluridae				
47	*Ompok bimaculatus*		1	1	1
48	*Wallago attu*	Padhin	1	1	1
	Family-Bagridae				
49	*Mystus cavasius*	kittu	1		
50	*Mystus tengra*	tengra	1		
51	*Mystus bleekeri*	Kittu	1	1	1
52	*Mystus seenghala*	Sighad	1	1	1
53	*Mystus aor*	Diger	1	1	
54	*Rita rita*	Gagra	1		
	Family-Clupeidae				
55	*Gonialosa manmina*	Baroti	1		1
56	*Gudusia chapra*	Chapra		1	1
	Family-Belonidae				
57	*Xenentodon cancila*	Suza Bam	1	1	1
	Family-Nandidae				
58	*Nandus nandus*	Kabri	1		
	Family-Ophiocephalidae				
59	*Channa marulius*	Samal	1	1	
60	*Channa gachua*	Samal	1		1
61	*Channa punctatus*	Karra	1		
62	*Channa striatus*	Kabra	1		1
	Family-Saccobranchidae				
63	*Heteropneustes fossilis*	Singhi	1		1
	Family-Claridae				
64	*Clarias batrachus*	Magur	1		
	Family-Mugilidae				
65	*Rhinomugil corsula*	Corsula	1	1	
	Family-Anabantidae				
66	*Colisa fasciatus*	Colisa			1
	Family-Cichlidae				
67	*Tilapia mossambica*	Tilapia	1		
			60	**31**	**37**

Figure 1. Fish diversity in Betwa basin of M.P.

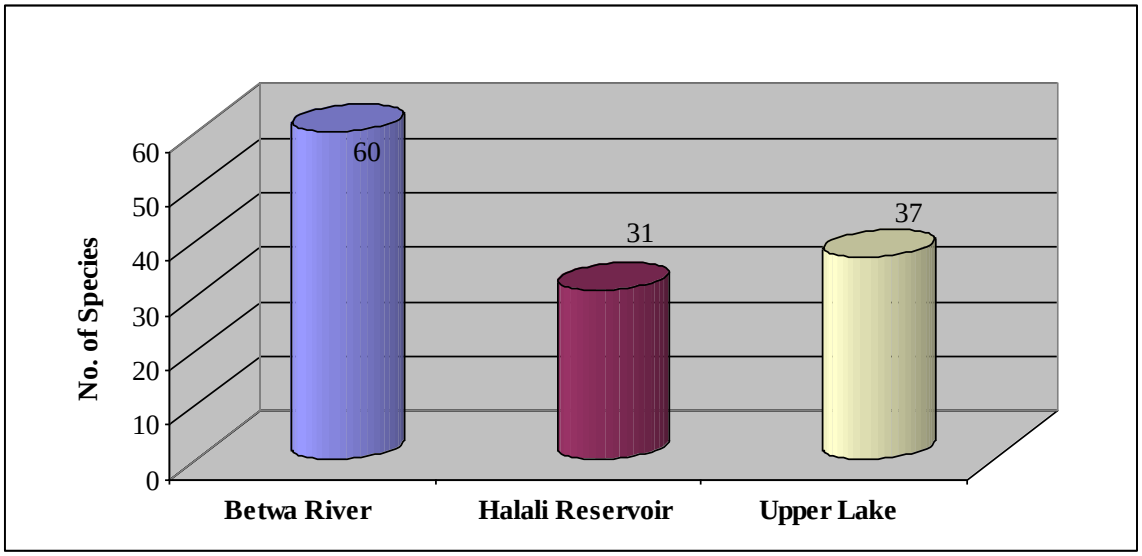


Figure 2. Family wise species composition of betwa basin of M.P.

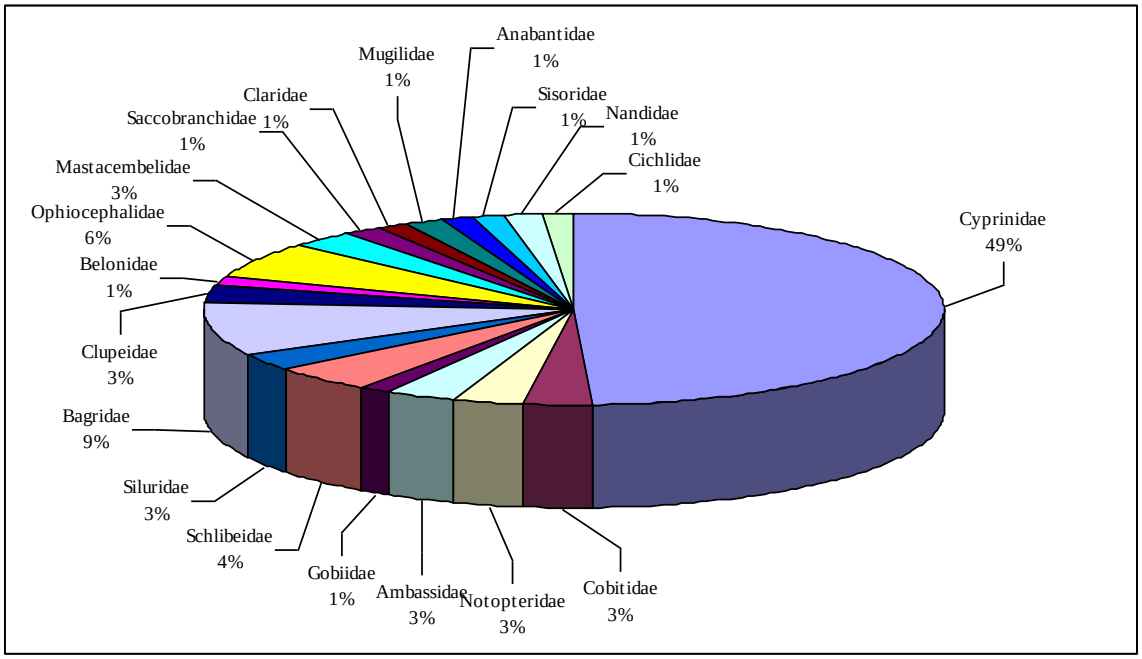


Table 9. Fish abundance of betwa basin in summer season

S. No	Species	Common Name	Betwa Basin		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	6		13
2	*Labeo dero*	Dudiya			2
3	*Labeo rohita*	Rohu		8	
4	*Labeo angra*	water	3		3
5	*Labeo fimbriatus*	-	2		
6	*Cirrhinus mrigala*	Naren	2	10	4
7	*Cyprinus carpio*	Common carp	5	6	
8	*Catla catla*	catla		5	
9	*Esomus danricus*	-			6
8	*Puntius conchonius*	Khardi	10		
9	*Puntius saphore*	Kharpata	5	12	
10	*Puntius dorsalis*	putty	11		
11	*Puntius ticto*	Kadita	15		11
12	*Puntius titius*	-	6		
13	*Danio davario*	Raiya	16		15
14	*Oxygaster bacaila*	Chal	25	30	
15	*Oxygaster clupeoides*	Chal	2		
16	*Rasbora elanga*	Darai	3		3
17	*Garra lamta*	Malya			2
18	*Barilius barila*	Fegata	5		
19	*Tor tor*	Badas	1		
	Family-Cobitidae				
20	*Lepidocephalichthys guntea*	Gunguch	5		6
	Family-Notopteridae				
21	*Notopterus notopterus*	Patola	2	6	3
	Family-Ambassidae				
22	*Chanda nama*	Kakhai	6		11
	Family-Gobiidae				
23	*Glossogobius giuris*	Gillu	6		10
	Family-Mastacembelidae				
24	*Mastacembelus pancalus*	Bam	5		2
	Family-Schlibeidae				
25	*Clupisoma garua*	Bekeri	4		
25	*Silondia silonia*		3		

	Family-Siluridae				
27	*Ompok bimaculatus*		5	5	6
28	*Wallago attu*	Padhin	4	4	
	Family-Bagridae				
29	*Mystus cavasius*	kittu	6		
	Mystus seenghala	Sigad		2	
30	*Mystus bleekeri*	Kittu	5	3	10
31	*Rita rita*	Gagra	1		
	Family-Clupeidae				
32	*Gudusia chapra*	Chapra		2	
	Family-Belonidae				
33	*Xenentodon cancila*	Suza Bam	3	2	
	Family-Ophiocephalidae				
35	*Channa punctatus*	Karra	2		
36	*Channa striatus*	Kabra	1		2
	Family-Saccobranchidae				
37	*Heteropneustes fossilis*	Singhi	1		2
	Family-Claridae				
38	*Clarias batrachus*	Magur	2		
	Family-Mugilidae				
39	*Rhinomugil corsula*	Corsula	3	6	
	Family-Anabantidae				
40	*Colisa fasciatus*	Colisa			2
		Total-	**181**	**101**	**113**

Table 10. Fish abundance of betwa basin in pre-monsoon season

S. No	**Species**	**Common Name**	**Betwa Basin**		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	10		6
2	*Labeo Bata*	Bata	3		
3	*Labeo gonius*	Khursa	3	3	
4	*Labeo rohita*	Rohu	4	5	3
5	*Labeo calbasu*	Kalot	5	4	5
6	*Labeo dero*	Dudiya			2
7	*Labeo angra*	water	3		2
8	*Labeo dussuniere*				2

9	*Catla catla*	Catla	3	2	4
10	*Chela laubuca*	Chalar	11		
11	*Puntius conchonius*	Khardi	12		8
12	*Puntius saphore*	Kharpata		8	25
13	*Puntius sarana*	Sikra	10	9	3
14	*Puntius ticto*	Kadita	8		15
15	*Danio davario*	Raiya	5		3
16	*Garra gotyla*	Malya	6	15	
17	*Oxygaster bacaila*	Chal	25	5	
18	*Oxygaster clupeoides*	Chal	3		
19	*Rasbora daniconius*	Darai	12		
20	*Osteobrama cotio*	Mohiya	3		10
21	*Barilius Bandelisis*	Fegata	2	4	
	Family-Cobitidae				
22	*Lepidocephalichthys guntea*	Gunguch	6		2
	Family-Notopteridae				
23	*Notopterus notopterus*	Patola	2	2	1
	Family-Ambassidae				
24	*Chanda ranga*	Kakhai	5		6
25	*Chanda nama*	Kakhai	6		2
	Family-Gobiidae				
26	*Glossogobius giuris*	Gillu	2		5
	Family-Mastacembelidae				
27	*Mastacembelus armatus*	Bam	2	1	2
	Family-Schlibeidae				
28	*Clupisoma garua*	Bekeri	2		
	Family-Siluridae				
29	*Ompok bimaculatus*		2	5	5
30	*Wallago attu*	Padhin		2	
	Family-Bagridae				
31	*Mystus cavasius*	Kittu	2		
32	*Mystus aor*	Diger		1	
33	*Rita rita*	Gagra	1		
	Family-Clupeidae				
34	*Gonialosa manmina*	Baroti	2		1
	Family-Belonidae				
35	*Xenentodon cancila*	Suza Bam		4	1
	Family-Nandidae				
36	*Nandus nandus*	Kabri	1		

	Family-Ophiocephalidae				
37	*Channa marulius*	Samal		2	
38	*Channa gachua*	Samal			2
	Family-Cichlidae				
39	*Tilapia mossambica*	Tilapia	3		
			164	**72**	**115**

Table 11. Fish abundance of betwa basin in post-monsoon season

S. No	**Species**	**Common Name**	**Betwa Basin**		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Labeo Bata*	Bata	10		
2	*Labeo gonius*	Khursa	6	4	
3	*Labeo boga*	Bhangan		2	
4	*Labeo rohita*	Rohu		6	3
5	*Labeo calbasu*	Kalot	10	5	2
6	*Labeo angra*	water	5		4
7	*Labeo fimbriatus*	-	3		
8	*Cirrhinus mrigala*	Naren		3	5
9	*Cyprinus carpio*	Common carp		10	
10	*Catla catla*	Catla		8	6
11	*Puntius saphore*	Kharpata	10	12	10
12	*Puntius dorsalis*	Putty	15		
13	*Puntius sarana*	Sikra	12	11	5
14	*Puntius titius*	-	9		
15	*Garra gotyla*	Malya	10	8	
16	*Oxygaster bacaila*	Chal	50	23	
17	*Rasbora daniconius*	Darai	23		
18	*Osteobrama cotio*	Mohiya	15		15
19	*Barilius Bandelisis*	Fegata	3	3	
	Family-Cobitidae				
20	*Lepidocephalichthys guntea*	Gunguch	11		7
21	*Nemacheilus botia*	Gunguch		12	6
	Family-Notopteridae				
22	*Notopterus notopterus*	Patola		3	4
	Family-Ambassidae				
23	*Chanda nama*	Kakhai	10		10

	Family-Gobiidae				
24	*Glossogobius giuris*	Gillu	5		5
	Family-Schlibeidae				
25	*Clupisoma garua*	Bekeri	15	7	
26	*Eutropiichthys vacha*	Vacha	5	8	
27	*Silondia silonia*		6		
	Family-Siluridae				
28	*Ompok bimaculatus*		8	7	8
29	*Wallago attu*	Padhin		4	3
	Family-Bagridae				
30	*Mystus cavasius*	kittu	2		
31	*Mystus bleekeri*	Kittu	6	3	7
32	*Mystus seenghala*	Sighad	4	2	2
33	*Mystus aor*	Diger	2	3	
	Family-Belonidae				
34	*Xenentodon cancila*	Suza Bam	3	2	1
	Family-Ophiocephalidae				
35	*Channa marulius*	Samal	1	2	
36	*Channa gachua*	Samal	2		2
	Family-Saccobranchidae				
37	*Heteropneustes fossilis*	Singhi	1		2
	Family-Cichlidae				
38	*Tilapia mossambica*	Tilapia	6		
			268	**148**	**107**

Table 12. Fish abundance of betwa basin in winter season

S. No	Species	Common Name	Betwa Basin		
			Betwa River	Halali Reservoir	Upper Lake
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	12		10
2	*Labeo Bata*	Bata	10	8	
3	*Labeo rohita*	Rohu		10	5
4	*Labeo calbasu*	Kalot	8	6	3
5	*Labeo fimbriatus*	-	3		
6	*Labeo gonius*			4	
7	*Labeo boga*	Bhangan	2		
8	*Cirrhinus mrigala*	Naren		6	5

9	*Cyprinus carpio*	Common carp		5	
10	*Catla catla*	Catla		6	3
11	*Chela laubuca*	Chalar	13		
12	*Puntius conchonius*	Khardi	22		12
13	*Puntius sarana*	Sikra		12	6
14	*Puntius saphore*		11	25	
15	*Puntius ticto*	Kadita	15		15
16	*Danio davario*	Raiya	20		20
17	*Oxygaster bacaila*	Chal	33	25	
18	*Oxygaster gora*	Chal	4		3
19	*Rasbora elanga*	Darai			4
20	*Rasbora daniconius*	Darai	15	13	
21	*Osteobrama cotio*	Mohiya	11	14	1
	Family-Cobitidae				
22	*Lepidocephalichthys guntea*	Gunguch	6		6
23	*Nemacheilus botia*	Gunguch	7		5
	Family-Notopteridae				
24	*Notopterus notopterus*	Patola	4	5	3
25	*Notopterus Chitala*	Chitala		2	
	Family-Sisoridae				
26	*Bagarius bagarius*	Andha	1		
	Family-Mastacembelidae				
27	*Mastacembelus pancalus*	Bam	2		1
28	*Mastacembelus armatus*	Bam	3	3	2
	Family-Schlibeidae				
29	*Clupisoma garua*	Bekeri	7	14	
30	*Silondia silonia*			3	
	Family-Siluridae				
31	*Ompok bimaculatus*		6	5	7
32	*Wallago attu*	Padhin		3	
	Family-Bagridae				
33	*Mystus tengra*	tengra	1		
34	*Mystus bleekeri*	Kittu	6	7	2
35	*Mystus seenghala*	Sighad		2	
	Family-Clupeidae				
36	*Gudusia chapra*	Chapra		3	2
37	*Gonialosa manmina*	Baroti	3		
	Family-Belonidae				

38	*Xenentodon cancila*	Suza Bam	2	2	2
	Family-Mugilidae				
39	*Rhinomugil corsula*	Corsula		3	
	Family-Anabantidae				
40	*Colisa fasciatus*	Colisa			3
	Family-Cichlidae				
41	*Tilapia mossambica*	Tilapia	5		
			232	**186**	**120**

Table 13. Overall fish abundance of betwa basin during the study

S. No	**Species**	**Common Name**	**Betwa Basin**		
			Betwa River	**Halali Reservoir**	**Upper Lake**
	Family-Cyprinidae				
1	*Amblypharogodon mola*	Dhawai	28		29
2	*Labeo Bata*	Bata	23	8	
3	*Labeo gonius*	Khursa	9	11	
4	*Labeo boga*	Bhangan	2	2	
5	*Labeo rohita*	Rohu	4	29	11
6	*Labeo calbasu*	Kalot	23	15	10
7	*Labeo dero*	Dudiya			4
8	*Labeo angra*	Water	11		9
9	*Labeo fimbriatus*	-	8		
10	*Labeo dussuniere*				2
11	*Cirrhinus mrigala*	Naren	2	19	14
12	*Cyprinus carpio*	Common carp	5	21	
13	*Catla catla*	Catla	3	21	13
14	*Chela laubuca*	Chalar	24		
15	*Esomus danricus*	-			6
16	*Puntius conchonius*	Khardi	44		20
17	*Puntius saphore*	Kharpata	26	57	35
18	*Puntius dorsalis*	putty	26		
19	*Puntius sarana*	Sikra	22	32	14
20	*Puntius ticto*	Kadita	38		41
21	*Puntius titius*	-	15		
22	*Danio davario*	Raiya	41		38
23	*Garra gotyla*	Malya	16	23	
24	*Oxygaster bacaila*	Chal	133	83	

25	*Oxygaster gora*	Chal	4		3
26	*Oxygaster clupeoides*	Chal	5		
27	*Rasbora elanga*	Darai	3		7
28	*Rasbora daniconius*	Darai	50	13	
29	*Osteobrama cotio*	Mohiya	29	14	26
30	*Garra lamta*	Malya			2
31	*Barilius Bandelisis*	Fegata	5	7	
32	*Barilius barila*	Fegata	5		
33	*Tor tor*	Badas	1		
	Family-Cobitidae				
34	*Lepidocephalichthys guntea*	Gunguch	28		21
35	*Nemacheilus botia*	Gunguch	7	12	11
	Family-Notopteridae				
36	*Notopterus notopterus*	Patola	8	16	11
37	*Notopterus Chitala*	Chitala		2	
	Family-Ambassidae				
38	*Chanda ranga*	Kakhai	5		6
39	*Chanda nama*	Kakhai	22		23
	Family-Sisoridae				
40	*Bagarius bagarius*	Andha	1		
	Family-Gobiidae				
41	*Glossogobius giuris*	Gillu	13		20
	Family-Mastacembelidae				
42	*Mastacembelus pancalus*	Bam	7		3
43	*Mastacembelus armatus*	Bam	5	4	4
	Family-Schlibeidae				
44	*Clupisoma garua*	Bekeri	28	21	
45	*Eutropiichthys vacha*	Vacha	5	8	
46	*Silondia silonia*		9	3	
	Family-Siluridae				
47	*Ompok bimaculatus*		21	22	26
48	*Wallago attu*	Padhin	4	13	3
	Family-Bagridae				
49	*Mystus cavasius*	kittu	10		
50	*Mystus tengra*	tengra	1		
51	*Mystus bleekeri*	Kittu	17	13	19
52	*Mystus seenghala*	Sighad	4	6	2
53	*Mystus aor*	Diger	2	4	

54	*Rita rita*	Gagra	2		
	Family-Clupeidae				
55	*Gonialosa manmina*	Baroti	5		1
56	*Gudusia chapra*	Chapra		5	2
	Family-Belonidae				
57	*Xenentodon cancila*	Suza Bam	8	10	4
	Family-Nandidae				
58	*Nandus nandus*	Kabri	1		
	Family-Ophiocephalidae				
59	*Channa marulius*	Samal	1	4	
60	*Channa gachua*	Samal	2		4
61	*Channa punctatus*	Karra	2		
62	*Channa striatus*	Kabra	1		2
	Family-Saccobranchidae				
63	*Heteropneustes fossilis*	Singhi	2		4
	Family-Claridae				
64	*Clarias batrachus*	Magur	2		
	Family-Mugilidae				
65	*Rhinomugil corsula*	Corsula	3	9	
	Family-Anabantidae				
66	*Colisa fasciatus*	Colisa			5
	Family-Cichlidae				
67	*Tilapia mossambica*	Tilapia	14		
			845	**507**	**455**

Figure 3. Fish abundance in betwa basin of M.P.

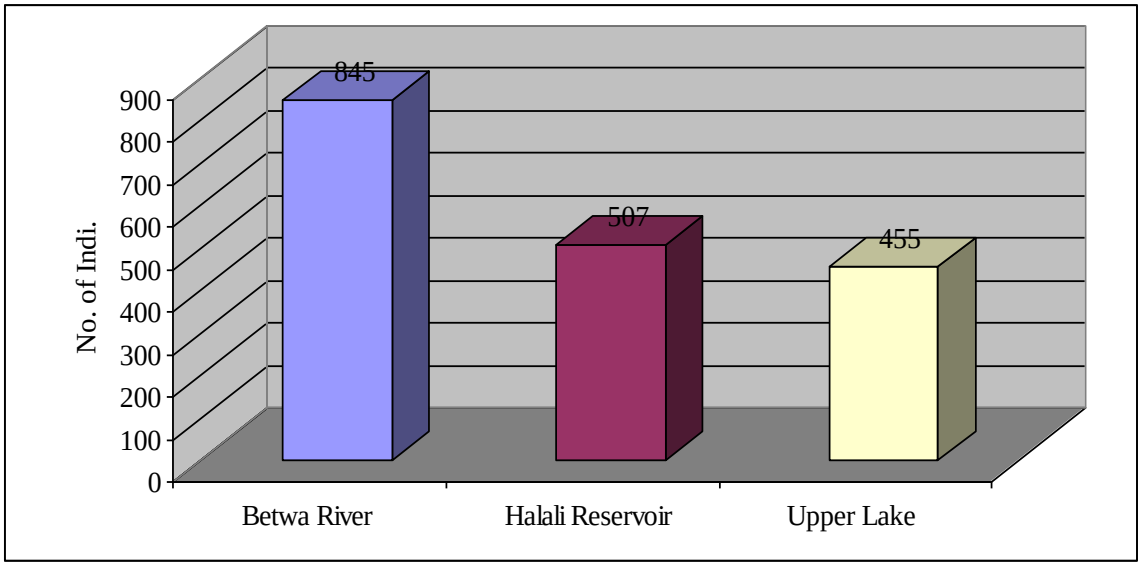


Figure 4. Family wise fish abundance in Betwa basin of M.P.

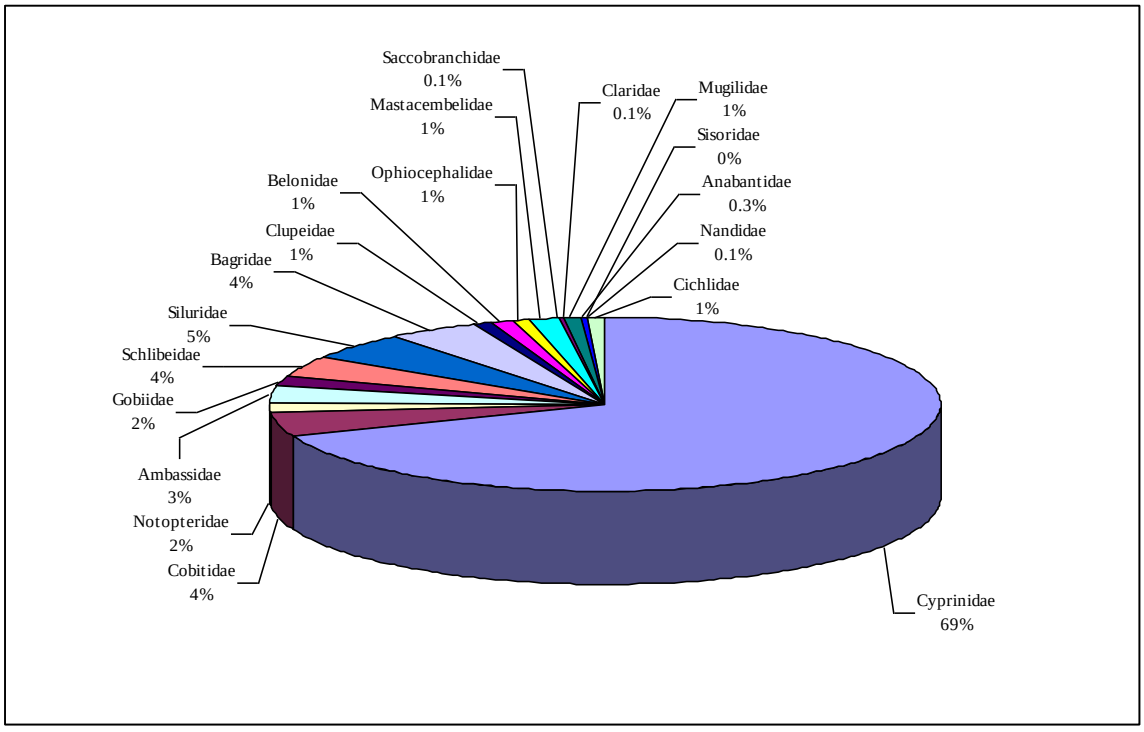


Table.4. Fish diversitiy of Chambal basin in summer season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	1	1		1	
2	*Labeo bata*	Bata	1	1	1	1	1
3	*Labeo fimbriatus*	Gohria	1	1			
4	*Labeo gonius*	khursa	1	1			
5	*Labeo rohita*	Rohu	1	1	1	1	
6	*Labeo boggat*	-	1				
7	*Catla catla*	Catla	1	1	1	1	1
8	*Puntius conchonius*	khardi	1	1	1	1	1
9	*Puntius phutunio*	putty	1				
10	*Puntius ticto*	Kadita	1	1	1		1
11	*Osteobrama cotio*	Mohiya	1	1		1	1
12	*Oxygaster bacaila*	Chal	1	1	1	1	1
13	*Oxygaster gora*	Chal	1				
14	*Danio davario*	Raiya	1	1	1	1	1
15	*Hypopthalimenthys molitrix*	Silver carp	1	1			
16	*Garra gotyla*	Phatarchata	1	1	1	1	
17	*Rasbora daniconius*	Darai	1	1	1	1	1
18	*Cirrhinus mrigala*	Naren	1	1	1		
	Family-Ambassidae						
19	*Chanda nama*	Kakhai	1	1	1	1	1
20	*Chanda ranga*	Kakhai	1	1	1		
	Family-Ophiocephalidae						
21	*Channa marulius*	Samal	1	1	1	1	1
	Family-Schlibeidae						
22	*Eutropiichthys vacha*	Charkhi	1	1	1	1	1
23	*Clupisoma garua*	Bekeri	1	1			
24	*Silonia silondia*	Silind	1	1	1		1
	Family-Cobitidae						
25	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
26	*Nemacheilus botia*	Gunguch	1	1			
	Family-						

	Mastacembelidae						
27	*Mastacembelus armatus*	Bam	1	1	1	1	1
28	*Mastacembelus pancalus*	Bam	1	1			
	Family-Bagridae						
29	*Mystus aor*	Diger	1	1	1	1	1
30	*Mystus bleekeri*	Kittu	1	1	1	1	1
31	*Mystus seenghala*	Sighad	1	1	1		
32	*Mystus tengra*	-	1				
	Family-Notopteridae						
33	*Notopterus notopterus*	Patola	1	1	1		1
	Family-Siluridae						
34	*Ompok bimaculatus*	Pabda	1	1		1	1
35	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Belonidae						
36	*Xenentodon cancila*	Suza	1	1	1	1	1
			36	**32**	**23**	**20**	**19**

Table.5. Fish diversitiy of Chambal basin in pre-monsoon season

S.No.	**Species**	**Local Name**	**Chambal River**	**Gandhi Sagar**	**Gambhir Dam**	**Gambhir River**	**Kshipra River**
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	1	1		1	
2	*Labeo bata*	Bata	1	1	1	1	1
3	*Labeo calbasu*	Kalot	1	1	1	1	
4	*Labeo rohita*	Rohu	1	1	1	1	
5	*Catla catla*	Catla	1	1	1	1	1
6	*Puntius conchonius*	khardi	1	1	1	1	1
7	*Puntius sophore*	Kharpata	1	1	1	1	1
8	*Puntius ticto*	Kadita	1	1	1		1
9	*Osteobrama cotio*	Mohiya	1	1		1	1
10	*Oxygaster bacaila*	Chal	1	1	1	1	1
11	*Danio davario*	Raiya	1	1	1	1	1

12	*Cyprinus carpio*	Common carp	1	1	1		
13	*Garra gotyla*	Phatarchata	1	1	1	1	
14	*Rasbora daniconius*	Darai	1	1	1	1	1
15	*Cirrhinus mrigala*	Naren	1	1	1		
	Family-Ambassidae						
16	*Chanda nama*	Kakhai	1	1	1	1	1
17	*Chanda ranga*	Kakhai	1	1	1		
	Family-Ophiocephalidae						
18	*Channa marulius*	Samal	1	1	1	1	1
19	*Channa gachua*	Samal	1				
	Family-Schlibeidae						
20	*Eutropiichthys vacha*	Charkhi	1	1	1	1	1
21	*Clupisoma garua*	Bekeri	1	1			
22	*Silonia silondia*	Silind	1	1	1		1
	Family-Saccobranchidae						
23	*Heteropneustes fossilis*	Singhi	1	1	1		1
	Family-Cobitidae						
24	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
	Family-Mastacembelidae						
25	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Bagridae						
26	*Mystus aor*	Diger	1	1	1	1	1
27	*Mystus bleekeri*	Kittu	1	1	1	1	1
28	*Mystus seenghala*	Sighad	1	1	1		
	Family-Notopteridae						

29	*Notopterus notopterus*	Patola	1	1	1		1
	Family-Siluridae						
30	*Ompok bimaculatus*	Pabda	1	1		1	1
31	*Wallago attu*	Padhin	1	1	1	1	1
			31	**30**	**26**	**21**	**20**

Table.6. Fish diversitiy of Chambal basin in post-monsoon season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	1	1		1	
2	*Labeo boga*	Bhangan	1	1			
3	*Labeo calbasu*	Kalot	1	1	1	1	
4	*Labeo dyocheilus*	Borat	1	1			
5	*Labeo fimbriatus*	Gohria	1	1			
6	*Labeo rohita*	Rohu	1	1	1	1	
7	*Labeo boggat*	-	1				
8	*Catla catla*	Catla	1	1	1	1	1
9	*Puntius sophore*	Kharpata	1	1	1	1	1
10	*Osteobrama cotio*	Mohiya	1	1		1	1
11	*Oxygaster bacaila*	Chal	1	1	1	1	1
12	*Oxygaster clupeoides*	Chal	1				
13	*Danio davario*	Raiya	1	1	1	1	1
14	*Cyprinus carpio*	Common carp	1	1	1		
15	*Rasbora daniconius*	Darai	1	1	1	1	1
16	*Cirrhinus mrigala*	Naren	1	1	1		
	Family-Ambassidae						
17	*Chanda nama*	Kakhai	1	1	1	1	1
18	*Chanda ranga*	Kakhai	1	1	1		
	Family-Ophiocephalidae						
19	*Channa marulius*	Samal	1	1	1	1	1
	Family-Claridae						
20	*Clarius batrachus*	Magur		1			1
	Family-Schlibeidae						
21	*Eutropiichthys vacha*	Charkhi	1	1	1	1	1
22	*Clupisoma garua*	Bekeri	1	1			

23	*Silonia silondia*	Silind	1	1	1		1
	Family-Gobiidae						
24	*Glossogobius giuris*	Gillu	1	1		1	
	Family-Clupeidae						
25	*Gonialosa manmina*	Baroti	1	1			
	Family-Cobitidae						
26	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
	Family-Mastacembelidae						
27	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Bagridae						
28	*Mystus aor*	Diger	1	1	1	1	1
29	*Mystus seenghala*	Sighad	1	1	1		
30	*Rita rita*	Gagra	1	1			
	Family-Notopteridae						
31	*Notopterus notopterus*	Patola	1	1	1		1
	Family-Siluridae						
32	*Ompok bimaculatus*	Pabda	1	1		1	1
33	*Wallago attu*	Padhin	1	1	1	1	1
			32	**31**	**20**	**18**	**16**

Table.7. Fish diversitiy of Chambal basin in winter season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Labeo bata*	Bata	1	1	1	1	1
2	*Labeo calbasu*	Kalot	1	1	1	1	
3	*Labeo gonius*	Khursa	1	1			
4	*Labeo rohita*	Rohu	1	1	1	1	
5	*Catla catla*	Catla	1	1	1	1	1
6	*Puntius conchonius*	khardi	1	1	1	1	1
7	*Puntius sophore*	Kharpata	1	1	1	1	1
8	*Puntius ticto*	Kadita	1	1	1		1
9	*Oxygaster bacaila*	Chal	1	1	1	1	1
10	*Oxygaster gora*	Chal	1				
11	*Danio davario*	Raiya	1	1	1	1	1
12	*Cyprinus carpio*	Common carp	1	1	1		
13	*Garra gotyla*	Phatarchata	1	1	1	1	
14	*Tor tor*	Badas	1	1	1		

15	*Cirrhinus mrigala*	Naren	1	1	1		
	Family-Ambassidae						
16	*Chanda ranga*	Kakhai	1	1	1		
	Family-Ophiocephalidae						
17	*Channa marulius*	Samal	1	1	1	1	1
18	*Channa striatus*	Kabra	1	1	1		
	Family-Claridae						
19	*Clarius batrachus*	Magur		1			1
	Family-Schlibeidae						
20	*Eutropiichthys vacha*	Charkhi	1	1	1	1	1
21	*Clupisoma garua*	Bekeri	1	1			
22	*Silonia silondia*	Silind	1	1	1		1
	Family-Cobitidae						
23	*Nemacheilus botia*	Gunguch	1	1			
	Family-Mastacembelidae						
24	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Bagridae						
25	*Mystus cavasius*	Kittu	1	1			
26	*Mystus seenghala*	Sighad	1	1	1		
	Family-Notopteridae						
27	*Notopterus notopterus*	Patola	1	1	1		1
	Family-Siluridae						
28	*Ompok bimaculatus*	Pabda	1	1		1	1
29	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Sisoridae						
30	*Bagarius bagarius*	Andha	1	1	1		
			29	**29**	**23**	**14**	**15**

Table.8. Over all fish diversitiy of Chambal basin during the study

S.No.	**Species**	**Local Name**	**Chambal River**	**Gandhi Sagar**	**Gambhir Dam**	**Gambhir River**	**Kshipra River**
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	1	1		1	
2	*Labeo bata*	Bata	1	1	1	1	1
3	*Labeo boga*	Bhangan	1	1			
4	*Labeo calbasu*	Kalot	1	1	1	1	
5	*Labeo dyocheilus*	Borat	1	1			
6	*Labeo fimbriatus*	Gohria	1	1			

7	*Labeo gonius*	khursa	1	1			
8	*Labeo rohita*	Rohu	1	1	1	1	
9	*Labeo boggat*	-	1				
10	*Catla catla*	Catla	1	1	1	1	1
11	*Puntius conchonius*	khardi	1	1	1	1	1
12	*Puntius phutunio*	putty	1				
13	*Puntius sophore*	Kharpata	1	1	1	1	1
14	*Puntius ticto*	Kadita	1	1	1		1
15	*Osteobrama cotio*	Mohiya	1	1		1	1
16	*Oxygaster bacaila*	Chal	1	1	1	1	1
17	*Oxygaster gora*	Chal	1				
18	*Oxygaster clupeoides*	Chal	1				
19	*Danio davario*	Raiya	1	1	1	1	1
20	*Cyprinus carpio*	Common carp	1	1	1		
21	*Hypopthalimenthys molitrix*	Silver carp	1	1			
22	*Garra gotyla*	Phatarchata	1	1	1	1	
23	*Rasbora daniconius*	Darai	1	1	1	1	1
24	*Tor tor*	Badas	1	1	1		
25	*Cirrhinus mrigala*	Naren	1	1	1		
	Family-Ambassidae						
26	*Chanda nama*	Kakhai	1	1	1	1	1
27	*Chanda ranga*	Kakhai	1	1	1		
	Family-Ophiocephalidae						
28	*Channa marulius*	Samal	1	1	1	1	1
29	*Channa striatus*	Kabra	1	1	1		
30	*Channa gachua*	Samal	1				
	Family-Claridae						
31	*Clarius batrachus*	Magur		1			1
	Family-Schlibeidae						
32	*Eutropiichthys vacha*	Charkhi	1	1	1	1	1
33	*Clupisoma garua*	Bekeri	1	1			
34	*Silonia silondia*	Silind	1	1	1		1
	Family-Gobiidae						
35	*Glossogobius giuris*	Gillu	1	1		1	
	Family-Clupeidae						
36	*Gonialosa manmina*	Baroti	1	1			
	Family-Saccobranchidae						
37	*Heteropneustes fossilis*	Singhi	1	1	1		1
	Family-Cobitidae						

38	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
39	*Nemacheilus botia*	Gunguch	1	1			
	Family-Mastacembelidae						
40	*Mastacembelus armatus*	Bam	1	1	1	1	1
41	*Mastacembelus pancalus*	Bam	1	1			
	Family-Bagridae						
42	*Mystus aor*	Diger	1	1	1	1	1
43	*Mystus bleekeri*	Kittu	1	1	1	1	1
44	*Mystus cavasius*	Kittu	1	1			
45	*Mystus seenghala*	Sighad	1	1	1		
46	*Mystus tengra*	Tengra	1				
47	*Rita rita*	Gagra		1			
	Family-Notopteridae						
48	*Notopterus notopterus*	Patola	1	1	1		1
	Family-Siluridae						
49	*Ompok bimaculatus*	Pabda	1	1		1	1
50	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Belonidae						
51	*Xenentodon cancila*	Suza	1	1	1	1	1
	Family-Sisoridae						
52	*Bagarius bagarius*	Andha	1	1	1		
			50	46	30	23	22

Figure 5. Fish diversity in Chambal basin of M.P.

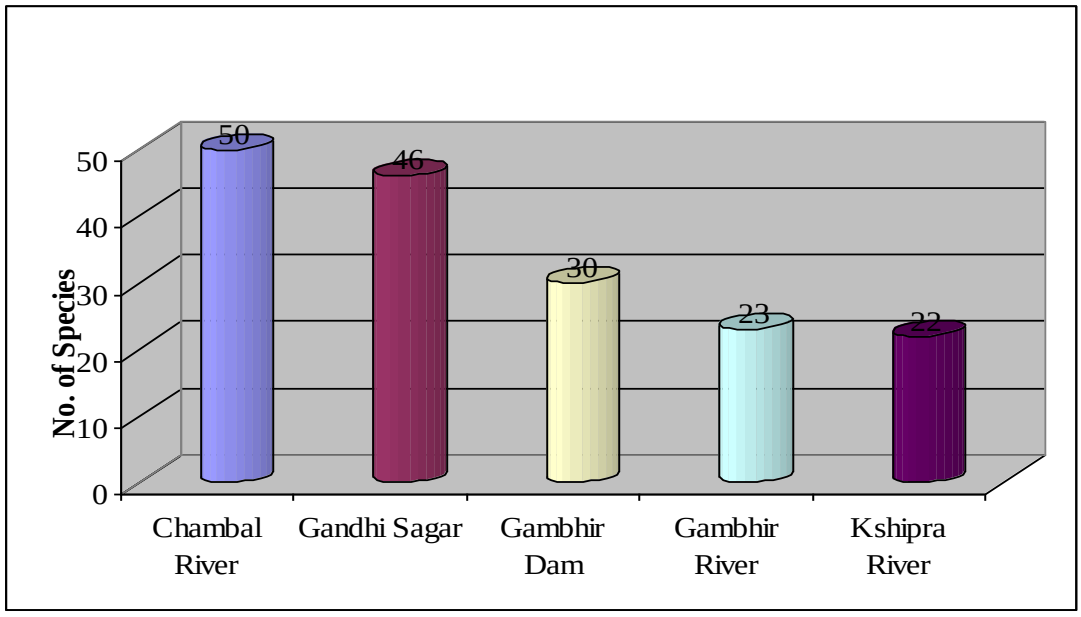


Figure 6. Family wise species composition in Chambal basin of M.P.

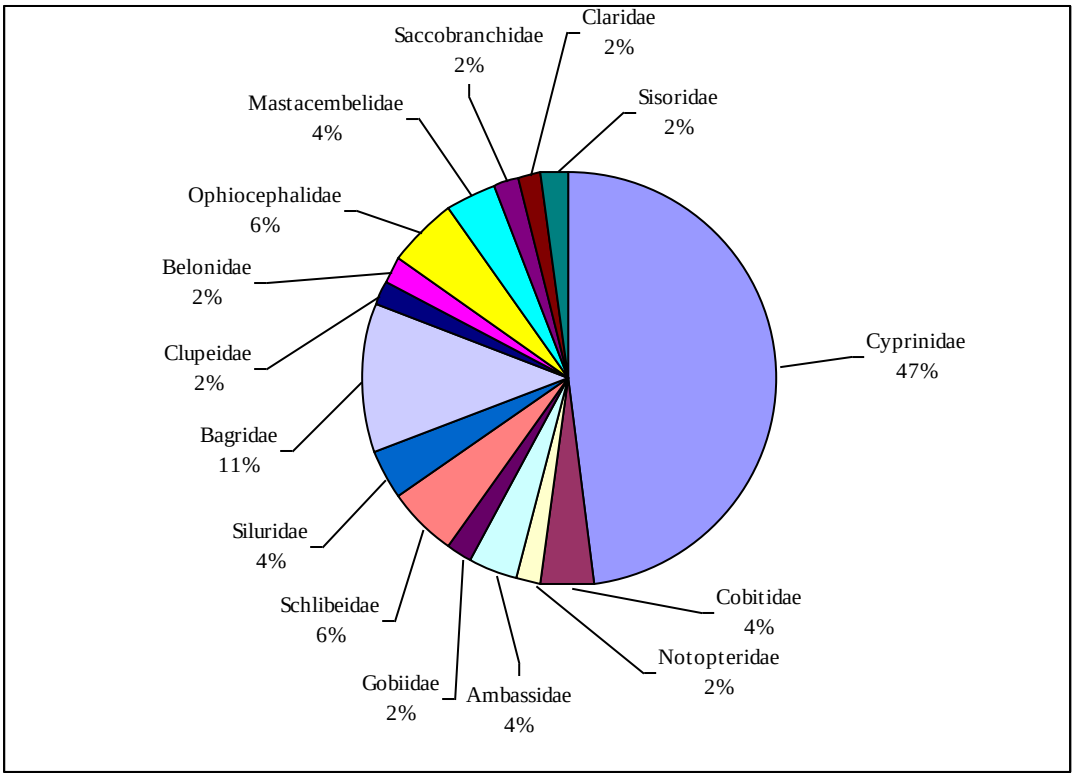


Table 9. Fish abundance of Chambal basin in summer season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	2	3		5	
2	*Labeo bata*	Bata	3	2	2	2	3
3	*Labeo fimbriatus*	Gohria	3	5			
4	*Labeo gonius*	khursa	4	3			
5	*Labeo rohita*	Rohu	2	4	3	1	
6	*Labeo boggat*	-	1				
7	*Catla catla*	Catla	4	2	4	3	5
8	*Puntius conchonius*	khardi	10	8	11	10	6
9	*Puntius phutunio*	putty	5				
10	*Puntius ticto*	Kadita	7	2	5		1
11	*Osteobrama cotio*	Mohiya	17	10		3	23
12	*Oxygaster bacaila*	Chal	16	13	18	20	25
13	*Oxygaster gora*	Chal	3				
14	*Danio davario*	Raiya	10	4	6	5	4
15	*Hypopthalimenthys molitrix*	Silver carp	1	1			

16	*Garra gotyla*	Phatarchata	12	6	7	5	
17	*Rasbora daniconius*	Darai	9	5	5	4	3
18	*Cirrhinus mrigala*	Naren	3	1	2		
	Family-Ambassidae						
19	*Chanda nama*	Kakhai	2	3	4	3	1
20	*Chanda ranga*	Kakhai	2	3	5		
	Family-Ophiocephalidae						
21	*Channa marulius*	Samal	2	1	1	2	1
	Family-Schlibeidae						
22	*Eutropiichthys vacha*	Charkhi	2	3	4	1	2
23	*Clupisoma garua*	Bekeri	3	2			
24	*Silonia silondia*	Silind	2	3	2		3
	Family-Cobitidae						
25	*Lepidocephalichthys guntea*	Gunguch	5	3	2	1	
26	*Nemacheilus botia*	Gunguch	3	2			
	Family-Mastacembelidae						
27	*Mastacembelus armatus*	Bam	3	2	3	2	4
28	*Mastacembelus pancalus*	Bam	1	3			
	Family-Bagridae						
29	*Mystus aor*	Diger	2	3	2	1	1
30	*Mystus bleekeri*	Kittu	3	5	4	2	2
31	*Mystus seenghala*	Sighad	3	2	1		
32	*Mystus tengra*	-	1				
	Family-Notopteridae						
33	*Notopterus notopterus*	Patola	2	1	1		1
	Family-Siluridae						
34	*Ompok bimaculatus*	Pabda	3	5		6	2
35	*Wallago attu*	Padhin	1	2	3	2	3
	Family-Belonidae						
36	*Xenentodon cancila*	Suza	2	3	1	1	2
			154	**115**	**96**	**79**	**92**

Table 10. Fish abundance of Chambal basin in pre-monsoon season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	10	2		2	
2	*Labeo bata*	Bata	5	6	4	3	2
3	*Labeo calbasu*	Kalot	7	11	6	4	
4	*Labeo rohita*	Rohu	5	12	3	2	
5	*Catla catla*	Catla	6	15	4	3	2

6	*Puntius conchonius*	khardi	10	8	6	9	4
7	*Puntius sophore*	Kharpata	9	5	10	6	5
8	*Puntius ticto*	Kadita	15	6	3		14
9	*Osteobrama cotio*	Mohiya	25	7		2	10
10	*Oxygaster bacaila*	Chal	50	10	19	10	15
11	*Danio davario*	Raiya	20	5	12	10	7
12	*Cyprinus carpio*	Common carp	3	6	3		
13	*Garra gotyla*	Phatarchata	15	12	2	2	
14	*Rasbora daniconius*	Darai	11	13	3	3	12
15	*Cirrhinus mrigala*	Naren	3	4	2		
	Family-Ambassidae						
16	*Chanda nama*	Kakhai	5	12	4	6	10
17	*Chanda ranga*	Kakhai	3	6	5		
	Family-Ophiocephalidae						
18	*Channa marulius*	Samal	1	2	1	2	1
19	*Channa gachua*	Samal	1				
	Family-Schlibeidae						
20	*Eutropiichthys vacha*	Charkhi	3	2	3	2	5
21	*Clupisoma garua*	Bekeri	2	5			
22	*Silonia silondia*	Silind	2	3	2		3
	Family-Saccobranchidae						
23	*Heteropneustes fossilis*	Singhi	1	1	2		1
	Family-Cobitidae						
24	*Lepidocephalichthys guntea*	Gunguch	10	5	6	2	
	Family-Mastacembelidae						
25	*Mastacembelus armatus*	Bam	2	2	1	1	2
	Family-Bagridae						
26	*Mystus aor*	Diger	1	10	2	2	2
27	*Mystus bleekeri*	Kittu	2	3	3	1	3
28	*Mystus seenghala*	Sighad	3	15	1		
	Family-Notopteridae						
29	*Notopterus notopterus*	Patola	2	6	3		2
	Family-Siluridae						
30	*Ompok bimaculatus*	Pabda	4	3		5	3
31	*Wallago attu*	Padhin	3	2	2	2	1
			239	**199**	**112**	**79**	**104**

Table 11. Fish abundance of Chambal basin in post-monsoon season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	3	2		4	
2	*Labeo boga*	Bhangan	1	3			
3	*Labeo calbasu*	Kalot	5	12	3	5	
4	*Labeo dyocheilus*	Borat	3	3			
5	*Labeo fimbriatus*	Gohria	3	1			
6	*Labeo rohita*	Rohu	2	15	3	2	
7	*Labeo boggat*	-	2				
8	*Catla catla*	Catla	5	11	2	1	4
9	*Puntius sophore*	Kharpata	10	4	3	2	5
10	*Osteobrama cotio*	Mohiya	20	5		7	2
11	*Oxygaster bacaila*	Chal	25	10	15	3	3
12	*Oxygaster clupeoides*	Chal	5				
13	*Danio devario*	Raiya	15	15	11	10	8
14	*Cyprinus carpio*	Common carp	3	2	3		
15	*Rasbora daniconius*	Darai	12	3	12	12	3
16	*Cirrhinus mrigala*	Naren	3	2	3		
	Family-Ambassidae						
17	*Chanda nama*	Kakhai	5	3	5	4	2
18	*Chanda ranga*	Kakhai	4	2	4		
	Family-Ophiocephalidae						
19	*Channa marulius*	Samal	1	5	2	1	2
	Family-Claridae						
20	*Clarias batrachus*	Magur		1			1
	Family-Schlibeidae						
21	*Eutropiichthys vacha*	Charkhi	5	6	3	2	3
22	*Clupisoma garua*	Bekeri	6	2			
23	*Silonia silondia*	Silind	2	3	2		2
	Family-Gobiidae						
24	*Glossogobius giuris*	Gillu	2	5		4	
	Family-Clupeidae						
25	*Gonialosa manmina*	Baroti	3	2			
	Family-Cobitidae						
26	*Lepidocephalichthys guntea*	Gunguch	4	2	4	3	
	Family-Mastacembelidae						
27	*Mastacembelus armatus*	Bam	3	3	1	2	3
	Family-Bagridae						
28	*Mystus aor*	Diger	2	2	2	2	1

29	*Mystus seenghala*	Sighad	2	1	1		
30	*Rita rita*	Gagra	1	3			
	Family-Notopteridae						
31	*Notopterus notopterus*	Patola	4	2	1		6
	Family-Siluridae						
32	*Ompok bimaculatus*	Pabda	5	3		1	2
33	*Wallago attu*	Padhin	2	1	1	2	5
			168	**134**	**81**	**67**	**52**

Table 12. Fish abundance of Chambal basin in winter season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Labeo bata*	Bata	2	3	2	4	3
2	*Labeo calbasu*	Kalot	3	4	3	2	
3	*Labeo gonius*	Khursa	5	2			
4	*Labeo rohita*	Rohu	2	3	2	6	
5	*Catla catla*	Catla	6	2	3	2	2
6	*Puntius conchonius*	Khardi	3	12	6	7	3
7	*Puntius sophore*	Kharpata	9	8	4	6	4
8	*Puntius ticto*	Kadita	11	6	2		3
9	*Oxygaster bacaila*	Chal	13	8	1	15	2
10	*Oxygaster gora*	Chal	2				
11	*Danio davario*	Raiya	5	10	6	12	4
12	*Cyprinus carpio*	Common carp	3	3	4		
13	*Garra gotyla*	Phatarchata	12	8	5	3	
14	*Tor tor*	Badas	2	1	3		
15	*Cirrhinus mrigala*	Naren	2	3	2		
	Family-Ambassidae						
16	*Chanda ranga*	Kakhai	3	2	4		
	Family-Ophiocephalidae						
17	*Channa marulius*	Samal	2	2	3	2	1
18	*Channa striatus*	Kabra	3	3	4		
	Family-Claridae						
19	*Clarius batrachus*	Magur		1			1
	Family-Schlibeidae						
20	*Eutropiichthys vacha*	Charkhi	2	3	2	3	2
21	*Clupisoma garua*	Bekeri	3	2			
22	*Silonia silondia*	Silind	4	4	4		4
	Family-Cobitidae						

23	*Nemacheilus botia*	Gunguch	5	3			
	Family-Mastacembelidae						
24	*Mastacembelus armatus*	Bam	2	2	3	1	2
	Family-Bagridae						
25	*Mystus cavasius*	Kittu	3	4			
26	*Mystus seenghala*	Sighad	2	3	3		
	Family-Notopteridae						
27	*Notopterus notopterus*	Patola	2	3	4		3
	Family-Siluridae						
28	*Ompok bimaculatus*	Pabda	3	3		2	1
29	*Wallago attu*	Padhin	2	2	3	4	1
	Family-Sisoridae						
30	*Bagarius bagarius*	Andha	1	1	1		
			117	**111**	**74**	**69**	**36**

Table 13. Overall fish abundance of Chambal basin in winter season

S.No.	Species	Local Name	Chambal River	Gandhi Sagar	Gambhir Dam	Gambhir River	Kshipra River
	Family-Cyprinidae						
1	*Amblypharyngodon mola*	Dhawai	15	7		11	
2	*Labeo bata*	Bata	10	11	6	9	8
3	*Labeo boga*	Bhangan	1	3	2		
4	*Labeo calbasu*	Kalot	15	27	12	11	
5	*Labeo dyocheilus*	Borat	3	3			
6	*Labeo fimbriatus*	Gohria	6	6			
7	*Labeo gonius*	khursa	9	5			
8	*Labeo rohita*	Rohu	11	34	11	11	
9	*Labeo boggat*	-	3				
10	*Catla catla*	Catla	21	30	13	9	13
11	*Puntius conchonius*	khardi	23	28	23	26	13
12	*Puntius phutunio*	putty	5				
13	*Puntius sophore*	Kharpata	28	17	17	14	14
14	*Puntius ticto*	Kadita	33	14	10		18
15	*Osteobrama cotio*	Mohiya	62	22		12	37
16	*Oxygaster bacaila*	Chal	104	41	53	48	43
17	*Oxygaster gora*	Chal	5				
18	*Oxygaster clupeoides*	Chal	5				
19	*Danio davario*	Raiya	50	34	35	37	23
20	*Cyprinus carpio*	Common carp	9	11	10		

21	*Hypopthalimenthys molitrix*	Silver carp	1	1			
22	*Garra gotyla*	Phatarchata	39	26	14	10	
23	*Rasbora daniconius*	Darai	32	21	20	19	18
24	*Tor tor*	Badas	2	1	3		
25	*Cirrhinus mrigala*	Naren	11	10	9		
	Family-Ambassidae						
26	*Chanda nama*	Kakhai	12	18	13	13	13
27	*Chanda ranga*	Kakhai	12	13	18		
	Family-Ophiocephalidae						
28	*Channa marulius*	Samal	6	10	7	7	5
29	*Channa striatus*	Kabra	4	3	4		
30	*Channa gachua*	Samal	1				
	Family-Claridae						
31	*Clarius batrachus*	Magur		2			2
	Family-Schlibeidae						
32	*Eutropiichthys vacha*	Charkhi	12	14	12	8	12
33	*Clupisoma garua*	Bekeri	14	11			
34	*Silonia silondia*	Silind	10	13	10		12
	Family-Gobiidae						
35	*Glossogobius giuris*	Gillu	2	5		4	
	Family-Clupeidae						
36	*Gonialosa manmina*	Baroti	3	2			
	Family-Saccobranchidae						
37	*Heteropneustes fossilis*	Singhi	1	1	2		1
	Family-Cobitidae						
38	*Lepidocephalichthys guntea*	Gunguch	19	10	12	6	
39	*Nemacheilus botia*	Gunguch	8	5			
	Family-Mastacembelidae						
40	*Mastacembelus armatus*	Bam	10	9	8	6	11
41	*Mastacembelus pancalus*	Bam	1	3			
	Family-Bagridae						
42	*Mystus aor*	Diger	5	15	6	5	4
43	*Mystus bleekeri*	Kittu	5	8	7	3	5
44	*Mystus cavasius*	Kittu	3	4			
45	*Mystus seenghala*	Sighad	10	21	6		
46	*Mystus tengra*	Tengra	1				
47	*Rita rita*	Gagra	1	3			
	Family-Notopteridae						
48	*Notopterus notopterus*	Patola	10	12	9		12
	Family-Siluridae						
49	*Ompok bimaculatus*	Pabda	15	14		14	8

50	*Wallago attu*	Padhin	8	7	9	10	10
	Family-Belonidae						
51	*Xenentodon cancila*	Suza	2	3	1	1	2
	Family-Sisoridae						
52	*Bagarius bagarius*	Andha	1	1	1		
			679	**559**	**363**	**294**	**284**

Figure 7. Fish abundance in Chambal basin of M.P.

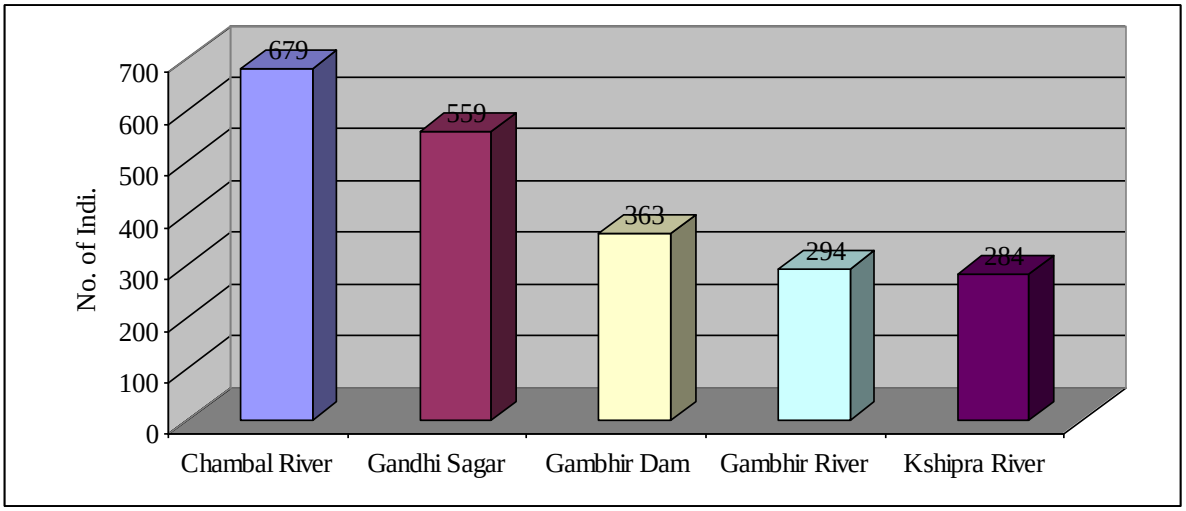


Figure 8. Family wise fish abundance in Chambal basin of M.P.

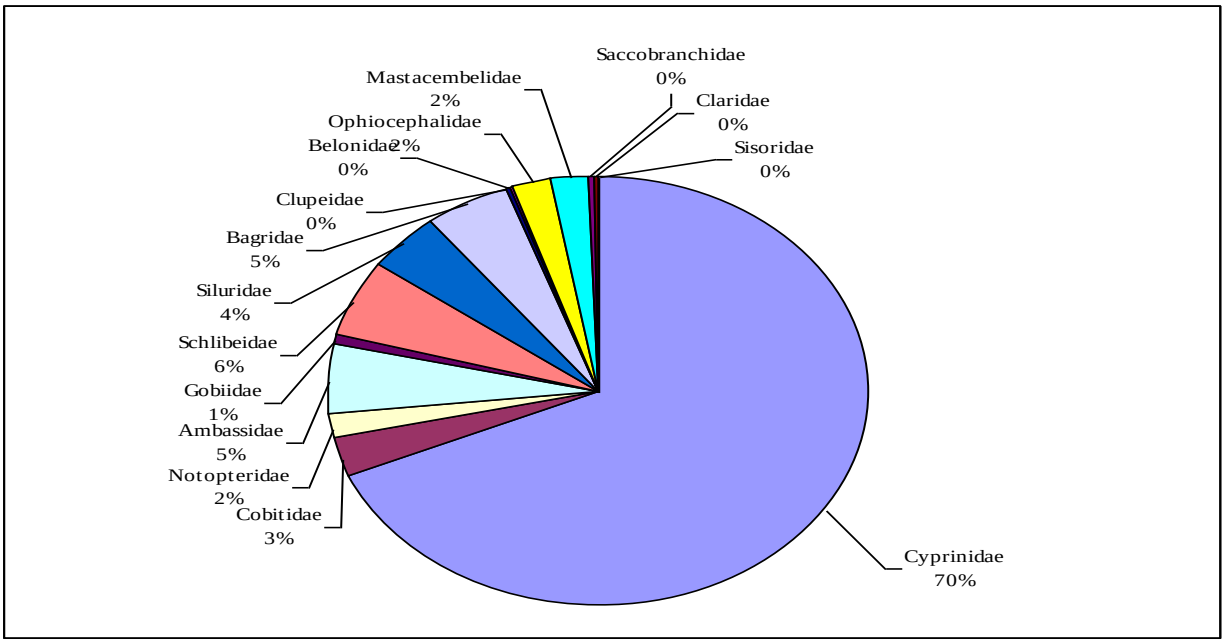


Table.14. Fish diversity of Tapti and others basin in summer season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	1	1		1	1
2	*Labeo Bata*	Bata	1	1	1	1	1
3	*Labeo rohita*	Rohu	1	1	1	1	1
4	*Labeo calbasu*	Kalot	1	1		1	1
5	*Labeo angra*	water	1				1
6	*Cirrhinus mrigala*	Naren	1	1	1	1	1
7	*Crossocheilus latius*	-	1				
8	*Catla catla*	Catla	1	1	1	1	1
9	*Puntius conchonius*	Khardi	1	1	1	1	1
10	*Puntius saphore*	Kharpata	1	1		1	1
11	*Puntius ticto*	Kadita	1	1	1	1	1
12	*Garra gotyla*	Malya	1	1	1	1	1
13	*Oxygaster bacaila*	Chal	1	1	1	1	1
14	*Oxygaster clupeoides*	Chal	1				
15	*Rasbora daniconius*	Darai	1	1	1	1	1
16	*Barilius barila*	Fegata	1				1
	Family-Cobitidae						
17	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
	Family-Notopteridae						
18	*Notopterus notopterus*	Patola	1	1	1	1	
	Family-Gobiidae						
19	*Glossogobius giuris*	Gillu	1	1	1	1	
	Family-Mastacembelidae						
20	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Schlibeidae						
21	*Clupisoma garua*	Bekeri	1	1		1	1
	Family-Siluridae						
22	*Ompok bimaculatus*	Pabda	1	1	1	1	1
23	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Bagridae						
24	*Mystus cavasius*	kittu	1	1	1	1	1
25	*Mystus bleekeri*	Kittu	1	1		1	1
26	*Mystus seenghala*	Sighad	1	1	1	1	1
	Family-Belonidae						
27	*Xenentodon cancila*	Suza Bam	1	1	1	1	

	Family-Ophiocephalidae						
28	*Channa marulius*	Samal	1	1		1	1
29	*Channa striatus*	Kabra	1	1		1	1
	Family-Cichlidae						
30	*Tilapia mossambica*	Tilapia	1				1
	Family-Mugilidae						
31	*Rhinomugil corsula*	Corsula	1				
			31	**25**	**18**	**25**	**24**

Table.15. Fish diversity of Tapti and others basin in pre-monsoon season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	1	1		1	1
2	*Labeo Bata*	Bata	1	1	1	1	1
3	*Labeo boga*	Bhangan		1			
4	*Labeo calbasu*	Kalot	1	1		1	1
5	*Labeo dero*	Dudiya		1			1
6	*Cirrhinus mrigala*	Naren	1	1	1	1	1
7	*Cyprinus carpio*	Common carp	1		1	1	1
8	*Catla catla*	Catla	1	1	1	1	1
9	*Puntius conchonius*	Khardi	1	1	1	1	1
10	*Puntius sarana*	Sikra	1	1		1	1
11	*Puntius chola*	Putty				1	
12	*Garra gotyla*	Malya	1	1	1	1	1
13	*Oxygaster bacaila*	Chal	1	1	1	1	1
14	*Rasbora daniconius*	Darai	1	1	1	1	1
15	*Osteobrama cotio*	Mohiya	1	1		1	1
16	*Barilius Bandelisis*	Fegata	1			1	1
17	*Tor tor*	Barus	1	1	1	1	
	Family-Cobitidae						
18	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
19	*Nemacheilus botia*	Gunguch	1	1		1	
	Family-Notopteridae						
20	*Notopterus notopterus*	Patola	1	1	1	1	
21	*Notopterus Chitala*	Chitala				1	
	Family-Ambassidae						
22	*Chanda ranga*	Kakhai	1	1	1	1	1
23	*Chanda nama*	Kakhai	1	1		1	1

	Family-Mastacembelidae						
24	*Mastacembelus pancalus*	Bam	1	1			1
	Family-Schlibeidae						
25	*Eutropiichthys vacha*	Vacha	1				
26	*Silondia silonia*	Silind	1				
	Family-Siluridae						
27	*Ompok bimaculatus*	Pabda	1	1	1	1	1
28	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Bagridae						
29	*Mystus tengra*	tengra	1				
30	*Mystus seenghala*	Sighad	1	1	1	1	1
31	*Mystus aor*	Diger	1	1	1		1
	Family-Ophiocephalidae						
32	*Channa gachua*	Samal	1	1		1	1
33	*Channa striatus*	Kabra	1	1		1	1
	Family-Saccobranchidae						
34	*Heteropneustes fossilis*	Singhi		1	1	1	1
	Family-Cichlidae						
35	*Tilapia mossambica*	Tilapia	1				1
	Family-Anabantidae						
36	*Badis badis*	-				1	
			30	**27**	**17**	**28**	**25**

Table.16. Fish diversity of Tapti and others basin in post-monsoon season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Hypopthalimenthys molitrix*	Silver carp	1			1	
2	*Labeo gonius*	Khursa	1	1		1	
3	*Labeo rohita*	Rohu	1	1	1	1	1
4	*Labeo calbasu*	Kalot	1	1		1	1
5	*Labeo angra*	water	1				1
6	*Labeo fimbriatus*	-	1				1
7	*Labeo dyocheilus*	Borat	1				
8	*Catla catla*	Catla	1	1	1	1	1
9	*Puntius saphore*	Kharpata	1	1		1	1
10	*Puntius sarana*	Sikra	1	1		1	1
11	*Danio davario*	Raiya	1	1			

12	*Garra gotyla*	Malya	1	1	1	1	1
13	*Oxygaster bacaila*	Chal	1	1	1	1	1
14	*Oxygaster gora*	Chal	1				1
15	*Rasbora daniconius*	Darai	1	1	1	1	1
16	*Barilius Bandelisis*	Fegata	1			1	1
17	*Tor tor*	Barus	1	1	1	1	
	Family-Cobitidae						
18	*Nemacheilus duyi*	Gunguch	1				
19	*Nemacheilus evezardi*	Gunguch	1				
	Family-Notopteridae						
20	*Notopterus notopterus*	Patola	1	1	1	1	
	Family-Ambassidae						
21	*Chanda nama*	Kakhai	1	1		1	1
	Family-Sisoridae						
22	*Bagarius bagarius*	Andha	1				
	Family-Gobiidae						
	Family-Mastacembelidae						
23	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Schlibeidae						
24	*Clupisoma garua*	Bekeri	1	1		1	1
25	*Eutropiichthys vacha*	Vacha	1				
	Family-Siluridae						
26	*Ompok bimaculatus*	Pabda	1	1	1	1	1
	Family-Bagridae						
27	*Mystus cavasius*	kittu	1	1	1	1	1
28	*Mystus seenghala*	Sighad	1	1	1	1	1
29	*Rita rita*	Gagra		1			
	Family-Belonidae						
30	*Xenentodon cancila*	Suza Bam	1	1	1	1	
	Family-Nandidae						
31	*Nandus nandus*	Kabri		1		1	1
	Family-Ophiocephalidae						
32	*Channa marulius*	Samal	1	1		1	1
33	*Channa punctatus*	Karra	1				
	Family-Saccobranchidae						
34	*Heteropneustes fossilis*	Singhi		1	1	1	1
	Family-Claridae						
35	*Clarias batrachus*	Magur	1	1	1		
			32	**24**	**14**	**23**	**21**

Table 17. Fish diversity of Tapti and others basin in winter season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	1	1		1	1
2	*Labeo Bata*	Bata	1	1	1	1	1
3	*Labeo gonius*	Khursa	1	1		1	
4	*Labeo rohita*	Rohu	1	1	1	1	1
5	*Labeo calbasu*	Kalot	1	1		1	1
6	*Labeo fimbriatus*	-	1				1
7	*Cirrhinus mrigala*	Naren	1	1	1	1	1
8	*Cyprinus carpio*	Common carp	1		1	1	1
9	*Catla catla*	Catla	1	1	1	1	1
10	*Chela laubuca*	Chelar	1	1		1	1
11	*Puntius conchonius*	Khardi	1	1	1	1	1
12	*Puntius sarana*	Sikra	1	1		1	1
13	*Puntius ticto*	Kadita	1	1	1	1	1
14	*Danio davario*	Raiya	1	1			
15	*Garra gotyla*	Malya	1	1	1	1	1
16	*Oxygaster bacaila*	Chal	1	1	1	1	1
17	*Rasbora daniconius*	Darai	1	1	1	1	1
18	*Osteobrama cotio*	Mohiya	1	1		1	1
	Family-Cobitidae						
19	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
20	*Nemacheilus evezardi*	Gunguch	1				
	Family-Notopteridae						
21	*Notopterus notopterus*	Patola	1	1	1	1	
	Family-Ambassidae						
22	*Chanda nama*	Kakhai	1	1		1	1
	Family-Gobiidae						
23	*Glossogobius giuris*	Gillu	1	1	1	1	
	Family-Mastacembelidae						
24	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Schlibeidae						
25	*Clupisoma garua*	Bekeri	1	1		1	1
	Family-Siluridae						
26	*Ompok bimaculatus*	Pabda	1	1	1	1	1
27	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Bagridae						
28	*Mystus cavasius*	kittu	1	1	1	1	1

29	*Mystus bleekeri*	Kittu	1	1		1	1
	Family-Ophiocephalidae						
30	*Channa marulius*	Samal	1	1		1	1
31	*Channa gachua*	Samal	1	1		1	1
	Family-Cichlidae						
32	*Tilapia mossambica*	Tilapia	1				1
			32	**28**	**17**	**28**	**26**

Table 18. Overall fish diversity of Tapti and others basin during the study

S. No	Species	Common Name	Tapti basin	Ken basin	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	1	1		1	1
2	*Hypopthalimenthys molitrix*	Silver carp	1			1	
3	*Labeo Bata*	Bata	1	1	1	1	1
4	*Labeo gonius*	Khursa	1	1		1	
5	*Labeo boga*	Bhangan		1			
6	*Labeo rohita*	Rohu	1	1	1	1	1
7	*Labeo calbasu*	Kalot	1	1		1	1
8	*Labeo dero*	Dudiya		1			1
9	*Labeo angra*	water	1				1
10	*Labeo fimbriatus*	-	1				1
11	*Labeo dyocheilus*	Borat	1				
12	*Cirrhinus mrigala*	Naren	1	1	1	1	1
13	*Cyprinus carpio*	Common carp	1		1	1	1
14	*Crossocheilus latius*	-	1				
15	*Catla catla*	Catla	1	1	1	1	1
16	*Chela laubuca*	Chelar	1	1		1	1
17	*Puntius conchonius*	Khardi	1	1	1	1	1
18	*Puntius saphore*	Kharpata	1	1		1	1
19	*Puntius sarana*	Sikra	1	1		1	1
20	*Puntius ticto*	Kadita	1	1	1	1	1
21	*Puntius chola*	putty				1	
22	*Danio davario*	Raiya	1	1			
23	*Garra gotyla*	Malya	1	1	1	1	1
24	*Oxygaster bacaila*	Chal	1	1	1	1	1
25	*Oxygaster gora*	Chal	1				1
26	*Oxygaster clupeoides*	Chal	1				
27	*Rasbora daniconius*	Darai	1	1	1	1	1

28	*Osteobrama cotio*	Mohiya	1	1		1	1
29	*Barilius Bandelisis*	Fegata	1			1	1
30	*Barilius barila*	Fegata	1				1
31	*Tor tor*	Barus	1	1	1	1	
	Family-Cobitidae						
32	*Lepidocephalichthys guntea*	Gunguch	1	1	1	1	
33	*Nemacheilus botia*	Gunguch	1	1			
34	*Nemacheilus duyi*	Gunguch	1				
35	*Nemacheilus evezardi*	Gunguch	1				
	Family-Notopteridae						
36	*Notopterus notopterus*	Patola	1	1	1	1	
37	*Notopterus Chitala*	Chitala					
	Family-Ambassidae						
38	*Chanda ranga*	Kakhai	1	1	1	1	1
39	*Chanda nama*	Kakhai	1	1		1	1
	Family-Sisoridae						
40	*Bagarius bagarius*	Andha	1				
	Family-Gobiidae						
41	*Glossogobius giuris*	Gillu	1	1	1	1	
	Family-Mastacembelidae						
42	*Mastacembelus pancalus*	Bam	1	1			1
43	*Mastacembelus armatus*	Bam	1	1	1	1	1
	Family-Schlibeidae						
44	*Clupisoma garua*	Bekeri	1	1		1	1
45	*Eutropiichthys vacha*	Vacha	1				
46	*Silondia silonia*	Silind	1				
	Family-Siluridae						
47	*Ompok bimaculatus*	Pabda	1	1	1	1	1
48	*Wallago attu*	Padhin	1	1	1	1	1
	Family-Bagridae						
49	*Mystus cavasius*	kittu	1	1	1	1	1
50	*Mystus tengra*	tengra	1				
51	*Mystus bleekeri*	Kittu	1	1		1	1
52	*Mystus seenghala*	Sighad	1	1	1	1	1
53	*Mystus aor*	Diger	1	1	1		1
54	*Rita rita*	Gagra		1			
	Family-Belonidae						
55	*Xenentodon cancila*	Suza Bam	1	1	1	1	
	Family-Nandidae						
56	*Nandus nandus*	Kabri		1		1	1
	Family-Ophiocephalidae						

57	*Channa marulius*	Samal	1	1		1	1
58	*Channa gachua*	Samal	1	1		1	1
59	*Channa punctatus*	Karra	1				
60	*Channa striatus*	Kabra	1	1		1	1
	Family-Saccobranchidae						
61	*Heteropneustes fossilis*	Singhi		1	1	1	1
	Family-Claridae						
62	*Clarias batrachus*	Magur	1	1	1		
	Family-Cichlidae						
63	*Tilapia mossambica*	Tilapia	1				1
	Family-Anabantidae						
64	*Badis badis*	-				1	
	Family-Mugilidae						
65	*Rhinomugil corsula*	Corsula	1				
			57	**43**	**24**	**42**	**39**

Figure 9. Fish diversity in Tapti and others basin of M.P.

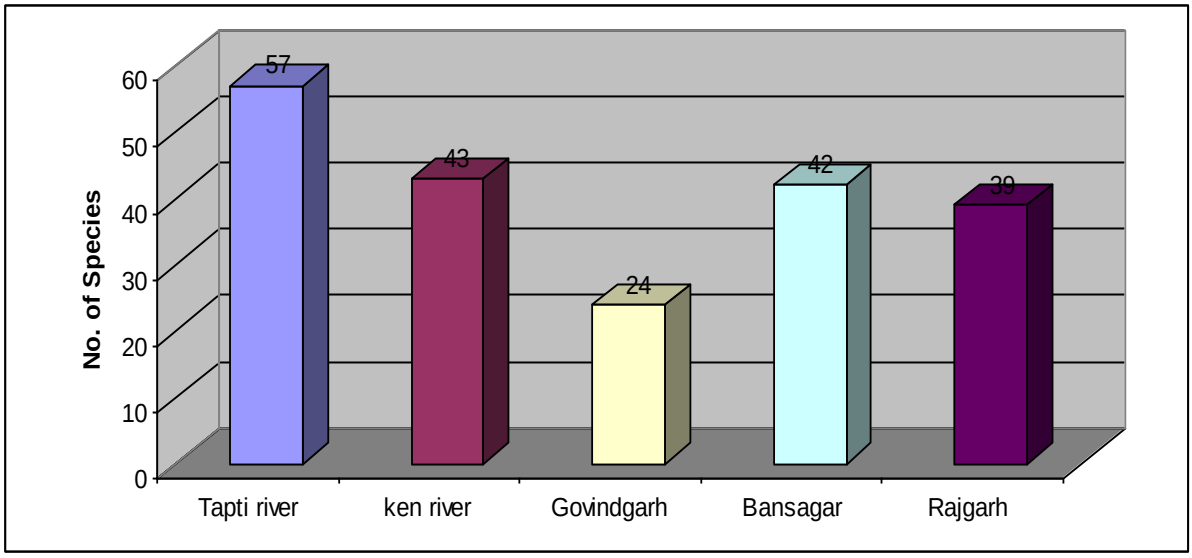


Figure 10. Family wise composition in Tapti and others basin of M.P.

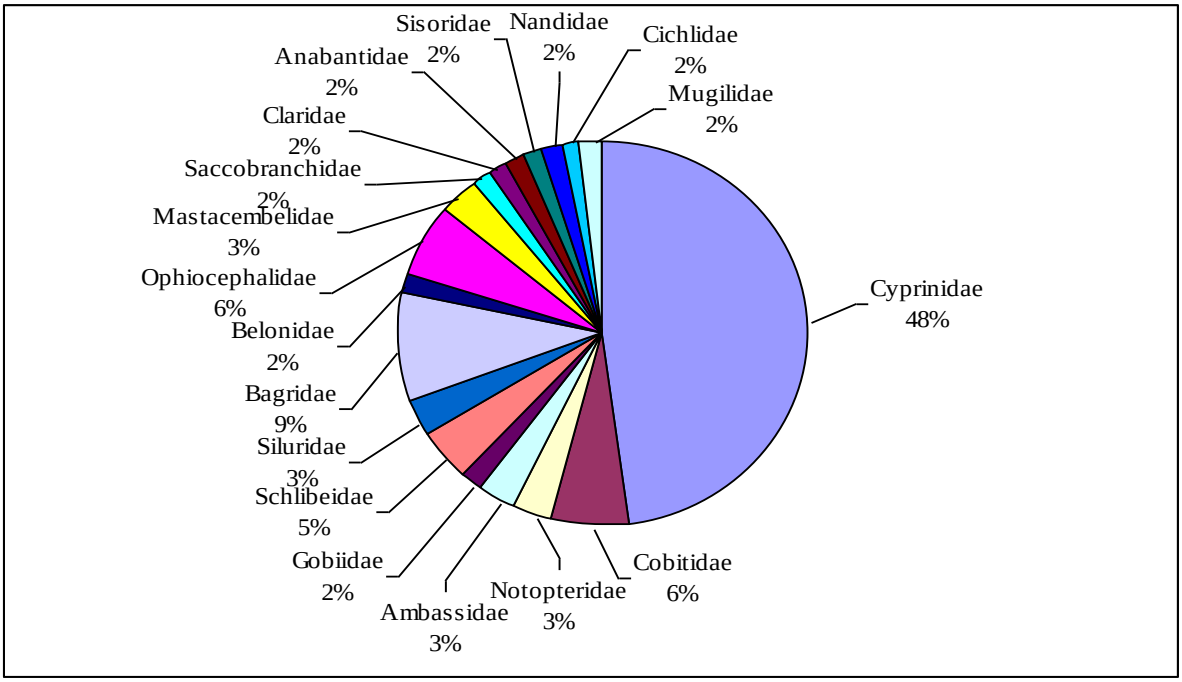


Table 19. Fish abundance of Tapti and others basin in summer season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	2	1		3	5
2	*Labeo Bata*	Bata	3	1	2	2	3
3	*Labeo rohita*	Rohu	1	2	3	5	2
4	*Labeo calbasu*	Kalot	3	1		3	3
5	*Labeo angra*	water	1				1
6	*Cirrhinus mrigala*	Naren	3	2	2	1	1
7	*Crossocheilus latius*	-	3				
8	*Catla catla*	Catla	2	2	2	3	1
9	*Puntius conchonius*	Khardi	10	3	13	2	10
10	*Puntius saphore*	Kharpata	11	1		6	2
11	*Puntius ticto*	Kadita	15	10	6	3	15
12	*Garra gotyla*	Malya	16	6	3	2	7
13	*Oxygaster bacaila*	Chal	25	10	7	12	6
14	*Oxygaster clupeoides*	Chal	3				
15	*Rasbora daniconius*	Darai	5	2	5	4	2
16	*Barilius barila*	Fegata	1				1
	Family-Cobitidae						

17	*Lepidocephalichthys guntea*	Gunguch	5	3	3	3	
	Family-Notopteridae						
18	*Notopterus notopterus*	Patola	3	1	2	1	
	Family-Gobiidae						
19	*Glossogobius giuris*	Gillu	3	2	1	3	
	Family-Mastacembelidae						
20	*Mastacembelus armatus*	Bam	2	3	1	2	3
	Family-Schlibeidae						
21	*Clupisoma garua*	Bekeri	4	2		3	2
	Family-Siluridae						
22	*Ompok bimaculatus*	Pabda	3	1	6	5	3
23	*Wallago attu*	Padhin	2	2	3	2	2
	Family-Bagridae						
24	*Mystus cavasius*	kittu	2	3	2	3	3
25	*Mystus bleekeri*	Kittu	2	2		2	4
26	*Mystus seenghala*	Sighad	1	1	3	1	2
	Family-Belonidae						
27	*Xenentodon cancila*	Suza Bam	3	2	1	2	
	Family-Ophiocephalidae						
28	*Channa marulius*	Samal	1	2		1	1
29	*Channa striatus*	Kabra	2	1		1	1
	Family-Cichlidae						
30	*Tilapia mossambica*	Tilapia	3				4
	Family-Mugilidae						
31	*Rhinomugil corsula*	Corsula	2				
			142	**66**	**65**	**75**	**84**

Table 20. Fish abundance of Tapti and others basin in pre monsoon season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	3	2		2	4
2	*Labeo Bata*	Bata	2	4	2	3	1
3	*Labeo boga*	Bhangan		1			
4	*Labeo calbasu*	Kalot	6	3		3	2
5	*Labeo dero*	Dudiya		2			3
6	*Cirrhinus mrigala*	Naren	2	1	3	4	2
7	*Cyprinus carpio*	Common carp	2		3	2	1

8	*Catla catla*	Catla	3	3	2	3	2
9	*Puntius conchonius*	Khardi	13	20	10	5	2
10	*Puntius sarana*	Sikra	3	5		6	2
11	*Puntius chola*	Putty				3	
12	*Garra gotyla*	Malya	5	2	11	5	2
13	*Oxygaster bacaila*	Chal	15	22	25	10	17
14	*Rasbora daniconius*	Darai	11	3	9	7	23
15	*Osteobrama cotio*	Mohiya	10	3		6	3
16	*Barilius Bandelisis*	Fegata	3			3	3
17	*Tor tor*	Barus	3	2	1	1	
	Family-Cobitidae						
18	*Lepidocephalichthys guntea*	Gunguch	6	3	6	2	
19	*Nemacheilus botia*	Gunguch	3	2		3	
	Family-Notopteridae						
20	*Notopterus notopterus*	Patola	2	1	2	2	
21	*Notopterus Chitala*	Chitala				1	
	Family-Ambassidae						
22	*Chanda ranga*	Kakhai	4	2	2	2	3
23	*Chanda nama*	Kakhai	5	3		1	6
	Family-Mastacembelidae						
24	*Mastacembelus pancalus*	Bam	3	1			2
	Family-Schlibeidae						
25	*Eutropiichthys vacha*	Vacha	2				
26	*Silondia silonia*	Silind	1				
	Family-Siluridae						
27	*Ompok bimaculatus*	Pabda	3	2	3	4	3
28	*Wallago attu*	Padhin	2	1	2	3	6
	Family-Bagridae						
29	*Mystus tengra*	tengra	1				
30	*Mystus seenghala*	Sighad	2	1	2	3	4
31	*Mystus aor*	Diger	2	2	1		2
	Family-Ophiocephalidae						
32	*Channa gachua*	Samal	2	1		2	1
33	*Channa striatus*	Kabra	1	2		1	1
	Family-Saccobranchidae						
34	*Heteropneustes fossilis*	Singhi		1	2	1	1
	Family-Cichlidae						
35	*Tilapia mossambica*	Tilapia	20				3
	Family-Anabantidae						

36	*Badis badis*	-				3	
			141	**95**	**86**	**91**	**99**

Table 21. Fish abundance of Tapti and others basin in post monsoon season

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Hypopthalimenthys molitrix*	Silver carp	1			1	
2	*Labeo gonius*	Khursa	2	3		4	
3	*Labeo rohita*	Rohu	3	2	2	6	3
4	*Labeo calbasu*	Kalot	3	3		3	4
5	*Labeo angra*	water	3				2
6	*Labeo fimbriatus*	-	2				3
7	*Labeo dyocheilus*	Borat	2				
8	*Catla catla*	Catla	2	3	4	3	4
9	*Puntius saphore*	Kharpata	6	2		6	2
10	*Puntius sarana*	Sikra	3	3		2	3
11	*Danio davario*	Raiya	5	3			
12	*Garra gotyla*	Malya	6	2	5	3	4
13	*Oxygaster bacaila*	Chal	20	8	10	2	3
14	*Oxygaster gora*	Chal	2				2
15	*Rasbora daniconius*	Darai	7	3	6	4	3
16	*Barilius Bandelisis*	Fegata	2			2	2
17	*Tor tor*	Barus	3	2	1	1	
	Family-Cobitidae						
18	*Nemacheilus dayi*	Gunguch	6				
19	*Nemacheilus evezardi*	Gunguch	4				
	Family-Notopteridae						
20	*Notopterus notopterus*	Patola	2	2	3	2	
	Family-Ambassidae						
21	*Chanda nama*	Kakhai	6	3		7	5
	Family-Sisoridae						
22	*Bagarius bagarius*	Andha	3				
	Family-Gobiidae						
	Family-Mastacembelidae						
23	*Mastacembelus armatus*	Bam	2	2	1	2	3
	Family-Schlibeidae						
24	*Clupisoma garua*	Bekeri	3	4		4	5
25	*Eutropiichthys vacha*	Vacha	2				
	Family-Siluridae						
26	*Ompok bimaculatus*	Pabda	2	3	2	3	2

	Family-Bagridae						
27	*Mystus cavasius*	Kittu	2	3	3	2	1
28	*Mystus seenghala*	Sighad	3	2	1	2	3
29	*Rita rita*	Gagra		1			
	Family-Belonidae						
30	*Xenentodon cancila*	Suza Bam	2	3	1	2	
	Family-Nandidae						
31	*Nandus nandus*	Kabri		2		1	3
	Family-Ophiocephalidae						
32	*Channa marulius*	Samal	1	2		1	1
33	*Channa punctatus*	Karra	2				
	Family-Saccobranchidae						
34	*Heteropneustes fossilis*	Singhi		2	3	1	2
	Family-Claridae						
35	*Clarias batrachus*	Magur	2	1	1		
			115	**64**	**43**	**64**	**60**

Table 22. Fish abundance of Tapti and others basin in winter season

S. No	Species	Common Name	Tapti	Ken	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	6	2		2	6
2	*Labeo Bata*	Bata	2	1	2	3	4
3	*Labeo gonius*	Khursa	3	2		1	
4	*Labeo rohita*	Rohu	1	2	3	2	3
5	*Labeo calbasu*	Kalot	4	3		4	4
6	*Labeo fimbriatus*	-	2				2
7	*Cirrhinus mrigala*	Naren	1	2	3	2	3
8	*Cyprinus carpio*	Common carp	3		4	3	10
9	*Catla catla*	Catla	2	3	2	2	15
10	*Chela laubuca*	Chelar	3	4		3	3
11	*Puntius conchonius*	Khardi	11	3	9	6	10
12	*Puntius sarana*	Sikra	5	2		2	5
13	*Puntius ticto*	Kadita	13	9	7	9	14
14	*Danio davario*	Raiya	10	5			
15	*Garra gotyla*	Malya	8	4	5	7	6
16	*Oxygaster bacaila*	Chal	18	10	6	8	15
17	*Rasbora daniconius*	Darai	6	5	4	2	6
18	*Osteobrama cotio*	Mohiya	7	4		4	3
	Family-Cobitidae						

19	*Lepidocephalichthys guntea*	Gunguch	3	6	5	4	
20	*Nemacheilus evezardi*	Gunguch	2				
	Family-Notopteridae						
21	*Notopterus notopterus*	Patola	3	1	2	3	
	Family-Ambassidae						
22	*Chanda nama*	Kakhai	3	2		6	5
	Family-Gobiidae						
23	*Glossogobius giuris*	Gillu	2	3	1	4	
	Family-Mastacembelidae						
24	*Mastacembelus armatus*	Bam	2	2	1	3	3
	Family-Schlibeidae						
25	*Clupisoma garua*	Bekeri	3	4		2	6
	Family-Siluridae						
26	*Ompok bimaculatus*	Pabda	4	2	6	3	4
27	*Wallago attu*	Padhin	3	2	1	2	5
	Family-Bagridae						
28	*Mystus cavasius*	kittu	3	2	1	2	5
29	*Mystus bleekeri*	Kittu	4	3	5	4	4
	Family-Ophiocephalidae						
30	*Channa marulius*	Samal	1	2		1	2
31	*Channa gachua*	Samal	2	1		1	3
	Family-Cichlidae						
32	*Tilapia mossambica*	Tilapia	12				4
			152	**91**	**67**	**95**	**150**

Table 23. Overall fish abundance of Tapti and others basin during the study

S. No	Species	Common Name	Tapti River	Ken River	Son Basin		Rajgarh
					Govindgarh	Bansagar	
	Family-Cyprinidae						
1	*Amblypharogodon mola*	Dhawai	12	5		7	15
2	*Hypopthalimenthys molitrix*	Silver carp				1	
3	*Labeo Bata*	Bata	7	6	6	8	8
4	*Labeo gonius*	Khursa	5	5		5	
5	*Labeo boga*	Bhangan		1			
6	*Labeo rohita*	Rohu	5	6	8	13	8
7	*Labeo calbasu*	Kalot	16	10		13	13
8	*Labeo dero*	Dudiya		2			3
9	*Labeo angra*	water	4				3
10	*Labeo fimbriatus*	-	4				5
11	*Labeo dyocheilus*	Borat	2				

12	*Cirrhinus mrigala*	Naren	6	5	8	7	6
13	*Cyprinus carpio*	Common carp	5		7	5	11
14	*Crossocheilus latius*	-	3				
15	*Catla catla*	Catla	9	11	10	11	22
16	*Chela laubuca*	Chelar	3	4		3	3
17	*Puntius conchonius*	Khardi	34	26	32	13	22
18	*Puntius saphore*	Kharpata	17	3		12	4
19	*Puntius sarana*	Sikra	11	10		10	10
20	*Puntius ticto*	Kadita	28	19	13	12	29
21	*Puntius chola*	Putty				3	
22	*Danio davario*	Raiya	15	8			
23	*Garra gotyla*	Malya	35	14	24	17	19
24	*Oxygaster bacaila*	Chal	78	50	48	32	41
25	*Oxygaster gora*	Chal	2				2
26	*Oxygaster clupeoides*	Chal	3				
27	*Rasbora daniconius*	Darai	29	13	24	17	34
28	*Osteobrama cotio*	Mohiya	17	7		10	6
29	*Barilius Bandelisis*	Fegata	5			5	5
30	*Barilius barila*	Fegata	1				1
31	*Tor tor*	Barus	6	4	2	2	
	Family-Cobitidae						
32	*Lepidocephalichthys guntea*	Gunguch	14	12	14	9	
33	*Nemacheilus botia*	Gunguch	3	2		3	
34	*Nemacheilus duyi*	Gunguch	6				
35	*Nemacheilus evezardi*	Gunguch	6				
	Family-Notopteridae						
36	*Notopterus notopterus*	Patola	10	5	9	8	
37	*Notopterus chitala*	Chitala				1	
	Family-Ambassidae						
38	*Chanda ranga*	Kakhai	4	2	2	2	3
39	*Chanda nama*	Kakhai	14	8		14	16
	Family-Sisoridae						
40	*Bagarius bagarius*	Andha	3				
	Family-Gobiidae						
41	*Glossogobius giuris*	Gillu	5	5	2	7	
	Family-Mastacembelidae						
42	*Mastacembelus pancalus*	Bam	3	1			2
43	*Mastacembelus armatus*	Bam	6	7	3	7	9
	Family-Schlibeidae						
44	*Clupisoma garua*	Bekeri	10	10		9	13

45	*Eutropiichthys vacha*	Vacha	4				
46	*Silondia silonia*	Silind	1				
	Family-Siluridae						
47	*Ompok bimaculatus*	Pabda	12	8	17	15	12
48	*Wallago attu*	Padhin	7	5	6	7	13
	Family-Bagridae						
49	*Mystus cavasius*	Tittu	7	8	6	7	9
50	*Mystus tengra*	Tengra	1				
51	*Mystus bleekeri*	Kittu	6	5	5	6	8
52	*Mystus seenghala*	Sighad	6	4	6	6	9
53	*Mystus aor*	Diger	2	2	1		2
54	*Rita rita*	Gagra		1			
	Family-Belonidae						
55	*Xenentodon cancila*	Suza Bam	5	5	2	4	
	Family-Nandidae						
56	*Nandus nandus*	Kabri		2		1	3
	Family-Ophiocephalidae						
57	*Channa marulius*	Samal	3	6		3	4
58	*Channa gachua*	Samal	4	2		3	4
59	*Channa punctatus*	Karra	2				
60	*Channa striatus*	Kabra	3	3		2	2
	Family-Saccobranchidae						
61	*Heteropneustes fossilis*	Singhi		3	5	2	3
	Family-Claridae						
62	*Clarias batrachus*	Magur	2	1	1		
	Family-Cichlidae						
63	*Tilapia mossambica*	Tilapia	35				11
	Family-Anabantidae						
64	*Badis badis*	-				3	
	Family-Mugilidae						
65	*Rhinomugil corsula*	Corsula	2				
			549	**316**	**261**	**325**	**393**

Figure 11. Fish abundance in Tapti and other basin of M.P

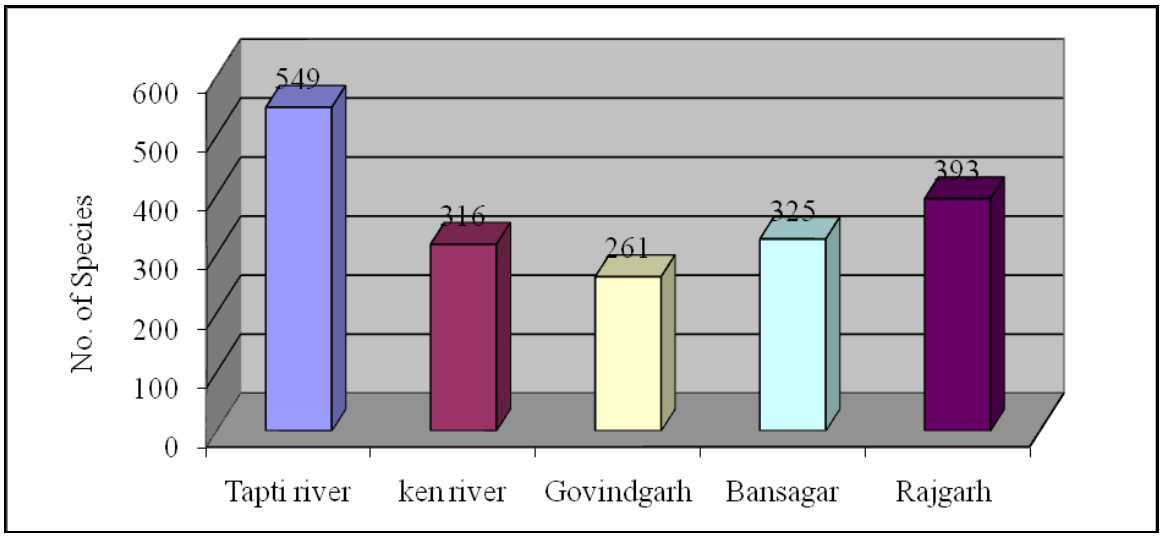
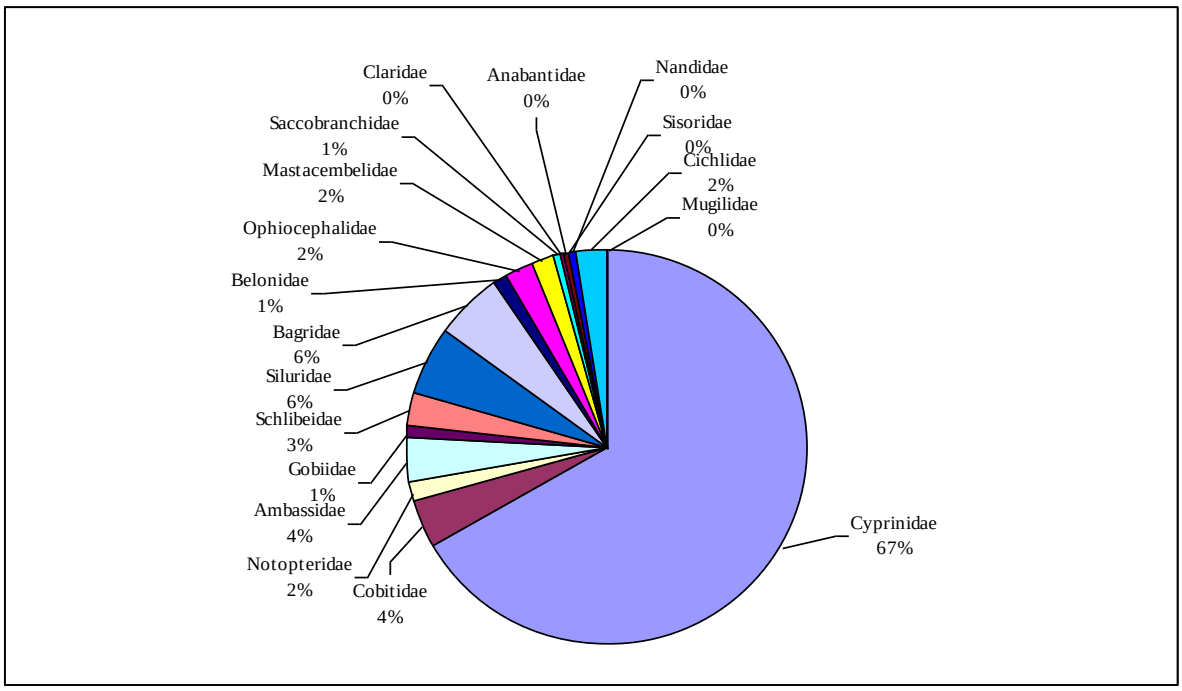


Figure 12. Family wise fish abundance in Tapti and other basin of M.P.



8.2. Conservation status of fishes

Freshwater fish species of Madhya Pradesh Under conservation status as per CAFF (2006) has been made in six categories viz. EN (Endangered), VU (Vulnerable), LRlc (Lower risk lest concern), LRnt (Lower risk near threatened), DD (Data deficient) and NE (Not evaluated).

Over all fish conservation status of fishes in M.P. throughout the study period. The total of 86 species were recorded in different river basin of M.P. out of 27 (31%) species belongs to LRnt, 19 (22%) species belongs to VU, 9 (11%) species under LRlc, 9 (10%) species were found in EN, 12 (14%) species represented DD and 10 (12%) species belongs to NE category.

8.2.1 Basin wise conservation status of fishes

8.2.1.1. Betwa basin

Total 67 species were documented in Betwa basin of M.P. out of 26 (39%) species belongs to LRnt, 16 (24%) species belongs to VU, 8 (12%) species under LRlc, 8 (12%) species were found in EN, 4 (6%) species represented DD and 5 (7%) species belongs to NE category.

8.2.1.2. Chambal basin

During the study 52 species were recorded in Chambal basin of M.P. out of 22 (42%) species belongs to LRnt, 11 (21%) species belongs to VU, 6 (12%) species under LRlc, 6 (12%) species were found in EN, 4 (8%) species represented DD and 3 (6%) species belongs to NE category.

8.2.1.3. Tapti basin

A total of 57 species were recorded in Tapti basin of M.P throughout the study, out of 24 (42%) species belongs to LRnt, 12 (21%) species belongs to VU, 5 (9%) species under LRlc, 5 (9%) species were found in EN, 7 (12%) species represented DD and 4 (7%) species belongs to NE category.

8.2.1.4. Ken basin

A total of 43 species were recorded in Ken basin of M.P throughout the study, out of 19 (44%) species belongs to LRnt, 10 (23%) species belongs to VU, 6 (14%) species under LRlc, 5 (12%) species were found in EN, 1 (2%) species represented DD and 2 (5%) species belongs to NE category.

8.2.1.5. Son basin

A total of 44 species were recorded in Ken basin of M.P throughout the study, out of 19 (43%) species belongs to LRnt, 9 (20%) species belongs to VU, 6 (14%) species under LRlc, 5 (11%) species were found in EN, 2 (5 %) species represented DD and 3 (8%) species belongs to NE category.

8.2.1.6. Rajgarh district

A total of 39 species were recorded in Rajgarh basin of M.P throughout the study, out of 19 (49%) species belongs to LRnt, 9 (23%) species belongs to VU, 5 (13%) species under LRlc, 1 (2%) species were found in EN, 2 (5%) species represented DD and 3 (8%) species belongs to NE category.

Table. 24. Fish conservation status in Betwa basin

S. No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharogodon mola*	Cyprinidae	Betwa river,Upper lake	LR-lc
2	*Labeo Bata*	Cyprinidae	Betwa river	LRnt
3	*Labeo gonius*	Cyprinidae	Betwa river,Halali Reservoir	LRnt
4	*Labeo boga*	Cyprinidae	Betwa river,Upper lake	LRnt
5	*Labeo rohita*	Cyprinidae	Betwa river,Upper lake, Halali Reservoir	LR-lc
6	*Labeo calbasu*	Cyprinidae	Betwa river,Halali Reservoir,Upper lake	LRnt
7	*Labeo dero*	Cyprinidae	Upper lake	VU
8	*Labeo angra*	Cyprinidae	Betwa river,Upper lake	LRnt
9	*Labeo fimbriatus*	Cyprinidae	Betwa river	LRnt
10	*Labeo dussuniere*	Cyprinidae	Upper lake	VU
11	*Cirrhinus mrigala*	Cyprinidae	Betwa river,Halali Reservoir,Upper lake	LRnt
12	*Cyprinus carpio*	Cyprinidae	Betwa river	NE
13	*Catla catla*	Cyprinidae	Betwa river,Halali Reservoir,Upper lake	LRnt
14	*Chela laubuca*	Cyprinidae	Betwa river	LR-lc
15	*Esomus danricus*	Cyprinidae	Upper lake	LR-lc
16	*Puntius conchonius*	Cyprinidae	Betwa river,Upper lake	LRnt
17	*Puntius saphore*	Cyprinidae	Betwa river,Halali Reservoir,Upper lake	LRnt

18	*Puntius dorsalis*	Cyprinidae	Betwa river	EN
19	*Puntius sarana*	Cyprinidae	Betwa river,Halali Reservoir,Upper lake	VU
20	*Puntius ticto*	Cyprinidae	Betwa river,Upper lake	LRnt
21	*Puntius titius*	Cyprinidae	Betwa river	NE
22	*Danio davario*	Cyprinidae	Betwa river,Upper lake	LRnt
23	*Garra gotyla*	Cyprinidae	Betwa river,Halali Reservoir	VU
24	*Oxygaster bacaila*	Cyprinidae	Betwa river,Halali Reservoir	DD
25	*Oxygaster gora*	Cyprinidae	Betwa river,Upper lake	DD
26	*Oxygaster clupeoides*	Cyprinidae	Betwa river	DD
27	*Rasbora elanga*	Cyprinidae	Betwa river,Upper lake	NE
28	*Rasbora daniconius*	Cyprinidae	Betwa river	LR-lc
29	*Osteobrama cotio*	Cyprinidae	Betwa river,Upper lake	LRnt
30	*Garra lamta*	Cyprinidae	Upper lake	VU
31	*Barilius Bandelisis*	Cyprinidae	Betwa river,Halali Reservoir	LRnt
32	*Barilius barila*	Cyprinidae	Betwa river	LRnt
33	*Tor tor*	Cyprinidae	Betwa river	EN
34	*Lepidocephalichthys guntea*	Cobitidae	Betwa river,Upper lake	LR-lc
35	*Nemacheilus botia*	Cobitidae	Betwa river,Upper lake	EN
36	*Notopterus notopterus*	Notopteridae	Betwa river,Halali Reservoir,Upper lake	EN
37	*Notopterus Chitala*	Notopteridae	Halali Reservoir	EN
38	*Chanda ranga*	Ambassidae	Betwa river,Upper lake	LR-lc
39	*Chanda nama*	Ambassidae	Betwa river,Upper lake	VU
40	*Bagarius bagarius*	Sisoridae	Betwa river	VU
41	*Glossogobius giuris*	Gobiidae	Betwa river,Upper lake	LRnt
42	*Mastacembelus pancalus*	Mastacembelidae	Betwa river,Upper lake	VU
43	*Mastacembelus armatus*	Mastacembelidae	Betwa river,Halali Reservoir,Upper lake	LRnt
44	*Clupisoma garua*	Schlibeidae	Betwa river	VU
45	*Eutropiichthys vacha*	Schlibeidae	Betwa river	EN
46	*Silondia silonia*	Schlibeidae	Betwa river	LRnt
47	*Ompok bimaculatus*	Siluridae	Betwa river,Halali Reservoir,Upper lake	EN
48	*Wallago attu*	Siluridae	Betwa river,Halali Reservoir	LRnt
49	*Mystus cavasius*	Bagridae	Betwa river	LRnt

50	*Mystus tengra*	Bagridae	Betwa river	DD
51	*Mystus bleekeri*	Bagridae	Betwa river,Halali Reservoir,Upper lake	VU
52	*Mystus seenghala*	Bagridae	Betwa river,Halali Reservoir	LRnt
53	*Mystus aor*	Bagridae	Betwa river,Halali Reservoir	LRnt
54	*Rita rita*	Bagridae	Betwa river	EN
55	*Gonialosa manmina*	Clupeidae	Betwa river,Upper lake	VU
56	*Gudusia chapra*	Clupeidae	Halali Reservoir	LR-lc
57	*Xenentodon cancila*	Belonidae	Betwa river,Halali Reservoir,Upper lake	LRnt
58	*Nandus nandus*	Nandidae	Betwa river	LRnt
59	*Channa marulius*	Ophiocephalidae	Betwa river,Halali Reservoir	VU
60	*Channa gachua*	Ophiocephalidae	Betwa river,Upper lake	NE
61	*Channa punctatus*	Ophiocephalidae	Betwa river	LRnt
62	*Channa striatus*	Ophiocephalidae	Betwa river,Upper lake	LRnt
63	*Heteropneustes fossilis*	Saccobranchidae	Betwa river,Upper lake	VU
64	*Clarias batrachus*	Clariidae	Betwa river	VU
65	*Rhinomugil corsula*	Mugilidae	Betwa river,Halali Reservoir	VU
66	*Colisa fasciatus*	Anabantidae	Upper lake	VU
67	*Tilapia mossambica*	Cichlidae	Betwa river	NE

Figure 13. Fish species conservation status according to CAFF (2006) in Betwa basin

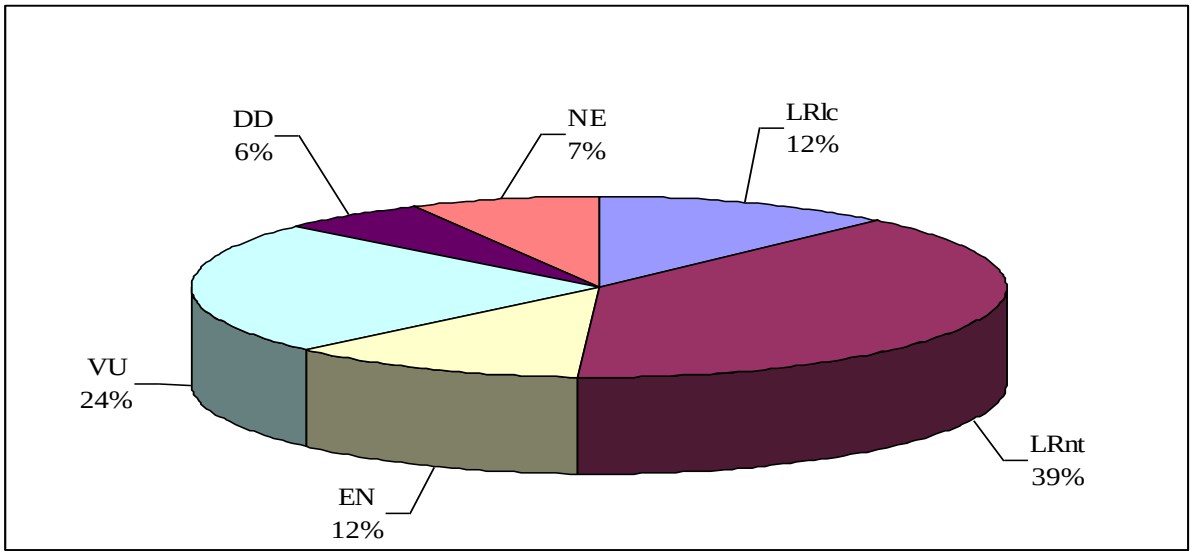


Table 25. Fish conservation status in Chambal basin

S.No.	Species	Family	Distribution	CAFF (2006)
1	*Amblypharyngodon mola*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir river	LR-lc
2	*Labeo bata*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
3	*Labeo boga*	Cyprinidae	Chambal river,Gandhi sagar,	LRnt
4	*Labeo calbasu*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river	LRnt
5	*Labeo dyocheilus*	Cyprinidae	Chambal river,Gandhi sagar	VU
6	*Labeo fimbriatus*	Cyprinidae	Chambal river,Gandhi sagar	LRnt
7	*Labeo gonius*	Cyprinidae	Chambal river,Gandhi sagar,	LRnt
8	*Labeo rohita*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river	LR-lc
9	*Labeo boggat*	Cyprinidae	Chambal river	LRnt
10	*Catla catla*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
11	*Puntius conchonius*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
12	*Puntius phutunio*	Cyprinidae	Chambal river	LR-lc
13	*Puntius sophore*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
14	*Puntius ticto*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam	LRnt
15	*Osteobrama cotio*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir river, Shipra river	LRnt

16	*Oxygaster bacaila*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	DD
17	*Oxygaster gora*	Cyprinidae	Chambal river	DD
18	*Oxygaster clupeoides*	Cyprinidae	Chambal river	DD
19	*Danio davario*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
20	*Cyprinus carpio*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam	NE
21	*Hypopthalimenthys molitrix*	Cyprinidae	Chambal river,Gandhi sagar	NE
22	*Garra gotyla*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river	VU
23	*Rasbora daniconius*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LR-lc
24	*Tor tor*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam	EN
25	*Cirrhinus mrigala*	Cyprinidae	Chambal river,Gandhi sagar, Gambhir dam	LRnt
26	*Chanda nama*	Ambassidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LR-lc
27	*Chanda ranga*	Ambassidae	Chambal river,Gandhi sagar, Gambhir dam	VU
28	*Channa marulius*	Ophiocephalidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	VU
29	*Channa striatus*	Ophiocephalidae	Chambal river,Gandhi sagar, Gambhir dam	LRnt
30	*Channa gachua*	Ophiocephalidae	Chambal river	NE
31	*Clarius batrachus*	Clariidae	Gandhi sagar, Shipra river	VU
32	*Eutropiichthys vacha*	Schlibeidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	EN
33	*Clupisoma garua*	Schlibeidae	Chambal river,Gandhi	VU

			sagar	
34	*Silonia silondia*	Schlibeidae	Chambal river,Gandhi sagar, Gambhir dam, Shipra river	LRnt
35	*Glossogobius giuris*	Gobiidae	Chambal river,Gandhi sagar, Gambhir river	LRnt
36	*Gonialosa manmina*	Clupeidae	Chambal river,Gandhi sagar	VU
37	*Heteropneustes fossilis*	Saccobranchidae	Chambal river,Gandhi sagar, Gambhir dam,Shipra river	VU
38	*Lepidocephalichthys guntea*	Cobitidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river	LR-lc
39	*Nemacheilus botia*	Cobitidae	Chambal river,Gandhi sagar	EN
40	*Mastacembelus armatus*	Mastacembelidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	VU
41	*Mastacembelus pancalus*	Mastacembelidae	Chambal river,Gandhi saga	LRnt
42	*Mystus aor*	Bagridae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
43	*Mystus bleekeri*	Bagridae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	VU
44	*Mystus cavasius*	Bagridae	Chambal river,Gandhi sagar	LRnt
45	*Mystus seenghala*	Bagridae	Chambal river,Gandhi sagar, Gambhir dam	LRnt
46	*Mystus tengra*	Bagridae	Chambal river	DD
47	*Rita rita*	Bagridae	Chambal river,Gandhi sagar	EN
48	*Notopterus notopterus*	Notopteridae	Chambal river,Gandhi sagar, Gambhir dam, Shipra river	EN
49	*Ompok bimaculatus*	Siluridae	Chambal river,Gandhi sagar, Gambhir river, Shipra river	EN
50	*Wallago attu*	Siluridae	Chambal river,Gandhi sagar, Gambhir	LRnt

			dam,Gambhir river, Shipra river	
51	*Xenentodon cancila*	Belonidae	Chambal river,Gandhi sagar, Gambhir dam,Gambhir river, Shipra river	LRnt
52	*Bagarius bagarius*	Sisoridae	Chambal river,Gandhi sagar, Gambhir dam	VU

Figure 14. Fish species conservation status according to CAFF (2006) in Chambal basin

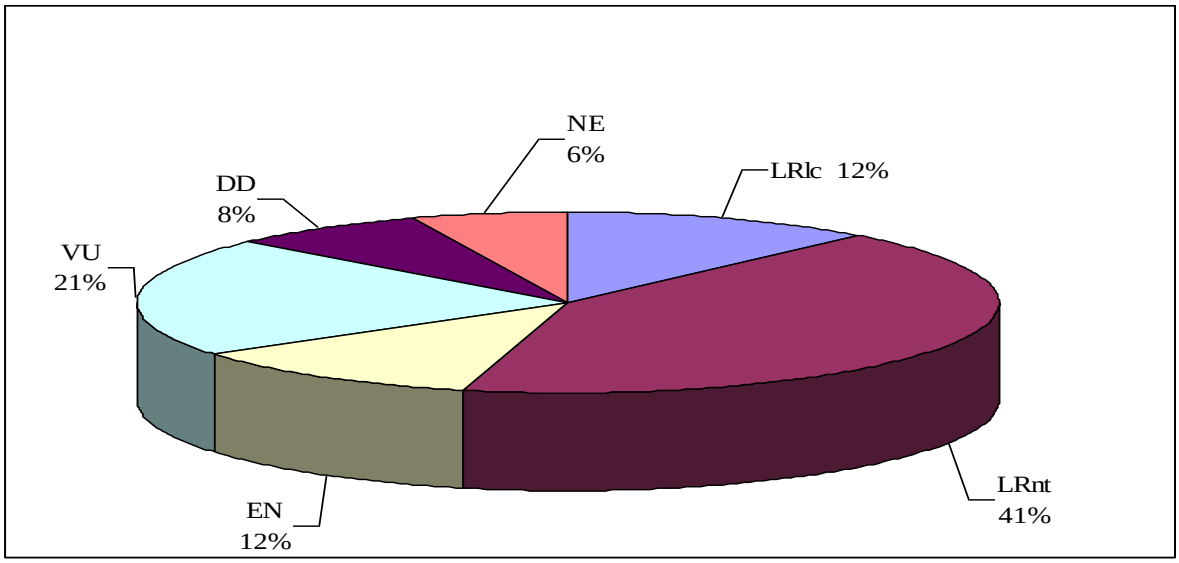


Table 26. Fish conservation status in Tapti basin

S.No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharogodon mola*	Cyprinidae	Tapti river	LR-lc
2	*Hypopthalimenthys molitrix*	Cyprinidae	Tapti river	NE
3	*Labeo bata*	Cyprinidae	Tapti river	LRnt
4	*Labeo gonius*	Cyprinidae	Tapti river	LRnt
5	*Labeo rohita*	Cyprinidae	Tapti river	LR-lc
6	*Labeo calbasu*	Cyprinidae	Tapti river	LRnt
7	*Labeo angra*	Cyprinidae	Tapti river	LRnt
8	*Labeo fimbriatus*	Cyprinidae	Tapti river	LRnt
9	*Labeo dyocheilus*	Cyprinidae	Tapti river	VU
10	*Cirrhinus mrigala*	Cyprinidae	Tapti river	LRnt
11	*Cyprinus carpio*	Cyprinidae	Tapti river	NE

12	*Crossocheilus latius*	Cyprinidae	Tapti river	DD
13	*Catla catla*	Cyprinidae	Tapti river	LRnt
14	*Chela laubuca*	Cyprinidae	Tapti river	LR-lc
15	*Puntius conchonius*	Cyprinidae	Tapti river	LRnt
16	*Puntius saphore*	Cyprinidae	Tapti river	LRnt
17	*Puntius sarana*	Cyprinidae	Tapti river	VU
18	*Puntius ticto*	Cyprinidae	Tapti river	LRnt
19	*Danio davario*	Cyprinidae	Tapti river	LRnt
20	*Garra gotyla*	Cyprinidae	Tapti river	VU
21	*Oxygaster bacaila*	Cyprinidae	Tapti river	DD
22	*Oxygaster gora*	Cyprinidae	Tapti river	DD
23	*Oxygaster clupeoides*	Cyprinidae	Tapti river	DD
24	*Rasbora daniconius*	Cyprinidae	Tapti river	VU
25	*Osteobrama cotio*	Cyprinidae	Tapti river	LRnt
26	*Barilius Bandelisis*	Cyprinidae	Tapti river	LRnt
27	*Barilius barila*	Cyprinidae	Tapti river	LRnt
28	*Tor tor*	Cyprinidae	Tapti river	EN
29	*Lepidocephalichthys guntea*	Cobitidae	Tapti river	LR-lc
30	*Nemacheilus botia*	Cobitidae	Tapti river	EN
31	*Nemacheilus duyi*	Cobitidae	Tapti river	DD
32	*Nemacheilus evezardi*	Cobitidae	Tapti river	DD
33	*Notopterus notopterus*	Notopteridae	Tapti river	EN
34	*Chanda ranga*	Ambassidae	Tapti river	LR-lc
35	*Chanda nama*	Ambassidae	Tapti river	VU
36	*Bagarius bagarius*	Sisoridae	Tapti river	VU
37	*Glossogobius giuris*	Gobiidae	Tapti river	LRnt
38	*Mastacembelus pancalus*	Mastacembelidae	Tapti river	VU
39	*Mastacembelus armatus*	Mastacembelidae	Tapti river	LRnt
40	*Clupisoma garua*	Schlibeidae	Tapti river	VU
41	*Eutropiichthys vacha*	Schlibeidae	Tapti river	EN
42	*Silondia silonia*	Schlibeidae	Tapti river	LRnt
43	*Ompok bimaculatus*	Siluridae	Tapti river	EN
44	*Wallago attu*	Siluridae	Tapti river	LRnt
45	*Mystus cavasius*	Bagridae	Tapti river	LRnt
46	*Mystus tengra*	Bagridae	Tapti river	DD
47	*Mystus bleekeri*	Bagridae	Tapti river	VU
48	*Mystus seenghala*	Bagridae	Tapti river	LRnt
49	*Mystus aor*	Bagridae	Tapti river	LRnt
50	*Xenentodon cancila*	Belonidae	Tapti river	LRnt

51	*Channa marulius*	Ophiocephalidae	Tapti river	VU
52	*Channa gachua*	Ophiocephalidae	Tapti river	NE
53	*Channa punctatus*	Ophiocephalidae	Tapti river	LRnt
54	*Channa striatus*	Ophiocephalidae	Tapti river	LRnt
55	*Clarias batrachus*	Clariidae	Tapti river	VU
56	*Tilapia mossambica*	Cichlidae	Tapti river	NE
57	*Rhinomugil corsula*	Mugilidae	Tapti river	VU

Figure 15. Fish species conservation status according to CAFF (2006) in Tapti basin

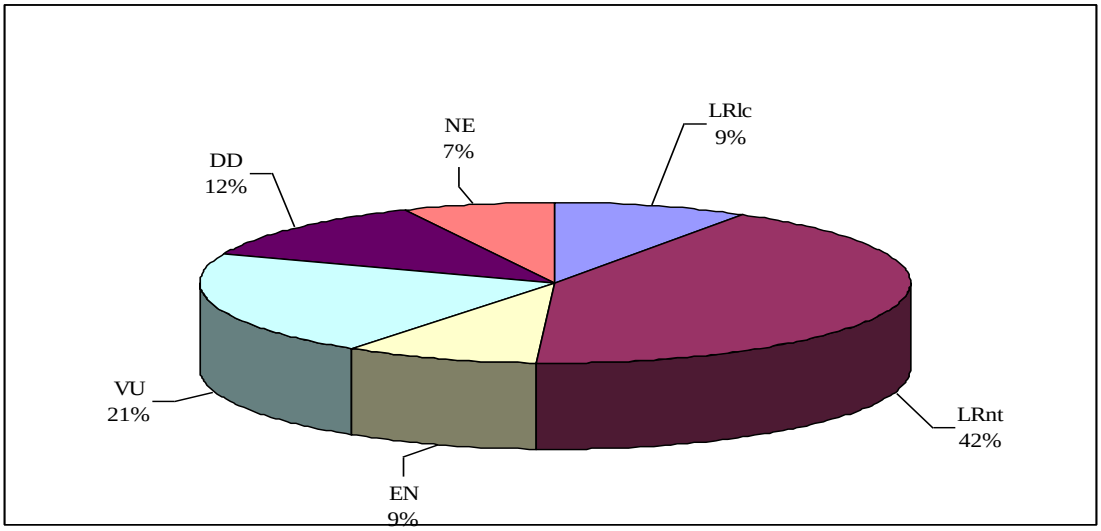


Table 27. Fish conservation status in Ken basin

S. No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharogodon mola*	Cyprinidae	Ken river	LR-lc
2	*Labeo Bata*	Cyprinidae	Ken river	LRnt
3	*Labeo gonius*	Cyprinidae	Ken river	LRnt
4	*Labeo boga*	Cyprinidae	Ken river	LRnt
5	*Labeo rohita*	Cyprinidae	Ken river	LRnt
6	*Labeo calbasu*	Cyprinidae	Ken river	LR-lc
7	*Labeo dero*	Cyprinidae	Ken river	LRnt
8	*Cirrhinus mrigala*	Cyprinidae	Ken river	VU
9	*Catla catla*	Cyprinidae	Ken river	LRnt
10	*Chela laubuca*	Cyprinidae	Ken river	LR-lc
11	*Puntius conchonius*	Cyprinidae	Ken river	LRnt
12	*Puntius saphore*	Cyprinidae	Ken river	LRnt

13	*Puntius sarana*	Cyprinidae	Ken river	VU
14	*Puntius ticto*	Cyprinidae	Ken river	LRnt
15	*Danio davario*	Cyprinidae	Ken river	LRnt
16	*Garra gotyla*	Cyprinidae	Ken river	VU
17	*Oxygaster bacaila*	Cyprinidae	Ken river	DD
18	*Rasbora daniconius*	Cyprinidae	Ken river	LR-lc
19	*Osteobrama cotio*	Cyprinidae	Ken river	LRnt
20	*Tor tor*	Cyprinidae	Ken river	EN
21	*Lepidocephalichthys guntea*	Cobitidae	Ken river	LR-lc
22	*Nemacheilus botia*	Cobitidae	Ken river	EN
23	*Notopterus notopterus*	Notopteridae	Ken river	EN
24	*Chanda ranga*	Ambassidae	Ken river	LR-lc
25	*Chanda nama*	Ambassidae	Ken river	VU
26	*Glossogobius giuris*	Gobiidae	Ken river	LRnt
27	*Mastacembelus pancalus*	Mastacembelidae	Ken river	VU
28	*Mastacembelus armatus*	Mastacembelidae	Ken river	LRnt
29	*Clupisoma garua*	Schlibeidae	Ken river	VU
30	*Ompok bimaculatus*	Siluridae	Ken river	EN
31	*Wallago attu*	Siluridae	Ken river	LRnt
32	*Mystus cavasius*	Bagridae	Ken river	LRnt
33	*Mystus bleekeri*	Bagridae	Ken river	VU
34	*Mystus seenghala*	Bagridae	Ken river	LRnt
35	*Mystus aor*	Bagridae	Ken river	LRnt
36	*Rita rita*	Bagridae	Ken river	EN
37	*Xenentodon cancila*	Belonidae	Ken river	LRnt
38	*Nandus nandus*	Nandidae	Ken river	LRnt
39	*Channa marulius*	Ophiocephalidae	Ken river	VU
40	*Channa gachua*	Ophiocephalidae	Ken river	NE
41	*Channa striatus*	Ophiocephalidae	Ken river	LRnt
42	*Heteropneustes fossilis*	Saccobranchidae	Ken river	VU
43	*Clarias batrachus*	Clariidae	Ken river	VU

Figure 16. Fish species conservation status according to CAFF (2006) in Ken basin

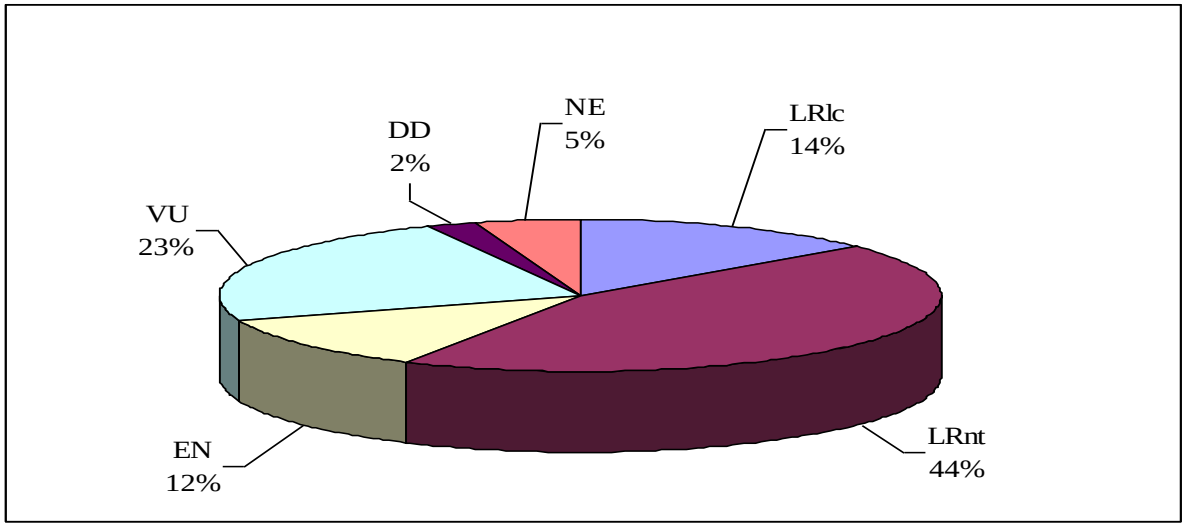


Table. 28. Fish conservation status in Son basin

S. No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharogodon mola*	Cyprinidae	Bansagar	LR-lc
2	*Hypopthalimenthys molitrix*	Cyprinidae	Bansagar	NE
3	*Labeo Bata*	Cyprinidae	Govind sagar,Bansagar	LRnt
4	*Labeo gonius*	Cyprinidae	Bansagar	LRnt
5	*Labeo rohita*	Cyprinidae	Govind sagar,Bansagar	LR-lc
6	*Labeo calbasu*	Cyprinidae	Bansagar	LRnt
7	*Cirrhinus mrigala*	Cyprinidae	Govind sagar,Bansagar	LRnt
8	*Cyprinus carpio*	Cyprinidae	Govind sagar,Bansagar	NE
9	*Catla catla*	Cyprinidae	Govind sagar,Bansagar	LRnt
10	*Chela laubuca*	Cyprinidae	Bansagar	LR-lc
11	*Puntius conchonius*	Cyprinidae	Govind sagar,Bansagar	LRnt
12	*Puntius saphore*	Cyprinidae	Bansagar	LRnt
13	*Puntius sarana*	Cyprinidae	Bansagar	VU
14	*Puntius ticto*	Cyprinidae	Govind sagar,Bansagar	LRnt
15	*Puntius chola*	Cyprinidae	Bansagar	VU
16	*Garra gotyla*	Cyprinidae	Govind	VU

			sagar,Bansagar	
17	*Oxygaster bacaila*	Cyprinidae	Govind sagar,Bansagar	DD
18	*Rasbora daniconius*	Cyprinidae	Govind sagar,Bansagar	LR-lc
19	*Osteobrama cotio*	Cyprinidae	Bansagar	LRnt
20	*Barilius Bandelisis*	Cyprinidae	Bansagar	LRnt
21	*Tor tor*	Cyprinidae	Govind sagar,Bansagar	EN
22	*Lepidocephalichthys guntea*	Cobitidae	Govind sagar,Bansagar	LR-lc
23	*Nemacheilus botia*	Cobitidae	Bansagar	EN
24	*Notopterus notopterus*	Notopteridae	Govind sagar,Bansagar	EN
25	*Notopterus Chitala*	Notopteridae	Bansagar	EN
26	*Chanda ranga*	Ambassidae	Govind sagar,Bansagar	LR-lc
27	*Chanda nama*	Ambassidae	Bansagar	VU
28	*Glossogobius giuris*	Gobiidae	Govind sagar,Bansagar	LRnt
29	*Mastacembelus armatus*	Mastacembelidae	Govind sagar,Bansagar	LRnt
30	*Clupisoma garua*	Schlibeidae	Bansagar	VU
31	*Ompok bimaculatus*	Siluridae	Govind sagar,Bansagar	EN
32	*Wallago attu*	Siluridae	Govind sagar,Bansagar	LRnt
33	*Mystus cavasius*	Bagridae	Govind sagar,Bansagar	LRnt
34	*Mystus bleekeri*	Bagridae	Bansagar	VU
35	*Mystus seenghala*	Bagridae	Govind sagar,Bansagar	LRnt
36	*Mystus aor*	Bagridae	Govind sagar	LRnt
37	*Xenentodon cancila*	Belonidae	Govind sagar,Bansagar	LRnt
38	*Nandus nandus*	Nandidae	Bansagar	LRnt
39	*Channa marulius*	Ophiocephalidae	Bansagar	VU
40	*Channa gachua*	Ophiocephalidae	Bansagar	NE
41	*Channa striatus*	Ophiocephalidae	Bansagar	LRnt
42	*Heteropneustes fossilis*	Saccobranchidae	Govind sagar,Bansagar	VU
43	*Clarias batrachus*	Claridae	Govind sagar	VU
44	*Badis badis*	Anabantidae	Bansagar	DD

Figure 17. Fish species conservation status according to CAFF (2006) in Son basin

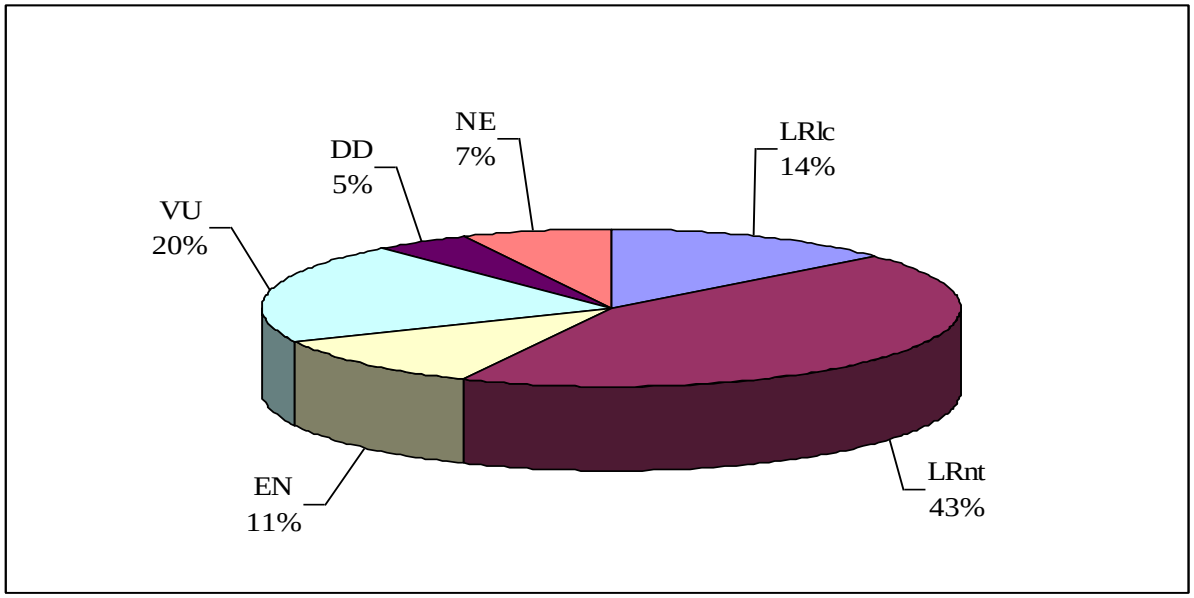


Table 29. Fish conservation status in Rajgarh basin

S.No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharyngodon mola*	Cyprinidae	Bandavedra pond,Namaj river	LR-lc
2	*Barilius bendelisis*	Cyprinidae	Kudali pond,Namaj river	LRnt
3	*Barilius barila*	Cyprinidae	Bandavedra pond,Namaj river	LRnt
4	*Cyprinus carpio*	Cyprinidae	Bandavedra pond	NE
5	*Catla catla*	Cyprinidae	Bandavedra pond,Kudali pond,Namaj river	LRnt
6	*Cirrhinus mrigala*	Cyprinidae	Bandavedra pond	LRnt
7	*Chela laubuca*	Cyprinidae	Bandavedra pond,Kudali pond,Namaj river	LR-lc
8	*Labeo dero*	Cyprinidae	Kudali pond,Namaj river	VU
9	*Labeo bata*	Cyprinidae	Kudali pond,Namaj river	LRnt
10	*Labeo rohita*	Cyprinidae	Bandavedra pond	LR-lc
11	*Labeo calbasu*	Cyprinidae	Namaj river	LRnt
12	*Labeo angra*	Cyprinidae	Kudali pond,Namaj	LRnt

			river	
13	*Labeo fimbraitus*	Cyprinidae	Namaj river	LRnt
14	*Puntius conchonius*	Cyprinidae	Kudali pond,Namaj river	LRnt
15	*Puntius ticto*	Cyprinidae	Bandavedra pond,Kudali pond,Namaj river	LRnt
16	*Puntius saphore*	Cyprinidae	Bandavedra pond,Namaj river	LRnt
17	*Puntius sarana*	Cyprinidae	Bandavedra pond,Kudali pond,Namaj river	VU
18	*Osteobrama cotio*	Cyprinidae	Namaj river	LRnt
19	*Oxygaster bacaila*	Cyprinidae	Bandavedra pond,Kudali pond,Namaj river	DD
20	*Oxygaster gora*	Cyprinidae	Kudali pond,Namaj river	DD
21	*Rasbora daniconius*	Cyprinidae	Kudali pond,Namaj river	LR-lc
22	*Garra gotyla*	Cyprinidae	Namaj river	VU
23	*Wallago attu*	Siluridae	Kudali pond,Namaj river	LRnt
24	*Ompok bimaculatus*	Siluridae	Namaj river	EN
25	*Clupisoma garua*	Sichilibedae	Namaj river	VU
26	*Mystus cavasius*	Bagridae	Namaj river	LRnt
27	*Mystus seenghala*	Bagridae	Namaj river	LRnt
28	*Mystus aor*	Bagridae	Namaj river	LRnt
29	*Mystus bleekeri*	Bagridae	Namaj river	VU
30	*Chanda ranga*	Ambassidae	Namaj river	LR-lc
31	*Chanda nama*	Ambassidae	Bandavedra pond,Namaj river	VU
32	*Channa marulius*	Ophiocephalidae	Kudali pond,Namaj river	VU
33	*Channa gachua*	Ophiocephalidae	Namaj river	
34	*Channa straitus*	Ophiocephalidae	Namaj river	LRnt
35	*Mastacembelus armatus*	Mastacembelidae	Bandavedra pond,Kudali pond,Namaj river	LRnt
36	*Mastacembelus pancalus*	Mastacembelidae	Namaj river	VU
37	*Nandus nandus*	Nandidae	Namaj river	LRnt
38	*Heterupneustus fossilis*	Saccobranchidae	Namaj river	VU
39	*Tilapia mossambica*	Cichlidae	Namaj river	NE

Figure 18. Fish species conservation status according to CAFF (2006) in Rajgarh basin

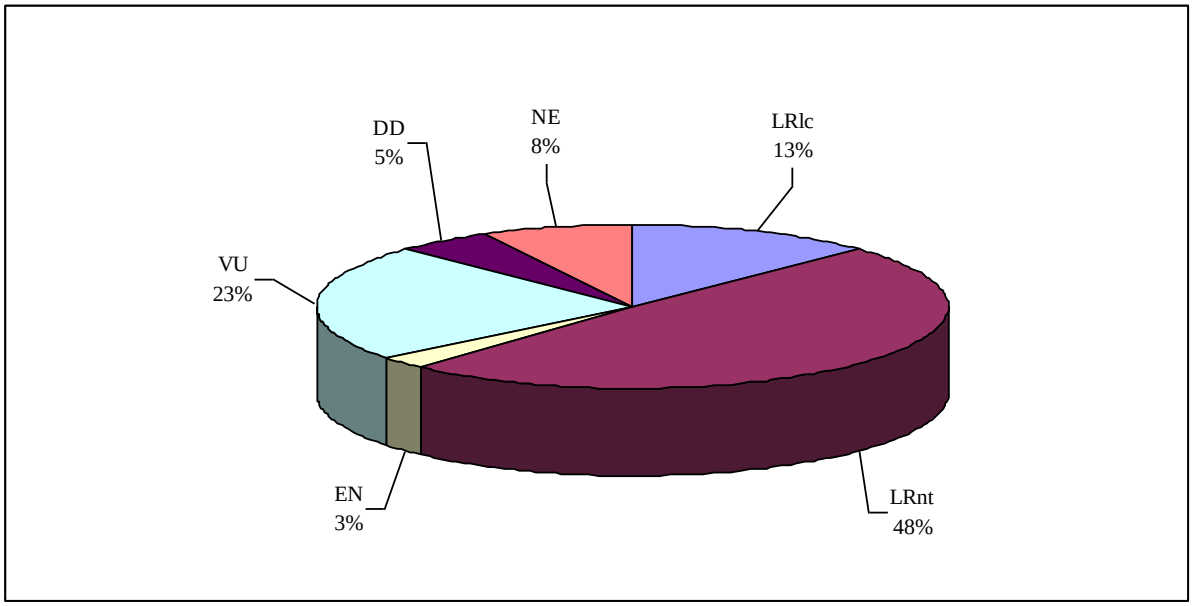


Table. 30. Overall fish conservation status during the study

S.No	Species	Family	Distribution	CAFF (2006)
1	*Amblypharyngodon mola*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin, Rajgarh basin	LR-lc
2	*Cenopharyngodon idella*	Cyprinidae	Narmada basin	NE
3	*Barilius bandelisis*	Cyprinidae	Betwa basin, Son basin, tapti basin, Narmada basin, Rajgarh basin	LRnt
4	*Barilius barila*	Cyprinidae	Betwa basin, Tapti basin, Narmada basin,Rajgarh basin	LRnt
5	*Catla catla*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LRnt

6	*Chela laubuca*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LR-lc
7	*Esomus danricus*	Cyprinidae	Betwa basin	LR-lc
8	*Cirrhinus mrigala*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LRnt
9	*Cyprinus carpio*	Cyprinidae	Chambal basin, Betwa basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	NE
10	*Crossocheilus latius*	Cyprinidae	Tapti basin	DD
11	*Danio davario*	Cyprinidae	Chambal basin, Betwa basin, Ken basin, Tapti basin,Narmada basin	LRnt
12	*Garra gotyla*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin	VU
13	*Garra lamta*	Cyprinidae	Betwa basin, Narmada basin	VU
14	*Hypopthalimenthys molitrix*	Cyprinidae	Chambal basin,Son basin, Tapti basin	NE
15	*Labeo bata*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LRnt
16	*Labeo boga*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Narmada basin	LRnt
17	*Labeo calbasu*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LRnt
18	*Labeo dyocheilus*	Cyprinidae	Chambal basin, Tapti basin,	VU

19	*Labeo fimbriatus*	Cyprinidae	Chambal basin, Betwa basin,Tapti basin,Narmada basin,Rajgarh basin	LRnt
20	*Labeo gonius*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LRnt
21	*Labeo rohita*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin,Rajgarh basin	LR-lc
22	*Labeo dero*	Cyprinidae	Betwa basin, Ken basin,Rajgarh basin	VU
23	*Labeo angra*	Cyprinidae	Betwa basin, Tapti basin,Rajgarh basin	LRnt
24	*Labeo pangusia*	Cyprinidae	Narmada basin	DD
25	*Labeo boggut*	Cyprinidae	Chambal basin, Narmada basin	LRnt
26	*Labeo dussuniere*	Cyprinidae	Betwa basin	VU
27	*Puntius conchonius*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
28	*Puntius phutunio*	Cyprinidae	Chambal basin	LR-lc
29	*Puntius dorsalis*	Cyprinidae	Betwa basin, Son basin	EN
30	*Puntius sarana*	Cyprinidae	Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
31	*Puntius sophore*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
32	*Puntius ticto*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
33	*Puntius amphibius*	Cyprinidae	Narmada basin	DD

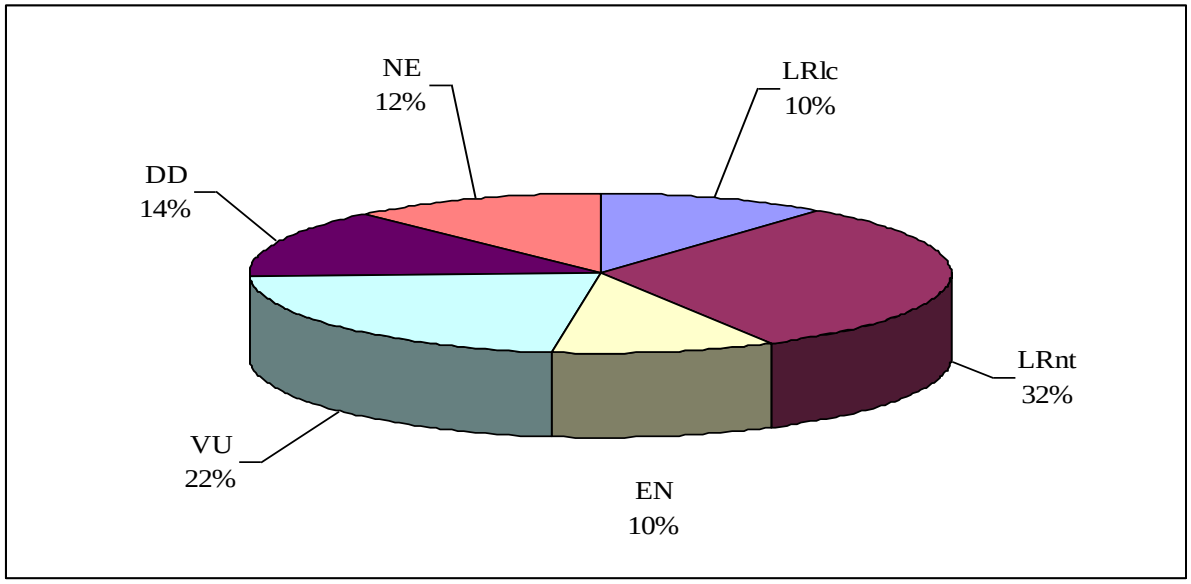
34	*Puntius chrysopoma*	Cyprinidae	Narmada basin	NE
35	*Puntius ambasis*	Cyprinidae	Narmada basin	NE
36	*Puntius chola*	Cyprinidae	Son basin	VU
37	*Puntius titius*	Cyprinidae	Betwa basin,Narmada basin	NE
38	*Osteobrama cotio*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
39	*Osteobrama vigorsii*	Cyprinidae	Narmada basin	DD
40	*Oxygaster bacaila*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	DD
41	*Oxygaster gora*	Cyprinidae	Chambal basin, Betwa basin, Tapti basin,Narmada basin	DD
42	*Oxygaster clupeoides*	Cyprinidae	Chambal basin, Betwa basin, Tapti basin,Narmada basin	DD
43	*Rasbora daniconius*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LR-lc
44	*Rasbora elanga*	Cyprinidae	Betwa basin	NE
45	*Tor tor*	Cyprinidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	EN
46	*Lepidocephalichthys guntea*	Cobitidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LR-lc
47	*Nemacheilus botia*	Cobitidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	EN
48	Nemacheilus duyi	Cobitidae	Tapti basin	DD
49	Nemacheilus evezardi	Cobitidae	Tapti basin	DD

50	*Clupisoma garua*	Schlibeidae	Chambal basin, Betwa basin,Son basin, Tapti basin,Narmada basin	VU
51	*Eutropiichthys vacha*	Schlibeidae	Chambal basin, Betwa basin, Tapti basin,Narmada basin	EN
52	*Silondia silondia*	Schlibeidae	Chambal basin, Betwa basin, Tapti basin,Narmada basin	LRnt
53	*Glossogobius giuris*	Gobiidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
54	*Heteropneustes fossilis*	Saccobranchidae	Chambal basin, Betwa basin, Ken basin,Son basin,Narmada basin	VU
55	*Gonialosa manmina*	Clupeidae	Chambal basin, Betwa basin, Narmada basin	VU
56	*Gudusia chapra*	Clupeidae	Betwa basin	LR-lc
57	*Mastacembelus armatus*	Mastacembelidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
58	*Mastacembelus pancalus*	Mastacembelidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
59	*Clarius batrachus*	Clariidae	Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
60	*Channa gachua*	Ophiocephalidae	Chambal basin, Betwa basin, Tapti basin,Narmada basin	
61	*Channa marulius*	Ophiocephalidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
62	*Channa punctatus*	Ophiocephalidae	Betwa basin, Tapti	LRnt

			basin	
63	*Channa striatus*	Ophiocephalidae	Chambal basin, Betwa basin, Ken basin,Tapti basin,Narmada basin	LRnt
64	*Chanda nama*	Ambassidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LR-lc
65	*Chanda ranga*	Ambassidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
66	*Chanda baculis*	Ambassidae		DD
67	*Mystus aor*	Bagridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
68	*Mystus bleekeri*	Bagridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	VU
69	*Mystus cavasius*	Bagridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin	LRnt
70	*Mystus seenghala*	Bagridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin, Narmada basin	LRnt
71	*Mystus tengra*	Bagridae	Chambal basin, Betwa basin,	DD
72	*Rita rita*	Bagridae	Chambal basin, Betwa basin, Ken basin, Narmada basin	EN
73	*Notopterus chitala*	Notopteridae	Betwa basin, Son basin	EN

74	*Notopterus notopterus*	Notopteridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	EN
75	*Ompok bimaculatus*	Siluridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	EN
76	*Ompok pabda*	Siluridae	Narmada basin	EN
77	*Wallago attu*	Siluridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
78	*Nandus nandus*	Nandidae	Betwa basin, Ken basin,Narmada basin	LRnt
79	*Xenentodon cancila*	Belonidae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin,Narmada basin	LRnt
80	*Rhinomugil corsula*	Mugilidae	Betwa basin, Tapti basin	VU
81	*Colisa fasciatus*	Anabantidae	Betwa basin,Narmada basin	VU
82	*Anabas testudineus*	Anabantidae	Son basin, Narmada basin	VU
83	*Badis badis*	Anabantidae	Son basin	DD
84	*Tilapia mossambica*	Cichlidae	Betwa basin,Tapti basin	NE
85	*Bagarius bagarius*	Sisoridae	Chambal basin, Betwa basin, Ken basin,Son basin, Tapti basin	VU
86	*Parapsilorhynchus tentaculatus*	Parasilorhynchidae	Chambal basin, Narmada basin	NE

Figure 19. Overall fish species conservation status according to CAFF (2006) during the study



9. Plankton diversity

9.1. Phytoplankton

Phytoplanktons are the autotrophic component of the plankton community. Phytoplanktons are chlorophyll bearing suspended microscopic organisms consisting of algae. Their unique ability to fix inorganic carbon to build up organic matter through primary production makes their study a subject of primary importance. Phytoplankton Diversity in fresh water is one of the most important steps in the complex analysis of aquatic ecosystem, because phytoplankton being the primary producers constitutes the basic food source of the water body which supports the aquatic animals. Thus for any kind of utilization of water from a natural source the study of phytoplankton is of primary interest.

During the Phytoplanktonic study at different river basin of Madhya Pradesh a total of 83 species belonging to three major group's viz. ***Chlorophyceae, Bacillariophyceae, Cyanophyceae*** were identified. *Chlorophyceae* has been recorded as the most dominant group of phytoplankton in the river basins represented by 39 species(47%) followed by *Bacillariophyceae* represented by 23 species (28%) and *Cyanophyceae* represented by 21 species(25%).

Phytoplankton community of the different river basin showed a rich diversity. During the Phytoplankton study at the river basin the higher diversity was observed in Betwa Basin comprises of 63 species followed by Chambal Basin comprises of 48 species, Tapti basin comprises of 34 species, Sone Basin comprises of 31 species, Ken Basin comprises of 23 species, Seasonal ponds and river of Rajgarh District comprises of 24 species.

9.1.1 Phytoplankton diversity in Betwa Basin

During the study the higher phytoplankton community was recorded at the Betwa basin with a total of 63 species. The most dominant group was *Chlorophyceae* represented by 25 species (40%). Other significant groups which are *Bacillariophyceae* and *Cyanophyceae* independently comprises of 19 species (30%). The higher diversity of phytoplankton was observed during summer (51species) followed by a gradual

decreasing trend in winter (47species) season, ultimately lowest to post monsoon (41species) season.

Chlorophyceae

During the study 25 species *of Chlorophyceae* group was identified as the most dominant group of phytoplankton. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Chlorophyceae* was observed during winter and summer season were same (20pecies) while in the post monsoon season 19 species were recorded.

Bacillariophyceae

During the period under study 19 species of *Bacillariophyceae* group was identified and represented as second dominant group of phytoplankton. The maximum diversity of *Bacillariophyceae* was observed during summer (15species) season while the minimum was observed in the Post monsoon (8 species) season.

Cyanophyceae

During the period under study 19 species of *Cyanophyceae* group was identified. The maximum diversity of *Cyanophyceae* was observed during summer and winter season were same (16pecies) while in the post monsoon season 14 species were recorded.

9.1.2. Phytoplankton diversity in Chambal Basin

Rich diversity in the species of phytoplankton has been recorded in the Chambal Basin with a total of 48 species. The most dominant group was *Chlorophyceae* represented by 22 species (46%), followed by *Bacillariophyceae* comprises with 14 species (29%) and *Cyanophyceae* represented by 12 species (25%). The higher diversity of phytoplankton was observed during winter (36 species) and summer (30 species) season while lower diversity was observed during post monsoon (24 species) season.

Chlorophyceae

During the study 22 species *of Chlorophyceae group* was identified as the most dominant group of phytoplankton. The maximum diversity of *Chlorophyceae* was observed during

winter (18species) season while the minimum was observed in the Post monsoon (10species) season.

Bacillariophyceae

During the period under study 14 species of *Bacillariophyceae* group was identified and represented as second dominant group of phytoplankton. Not much variation was observed in winter and post monsoon season. The higher diversity was recorded during winter (12 species) season followed by a gradual decreasing trend in post monsoon (10 species) season, ultimately lowest to summer (7 species) season.

Cyanophyceae

Cyanophyceae as a component of phytoplankton was third to *Chlorophyceae in showing* prominence. During the study 12 species of *Cyanophyceae* group was identified. The maximum diversity was recorded during summer (10 species) season while the minimum diversity was recorded in the post monsoon (4 species) season.

9.1.3. Phytoplanton diversity Tapti Basin

The phytoplankton community of Tapti Basin comprises of 34 species. The most dominant group was *Chlorophyceae* represented by 19 species (56%) followed by *Bacillariophyceae* with 10 species (29%) and *Cyanophyceae* represented by 5 species (15%). Not much variation seen in diversity of phytoplankton during seasons. Their higher diversity was recorded during summer (26 species) season followed by a gradual decreasing trend in winter (22 species) season, ultimately lowest to post monsoon (21 species) season.

Chlorophyceae

During the study *Chlorophyceae* groups comprises of 19 species. During season not much variation seen in diversity of Chlorophyceae. Their higher diversity was observed in summer (14pecies) season while in the winter and post monsoon season diversity was observed same (13species).

Bacillariophyceae

During the period under study 10 species of *Bacillariophyceae* group was identified and represented as second dominant group of phytoplankton. The maximum diversity of *Bacillariophyceae* was observed during summer (8 species) season while the minimum was observed in the winter and Post monsoon season independently 5 species.

Cyanophyceae

During the study *Cyanophyceae* groups comprises of 5 species. The diversity of *Cyanophyceae was* observed during winter and summer season were same (4 species) while in the post monsoon season 3 species were recorded.

9.1.4. Phytoplankton diversity in Ken Basin

The phytoplankton community has been recorded in the Ken Basin with a total of 23 species. The most dominant group was *Chlorophyceae* represented by 14 species (61%), followed by *Bacillariophyceae* with 5 species (22%) and *Cyanophyceae* represented by 4 species (17%). The higher diversity of phytoplankton was observed during summer (20 species) season followed by a gradual decreasing trend in winter (17 species) season, ultimately lowest to post monsoon (16 species) season.

Chlorophyceae

During the study 14 species of *Chlorophyceae* group was identified as the most dominant group of phytoplankton. The maximum diversity of *Chlorophyceae* was observed during summer (14 species) season followed by a gradual decreasing trend in winter (11 species) season, ultimately lowest to post monsoon (10 species) season.

Bacillariophyceae

During the period under study 5 species of *Bacillariophyceae* group was identified. During season not much variation seen in diversity of *Bacillariophyceae*. Their higher diversity was observed in post monsoon (4 species) season while in the winter and summer season diversity was observed same (3 species).

Cyanophyceae

During the period under study 4 species of *Cyanophyceae group* was identified. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Cyanophyceae* was observed during winter and summer season were same (3 species) while in the post monsoon season 2 species were recorded.

9.1.5. Phytoplankton diversity in Son Basin

The phytoplankton community of Son Basin comprises of 31 species. The most dominant group was *Chlorophyceae* represented by 20 species (65%) followed by *Cyanophyceae* with 6 species (19%) and *Bacillariophyceae* represented by 5 species (16%). Not much variation seen in diversity of phytoplankton during seasons. Their higher diversity was recorded during summer and winter season were same (23 species) while in the post monsoon season 20 species were recorded.

Chlorophyceae

During the study *Chlorophyceae* groups comprises of 20 species. The higher diversity of *Chlorophyceae* was observed during winter (16 species) season followed by a gradual decreasing trend in summer (16 species) season. The minimum diversity was recorded during Post Monsoon (13 species) season.

Bacillariophyceae

During the period under study 5 species of *Bacillariophyceae* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Bacillariophyceae* was observed during summer and post monsoon season were same (4 species) while in the winter season 3 species were recorded.

Cyanophyceae

During the period under study 6 species of *Cyanophyceae* group was identified and represented as second dominant group of phytoplankton. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Cyanophyceae*

was observed during summer and winter season were same (4 species) while in the post monsoon season 3 species were recorded.

9.1.6. Phytoplankton diversity in Rajgarh District

The phytoplankton community has been recorded in the Seasonal ponds and river of Rajgarh District comprises of 24 species. The most dominant group was *Chlorophyceae* represented by 13 species (54%), followed by *Bacillariophyceae* with 7 species (29%) and *Cyanophyceae* represented by 4 species (17%). The higher diversity of phytoplankton was observed during winter (20 species) season followed by a gradual decreasing trend in summer (18 species) season, ultimately lowest to post monsoon (14 species) season.

Chlorophyceae

During the study 13 species of Chlorophyceae group was identified as the most dominant group of phytoplankton. The maximum diversity of Chlorophyceae was observed during winter (14 species) season followed by a gradual decreasing trend in summer (9 species) season, ultimately lowest to post monsoon (8 species) season.

Bacillariophyceae

During the period under study 7 species of *Bacillariophyceae* group was identified and represented as second dominant group of phytoplankton. Not much variation was observed in summer, winter and post monsoon seasons. The maximum diversity of *Bacillariophyceae* was observed during winter (6 species) season followed by a gradual decreasing trend in summer (5 species) season, ultimately lowest to post monsoon (4 species) season.

Cyanophyceae

During the period under study 4 species of *Cyanophyceae group* was identified. The maximum diversity of *Cyanophyceae* was observed during summer (4 species) season while the minimum was observed in the winter (1 species) season.

Table 31. Overall Phytoplankton diversity in different river basin of M.P.

S.No	Species	Chambal Basin	Betwa basin	Tapti basin	Ken Basin	Sone Basin	Rajgarh District.
	Chlorophyceae						
1	*Botryoceoceus bramii*		1		1	1	
2	*Clostarium* sps.		1	1	1	1	1
3	*Cosmarium reniforme*	1	1	1		1	
4	*Cosmarium* sps.	1		1	1	1	1
5	*Edorina* sps.	1		1		1	
6	*Spirogyra* sps.	1	1	1	1	1	1
7	*Chlamydomonas* sps.	1	1	1			
8	*Gonium* sps.	1	1			1	
9	*Haematococcus locusteris*		1				
10	*Haemalocaccus* sps.		1				
11	*Microspora floccose*		1		1		1
12	*Uronema elongatum*	1	1				
13	*Cylindrocapses* sps.	1	1				
14	*Sphaerocystis* sps.		1				
15	*Staurastrum* sps.		1				
16	*Mougeotia sps.*	1	1	1		1	
17	*Golenkinia sps.*		1				
18	*Sehroederia sps.*		1				
19	*Ankistrodesmus* sps.	1	1				1
20	*Zygnema* sps.	1	1			1	
21	*Pandorina* sps.	1		1			
22	*Volvox* sps.	1	1	1	1	1	1
23	*Ulothrix* sps.				1		1
24	*Zygnema pectinata*	1	1	1	1	1	
25	*Zygnemaopsis* sps.			1			
26	*Desmidium* sps.			1	1	1	1
27	*Tetrahedron* sps.			1			
28	*Mougeotia* sps.			1		1	
29	*Ankristodesmus falcatus*	1	1	1			
30	*Arthrodesmus* sps.				1	1	1
31	*Stichococcus* sps.	1				1	
32	*Dispora* sps.						
33	*Pediastrum duplex*	1	1	1	1	1	1

34	*Pediastrum simplex*	1	1	1	1	1	1
35	*Oedogonium* sps.		1	1	1	1	
36	*Spirogyra communis*	1		1	1	1	1
37	*Scenedesmus quadricauda*	1					1
38	*Scenedesmus opotiensis*	1	1			1	
39	*Scenedesmus* sps.	1					
	Bacillariophyceae						
40	*Pinnularia* sps.	1	1	1	1	1	1
41	*Bacillaria* sps.	1		1		1	1
42	*Navicula subrhiynchocephalus*		1	1	1	1	1
43	*Navicula cuspidata*	1	1				
44	*Navicula gracilis*	1	1				
45	*Amphipleura* sps.	1					
46	*Synedra* sps.	1	1	1	1		1
47	*Nitzschia* sps.	1	1			1	
48	*Melosira* sps.	1	1				
49	*Cyclotella* sps.		1	1		1	
50	*Cocconesis* sps.	1					
51	*Eunotia* sps.	1	1	1			1
52	*Tabellaria* sps.	1	1				1
53	*Biddulhhia laevis*		1				
54	*Xsteionella* sps.		1				
55	*Denticula* sps.		1				
56	*Cylindrospermum* sps.		1				
57	*Surirella* sps.	1	1				
58	*Cymbella affinis*		1	1			
59	*Gomphonema* sps.	1	1	1			
60	*Diatomella* sps.	1					
61	*Fragilaria* sps.		1	1	1		1
62	*Asterionella* sps.		1	1	1		
	Cyanophyceae						
63	*Phormidium mucicola*	1		1	1	1	
64	*Spirulina laxissima*	1	1	1	1	1	1
65	*Spirulina priceps*	1	1				
66	*Chroococcus* sps.	1	1			1	
67	*Aphanocapsa banaresensis*	1	1	1		1	1
68	*Microcystis acruginosa*	1	1	1	1	1	
69	*Microcystis robusta*	1	1				1
70	*Microcystis marginata*		1				1

71	*Microcystis flosaquae*		1				
72	*Microcystis pseudofilumentosa*		1				
73	*Microcystis elongate*		1				
74	*Microcystis viridis*	1	1				
75	*Synechocystis* sps.	1		1	1	1	
76	*Rivularia* sps.	1	1				
77	*Stigonema* sps.		1				
78	*Ocilatoria limosa*		1				
79	*Ocilatoria curviceps*		1				
80	*Nodularia* sps.		1				
81	*Nostoc* sps.	1	1				
82	*Merismopedia* sps.		1				
83	*Anabena* sps.	1	1				
		48	**63**	**34**	**23**	**31**	**24**

Figure 20. Phytoplankton diversity in different river basin of M.P

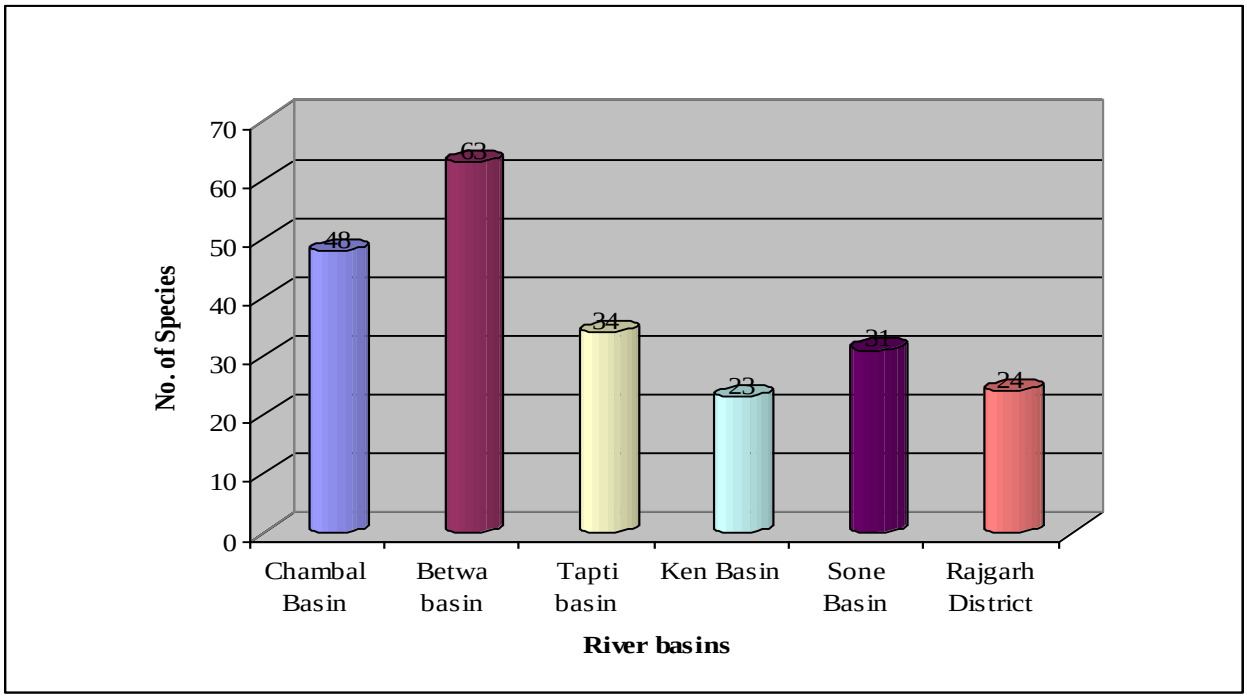


Figure 21. Group wise Phytoplankton species composition in river basin of M.P

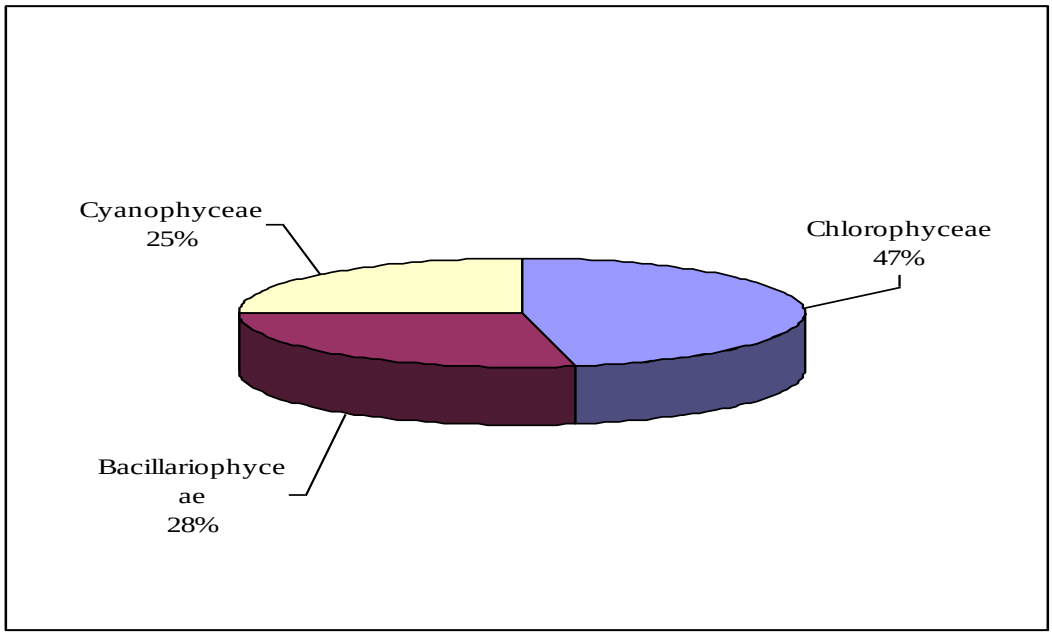


Table 32. Seasonal phytoplankton diversity in Chambal basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Scenedesmus opotiensis*		1	1
2	*Scenedesmus* sps.	1	1	1
3	*Scenedesmus quadricauda*		1	
4	*Cosmarium reniforme*	1		
5	*Cosmarium* sps.	1	1	1
6	*Edorina* sps.		1	
7	*Spirogyra* sps.	1	1	1
8	*Chlamydomonas* sps.	1	1	1
9	*Gonium* sps.		1	
10	*Uronema elongatum*	1		
11	*Cylindrocapses* sps.		1	
12	*Mougeotia* sps.		1	
13	*Ankistrodesmus* sps.	1	1	1
14	*Zygnema* sps.		1	
15	*Pandorina* sps.	1		
16	*Volvox* sps.	1	1	1
17	*Zygnema pectinata*	1		

18	*Ankristodesmus falcatus*		1	
19	*Stichococcus* sps.		1	
20	*Pediastrum duplex*	1	1	1
21	*Pediastrum simplex*	1	1	1
22	*Spirogyra communis*	1	1	1
	Bacillariophyceae			
23	*Pinnularia* sps.	1	1	1
24	*Bacillaria* sps.	1	1	1
25	*Navicula cuspidata*	1		1
26	*Navicula gracilis*	1	1	1
27	*Amphipleura* sps.	1		1
28	*Synedra* sps.		1	1
29	*Nitzschia* sps.		1	1
30	*Melosira* sps.	1	1	1
31	*Cocconesis* sps.		1	1
32	*Eunotia* sps.		1	
33	*Tabellaria* sps.	1	1	1
34	*Surirella* sps.		1	
35	*Gomphonema* sps.		1	
36	*Diatomella* sps.		1	
	Cyanophyceae			
37	*Phormidium mucicola*	1		
38	*Spirulina laxissima*	1		1
39	*Spirulina priceps*	1		1
40	*Chroococcus* sps.	1	1	
41	*Aphanocapsa banaresensis*		1	
42	*Microcystis acruginosa*	1		
43	*Microcystis robusta*	1		
44	*Microcystis viridis*		1	
45	*Synechocystis* sps.	1	1	1
46	*Rivularia* sps.	1		
47	*Nostoc* sps.	1	1	1
48	*Anabena* sps.	1	1	
		30	**36**	**24**

Figure 22 . Seasonal phytoplankton diversity in Chambal basin of M.P.

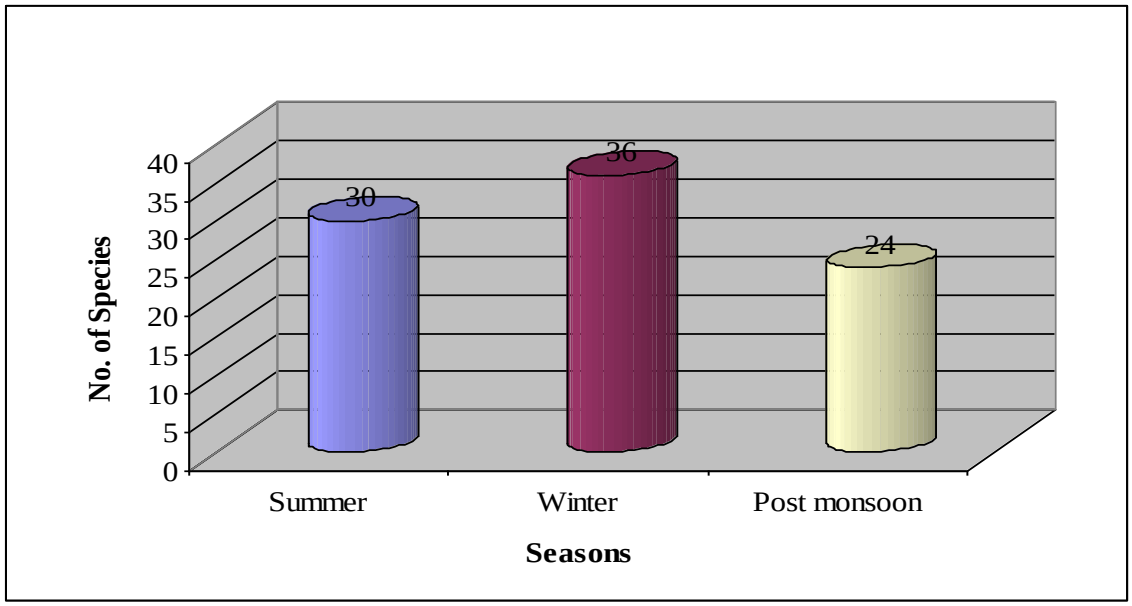


Figure 23. Group wise phytoplankton species composition at Chambal basin of M.P.

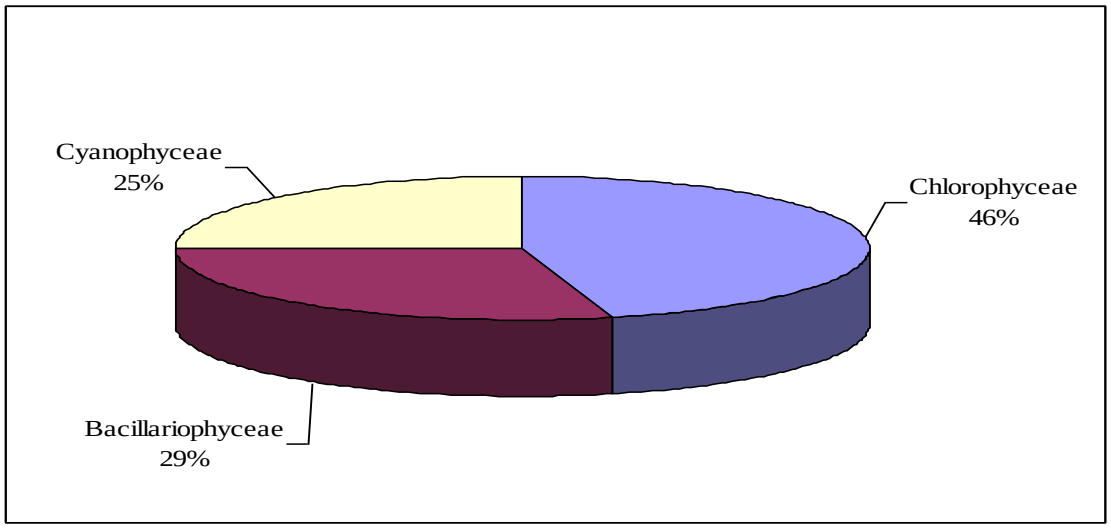


Table 33. Seasonal phytoplankton diversityin Betwa basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Botryoceoceus bramii*	1	1	1
2	*Scenedesmus opotiensis*	1	1	1
3	*Clostarium* sps.	1	1	1
4	*Cosmarium reniforme*	1	1	
5	*Spirogyra* sps.	1	1	1
6	*Chlamydomonas* sps.	1		1
7	*Gonium* sps.	1		1
8	*Cylindrocapses* sps.	1		1
9	*Haematococcus locusteris*	1	1	1
10	*Haemalocaccus* sps.	1	1	
11	*Microspora floccose*		1	
12	*Uronema elongatum*		1	1
13	*Sphaerocystis* sps.	1	1	1
14	*Staurastrum* sps.	1	1	
15	*Mougeotia* sps.		1	1
16	*Golenkinia* sps.		1	1
17	*Sehroederia* sps.		1	1
18	*Ankistrodesmus* sps.	1	1	1
19	*Zygnema* sps.	1	1	
20	*Volvox* sps.	1	1	1
21	*Zygnema pectinata*	1		1
22	*Ankristodesmus falcatus*	1		
23	*Pediastrum duplex*	1	1	1
24	*Pediastrum simplex*	1	1	1
25	*Oedogonium* sps.	1	1	1
	Bacillariophyceae			
26	*Pinnularia* sps.	1	1	1
27	*Navicula subrhiynchocephalus*		1	1
28	*Navicula cuspidata*			1
29	*Navicula gracilis*	1		
30	*Synedra* sps.	1		
31	*Nitzschia* sps.	1	1	
32	*Melosira* sps.	1	1	
33	*Cyclotella* sps.	1	1	

34	*Eunotia* sps.	1	1	
35	*Tabellaria* sps.	1	1	1
36	*Biddulhhia laevis*	1	1	
37	*Xsteionella* sps.	1	1	
38	*Denticula* sps.	1		1
39	*Cylindrospermum* sps.			1
40	*Surirella* sps.			1
41	*Cymbella affinis*	1		1
42	*Gomphonema* sps.	1		
43	*Fragilaria* sps.	1	1	
44	*Asterionella* sps.	1	1	
	Cyanophyceae			
45	*Spirulina laxissima*	1	1	1
46	*Spirulina priceps*	1	1	1
47	*Chroococcus* sps.	1	1	1
48	*Aphanocapsa banaresensis*	1	1	1
49	*Microcystis acruginosa*	1	1	
50	*Microcystis robusta*	1	1	
51	*Microcystis marginata*		1	1
52	*Microcystis flosaquae*	1	1	1
53	*Microcystis pseudofilumentosa*	1	1	1
54	*Microcystis elongate*	1		1
55	*Microcystis viridis*			1
56	*Rivularia* sps.	1		
57	*Stigonema* sps.	1	1	1
58	*Ocilatoria limosa*	1	1	1
59	*Nodularia* sps.	1	1	
60	*Ocilatoria curviceps*	1	1	
61	*Nostoc* sps.	1	1	1
62	*Merismopedia* sps.		1	1
63	*Anabena* sps.	1	1	1
		51	**47**	**41**

Figure 24. Seasonal phytoplankton diversity in Betwa basin of M.P.

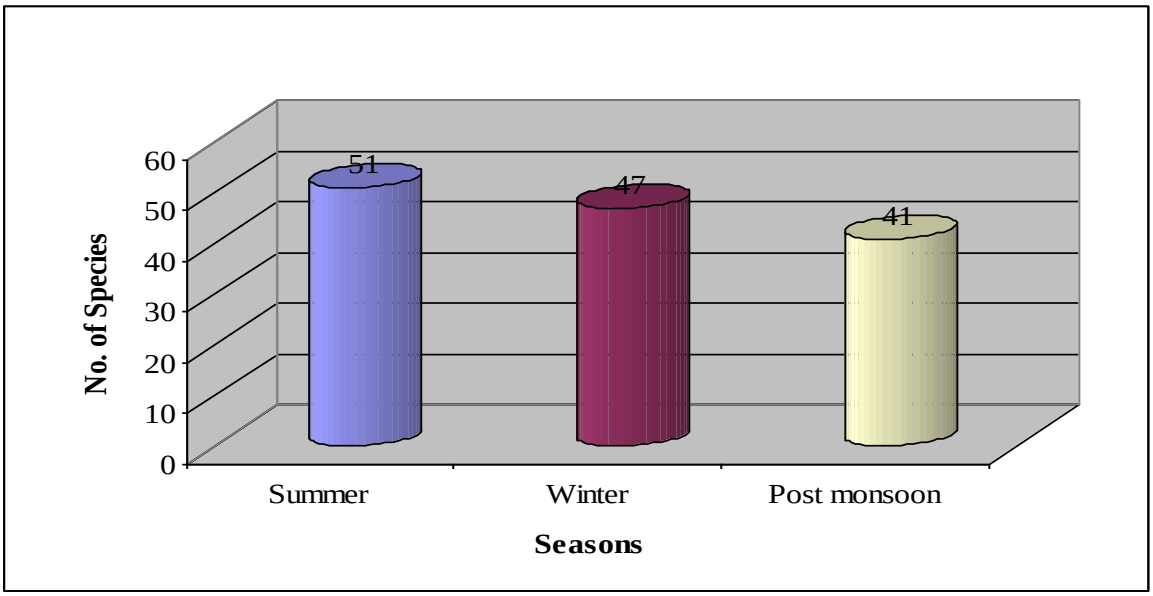


Figure 25. Group wise Phytoplankton species composition in Betwa basin of M.P.

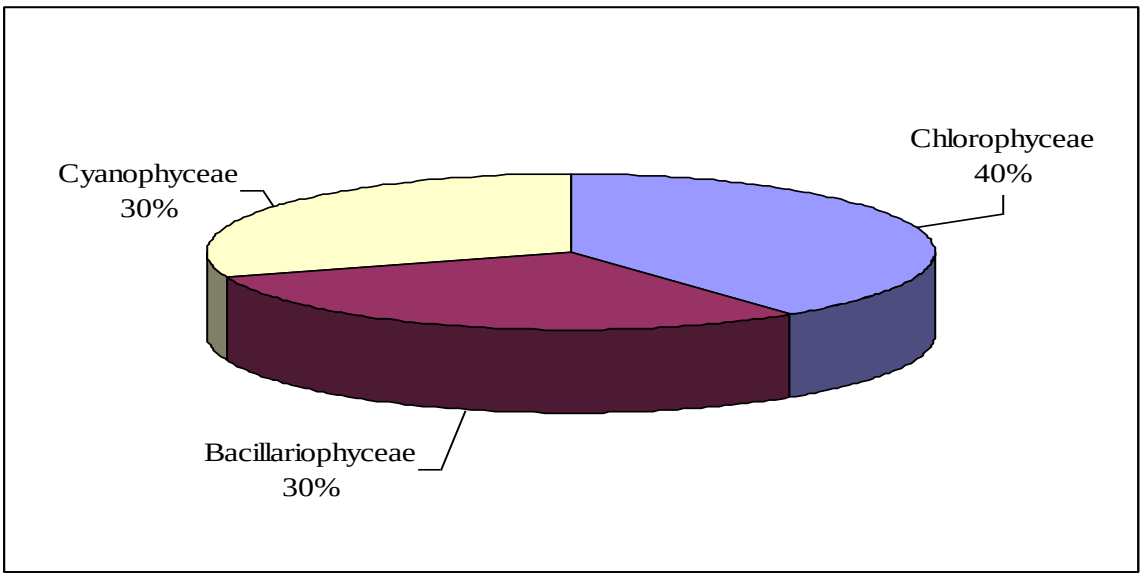


Table 34. Seasonal Phytoplankton diversity in Tapti basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Clostarium* sps.	1	1	1
2	*Cosmarium reniforme*		1	1
3	*Edorina* sps.	1	1	
4	*Spirogyra* sps.	1	1	1
5	*Chlamydomonas* sps.	1		1
6	*Pediastrum simplex*	1		1
7	*Padiastrum duplex*	1		1
8	*Pandorina* sps.	1		1
9	*Volvox* sps.	1		1
10	*Scenedesmus* sps.	1	1	1
11	*Cosmarium* sps.		1	1
12	*Zygnema pectinata*		1	1
13	*Zygnemaopsis* sps.		1	
14	*Desmidium* sps.	1	1	
15	*Tetrahedron* sps.	1	1	
16	*Mougeotia* sps.	1	1	
17	*Ankristodesmus falcatus*	1	1	1
18	*Oedogonium* sps.	1		1
19	*Spirogyra communis*		1	
	Bacillariophyceae			
20	*Pinnularia* sps.		1	
21	*Bacillaria* sps.	1		1
22	*Navicula subrhiynchocephalus*	1	1	
23	*Synedra* sps.	1	1	1
24	*Cyclotella* sps.	1		1
25	*Eunotia* sps.		1	1
26	*Cymbella affinis*	1		
27	*Gomphonema* sps.	1		
28	*Fragilaria* sps.	1		
29	*Asterionella* sps	1	1	1
	Cyanophyceae			
30	*Phormidium mucicola*	1		
31	*Spirulina laxissima*	1	1	
32	*Aphanocapsa banaresensis*	1	1	1
33	*Microcystis acruginosa*	1	1	1
34	*Synechocystis* sps.		1	1

		26	**22**	**21**

Figure 26. Seasonal Phytoplankton diversity in Tapti basin of M.P.

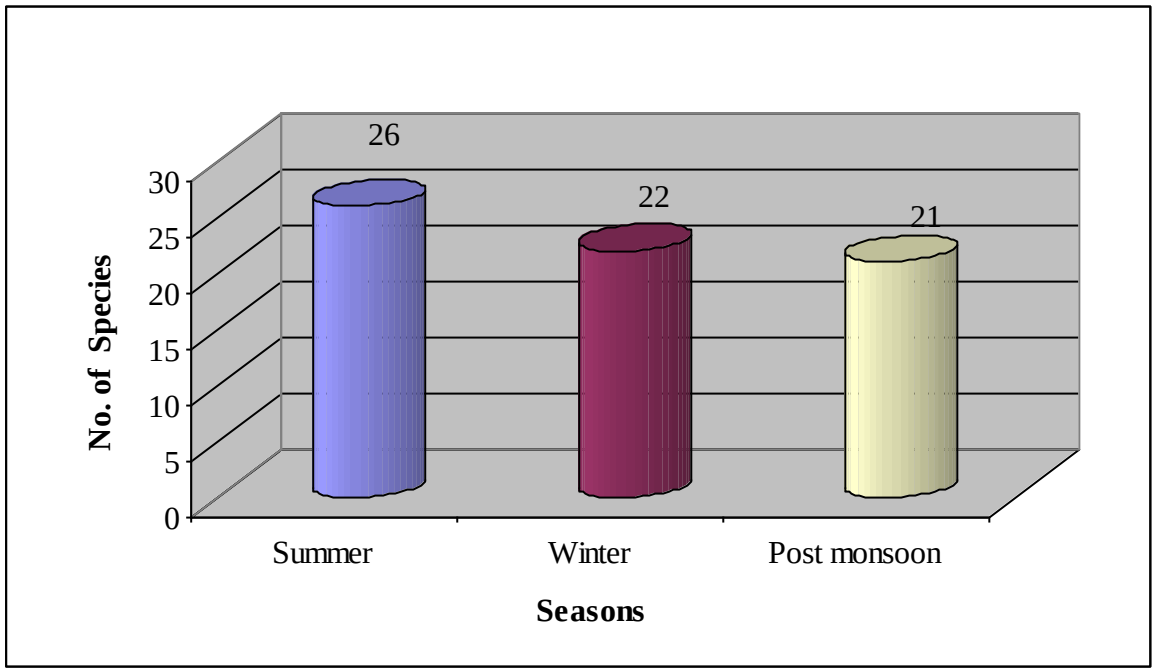


Table 27. Group wise Phytoplankton species composition inTapti basin of M.P.

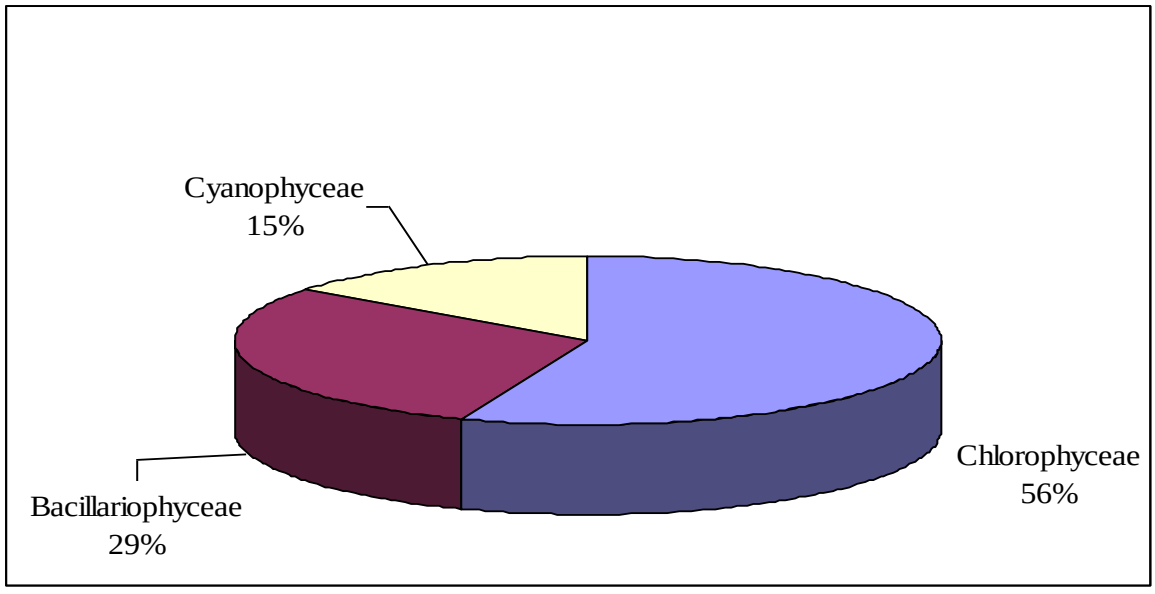


Table 35. Seasonal Phytoplankton diversity in Ken basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Botryoceoceus bramii*	1	1	
2	*Clostarium* sps.	1	1	1
3	*Spirogyra* sps.	1	1	1
4	*Volvox* sps.	1	1	1
5	*Cosmarium* sps.	1	1	1
6	*Ulothrix* sps.	1		1
7	*Zygnema pectinata*	1		
8	*Desmidium* sps.	1	1	1
9	*Arthrodesmus* sps.	1		
10	*Microspora floccose*	1	1	1
11	*Pediastrum duplex*	1	1	1
12	*Pediastrum simplex*	1	1	1
13	*Oedogonium* sps.	1	1	1
14	*Spirogyra communis*	1	1	
	Bacillariophyceae			
15	*Pinnularia* sps.		1	1
16	*Navicula subrhiynchocephalus*		1	1
17	*Synedra* sps.	1		1
18	*Fragilaria* sps.	1	1	1
19	*Asterionella* sps.	1		
	Cyanophyceae			
20	*Phormidium mucicola*	1	1	
21	*Spirulina laxissima*		1	
22	*Microcystis acruginosa*	1	1	1
23	*Synechocystis* sps.	1		1
		20	**17**	**16**

Figure 28. Seasonal Phytoplankton diversity in Ken basin of M.P.

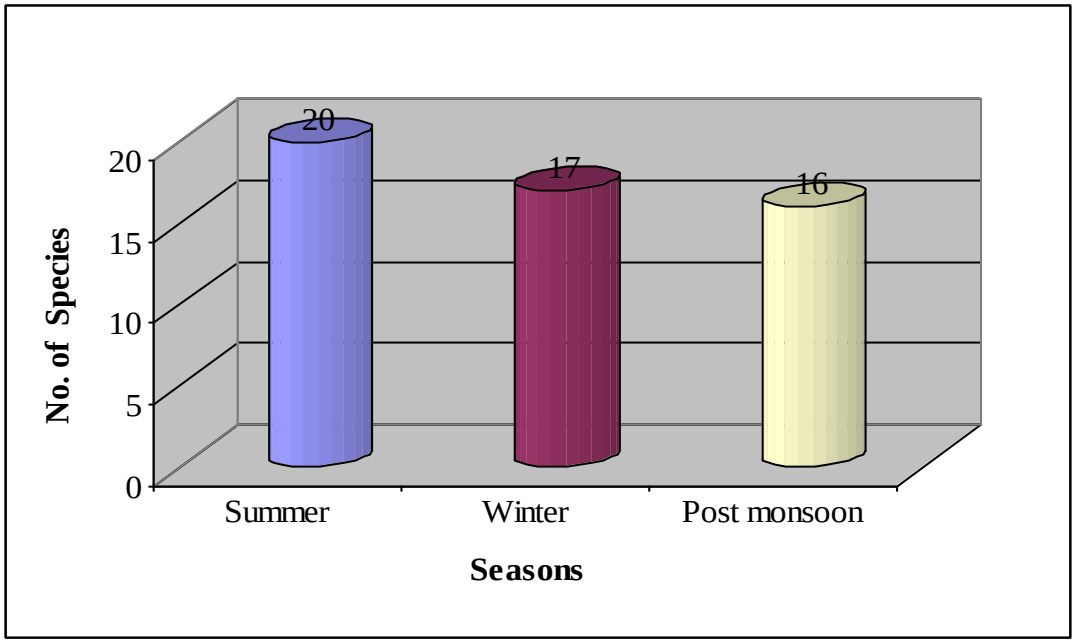


Figure 29.Group wise Phytoplankton species composition at Ken basin of M.P.

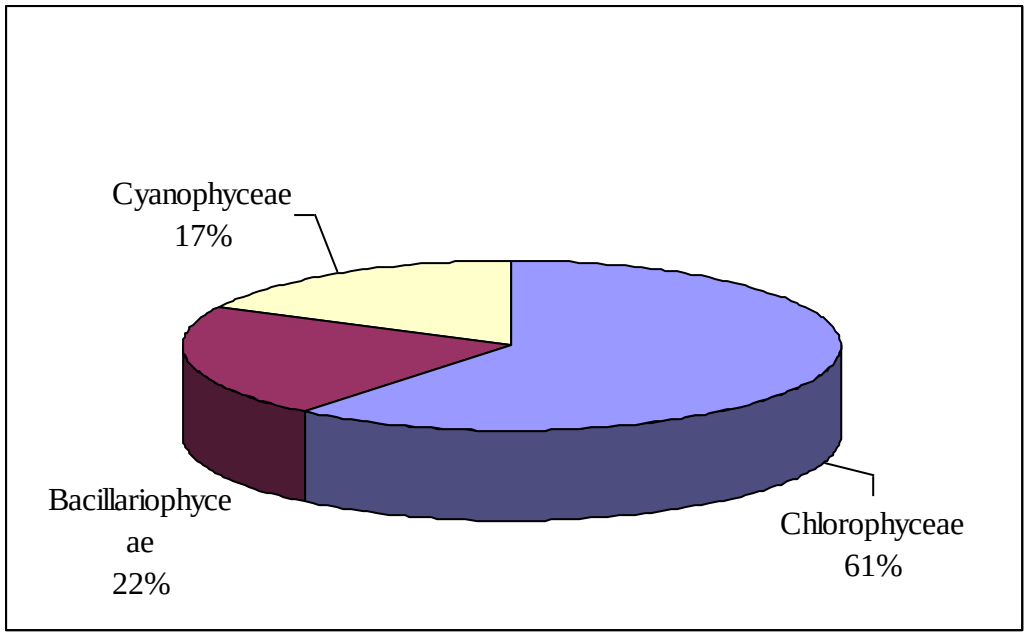


Table 36. Seasonal Phytoplankton diversity in Son basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Botryoceoceus bramii*		1	1
2	*Scenedesmus opotiensis*	1	1	
3	*Scenedesmus* sps.	1	1	1
4	*Clostarium* sps.	1	1	1
5	*Cosmarium reniforme*	1		
6	*Edorina* sps.		1	1
7	*Spirogyra* sps.	1	1	1
8	*Gonium* sps.		1	1
9	*Zygnema* sps.		1	
10	*Volvox* sps.	1	1	1
11	*Cosmarium* sps.	1		1
12	*Zygnema pectinata*		1	
13	*Desmidium* sps.	1	1	1
14	*Mougeotia* sps.	1	1	
15	*Arthrodesmus* sps.	1		
16	*Stichococcus* sps.	1		
17	*Pediastrum duplex*	1	1	1
18	*Pediastrum simplex*	1	1	1
19	*Oedogonium* sps.	1	1	1
20	*Spirogyra communis*	1	1	1
	Bacillariophyceae			
21	*Pinnularia* sps.	1	1	1
22	*Bacillaria* sps.	1	1	1
23	*Navicula subrhiynchocephalus*		1	
24	*Nitzschia* sps.	1		1
25	*Cyclotella* sps.	1		1
	Cyanophyceae			
26	*Phormidium mucicola*		1	
27	*Spirulina laxissima*	1		1
28	*Chroococcus* sps.	1		1
29	*Aphanocapsa banaresensis*		1	
30	*Microcystis acruginosa*	1	1	
31	*Synechocystis* sps.	1	1	1
		23	**23**	**20**

Figure 30. Seasonal Phytoplankton diversity in Son basin of M.P.

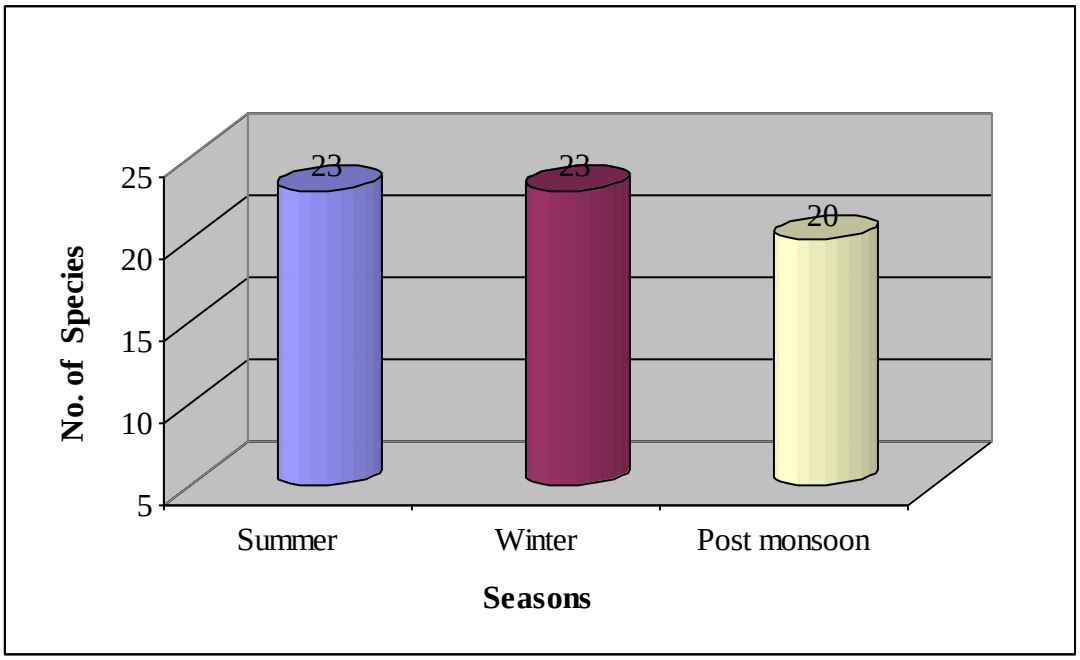


Figure 31. Group wise Phytoplankton species composition at Son basin of M.P.

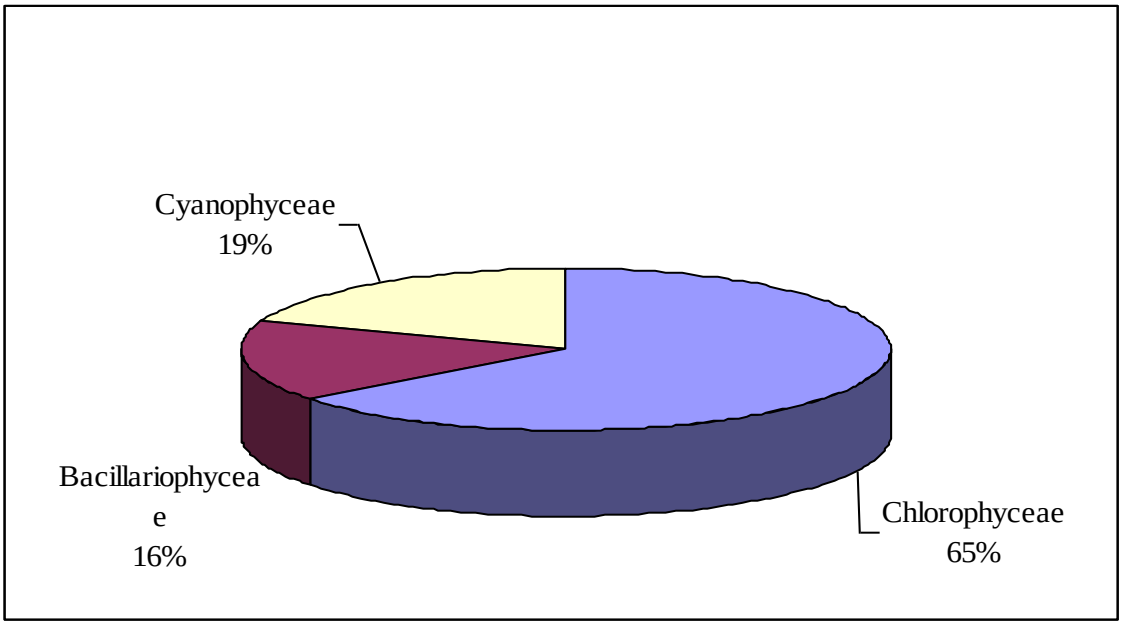


Table 37. Seasonal Phytoplankton diversity in Rajgarh distt. of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Chlorophyceae			
1	*Clostarium* sps.	1	1	1
2	*Spirogyra* sps.	1	1	1
3	*Ankistrodesmus*		1	
4	*Volvox* sps.	1	1	1
5	*Cosmarium* sps.	1	1	1
6	*Ulothrix* sps.	1	1	1
7	*Desmidium* sps.	1	1	
8	*Arthrodesmus* sps.		1	1
9	*Microspora floccose*		1	
10	*Pediastrum duplex*	1	1	1
11	*Pediastrum simplex*	1	1	1
12	*Spirogyra communis*	1	1	
13	*Scenedesmus quadricauda*		1	
	Bacillariophyceae			
14	*Pinnularia* sps.	1	1	1
15	*Bacillaria* sps.	1	1	1
16	*Navicula subrhiynchocephalus*		1	
17	*Synedra* sps.		1	1
18	*Eunotia* sps.	1	1	
19	*Tabellaria* sps.	1	1	1
20	*Fragilaria* sps.	1		
	Cyanophyceae			
21	*Spirulina laxissima*	1		
22	*Aphanocapsa banaresensis*	1		1
23	*Microcystis robusta*	1	1	1
24	*Microcystis marginata*	1		
		18	**20**	**14**

Figure 32. Seasonal Phytoplankton diversity in Rajgarh Distt. of M.P.

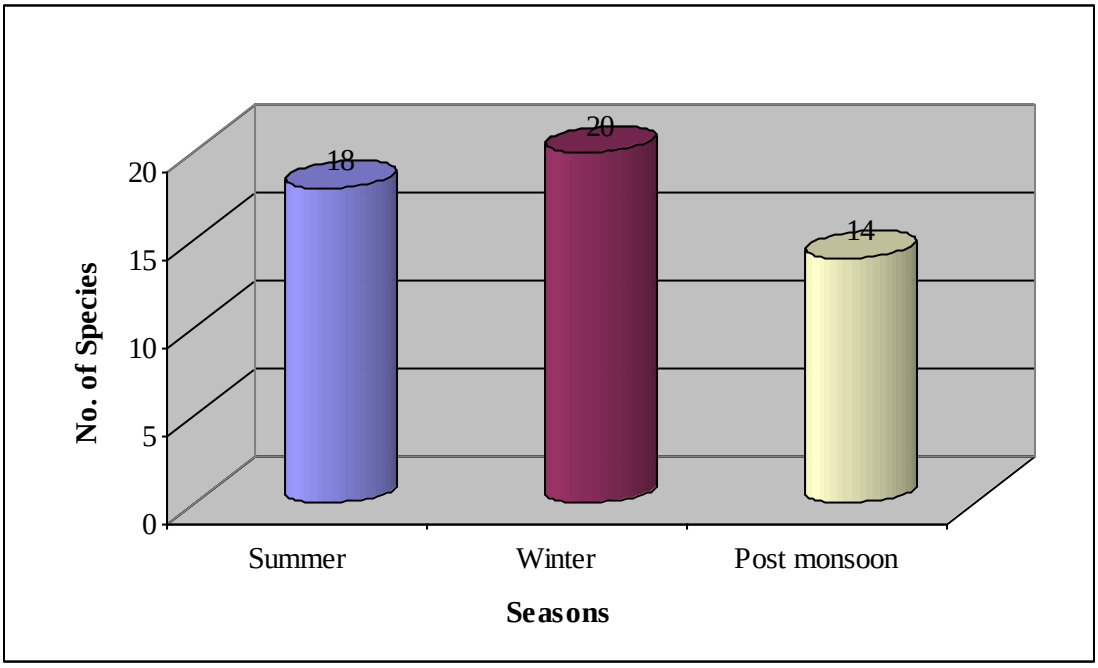
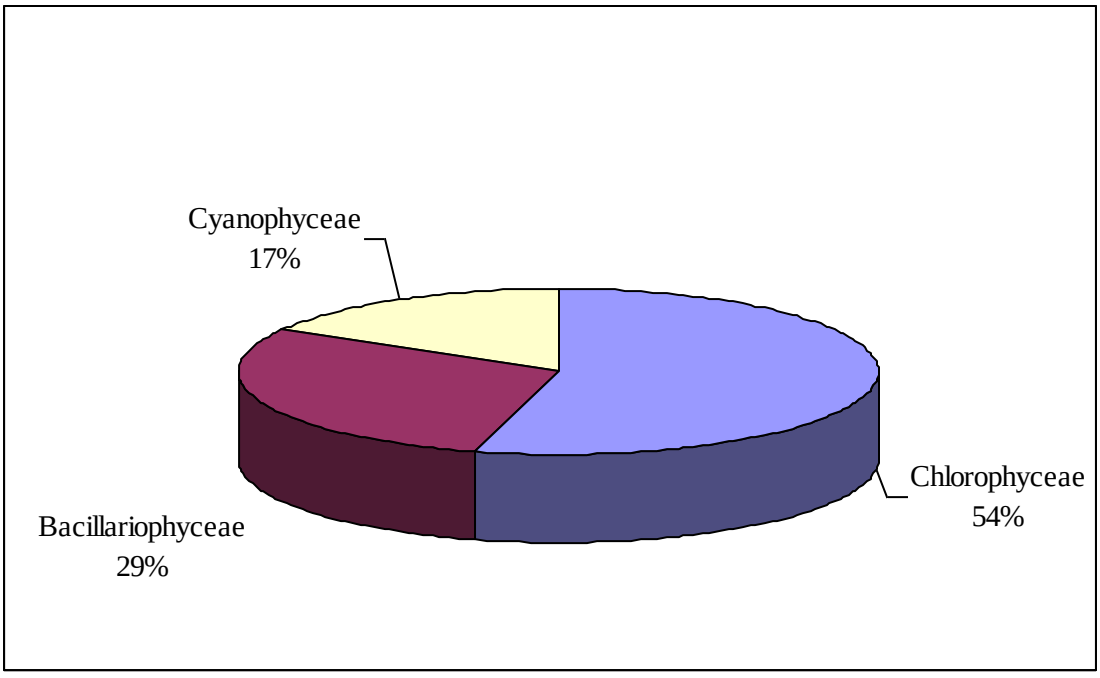


Figure 33. Group wise Phytoplankton species composition at Rajgarh Distt. of M.P.



9.2. Zooplankton

The microscopic free swimming animal components of aquatic system are known as zooplankton. Zooplankton play an important role in aquatic food webs, both as a resource for consumers on higher trophic levels (including fish), and as conduit for packaging the organic material in the biological pump. Since they are typically of small size, zooplankton can respond relatively rapidly to increases in phytoplankton abundance.

During the Zooplanktonic study at different river basin of Madhya Pradesh a total of 75 species belonging to four major group's viz. ***Rotifera, Cladocera, Ostracoda and Copepoda*** were identified. *Rotifera* has been recorded as the most dominant group of zooplankton in the river basins represented by 32 species (42%) followed by *Cladocera* represented by 20 species (27%) *Copepoda* represented by 18 species (24%) and *Ostracoda* represented by 5 species (7%).

Zooplankton community of the different river basin showed a rich diversity. During the Zooplanktonic study at the river basin the higher diversity was observed in Betwa Basin comprises of 56 species followed by Chambal Basin comprises of 50 species, Seasonal ponds and river of Rajgarh District comprises of 38 species, Tapti basin comprises of 36 species, Sone Basin comprises of 31 species and Ken Basin comprises of 29 species,.

9.2.1. Zooplankton diversity in Chambal Basin

A total of 50 species of zooplankton has been recorded in the Chambal basin. The dominant group in the zooplankton community in the Chambal basin has been the *Copepoda* represented by 17 species (34%), followed closely by *Rotifera* represented 16 species (32%). The other groups of zooplankton include *Cladocera* comprises of 12 species (*24*%) and *Ostracoda* comprises of 5 species (10%). The higher diversity of zooplankton was observed during summer (40 species) season while lower diversity was observed during post monsoon (34 species) season and winter (34 species) season

Copepoda

During the study 17 species *of Copepoda group* was identified as the most dominant group of zooplankton. Not much variation was observed in summer, winter and post

monsoon seasonsThe maximum diversity of *Copepoda* was observed during summer (13 species) season followed by a gradual decreasing trend in winter (12 species) season, ultimately lowest to post monsoon (11species) season

Rotifera

During the period under study 16 species of *Rotifera* group was identified and represented as second dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. The maximum diversity of *Rotifera* was observed during summer (13 species) season followed by a gradual decreasing trend in post monsoon (12 species) season, ultimately lowest to winter (10 species) season.

Cladocera

During the study 12 species of *Cladocera* group was identified. Their higher diversity was observed in summer (10 species) season while in the winter and post monsoon season diversity was observed same (8 species).

Ostracoda

Ostracoda as a component of zooplankton was forth to *Copepoda in showing* prominence. The diversity of *Ostracoda* was observed during summer and winter season were same (4 species) while in the post monsoon season 3 species were recorded.

9.2.2. Zooplankton diversity in Betwa Basin

During the study the higher zooplankton community was recorded at the Betwa basin with a total of 56 species. The most dominant group was *Rotifera* represented by 27 species (48%). The other significant groups which are *Cladocera* comprise of 14 species (25%), *Copepoda* comprises of 11 species (20%), and *Ostracoda* comprises of 4 species (10%). The higher diversity of zooplankton was observed during summer (39 species) followed by a gradual decreasing trend in winter (35species) season, ultimately lowest to post monsoon (33species) season.

Rotifera

During the study 27 species *of Rotifera group* was identified as the most dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. Their higher diversity was observed in summer (19 species) season while in the winter and post monsoon season diversity was observed same (17 species).

Cladocera

During the period under study 14species of *Cladocera* group was identified and represented as second dominant group of zooplankton. The diversity of *Cladocera* was observed during summer and winter season were same (9 species) while in the post monsoon season 7 species were recorded.

Copepoda

Copepoda as a component of zoooplankton was third to Rotifera in showing prominence. During the study 11 species of *Copepoda* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. Their higher diversity was recorded during summer (8 species) season followed by a gradual decreasing trend in post monsoon (7 species) season, ultimately lowest to winter (6 species) season.

Ostracoda

During the period under study 4 species of *Ostracoda* group was identified. The diversity of *Ostracoda* was observed during summer and winter season were same (3 species) while in the post monsoon season 2 species were recorded.

9.2.3. Zooplankton diversity in Tapti Basin

A total of 36 species of zooplankton has been recorded in the Chambal basin. The dominant group in the zooplankton community in the Tapti basin has been the *Rotifera* represented by 19 species (53%). The other significant groups which are *Cladocera* comprise of 7 species (19%), *Copepoda* comprises of 6 species (17%), and *Ostracoda* comprises of 4 species (11%). The higher diversity of zooplankton was observed during

post monsoon (24 species) followed by a gradual decreasing trend in winter (21species) season, ultimately lowest to summer (19species) season.

Rotifera

During the study 19 species *of Rotifera group* was identified as the most dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Rotifera* was observed during winter and post monsoon season were same (13 species) while in the summer season 11 species were recorded.

Cladocera

During the period under study 7 species of *Cladocera* group was identified and represented as second dominant group of zooplankton. The maximum diversity of *Cladocera* was observed during post monsoon (6 species) season while the minimum was observed in the winter (2 species) season.

Copepoda

Copepoda as a component of zooplankton was third to Rotifera in showing prominence. During the study 6 species of *Copepoda* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. Their higher diversity was recorded during winter (3 species) season followed by a gradual decreasing trend in summer (2 species) season, ultimately lowest to post monsoon (1 species) season.

Ostracoda

During the period under study 4 species of *Ostracoda* group was identified. The diversity of *Ostracoda* was observed during summer and winter season were same (3 species) while in the post monsoon season 4 species were recorded.

9.2.4. Zooplankton diversity in Ken Basin

The zooplankton community has been recorded in the Ken Basin with a total of 29 species. The most dominant group was *Rotifera* represented by 11 species (38%). The other significant groups which are *Copepoda* comprise of 9 species (31%), *Cladocera*

comprises of 6 species (21%), and *Ostracoda* comprises of 3 species (10%). The higher diversity of zooplankton was observed during winter and post monsoon season were same (24 species) while in the summer season 21 species were recorded..

Rotifera

During the study 11 species *of Rotifera group* was identified as the most dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Rotifera* was observed during winter and post monsoon season were same (9 species) while in the summer season 8 species were recorded.

Copepoda

During the period under study 9 species of *Copepoda* group was identified and represented as second dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. The maximum diversity of *Copepoda* was observed during winter (9 species) season followed by a gradual decreasing trend in post monsoon (8 species) season, ultimately lowest to summer (7 species) season.

Cladocera

Cladocera as a component of zooplankton was third to *Rotifera in showing* prominence. During the study 6 species of *Cladocera* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. Their higher diversity was recorded during summer (5 species) season while in the winter and post monsoon season diversity was observed same (4 species).

Ostracoda

During the period under study 3 species of *Ostracoda* group was identified. The maximum diversity of *Ostracoda* was observed during post monsoon (3 species) season followed by a gradual decreasing trend in winter (2 species) season, ultimately lowest to summer (1 species) season.

9.2.5. Zooplankton diversity in Son Basin

The zooplankton community of Son Basin comprises of 31 species. The most dominant group was *Rotifera* represented by 15 species (48%). The other significant groups which are *Cladocera* comprise of 7 species (23%), *Copepoda* comprises of 5 species (16%), and *Ostracoda* comprises of 4 species (13%). The higher diversity of zooplankton was observed during winter season (26 species) while in the summer season 23 species and post monsoon season 24 species were recorded.

Rotifera

During the study 15species *of Rotifera group* was identified as the most dominant group of zooplankton. The maximum diversity of *Rotifera* was observed during post monsoon (14 species) season while the minimum was observed in the summer (11 species) season.

Cladocera

During the period under study 7 species of *Cladocera* group was identified and represented as second dominant group of zooplankton. The maximum diversity of *Cladocera* was observed during winter (6 species) season while in the summer and post monsoon season diversity was observed same (4 species).

Copepoda

Copepoda as a component of zooplankton was third to *Rotifera in showing* prominence. During the study 5 species of *Copepoda* group was identified. No variation was observed in summer, winter and post monsoon seasons. The diversity of *Copepoda* was recorded during winter, summer and post monsoon season were same (4 species)

Ostracoda

During the period under study 4 species of *Ostracoda* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. Their higher diversity was recorded during summer (4 species) season followed by a gradual decreasing trend in winter (3 species) season, ultimately lowest to post monsoon (2 species) season.

9.2.6. Zooplankton diversity in Rajgarh District

The zooplankton community has been recorded in the Seasonal ponds and river of Rajgarh District comprises of 38 species. The most dominant group was *Rotifera* represented by 18 species (47%). The other significant groups which are *Cladocera* comprise of 9 species (24%), *Copepoda* comprises of 8 species (21%), and *Ostracoda* comprises of 3 species (8%). The higher diversity of zooplankton was observed during post monsoon season (28 species) while in the summer and post winter season diversity was observed same (27species).

Rotifera

During the study 18 species *of Rotifera group* was identified as the most dominant group of zooplankton. Not much variation was observed in summer, winter and post monsoon seasons. The maximum diversity of *Rotifera* was observed during winter (14 species) season followed by a gradual decreasing trend in summer (13 species) season, ultimately lowest to post monsoon (12 species) season.

Cladocera

During the period under study 9 species of *Cladocera* group was identified and represented as second dominant group of zooplankton. The maximum diversity of *Cladocera* was observed during post monsoon (8 species) season followed by a gradual decreasing trend in winter (6 species) season, ultimately lowest to summer (5 species) season

Copepoda

Copepoda as a component of zooplankton was third to Rotifera in showing prominence. During the study 8 species of Copepoda group was identified. No variation was observed in summer, winter and post monsoon seasons. The maximum diversity of Copepoda was observed during summer (6 species) season while in the winter and post monsoon season diversity was observed same (5 species).

Ostracoda

During the period under study 3 species of *Ostracoda* group was identified. Not much variation was observed in summer, winter and post monsoon seasons. The diversity of *Ostracoda* was observed during summer and post monsoon season were same (3 species) while in the winter season 2 species were recorded.

Table 38. Zooplankton diversity in different river basins of M.P.

S.No	Species	Chambal Basin	Betwa basin	Tapti basin	Ken Basin	Sone Basin	Rajgarh Distt.
	Zooplankton						
	Rotifera						
1	*Lecane bulla*		1	1		1	
2	*Lecane luna*		1	1			
3	*Keratella quadrata*	1	1	1	1	1	
4	*Keratella tropica*	1	1	1	1	1	1
5	*Keratella lengi*	1		1			1
6	*Keratella cochleris*	1	1	1		1	1
7	*Polyarthra vulgaris*	1					
8	*Filinia longiseta*	1	1				
9	*Monostyla spp.*	1	1				1
10	*Asplanchna brightwellii*	1					
11	*Trichotria spp.*	1	1		1	1	1
12	*Brachionus quardridentatus*	1	1	1		1	
13	*Brachionus calyciflorus*	1	1	1			1
14	*Brachionus falcatus*	1	1	1	1		1
15	*Brachionus patulus*		1				
16	*Brachionus caudatus*		1			1	1
17	*Brachionus pterodinodes*		1				
18	*Brachionus diversiarnis*		1	1		1	1
19	*Brachionus rubens*	1	1	1	1		
20	*Brachionus bidendata*		1			1	
21	*Brachionus angularis*		1	1			
22	*Brachionus forficula*	1	1	1		1	1
23	*Philodina spp.*	1	1		1		1
24	*Anuaeopsis fissia*			1	1	1	1
25	*Asplanchnopus multiceps*		1	1			1

26	*Notholca acuminata*	1	1	1		1	
27	*Chromogaster ovalis*		1	1	1		1
28	*Synchaeta pectinata*		1		1	1	1
29	*Polyarthyra vulgaris*		1	1	1		1
30	*Scaridium longicaudum*					1	1
31	*Platyias quadricornis*		1	1	1		1
32	*Asplanchna brightwelli*		1			1	
	Cladocera						
33	*Daphnia carinata*	1	1			1	1
34	*Daphnia oblusa*		1	1			
35	*Daphnia lumhaltyi*		1	1	1		
36	*Daphnia pulex*	1					1
37	*Daphnia retrocurva*		1				
38	*Daphnia similes*		1				
49	*Moindaphuinia*		1		1		1
40	*Daphnia lumholtzi*	1					
41	*Alonella dentifera*	1			1		
42	*Alona quatata*	1	1			1	1
43	*Alona quaffinis*	1	1		1		
44	*Alona quandrangularis*	1			1		
45	*Ceriodaphnia spp.*	1	1	1		1	1
46	*Bosmina longirostris*	1	1	1			
47	*Macrothrix sp.*		1	1		1	1
48	*Daphnossoma birgei*	1	1				
49	*Moina micrara*		1			1	1
50	*Simocephalus sp.*	1	1	1			
51	*Leydigia sp.*				1	1	1
52	*Scapholeberis sp.*	1		1		1	1
	Ostracoda						
53	*Cypris obensa*	1	1	1	1	1	1
54	*Cypris candona*	1	1	1	1		1
55	*Stenocypris sp.*	1	1			1	
56	*Heterocypris sp.*	1		1	1	1	1
57	*Nauplius sp.*	1	1	1		1	
	Copepoda						
58	*Ectocyclops phaleratus*	1				1	1
59	*Ectocyclops serrulatus*	1	1			1	
60	*Cyclops vicinus*	1	1	1	1		1
61	*Microcyclops varicans*	1	1				

62	*Macrocyclops distinctus*	1	1		1		
63	*Mesoocyclops hyalinus*	1					1
64	*Mesocyclops leuckarti*	1	1				
65	*Ergasilus spp.*	1	1		1	1	
66	*Allodiaptomus raio*	1					
67	*Heliodiaptomus vidus*	1	1		1		1
68	*Paradiaptomus greeni*	1		1			
69	*Synecella calanoides*	1	1				1
70	*Argulus japonicus*	1			1		
71	*Diaptomus spp.*	1	1	1		1	1
72	*Nauplius larvae*	1		1	1		
73	*Eucyclops sp.*	1	1	1	1		
74	*Neodiaptomus sp.*		1	1	1	1	1
75	*Cletocampus sp.*	1			1		1
		50	**56**	**36**	**29**	**31**	**38**

Figure 34. Zooplankton diversity in different river basins of M.P.

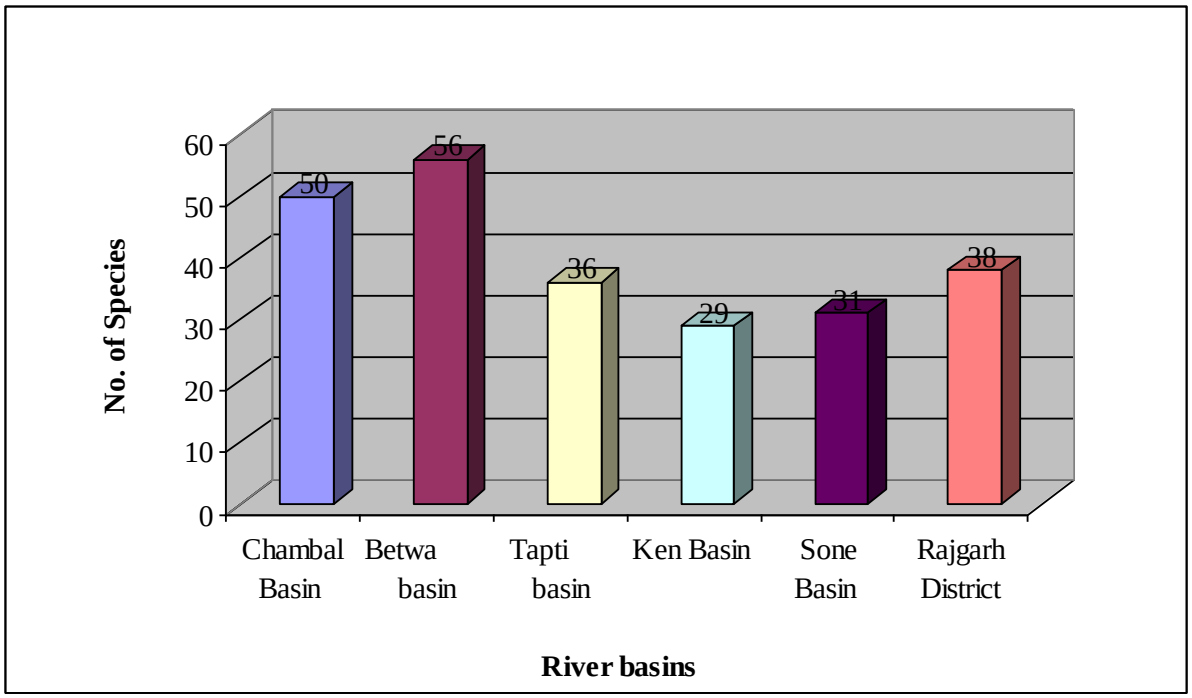


Figure 35. Groupwise Zooplankton species composition at different river basins of M.P.

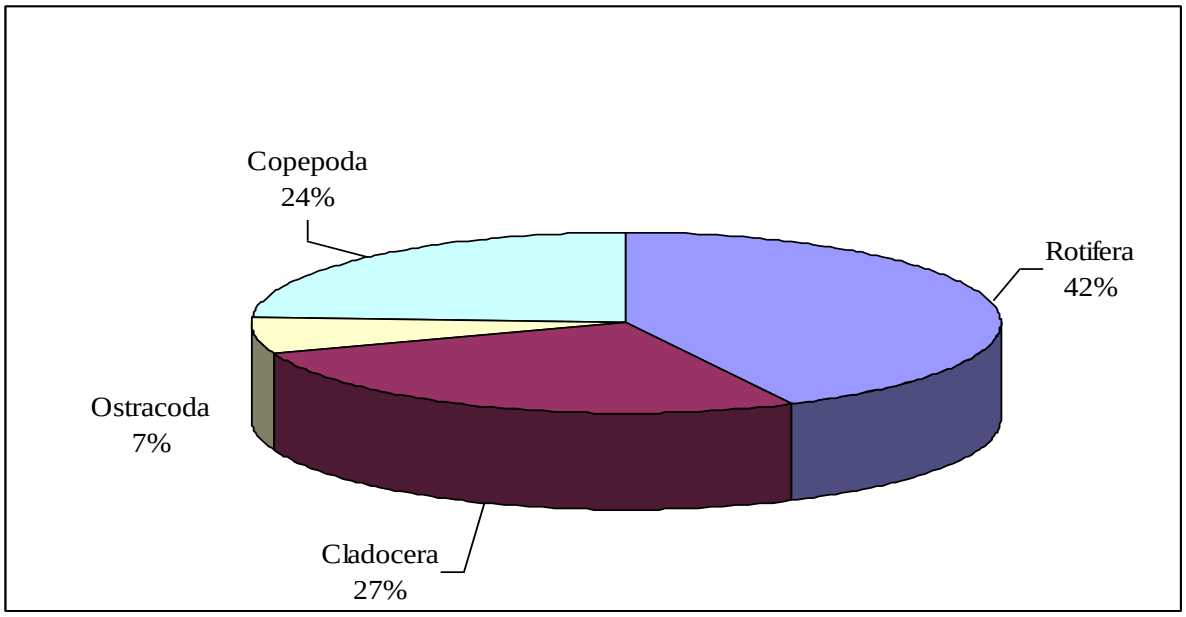


Table 39. Seasonal Zooplankton diversity in Chambal basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Keratella quadrata*	1	1	1
2	*Keratella tropica*	1	1	1
3	*Keratella lengi*	1		1
4	*Keratella cochleris*		1	1
5	*Polyarthra vulgaris*	1	1	
6	*Filinia longiseta*	1		1
7	*Monostyla spp.*	1	1	
8	*Asplanchna brightwellii*		1	1
9	*Trichotria spp.*	1		1
10	*Brachionus quardridentatus*	1	1	1
11	*Brachionus calyciflorus*		1	
12	*Brachionus falcatus*	1		1
13	*Brachionus rubens*	1		1
14	*Brachionus forficula*	1	1	
15	*Philodina spp.*	1	1	1
16	*Notholca acuminata*	1		1

	Cladocera			
17	*Daphnia carinata*	1	1	1
18	*Daphnia pulex*	1		1
19	*Daphnia lumholtzi*	1	1	1
20	*Alonella dentifera*	1		
21	*Alona quatata*		1	1
22	*Alona quaffinis*	1	1	
23	*Alona quandrangularis*		1	1
24	*Ceriodaphnia spp.*	1	1	1
25	*Bosmina longirostris*	1		
26	*Daphnossoma birgei*	1	1	
27	*Simocephalus sp.*	1		1
28	*Scapholeberis sp.*	1	1	1
	Ostracoda			
29	*Cypris obensa*	1	1	
30	*Cypris candona*	1	1	1
31	*Stenocypris sp.*		1	1
32	*Heterocypris sp.*	1		1
33	*Nauplius sp.*	1	1	
	Copepoda			
34	*Ectocyclops phaleratus*	1		1
35	*Ectocyclops serrulatus*	1	1	1
36	*Cyclops vicinus*	1	1	1
37	*Microcyclops varicans*		1	1
38	*Macrocyclops distinctus*	1		
39	*Mesoocyclops hyalinus*		1	1
40	*Mesocyclops leuckarti*	1	1	
41	*Ergasilus spp.*	1		
42	*Allodiaptomus raio*	1	1	1
43	*Heliodiaptomus vidus*	1		1
44	*Paradiaptomus greeni*	1	1	1
45	*Synecella calanoides*		1	
46	*Argulus japonicus*	1	1	1
47	*Diaptomus spp.*	1		
48	*Nauplius larvae*		1	1
49	*Eucyclops sp.*	1	1	1
50	*Cletocampus sp.*	1	1	
		40	**34**	**34**

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Figure 36. Seasonal Zooplankton diversity in Chambal basin of M.P.

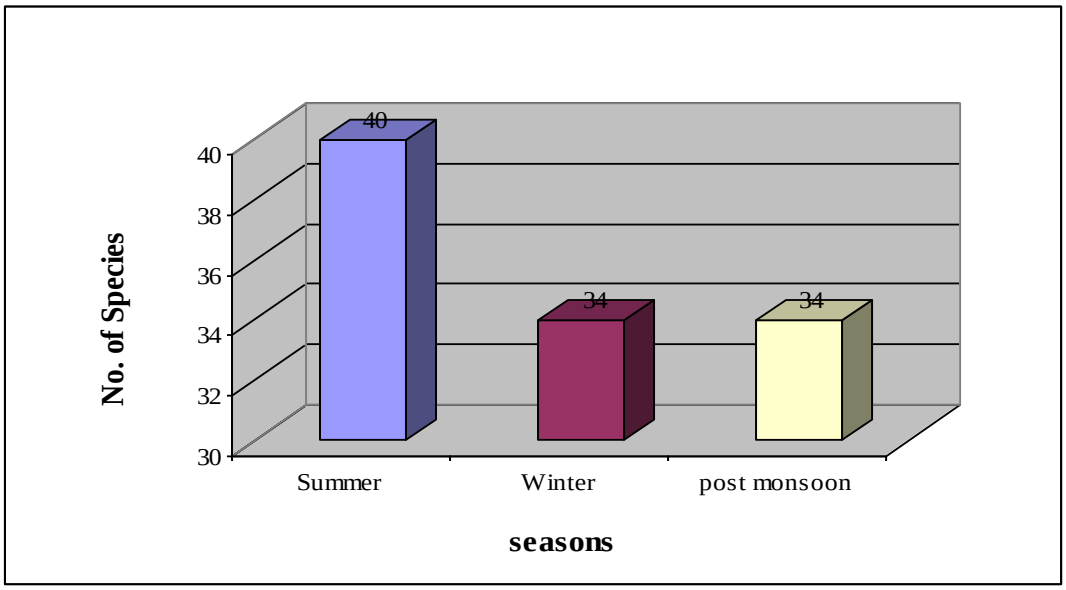


Figure 37. Group-wise Zooplankton species composition in Chambal basin of M.P.

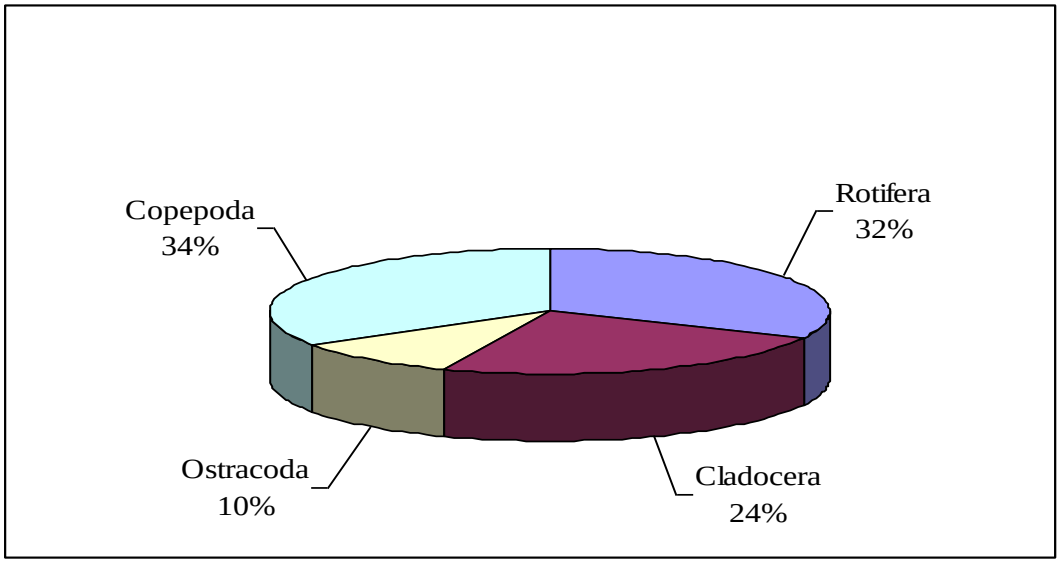


Table 40. Seasonal Zooplankton diversity in Betwa basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Lecane bulla*	1	1	
2	*Lecane luna*	1	1	
3	*Keratella quadrata*	1	1	1
4	*Keratella tropica*	1		1
5	*Keratella cochleris*	1		1
6	*Filinia longiseta*		1	1
7	*Monostyla spp.*		1	
8	*Trichotria spp.*	1	1	
9	*Brachionus quardridentatus*		1	1
10	*Brachionus calyciflorus*	1		1
11	*Brachionus falcatus*	1	1	
12	*Brachionus patulus*	1	1	1
13	*Brachionus caudatus*		1	
14	*Brachionus pterodinodes*		1	1
15	*Brachionus diversiarnis*	1	1	1
16	*Brachionus rubens*	1		1
17	*Brachionus bidendata*	1		1
18	*Brachionus angularis*	1	1	
19	*Brachionus forficula*	1	1	1
20	*Philodina spp.*	1		1
21	*Asplanchnopus multiceps*	1		1
22	*Notholca acuminata*			
23	*Chromogaster ovalis*	1	1	1
24	*Synchaeta pectinata*	1	1	1
25	*Polyarthyra vulgaris*		1	
26	*Platyias quadricornis*	1		
27	*Asplanchna brightwelli*			1
	Cladocera			
28	*Daphnia carinata*	1	1	
29	*Daphnia oblusa*	1		1
30	*Daphnia lumhaltyi*	1	1	1
31	*Daphnia retrocurva*	1		
32	*Daphnia similes*	1	1	1

33	*Moindaphuinia*		1	
34	*Alona quatata*	1		1
35	*Alona quaffinis*		1	1
36	*Ceriodaphnia spp.*	1	1	
37	*Bosmina longirostris*		1	1
38	*Macrothrix sp.*		1	1
39	*Daphnossoma birgei*	1		
40	*Moina micrara*			
41	*Simocephalus sp.*	1	1	
	Ostracoda			
42	*Cypris obensa*	1	1	1
43	*Cypris candona*		1	
44	*Stenocypris sp.*	1		
45	*Nauplius sp.*	1	1	1
	Copepoda			
46	*Ectocyclops serrulatus*	1	1	
47	*Cyclops vicinus*	1	1	1
48	*Microcyclops varicans*	1	1	1
49	*Macrocyclops distinctus*		1	
50	*Mesocyclops leuckarti*	1		
51	*Ergasilus spp.*			1
52	*Heliodiaptomus vidus*	1		1
53	*Synecella calanoides*	1	1	
54	*Diaptomus spp.*	1		1
55	*Eucyclops sp.*			1
56	*Neodiaptomus sp.*	1	1	1
		39	**35**	**33**

Figure 38. Seasonal Zooplankton diversity in Betwa basin of M.P.

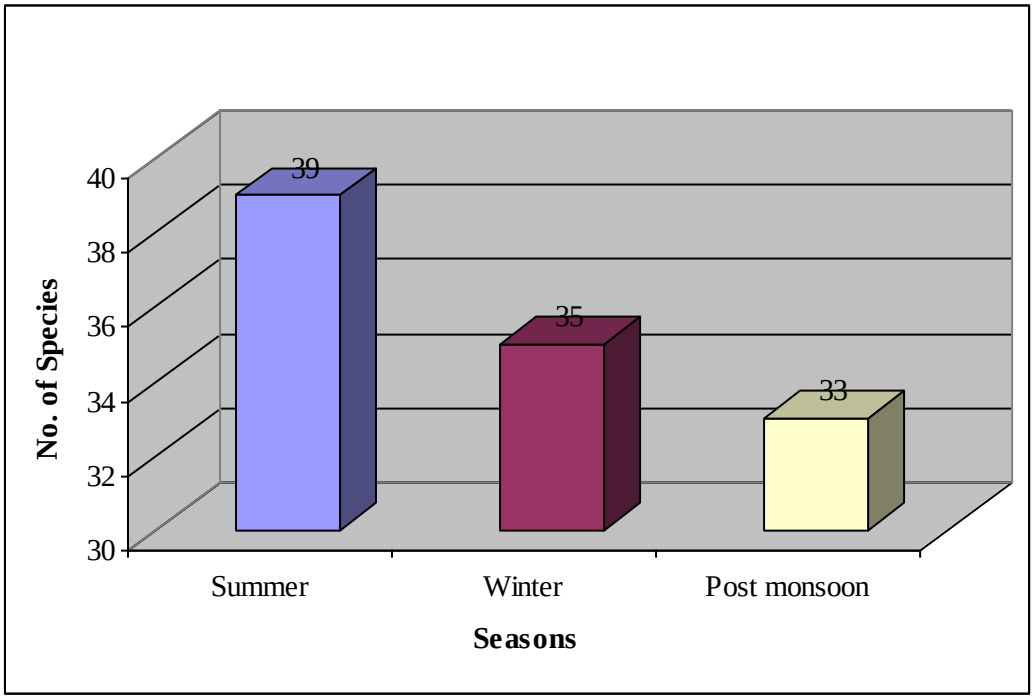


Figure 39. Group wise Zooplankton species composition in Betwa basin of M.P.

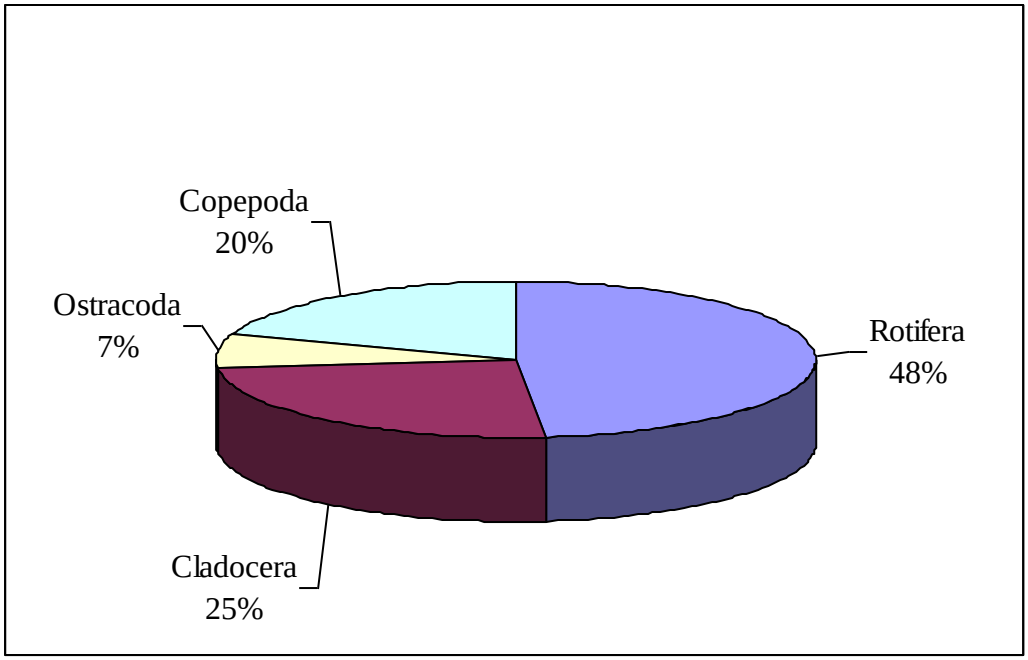


Table 41. Seasonal Zooplankton diversity in Tapti basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Lecane bulla*	1	1	
2	*Lecane luna*			1
3	*Keratella quadrata*			1
4	*Keratella tropica*	1	1	
5	*Keratella lengi*	1		1
6	*Keratella cochleris*	1	1	1
7	*Brachionus quardridentatus*	1	1	1
8	*Brachionus calyciflorus*	1	1	
9	*Brachionus falcatus*		1	1
10	*Brachionus diversiarnis*		1	1
11	*Brachionus rubens*			1
12	*Brachionus angularis*			1
13	*Brachionus forficula*	1	1	
14	*Anuaeopsis fissia*	1	1	1
15	*Asplanchnopus multiceps*		1	1
16	*Notholca acuminata*	1		
17	*Chromogaster ovalis*	1	1	1
18	*Polyarthyra vulgaris*	1	1	
19	*Platyias quadricornis*		1	1
	Cladocera			
20	*Daphnia oblusa*			1
21	*Daphnia lumhaltyi*	1		1
22	*Ceriodaphnia spp.*			1
23	*Bosmina longirostris*		1	1
24	*Macrothrix sp.*			1
25	*Simocephalus sp.*	1		1
26	*Scapholeberis sp.*	1	1	
	Ostracoda			
27	*Cypris obensa*	1	1	
28	*Cypris candona*	1	1	
29	*Heterocypris sp.*		1	
30	*Nauplius sp.*			1

	Copepoda			
31	*Cyclops vicinus*		1	
32	*Paradiaptomus greeni*	1	1	
33	*Diaptomus spp.*	1		1
34	*Nauplius larvae*	1	1	1
35	*Eucyclops sp.*			1
36	*Neodiaptomus sp.*			1
		19	**21**	**24**

Figure 40. Seasonal Zooplankton diversity in Tapti basin of M.P.

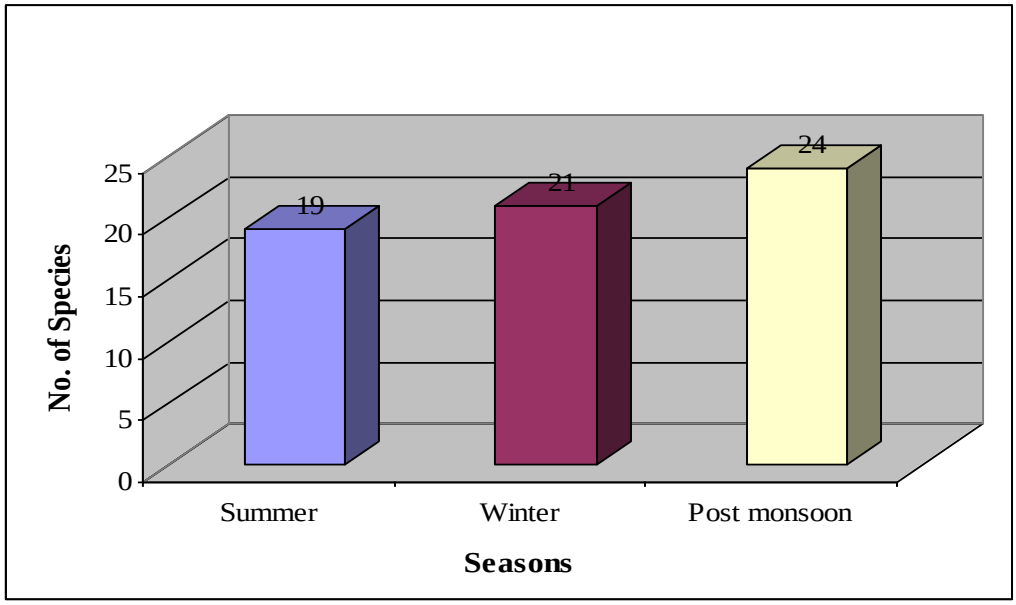


Figure 41. Group wise Zooplankton species composition in Tapti basin of M.P.

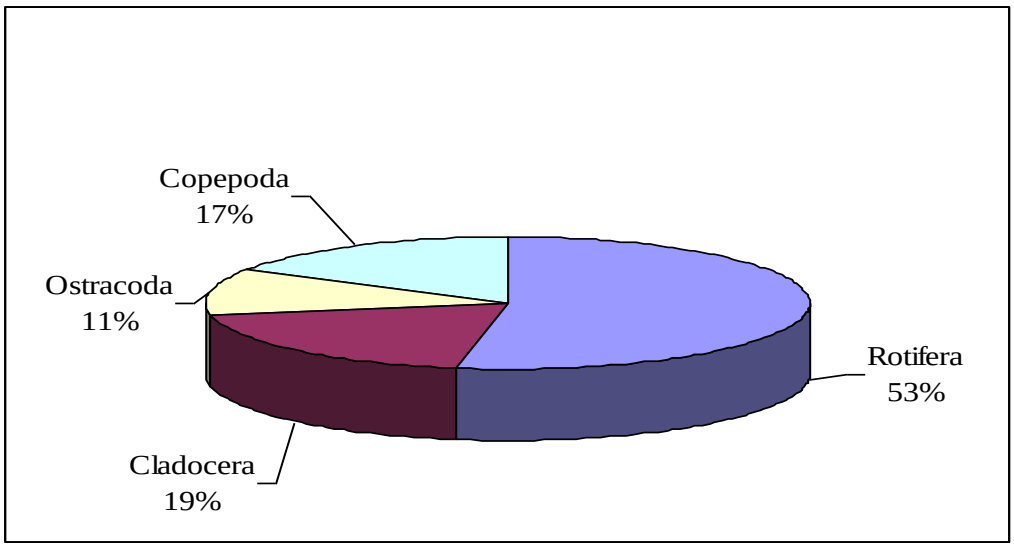


Table 42. Seasonal Zooplankton diversity in Ken basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Keratella quadrata*	1	1	1
2	*Keratella tropica*	1	1	1
3	*Trichotria spp.*	1	1	1
4	*Brachionus falcatus*	1	1	1
5	*Brachionus rubens*		1	1
6	*Philodina spp.*		1	1
7	*Anuaeopsis fissia*	1		
8	*Chromogaster ovalis*	1	1	1
9	*Synchaeta pectinata*	1	1	
10	*Polyarthyra vulgaris*		1	1
11	*Platyias quadricornis*	1		1
	Cladocera			
12	*Daphnia lumhaltyi*	1		1
13	*Moindaphuinia*	1	1	
14	*Alonella dentifera*		1	1
15	*Alona quaffinis*	1	1	
16	*Alona quandrangularis*	1		1
17	*Leydigia sp.*	1	1	1
	Ostracoda			
18	*Cypris obensa*		1	1
19	*Cypris candona*		1	1
20	*Heterocypris sp.*	1		1
	Copepoda			
21	*Cyclops vicinus*	1	1	1
22	*Macrocyclops distinctus*	1	1	1
23	*Ergasilus spp.*		1	1
24	*Heliodiaptomus vidus*	1	1	1
25	*Argulus japonicus*	1	1	
26	*Nauplius larvae*	1	1	1
27	*Eucyclops sp.*	1	1	1
28	*Neodiaptomus sp.*		1	1
29	*Cletocampus sp.*	1	1	1
		21	**24**	**24**

Figure 42. Seasonal Zooplankton diversity in Ken basin of M.P.

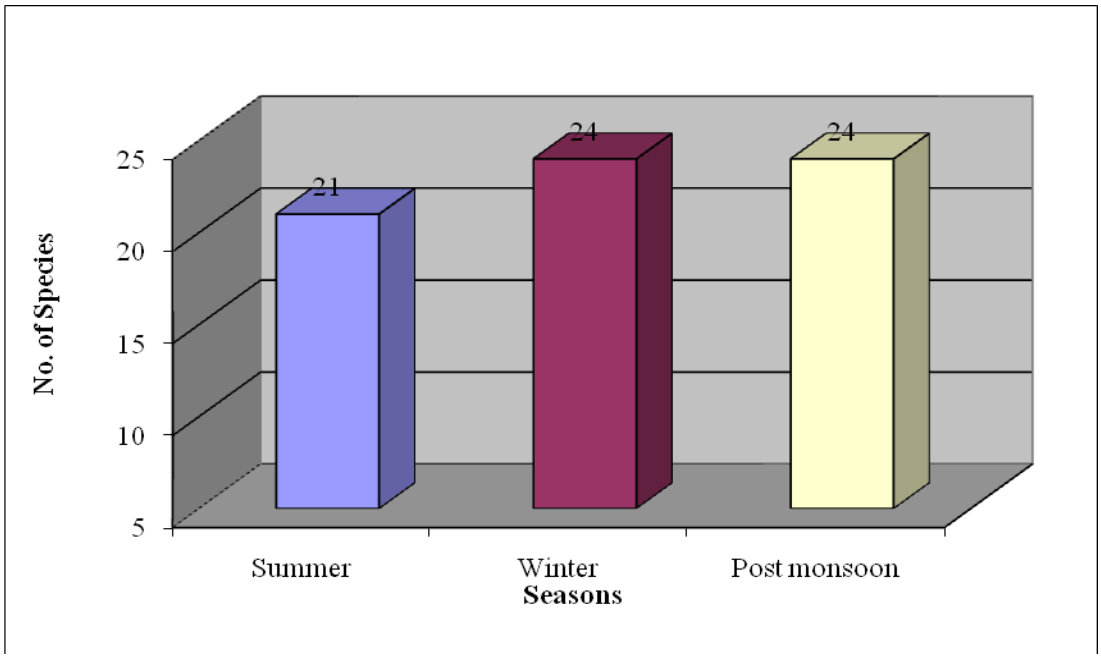


Figure 43. Group wise Zooplankton species composition in Ken basin of M.P.

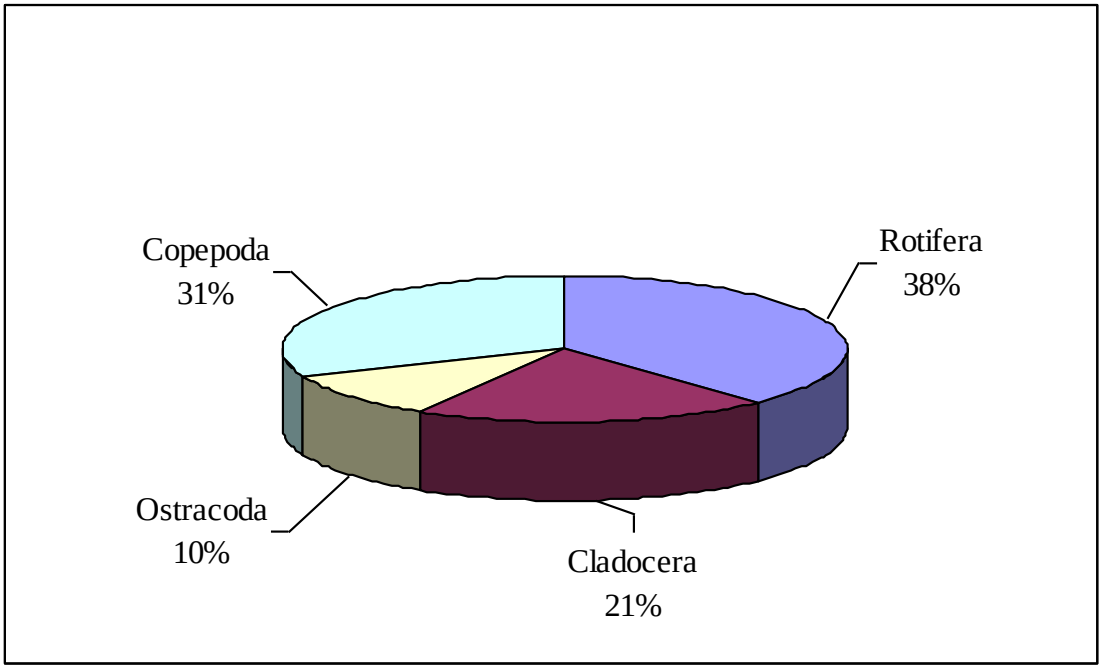


Table 43. Seasonal Zooplankton diversity in Son basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Lecane bulla*	1	1	1
2	*Keratella quadrata*	1	1	1
3	*Keratella tropica*	1	1	1
4	*Keratella cochleris*	1	1	1
5	*Trichotria spp.*	1	1	1
6	*Brachionus quardridentatus*		1	1
7	*Brachionus caudatus*	1	1	1
8	*Brachionus diversiarnis*	1		1
9	*Brachionus bidendata*		1	1
10	*Brachionus forficula*	1	1	1
11	*Anuaeopsis fissia*	1		1
12	*Notholca acuminata*	1	1	1
13	*Synchaeta pectinata*		1	1
14	*Scaridium longicaudum*		1	1
15	*Asplanchna brightwelli*	1	1	
	Cladocera			
16	*Daphnia carinata*	1		1
17	*Alona quatata*		1	
18	*Ceriodaphnia spp.*	1	1	1
19	*Macrothrix sp.*	1	1	1
20	*Moina micrara*		1	1
21	*Leydigia sp.*		1	
22	*Scapholeberis sp.*	1	1	
	Ostracoda			
23	*Cypris obensa*	1		
24	*Stenocypris sp.*	1	1	
25	*Heterocypris sp.*	1	1	1
26	*Nauplius sp.*	1	1	1
	Copepoda			
27	*Ectocyclops phaleratus*	1		1
28	*Ectocyclops serrulatus*	1	1	1
29	*Ergasilus spp.*		1	
31	*Diaptomus spp.*	1	1	1
32	*Neodiaptomus sp.*	1	1	1
		23	**26**	**24**

Figures 44. Seasonal Zooplankton diversity in Son basin of M.P.

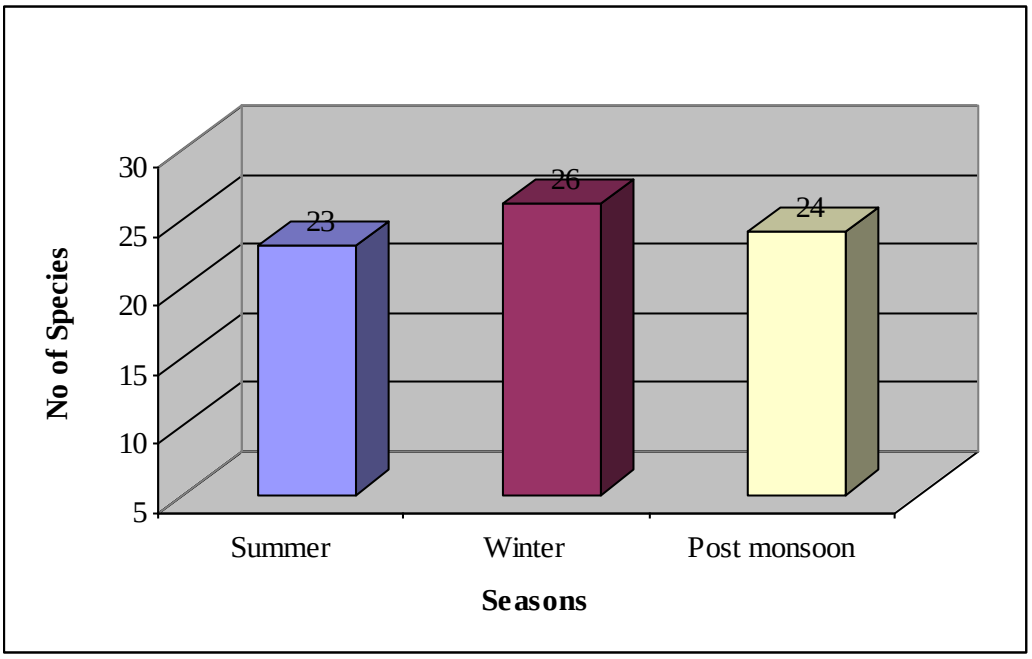


Figure 45. Groupwise Zooplankton species composition at Son basin of M.P.

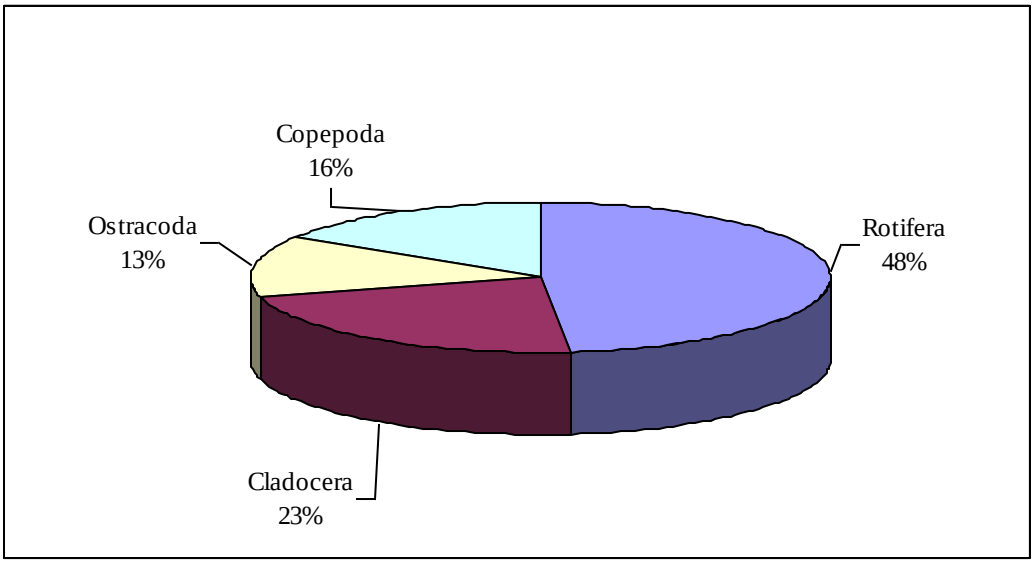


Table 44. Seasonal Zooplankton diversity in Rajgarh Distt. of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Zooplankton			
	Rotifera			
1	*Keratella tropica*	1	1	1
2	*Keratella lengi*	1	1	1
3	*Keratella cochleris*	1	1	
4	*Monostyla spp.*	1	1	1
5	*Trichotria spp.*	1	1	1
6	*Brachionus calyciflorus*	1	1	
7	*Brachionus falcatus*	1		1
8	*Brachionus caudatus*		1	1
9	*Brachionus diversiarnis*		1	1
10	*Brachionus forficula*	1	1	1
11	*Philodina spp.*			
12	*Anuaeopsis fissia*	1		
13	*Asplanchnopus multiceps*	1	1	
14	*Chromogaster ovalis*		1	1
15	*Synchaeta pectinata*	1	1	
16	*Polyarthyra vulgaris*	1	1	1
17	*Scaridium longicaudum*	1		1
18	*Platyias quadricornis*		1	1
	Cladocera			
19	*Daphnia carinata*	1	1	1
20	*Daphnia pulex*		1	1
21	*Moindaphuinia*	1		1
22	*Alona quatata*		1	1
23	*Ceriodaphnia spp.*		1	1
24	*Macrothrix sp.*	1		
25	*Moina micrara*	1		1
26	*Leydigia sp.*		1	1
27	*Scapholeberis sp.*	1	1	1
	Ostracoda			
28	*Cypris obensa*	1		1
29	*Cypris candona*	1	1	1
30	*Heterocypris sp.*	1	1	1
	Copepoda			

31	*Ectocyclops phaleratus*		1	
32	*Cyclops vicinus*	1	1	
33	*Mesoocyclops hyalinus*		1	1
34	*Heliodiaptomus vidus*	1		1
35	*Synecella calanoides*	1	1	1
36	*Diaptomus spp.*	1		1
37	*Neodiaptomus sp.*	1		
38	*Cletocampus sp.*	1	1	1
		27	**27**	**28**

Figure 46. Seasonal Zooplankton diversity in Rajgarh Distt. of M.P.

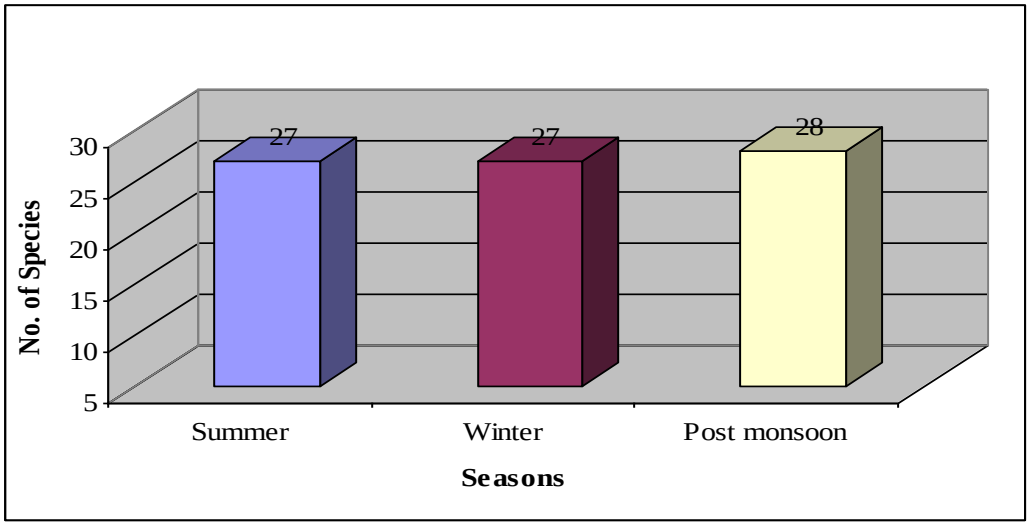
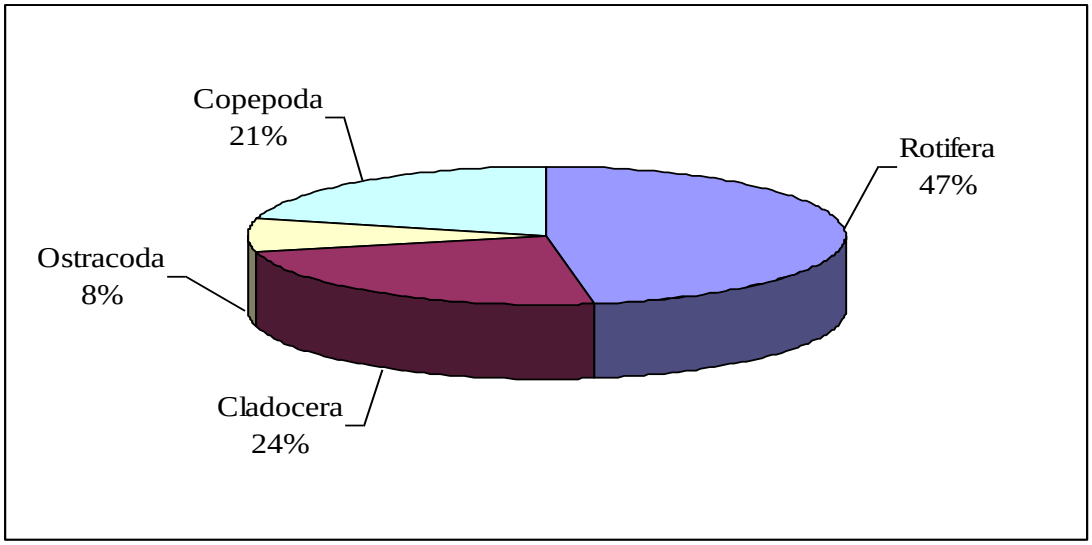


Figure 47. Group wise species composition in Rajgarh Distt. of M.P.



10. Benthic community

The term benthos denotes the whole assemblage of organisms dwelling at the bottom, which show a marked diversity depending upon the change in the depths and properties of the sediments. Most of the aquatic organisms are detritivores and form an important link in the food chain on account for higher organisms in the food web. Macroinvertibrates assemblages are good indicators of localized condition. Benthic Macroinvertibrates assemblages are made up of species that constitutes a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effect.

The invertebrates that inhabit the benthic zone are numerically dominated by small species and are species rich compared to the zooplankton of the open water. They include Crustaceans (e.g. crabs, crayfish, and shrimp), molluscs (e.g. clams and snails), and numerous types of insects. These organisms are mostly found in the areas of macrophyte growth, where the richest resources, highly oxygenated water, and warmest portion of the ecosystem are found. The structurally diverse macrophyte beds are important sites for the accumulation of organic matter, and provide an ideal area for colonizationts.

During the Benthic study at different river basin of Madhya Pradesh a total of 70 species belonging to seven major group's viz. ***Protozoa, Oligochaeta, Hirudinea, Diptera, Coleoptera, Ephemeroptera*** *and* ***Mollusca*** were identified. *Mollusca* has been recorded as the most dominant group of zoobenthos in the river basins represented by 38 species (54%) followed by *Protozoa* represented by 7 species (10%) *Diptera* represented by 7 species (10%), *Coleoptera* represented by 7 species (10%), *Oligochaeta* represented by 6 species (9%), *Ephemeroptera* represented by 3 species (4%) and *Hirudinea* represented by 2 species (3%)

Benthos community of the different river basin showed a rich diversity. During the zoobenthos study at the river basin the higher diversity was observed in Chambal Basin comprises of 55 species followed by Betwa Basin comprises of 37 species, Tapti basin

comprises of 20 species, Sone Basin comprises of 18 species, Seasonal ponds and river of Rajgarh District comprises of 16 species and Ken Basin comprises of 16 species.

10.1. Benthic diversity in Chambal Basin

Rich diversity in the species of benthos has been recorded in the Chambal Basin with a total of 55 species. The most dominant group was *Mollusca* represented by 29 species (53%), followed by *Coleoptera comprises* with 7 species (13%), *Diptera* represented by 6 species (11%). Other significant groups which are Protozoa and *Oligochaeta* independently comprises of 4 species (7%), *Ephemeroptera* represented by 3 species (5%), *Hirudinea r*epresented by 2 species (4%). The higher diversity of benthos was observed during summer (43 species) season followed by a gradual decreasing trend in winter (42 species) season while lower diversity was observed during post monsoon (22 species) season.

Mollusca

During the study 29 species *of Mollusca group* was identified as the most dominant group of benthos. The maximum diversity of *Mollusca* was observed during Summer(23 species) season while the minimum was observed in the Post monsoon (12 species) season.

Coleoptera

During the period under study 7 species of *Coleoptera* group was identified and represented as second dominant group of benthos. Not much variation was observed in summer, winter and post monsoon season. The diversity of *Coleoptera* was observed during summer and winter season were same (5 species) while in the post monsoon season 4 species were recorded.

Diptera

Diptera as a component of benthos was third to *Mollusca in showing* prominence. During the study 6 species of *Diptera* group was identified. The maximum diversity of *Diptera*

was observed during winter (5 species) season while the minimum was observed in the Post monsoon (2 species) season.

10.2. Benthic community in Betwa Basin

During the study the benthos community was recorded at the Betwa basin with a total of 37 species. The most dominant group was *Mollusca* represented by 36 species (64%), followed by *Diptera* and *Oligochaeta* independently comprises of 5species (9%).Other significant groups which are *Coleoptera* and *Ephemeroptera* separately comprises of 3 species (5%), *Protozoa* and *Hirudinea* independently comprises of 2 species (4%), The higher diversity of benthos was observed during winter (29 species) season followed by a gradual decreasing trend in summer (28 species) season while lower diversity was observed during post monsoon (20 species) season.

Mollusca

During the study 36 species *of Mollusca group* was identified as the most dominant group of benthos. The maximum diversity of *Mollusca* was observed during summer (13 species) season while the minimum was observed in the Post monsoon (9 species) season.

Diptera

During the study 5 species of *Diptera* group was identified. The diversity of *Diptera* was observed during winter and post monsoon season were same (5 species) while in the summer season 3 species were recorded.

Oligochaeta

During the study 5 species of *Oligochaeta* group was identified. The diversity of *Oligochaeta* was observed during summer and winter season were same (4 species) while in the post monsoon season 2 species were recorded.

10.3. Benthic diversity in Tapti Basin

During the study the benthos community was recorded at the Tapti basin with a total of 20 species. The most dominant group was *Mollusca* represented by 5 species (25%), followed by *Protozoa* and *Coleoptera* independently comprises of 4 species (20%).Other

significant groups which are *Diptera* comprises of 3 species (15%), *Oligochaeta* comprises of 2 species (10%), *Hirudinea* and *Ephemeroptera* independently comprises of 1 species (5%), The higher diversity of benthos was observed during summer (18 species) season followed by a gradual decreasing trend in winter (16 species) season while lower diversity was observed during post monsoon (12 species) season.

10.4. Benthic diversity in Ken Basin

During the study the benthos community was recorded at the Ken basin with a total of 16 species. The most dominant group was *Mollusca and Protozoa* independently comprises of 4 species (27%) followed by *Diptera* comprises of 3 species (20%), *Coleoptera* and *Oligochaeta* separately comprises of 2 species (13%). The higher diversity of benthos was observed during winter (13 species) season followed by a gradual decreasing trend in summer (12 species) season while lower diversity was observed during post monsoon (10 species) season.

10.5. Benthic diversity in Son Basin

During the study the benthos community was recorded at the Son basin with a total of 18 species. The most dominant group was *Mollusca* represented by 5 species (29%), followed by *Diptera* comprises of 4 species (23%).Other significant groups which are *Protozoa* comprises of 3 species (18%), *Oligochaeta* and *Coleoptera* independently comprises of 2 species (12%), and *Ephemeroptera* comprises of 1 species (6%).The higher diversity of benthos was observed during winter (17species) season while the minimum was observed in the Post monsoon (10 species) season.

10.6. Benthic diversity in Rajgarh District

During the study the benthos community was recorded at the Seasonal ponds and river of Rajgarh District with a total of 16 species. The most dominant group was *Mollusca* represented by 10 species (63%), followed by *Diptera* comprises of 3 species (19%).Other significant groups which are *Protozoa* comprises of 2 species (12%), and *Coleoptera* comprises of 1 species (6%). The higher diversity of benthos was observed

during winter (15 species) season while in the summer and post monsoon season diversity was observed same (13 species).

Table 45. Overall benthic diversity in different river basins of M.P.

S.No	Species	Chambal Basin	Betwa basin	Tapti basin	Ken Basin	Sone Basin	Rajgarh District
	Microzoobenthic Organisms						
	Protozoa						
1	*Diffugia* sps.	1	1	1	1	1	
2	*Arcella* sps.			1	1	1	1
3	*Neballa* sps.				1		
4	*Actinophrys* sps.	1					
5	*Voticella* sps.	1	1	1			
6	*Colpodium* sps.	1		1	1	1	1
7	*Opercularia* sps.				1		
	Macrozoobenthic organism						
	Oligochaeta						
8	*Nais communis*	1	1				
9	*Lumbricus* sps.		1				
10	*Stylaria* sps.		1	1	1		
11	*Pristina menori*	1					
12	*Tubifex tubifex*	1	1	1		1	
13	*Branchiura sowerbyi*	1	1		1	1	
	Hirudinea						
14	*Glossiphonia complanta*	1	1	1		1	
15	*Barbonia* sps.	1	1				
	Diptera						
16	*Penteneura* sps.	1		1	1		1
17	*Tantytarsus* sps.		1			1	
18	*Tabanus* sps.	1	1				
19	*Culicoides* sps.	1	1	1		1	
20	*Chironomids tentanus*	1	1	1	1	1	1
21	*Tripula* sps.	1					1
22	*Palpomyia* sps.	1	1		1	1	
	Coleoptera						
23	*Berosus* sps.	1					

24	*Enochrus* sps.	1	1	1	1		1
25	*Agabinus* sps.	1		1		1	
26	*Gyninus* sps.	1	1				
27	*Psephenus* sps.	1	1				
28	*Dineutus indicus*	1		1			
29	*Hydrophilusss* sps.	1		1	1	1	
	Ephemeroptera						
30	*Paraleptophalebia* sps.	1	1				
31	*Stenonema* sps.	1	1	1		1	
32	*Hepa* sps.	1	1				
	Mollusca						
33	*Vivipara* sps.	1	1	1	1	1	1
34	*Lymnea* sps.	1	1	1	1	1	1
35	*Lymnaea acuminate*		1				
36	*Lymnaea surnhoei*	1			1		1
37	*Lymnaea luteola*		1				
38	*Lymnaea andersonia*		1				
39	*Digoniostoma* sps.	1	1				
40	*Digoniostoma textum*	1					
41	*Thiara* sps.	1	1	1		1	
42	*Stenothyra solute*	1					
43	*Stenothyra minima*	1	1				
44	*Stenothyra atamus*	1					
45	*Paludomus neritoides*	1					
46	*Paludomus conica*	1					
47	*Paludomus acuta*	1					
48	*Stenomelania punctata*		1				
49	*Thaira maimoaringia*	1					
50	*Thaira melaloides*	1					
51	*Brotia costula*	1	1				
52	*Thaira scabra*	1	1				1
53	*Thaira pyramis*		1				1
54	*Mainwaringia paludomoidea*						1
55	*Thaira tuberculata*						1
56	*Thaira scabra*						1
57	*Corbicula* sps.	1	1	1	1	1	
58	*Parreysia favidens*	1					
59	*Parreysia radiatula*	1		1			
60	*Indoplanorbis exustus*	1					

61	*Planorbidea* sps.	1	1			1	
62	*Iravadia annandalei*	1					
63	*Scaphula deltae*	1	1				
64	*Scaphula celox*	1					
65	*Sulcospira huegeli*	1					
66	*Bellamya variata*	1	1				
67	*Bellamya micron*	1					
68	*Tcia theobaldi*	1					
69	*Hydrobioides nana*	1	1				1
70	*Forcipomypia* sps.						1
		55	**37**	**20**	**16**	**18**	**16**

Figure 48. Benthic community in different river basins of M.P.

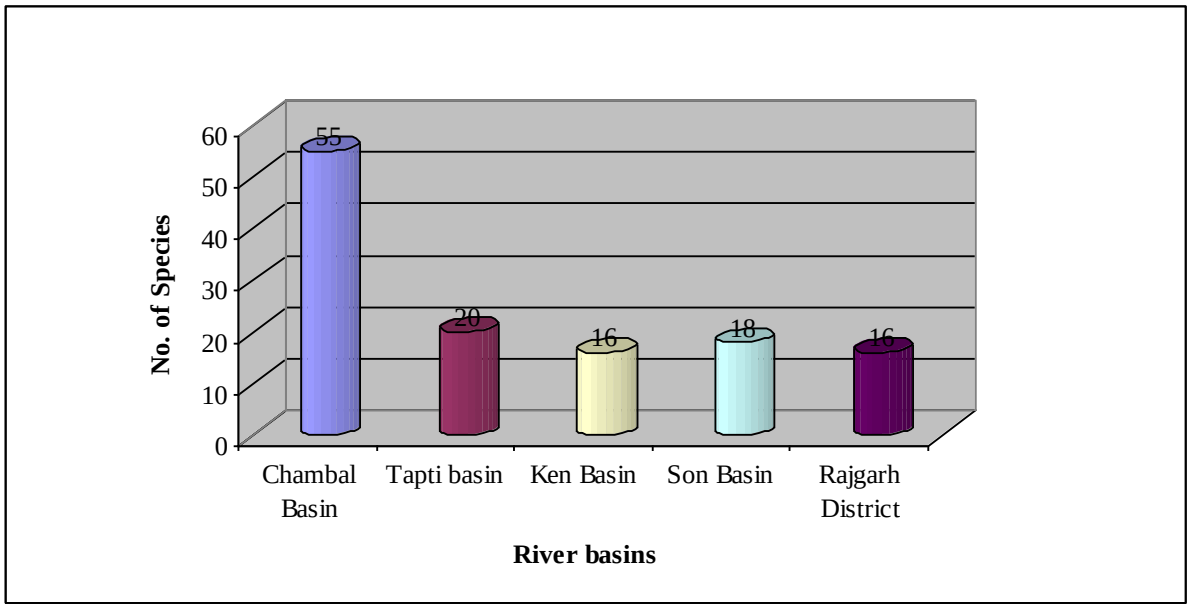


Figure 49. Group wise Benthic species composition in different basins of M.P.

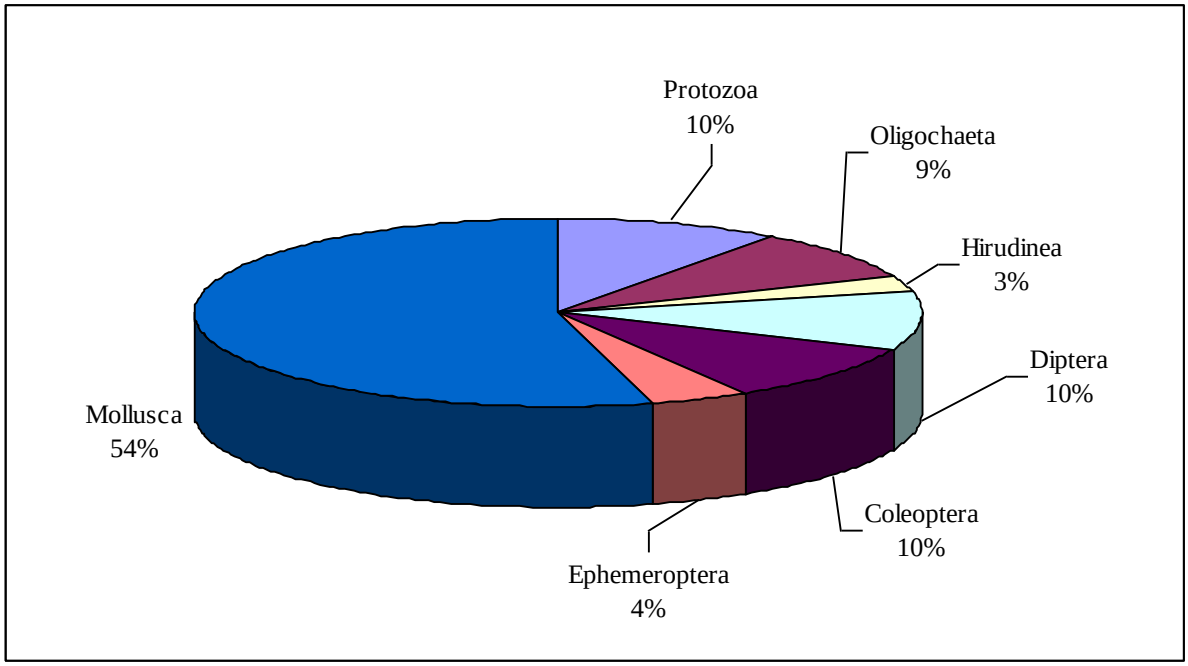


Table 46. Seasonal benthic diversity in Chambal basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobenthic Organisms			
	Protozoa			
1	*Diffugia* sps.	1	1	1
2	*Actinophrys* sps.		1	
3	*Voticella* sps.	1	1	
4	*Colpodium* sps.	1		
	Macrozoobenthic organism			
	Oligochaeta			
5	*Nais communis*	1	1	1
6	*Pristina menori*		1	
7	*Tubifex tubifex*	1	1	
8	*Branchiura sowerbyi*	1	1	1
	Hirudinea			
9	*Glossiphonia complanta*	1	1	
10	*Barbonia* sps.	1		
	Diptera			

11	*Penteneura* sps.		1	
12	*Tabanus* sps.	1	1	1
13	*Culicoides* sps.	1	1	1
14	*Chironomids tentanus*	1		
15	*Tripula* sps.	1	1	
16	*Palpomyia* sps.		1	
	Coleoptera			
17	*Berosus* sps.	1	1	1
18	*Enochrus* sps.	1	1	1
19	*Agabinus* sps.		1	1
20	*Gyninus* sps.	1		
21	*Psephenus* sps.	1		
22	*Dineutus indicus*	1	1	1
23	*Hydrophilusss* sps.		1	
	Ephemeroptera			
24	*Paraleptophalebia* sps.	1	1	
25	*Stenonema* sps.	1		
26	*Hepa* sps.	1	1	1
	Mollusca			
27	*Vivipara* sps.	1	1	1
28	*Lymnea* sps.	1	1	1
29	*Lymnaea surnhoei*	1	1	
30	*Digoniostoma* sps.	1	1	
31	*Digoniostoma textum*	1	1	
32	*Thiara* sps.	1	1	
33	*Stenothyra solute*	1	1	
34	*Stenothyra minima*	1	1	1
35	*Stenothyra atamus*	1		1
36	*Paludomus neritoides*		1	1
37	*Paludomus conica*		1	
38	*Paludomus acuta*	1		
39	*Thaira maimoaringia*	1	1	
40	*Thaira melaloides*	1		1
41	*Brotia costula*		1	
42	*Thaira scabra*		1	
43	*Corbicula* sps.	1	1	1
44	*Parreysia favidens*	1		1
45	*Parreysia radiatula*	1		1
46	*Indoplanorbis exustus.*	1	1	

47	***Planorbidea* sps.**	1	1	
48	*Iravadia annandalei*		1	
49	*Scaphula deltae*	1	1	
50	*Scaphula celox*		1	
51	*Sulcospira huegeli*	1	1	
52	*Bellamya variata*	1	1	
53	*Bellamya micron*	1		1
54	*Tcia theobaldi*	1	1	1
55	*Hydrobioides nana*	1		1
		43	**42**	**22**

Figure 50. Seasonal benthic diversity in Chambal basin of M.P.

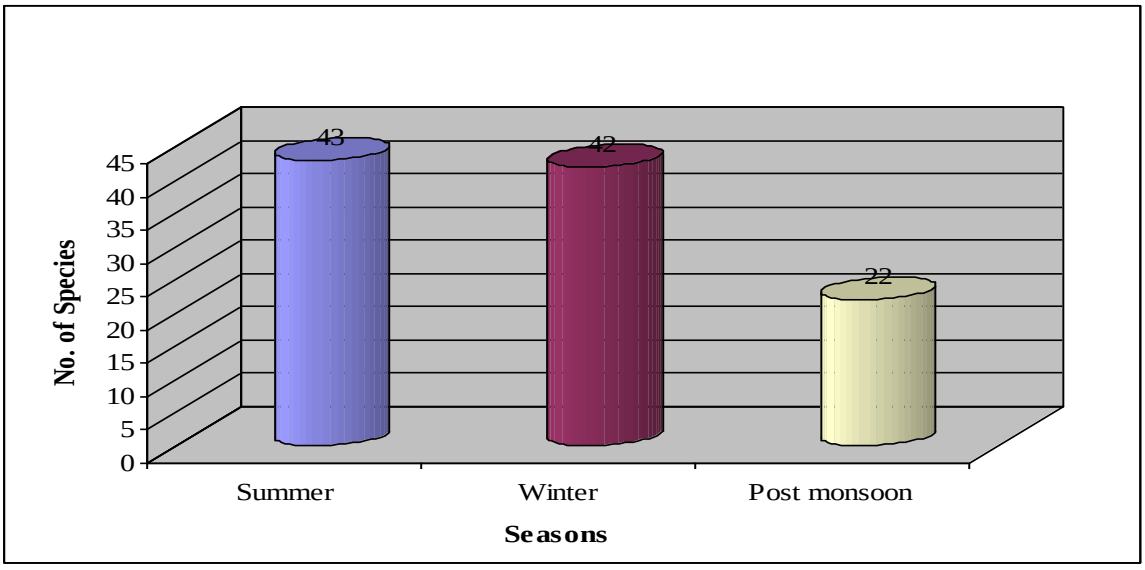


Figure 51. Group wise benthic species composition in Chambal basin of .P.

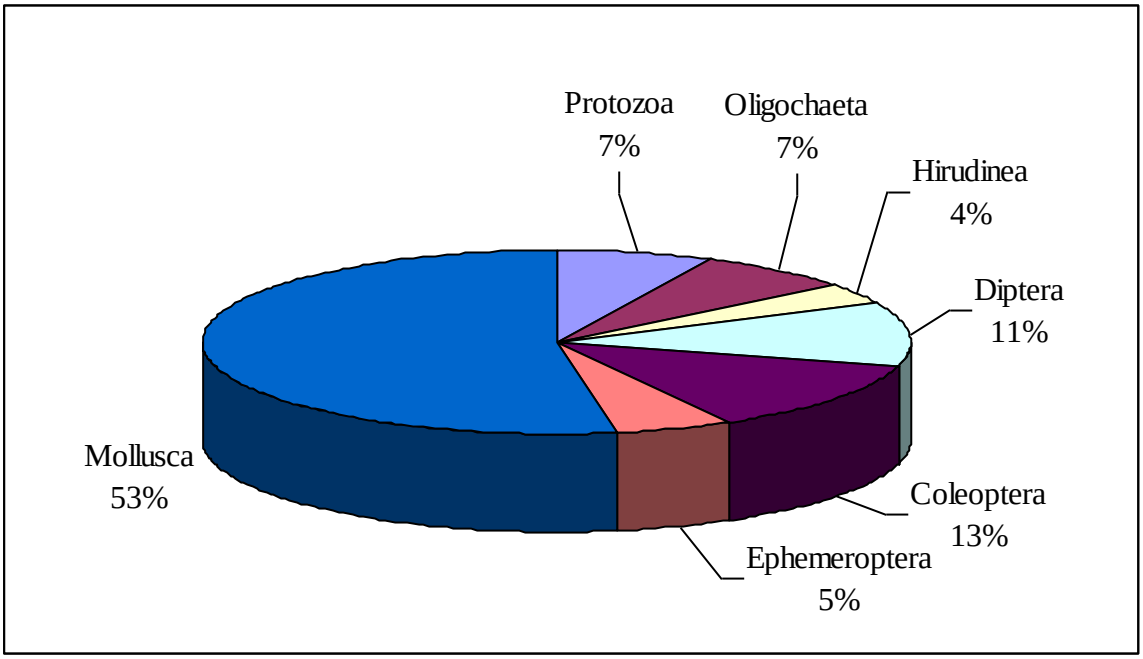


Table 47. Seasonal benthic diversity in Betwa basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobenthic Organisms			
	Protozoa			
1	*Diffugia* sps.	1	1	1
2	*Voticella* sps.	1	1	
	Macrozoobenthic organism			
	Oligochaeta			
3	*Nais communis*	1	1	1
4	*Lumbricus* sps.	1	1	
5	*Stylaria spp.*		1	
6	*Tubifex tubifex*	1	1	1
7	*Branchiura sowerbyi*	1		
	Hirudinea			
8	*Glossiphonia complanta*	1	1	
9	*Barbonia* sps.	1	1	1
	Diptera			
10	*Tantytarsus* sps.	1	1	1
11	*Tabanus* sps.		1	1

12	*Culicoides* sps.	1	1	1
13	*Chironomids tentanus*	1	1	1
14	*Palpomyia* sps.		1	1
	Coleoptera			
15	*Enochrus* sps.	1		1
16	*Gyninus* sps.	1		
17	*Psephenus* sps.	1		
	Ephemeroptera			
18	*Paraleptophalebia* sps.		1	
19	*Stenonema* sps.		1	1
20	*Hepa* sps.		1	
	Mollusca			
21	*Vivipara* sps.	1	1	1
22	*Lymnea* sps.	1	1	1
23	*Lymnaea acuminate*	1	1	
24	*Lymnaea luteola*	1		
25	*Lymnaea andersonia*	1	1	
26	*Digoniostoma* sps.	1	1	1
27	*Thiara* sps.	1	1	
28	*Stenothyra minima*	1		
29	*Stenomelania punctata*		1	
30	*Brotia costula*	1		1
31	*Thaira scabra*	1	1	1
32	*Thaira pyramis*		1	1
33	*Corbicula* sps.	1	1	1
34	***Planorbidea* sps.**		1	1
35	*Scaphula deltae*	1		
36	*Bellamya variata*	1	1	
37	*Hydrobioides nana*	1	1	1
		28	**29**	**20**

Figure 52. Seasonal Benthic diversity in Betwa basin of M.P.

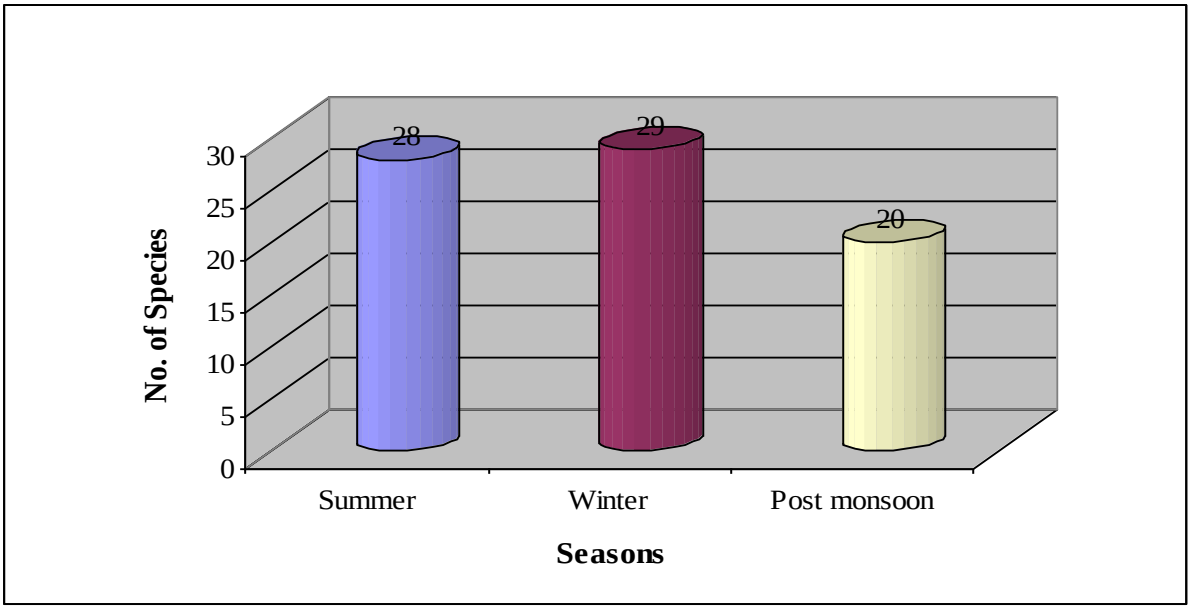


Figure 53. Groupwise benthic species composition in Betwa basin of M.P.

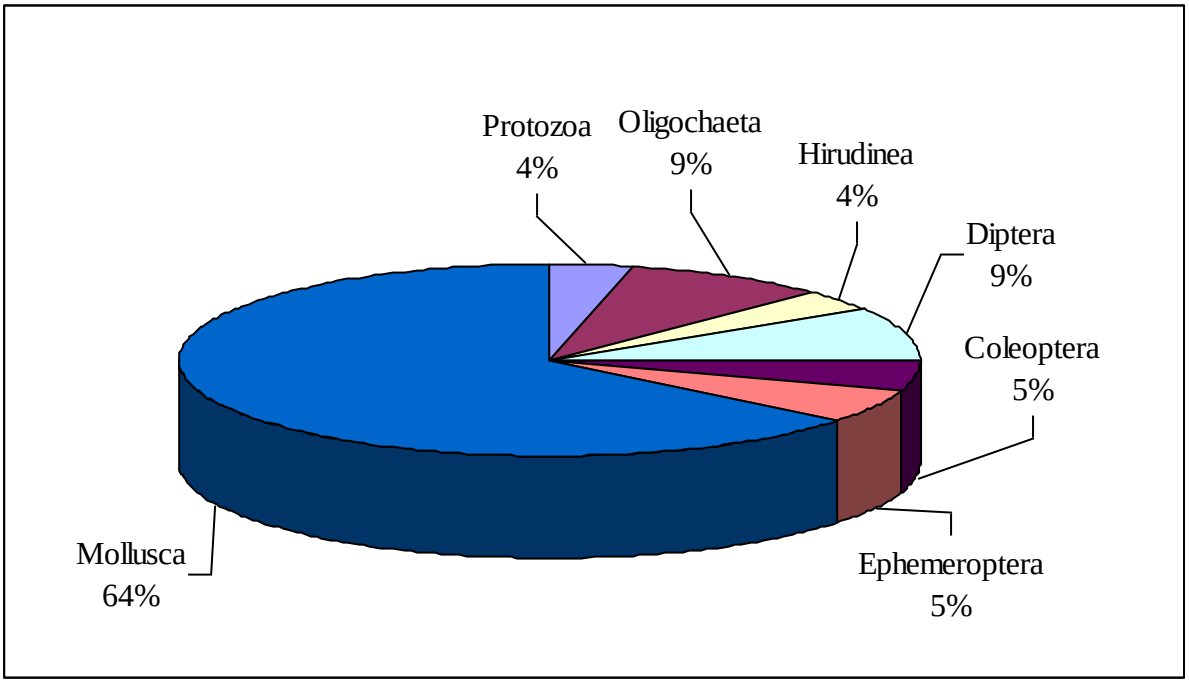


Table 48. Seasonal Benthic diversity in Tapti basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobenthic Organisms			
	Protozoa			
1	*Diffugia* sps.	1	1	1
2	*Arcella* sps.	1	1	1
3	*Voticella* sps.	1	1	1
4	*Colpodium* sps.	1	1	1
	Macrozoobenthic organism			
	Oligochaeta			
5	*Stylaria* sps.	1	1	
6	*Tubifex tubifex*	1	1	1
	Hirudinea			
7	*Glossiphonia complanta*	1		
	Diptera			
8	*Penteneura* sps.		1	
9	*Culicoides* sps.	1	1	1
10	*Chironomids tentanus*	1	1	1
	Coleoptera			
11	*Enochrus* sps.	1		
12	*Agabinus* sps.		1	
13	*Dineutus indicus*	1	1	
14	*Hydrophilusss* sps.	1		
	Ephemeroptera			
15	*Stenonema* sps.	1	1	1
	Mollusca			
16	*Vivipara* sps.	1	1	1
17	*Lymnea* sps.	1	1	1
18	*Thiara* sps.	1	1	
19	*Corbicula* sps.	1	1	1
20	*Parreysia radiatula*	1		1
		18	**16**	**12**

Figure 54. Seasonal Benthic diversity in Tapti basin of M.P.

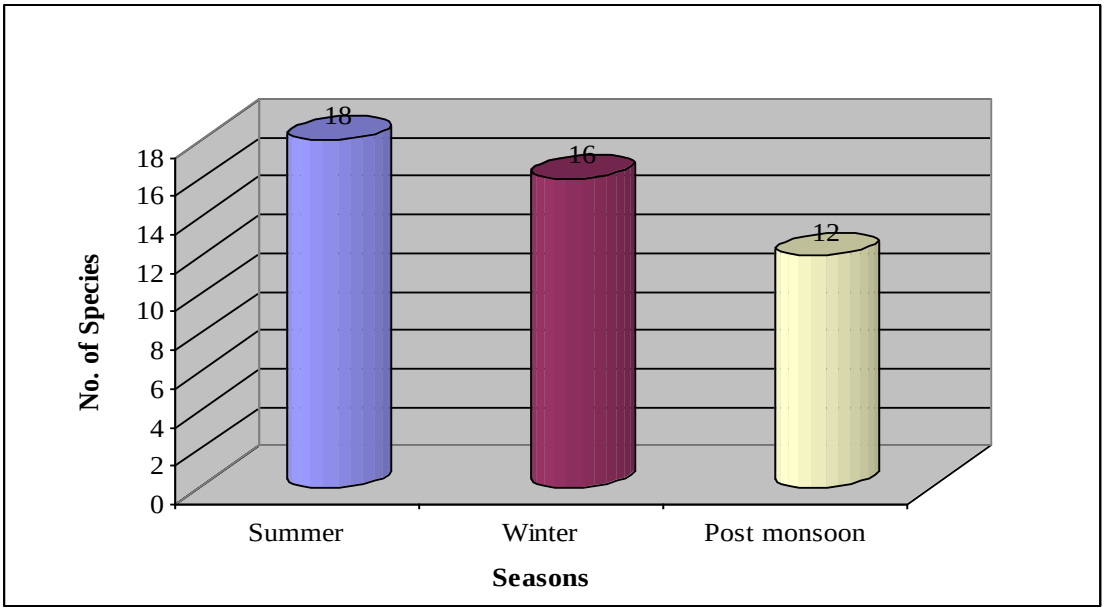


Figure 55. Group wise Benthic species composition in Tapti basin of M.P.

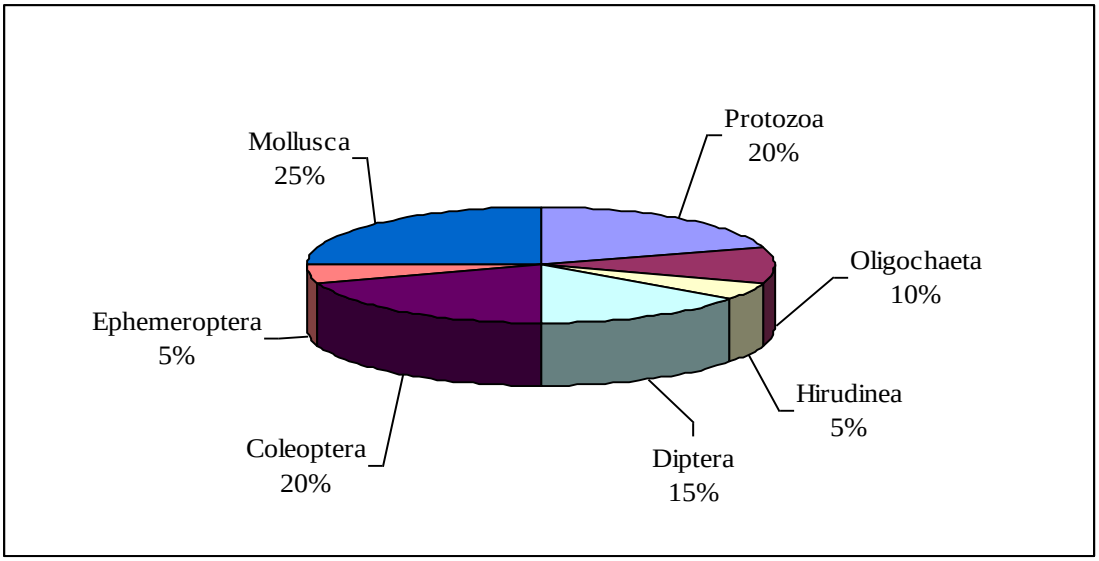


Table 49. Seasonal Benthic diversity in Ken basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobenthic Organisms			
	Protozoa			
1	*Arcella* sps.	1	1	
2	*Neballa* sps.	1	1	1
3	*Colpodium* sps.	1	1	1
4	*Opercularia* sps.	1		1
	Macrozoobenthic organism			
	Oligochaeta			
5	*Stylaria* sps.		1	
6	*Branchiura sowerbyi*	1	1	1
	Diptera			
7	*Penteneura* sps.		1	
8	*Chironomids tentanus*	1	1	1
9	*Palpomyia* sps.		1	
	Coleoptera			
10	*Enochrus* sps.	1	1	1
11	*Hydrophilusss* sps.	1	1	
	Mollusca			
12	*Vivipara* sps.	1	1	1
13	*Lymnea* sps.	1	1	1
14	*Lymnaea surnhoei*	1		1
15	*Corbicula* sps.	1	1	1
		12	**13**	**10**

Figure 56. Seasonal Benthic diversity in Ken basin of M.P.

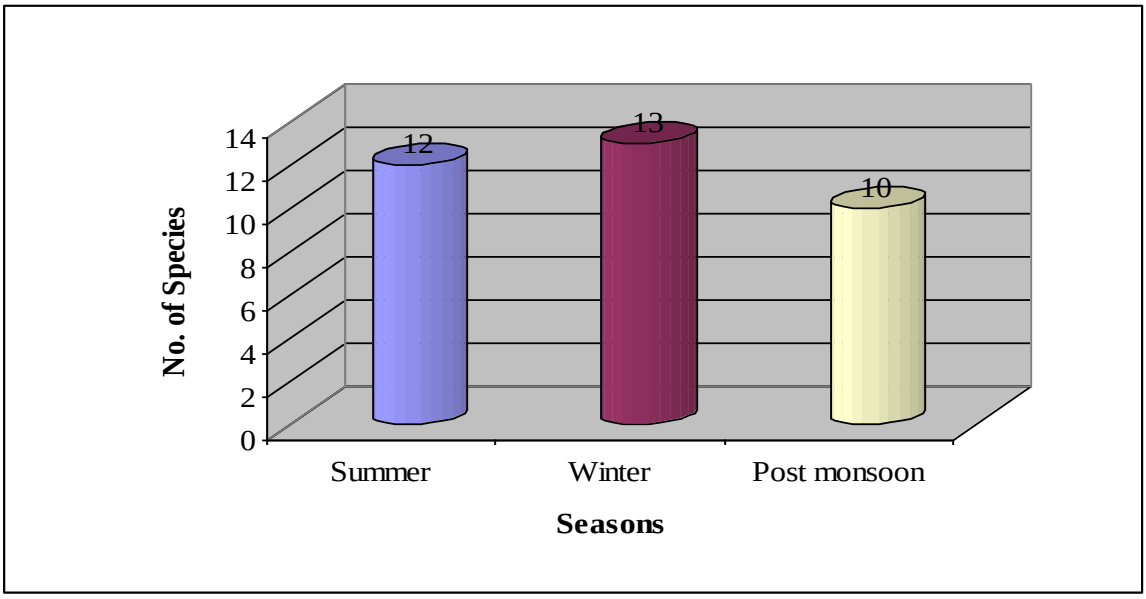


Figure 57. Group wise benthic species composition in Ken basin of M.P.

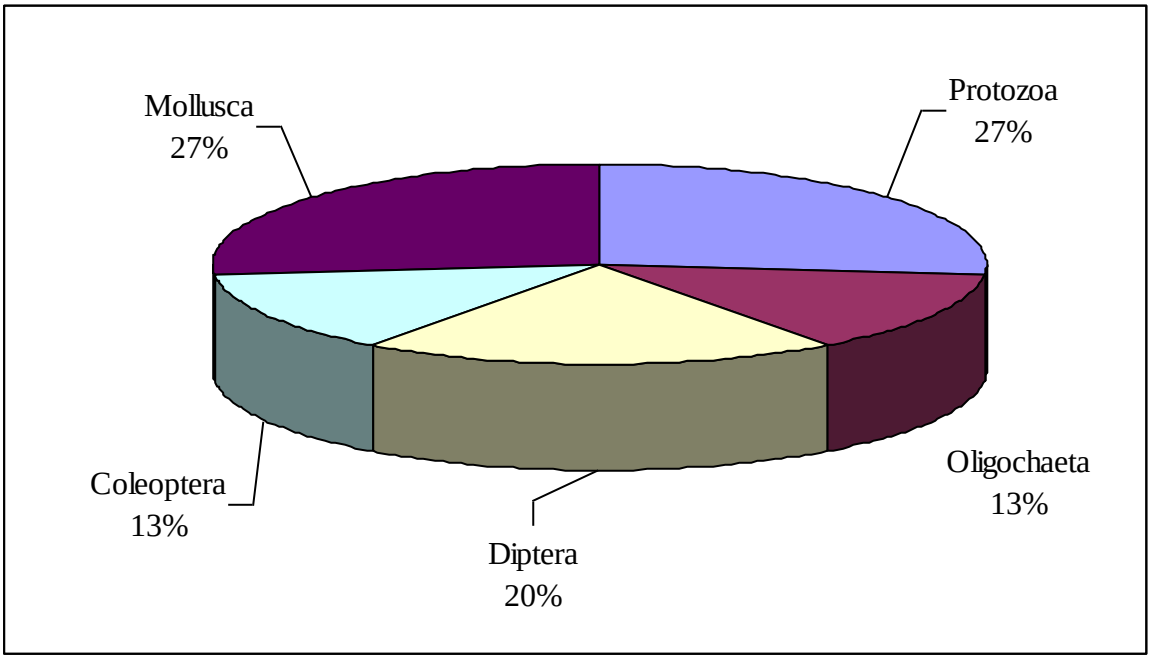


Table 50. Seasonal Benthic species composition in Son basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobenthic Organisms			
	Protozoa			
1	*Diffugia* sps.	1	1	1
2	*Arcella* sps.	1	1	1
3	*Colpodium* sps.	1	1	
	Macrozoobenthic organism			
	Oligochaeta			
4	*Tubifex tubifex*	1	1	
5	*Branchiura sowerbyi*	1	1	1
	Hirudinea			
6	*Glossiphonia complanta*		1	
	Diptera			
7	*Tantytarsus* sps.		1	1
8	*Culicoides* sps.	1		1
9	*Chironomids tentanus*	1	1	1
10	*Palpomyia* sps.		1	
	Coleoptera			
11	*Agabinus* sps.	1	1	1
12	*Hydrophilusss* sps.		1	
	Ephemeroptera			
13	*Stenonema* sps.	1	1	
	Mollusca			
14	*Vivipara* sps.	1	1	1
15	*Lymnea* sps.	1	1	1
16	*Thiara* sps.	1	1	
17	*Corbicula* sps.	1	1	1
18	*Planorbidea* sps.		1	
		13	**17**	**10**

Figure 58. Seasonal Benthic species composition in Son basin of M.P.

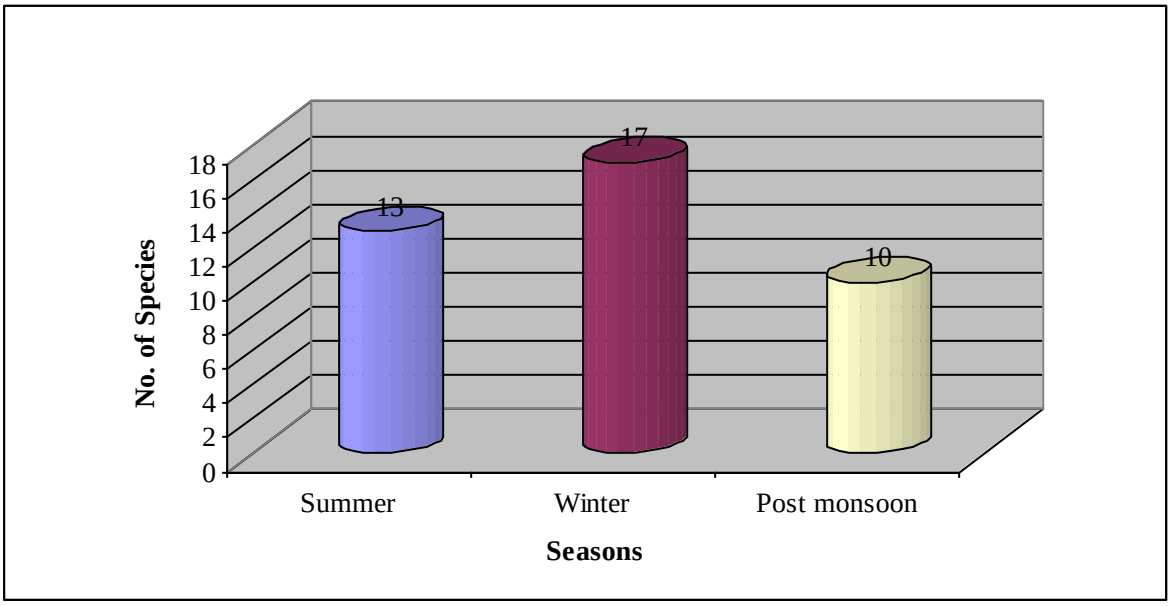


Figure 59. Group wise Benthic species composition in Son basin of M.P.

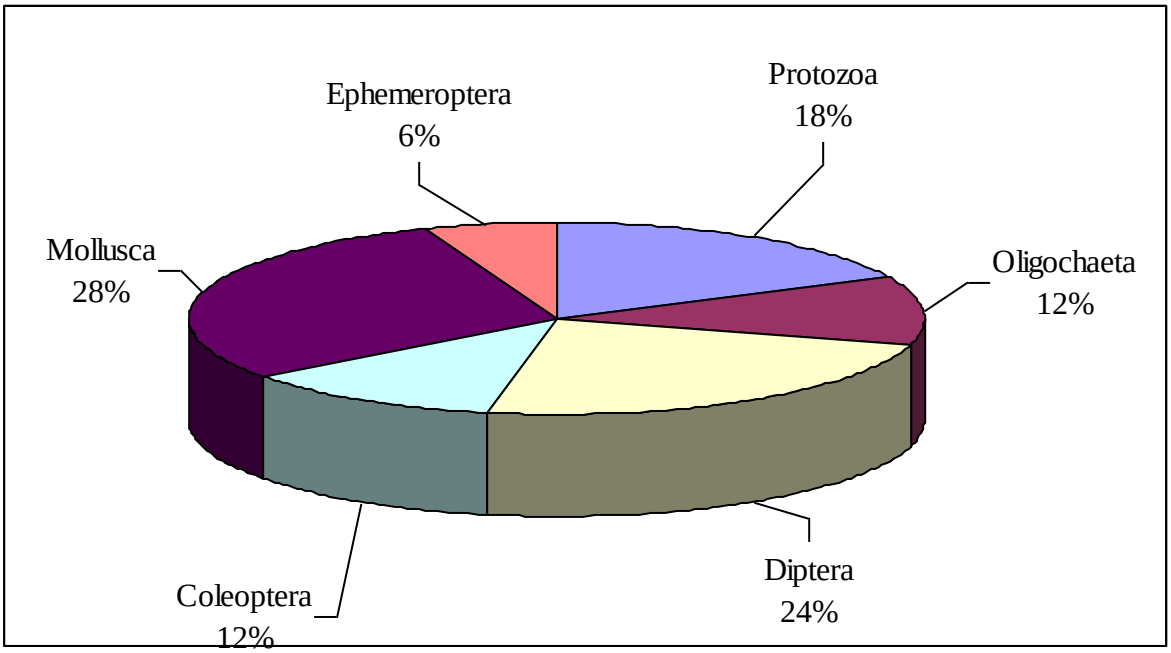


Table 51. Seasonal benthic diversity in Rajgarh Distt. basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
	Microzoobethic Organisms			
	Protozoa			
1	*Arcella* sps.	1	1	1
2	*Colpodium* sps.	1	1	1
	Diptera			
3	*Penteneura* sps.		1	1
4	*Chironomids tentanus*	1	1	1
5	*Tripula* sps.	1		1
	Coleoptera			
6	*Enochrus* sps.	1	1	
	Mollusca			
7	*Vivipara* sps.	1	1	1
8	*Lymnea* sps.	1	1	1
9	*Lymnaea surnhoei*	1	1	1
10	*Thaira scabra*	1	1	1
11	*Thaira pyramis*	1	1	1
12	*Mainwaringia paludomoidea*		1	1
13	*Thaira tuberculata*	1	1	1
14	*Thaira scabra*	1	1	
15	*Hydrobioides nana*	1	1	1
16	*Forcipomypia* sps.		1	
		13	**15**	**13**

Figure 60. Seasonal Benthic diversity in Rajgarh Distt. basin of M.P.

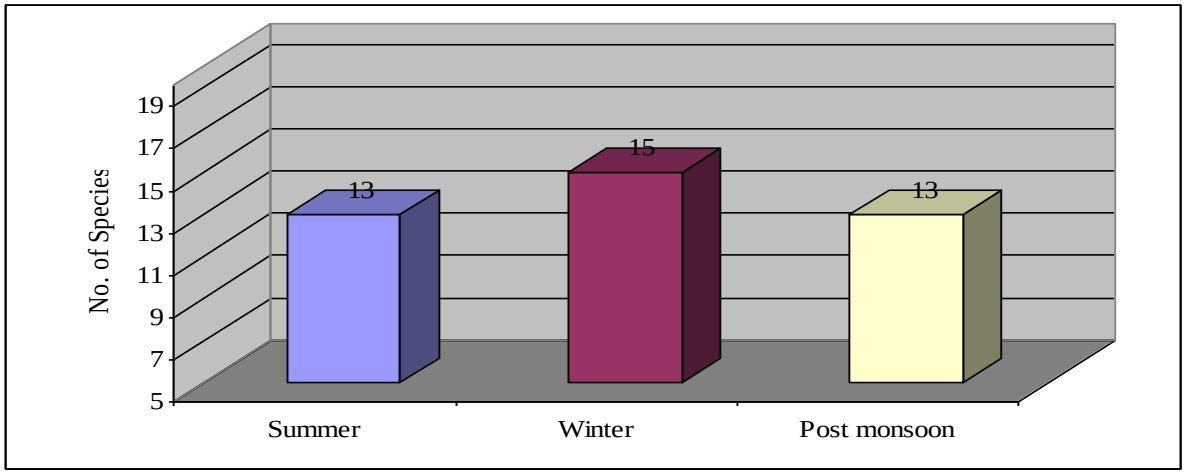
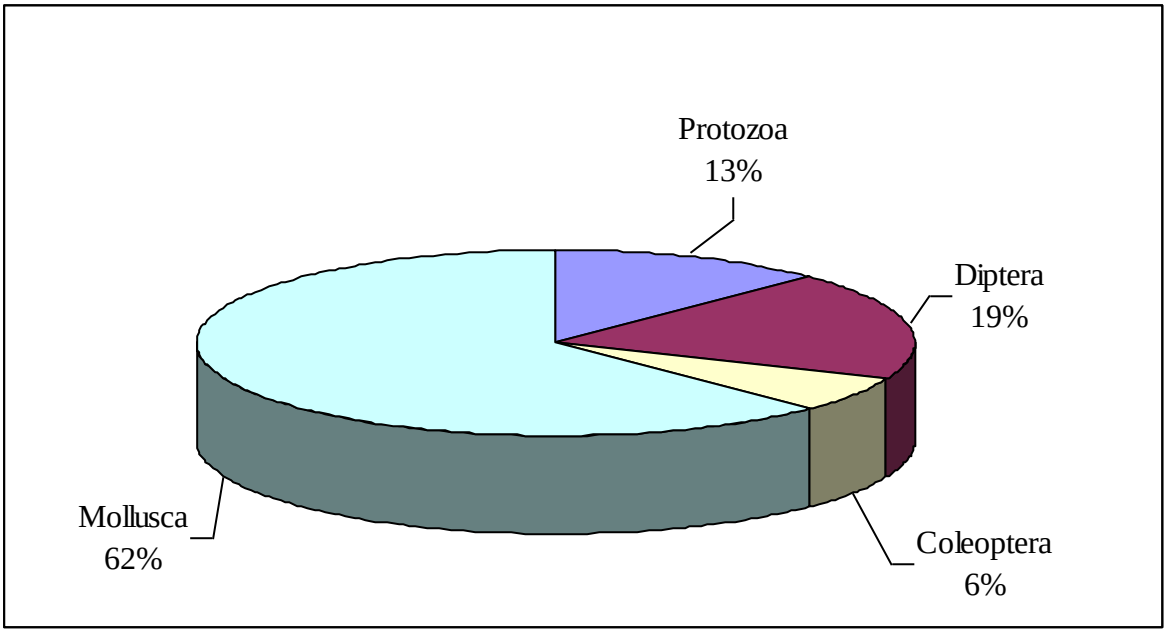


Figure 61. Group wise Benthic species composition in Rajgarh basin of M.P.



11. Macrophytes (Aquatic Plants)

Macrophytes are an aquatic plant that grows in or near water and is emergent, submergent or free floating. In Aquatic system Macrophytes provide cover for fish and substrate for aquatic invertebrates, produce oxygen and act as food for some fish and wildlife. Aquatic plants occupy the position of primary producers in aquatic ecosystems. They trap solar energy and convert it into chemical energy for the use of their own and other animals of the system, which is known as photosynthesis. These plants are extremely efficient in removing nutrients from polluted water thus minimizing eutrophication of aquatic habitats. Macrophytes provide habitats to epiphytes, eggs of certain insects, mollusks and fishes. They also attract birds for food, nesting and shelter.

Plants, or macrophytes, in aquatic systems live in both the benthic and pelagic zones and can be grouped according to their manner of growth: (1) emergent macrophytes = rooted in the substrate but with leaves and flowers extending into the air, (2) floating-leaved macrophytes = rooted in the substrate but with floating leaves, (3) submersed macrophytes = not rooted in the substrate and floating beneath the surface and(4) free-

floating macrophytes = not rooted in the substrate and floating on the surface. These various forms of macrophytes generally occur in different areas of the benthic zone, with emergent vegetation nearest the shoreline, then floating-leaved macrophytes, followed by submersed vegetation. Free-floating macrophytes can occur anywhere on the system's surface.

During the macrophytes study at different river basin of Madhya Pradesh a total of 31 species were identified. A total of 31 species of macrophytes have been recorded in the river basin, out of which 13 species emergent(42%), 14 are submersed(45%) and 4 are free floating(13%). The details of the macrophytic species encountered in the river basin are given in the table below.

Table 52. Macrophytes diversity in different river basin of Madhya Pradesh

Emergent	**Submersed**	**Free floating**
Polygonum glabrum	*Hydrilla vertecillata*	*Eichhornea crassipes*
Ipomea fistulosa	*Ceratophyllum demersum*	*Azolla pinnata*
Ipomea aqatica	*Potamogeton crispus*	*Trapa bispinosa*
Nelumbo nucirera	*Potamogeton pectinatus*	*Lemna minor*
Nymphea	*Chara sp.*	
Juscia repens	*Myriophylla spathulatum*	
Typha lattifolia	*Najas indica*	
Typha angustata	*Najas marina*	
Scirpus royeli	*Najas graminae*	
Ludwigia adscendens	*Nitella sp.*	
Hygrorhiza aristata	*Ottelia alismoides*	
Cyperus articulates	*Potamogeton natans*	
Cyperus rotundus	*Potamogeton nodosus*	
	Vallisneria spiralis	

During the macrophytes study at the river basin the higher diversity was observed in Betwa Basin comprises of 31 species followed by Sone Basin comprises of 23 species, Chambal Basin comprises of 19 species, Seasonal ponds and river of Rajgarh District comprises of 19 species, Tapti basin comprises of 17 species, and Ken Basin comprises of 13species

11.2. Macrophytes diversity in Chambal Basin

During the macrophytes study at Chambal basin a total of 19 species were identified. A total of 19 species of macrophytes have been recorded in the river basin, out of which 7 species are emergent (37%), 11 are submersed (58%) and 1 is free floating (5%). The higher diversity of macrophytes was observed during summer (16 species) season while the minimum was observed in the Post monsoon (8 species) season.

11.2. Macrophytes diversity in Betwa Basin

During the macrophytes study at Betwa basin a total of 31 species were identified. A total of 31 species of macrophytes have been recorded in the river basin, out of which 13 species are emergent (42%), 14 are submersed (45%) and 4 are free floating (13%). The higher diversity of macrophytes was observed during summer (30 species) season while in the winter and post monsoon season diversity was observed same (25 species).

11.3. Macrophytes diversity in Tapti Basin

During the macrophytes study at Tapti basin a total of 17 species were identified. A total of 17 species of macrophytes have been recorded in the river basin, out of which 7 species are emergent (41%) and 10 are submersed (59%). The higher diversity of macrophytes was observed during winter (17 species) season while the minimum was observed in the summer (12 species) season.

11.4. Macrophytes diversity in Ken Basin

During the macrophytes study at Ken basin a total of 13 species were identified. A total of 13 species of macrophytes have been recorded in the river basin, out of which 5species are emergent (38%) and 8 are submersed (62%). The higher diversity of macrophytes was

observed during winter (12 species) season while the minimum was observed in the summer (9 species) season.

11.5. Macrophytes diversity in Son Basin

During the macrophytes study at Son basin a total of 23 species were identified. A total of 23 species of macrophytes have been recorded in the river basin, out of which 10 species are emergent (43%), 12 are submersed (52%) and 1 is free floating (4%). The higher diversity of macrophytes was observed during summer (23 species) season followed by a gradual decreasing trend in winter (20 species) season while lower diversity was observed during post monsoon (17 species) season.

11.6. Macrophytes diversity in Rajgarh District

During the macrophytes study at Seasonal ponds and river of Rajgarh District a total of 19 species were identified. A total of 19 species of macrophytes have been recorded in the river basin, out of which 9 species are emergent (47%), 8 species are submersed (42%) and 2 are free floating (11%). The diversity of macrophytes was observed during summer and winter season were same (17 species) while in the post monsoon season 16 species were recorded.

Table 53. Macrophytes diversity in different river basin of M.P.

S.No	Species	Chambal Basin	Betwa basin	Tapti basin	Ken Basin	Sone Basin
1	*Azolla pinnata*		1			
2	*Cyperus rotundus*	1	1	1	1	
3	*Ceratophyllum demersum*	1	1	1	1	1
4	*Chara sp.*		1			1
5	*Cyperus articulatus*		1			
6	*Eichhornia crassipes*	1	1			1
7	*Hydrilla verticillata*	1	1	1	1	1
8	*Hygrorhiza aristata*		1		1	
9	*Ipomea aquatica*	1	1	1	1	1
10	*Ipomea fistulosa*		1	1		1
11	*Jussiaea repens*	1	1	1		1

12	*Lemna minor*		1			1
13	*Ludwigia adscendens*		1			1
14	*Myriophylla spathulatum*		1		1	1
15	*Najas indica*	1	1	1	1	1
16	*Najas marina*		1			
17	*Najas graminae*	1	1	1		1
18	*Nelumbo nucifera*	1	1			1
19	*Nitella sp.*	1	1	1	1	
20	*Nymphaea lotus*		1			1
21	*Ottelia alismoides*	1	1			
22	*Potamogeton cricpus*	1	1	1	1	1
23	*Potamogeton natans*	1	1	1		1
24	*Potamogeton pectinatus*	1	1	1	1	1
25	*Polygonum glabrum*	1	1	1	1	1
26	*Potamogeton nodosus*	1	1	1		1
27	*Scirpus royeli*	1	1	1	1	1
28	*Trapa bispinosa*		1			
29	*Typha angustata*		1	1		1
30	*Typha latifolia*	1	1			1
31	*Vallisneria spiralis*	1	1	1	1	1
		19	**31**	**17**	**13**	**23**

Figure 62. Macrophytes diversity in different river basin of M.P.

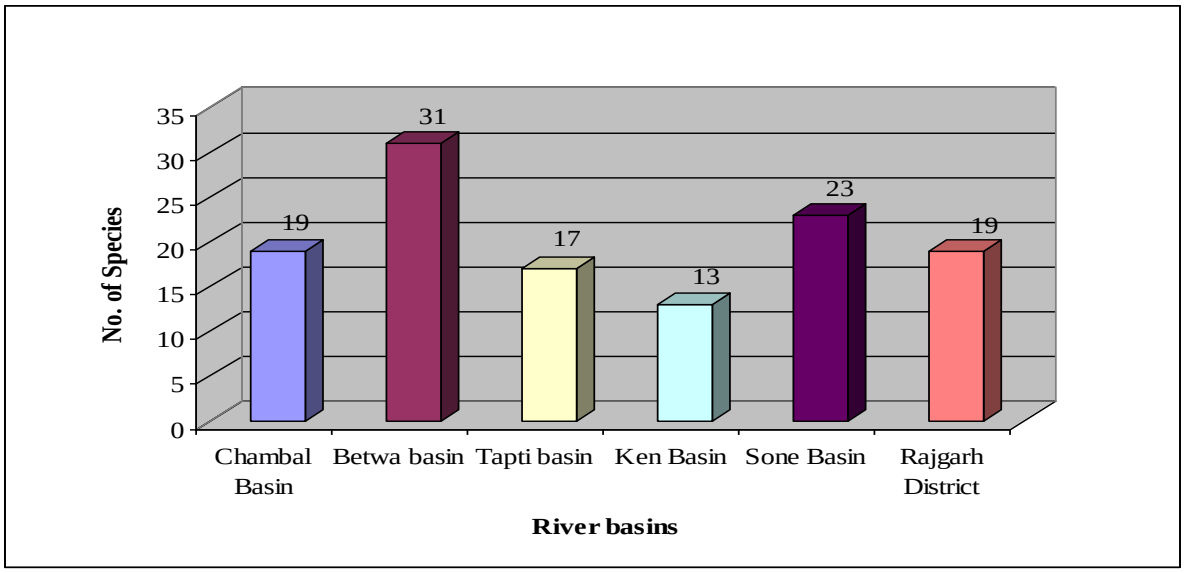


Table 54. Seasonal Macrophytes diversity in Chambal basin

S.No	Species	Summer	Winter	Post monsoon
1	*Cyperus rotundus*	1	1	1
2	*Ceratophyllum demersum*	1		
3	*Eichhornia crassipes*	1	1	
4	*Hydrilla verticillata*	1	1	1
5	*Ipomea aquatica*	1	1	1
6	*Jussiaea repens*		1	
7	*Najas indica*	1		1
8	*Najas graminae*	1		
9	*Nelumbo nucifera*	1		1
10	*Nitella sp.*	1		
11	*Ottelia alismoides*	1	1	
12	*Potamogeton cricpus*		1	1
13	*Potamogeton natans*	1	1	1
14	*Potamogeton pectinatus*	1	1	1
15	*Polygonum glabrum*	1	1	
16	*Potamogeton nodosus*	1	1	
17	*Scirpus royeli*		1	
18	*Typha latifolia*	1	1	
19	*Vallisneria spiralis*	1	1	
		16	**14**	**8**

Figure 63. Seasonal macrophytes diversity in Chambal basin of M.P.

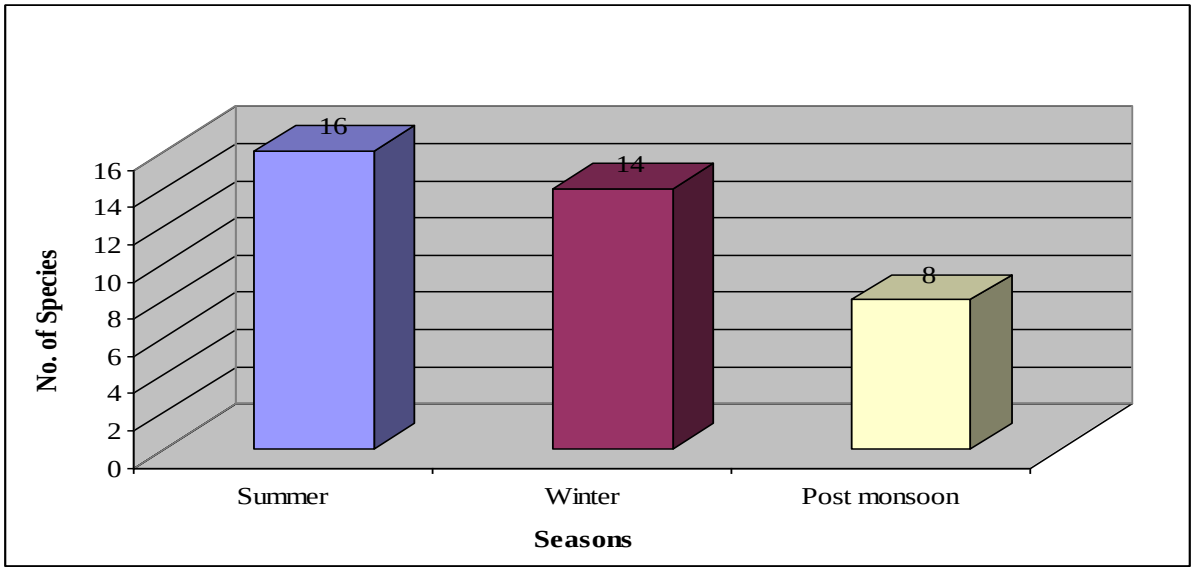


Table 55. Seasonal Macrophytes diversity in Betwa basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
1	*Azolla pinnata*	1		1
2	*Cyperus rotundus*	1		
3	*Ceratophyllum demersum*	1	1	
4	*Chara sp.*	1		
5	*Cyperus articulatus*	1		1
6	*Eichhornia crassipes*	1	1	1
7	*Hydrilla verticillata*	1	1	1
8	*Hygrorhiza aristata*	1	1	1
9	*Ipomea aquatica*	1	1	1
10	*Ipomea fistulosa*	1	1	1
11	*Jussiaea repens*		1	
12	*Lemna minor*	1	1	
13	*Ludwigia adscendens*	1	1	
14	*Myriophylla spathulatum*	1	1	1
15	*Najas indica*	1	1	1
16	*Najas marina*	1	1	1
17	*Najas graminae*	1	1	1
18	*Nelumbo nucifera*	1	1	1
19	*Nitella sp.*	1		1
20	*Nymphaea lotus*	1	1	1
21	*Ottelia alismoides*	1		1
22	*Potamogeton cricpus*	1	1	1
23	*Potamogeton natans*	1	1	1
24	*Potamogeton pectinatus*	1	1	1
25	*Polygonum glabrum*	1	1	1
26	*Potamogeton nodosus*	1	1	1
27	*Scirpus royeli*	1	1	1
28	*Trapa bispinosa*	1	1	1
29	*Typha angustata*	1	1	1
30	*Typha latifolia*	1	1	1
31	*Vallisneria spiralis*	1	1	1
		30	25	25

Figure 64. Seasonal macrophytes diversity in Betwa basin of M.P.

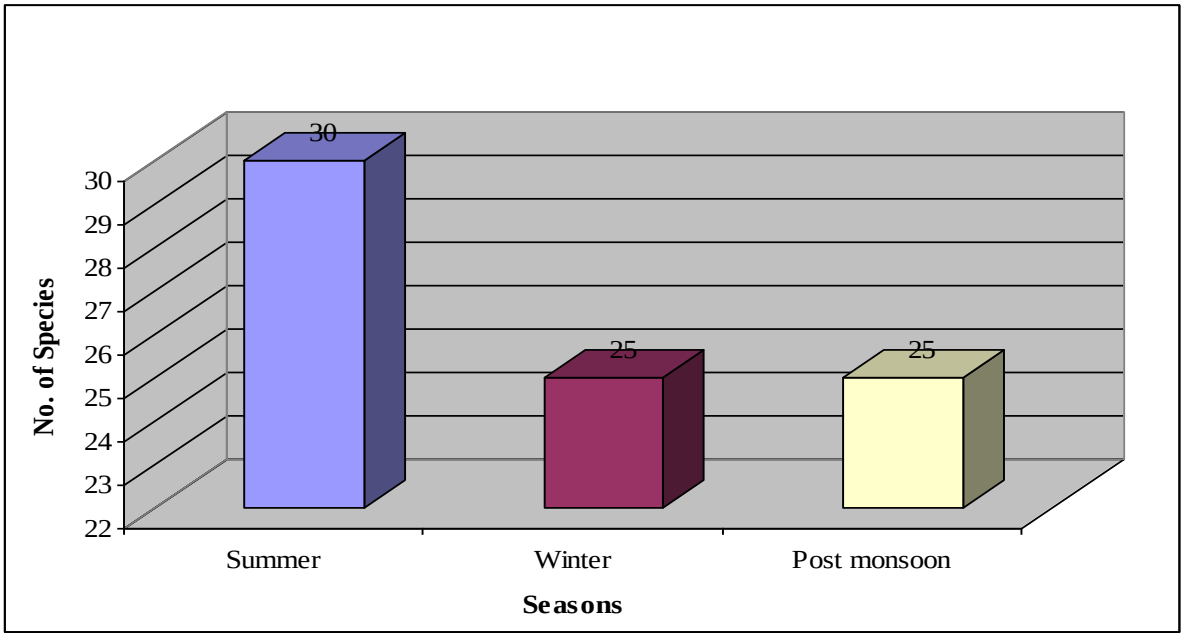


Table 56. Seasonal macrophytes diversity in Ken basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
1	*Cyperus rotundus*		1	
2	*Ceratophyllum demersum*	1	1	1
3	*Hydrilla verticillata*	1	1	1
4	*Hygrorhiza aristata*		1	1
5	*Ipomea aquatica*	1	1	1
6	*Myriophylla spathulatum*		1	1
7	*Najas indica*	1	1	
8	*Nitella sp.*		1	1
9	*Potamogeton cricpus*	1	1	
10	*Potamogeton pectinatus*	1	1	1
11	*Polygonum glabrum*	1	1	1
12	*Scirpus royeli*	1		1
13	*Vallisneria spiralis*	1	1	1
		9	**12**	**10**

Figure 65. Seasonal macrophytes diversity in Ken basin of M.P.

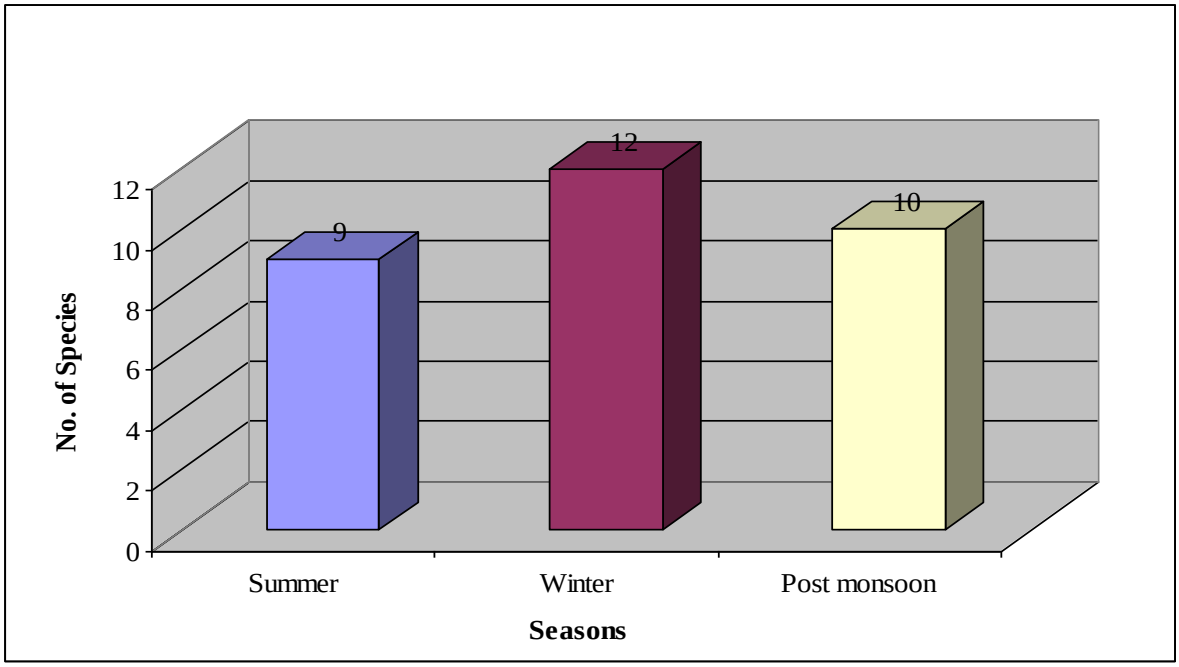


Table 57. Seasonal macrophytes diversity in Tapti basin of M.P.

S.No	Species	Summer	Winter	Post monsoon
1	*Cyperus rotundus*		1	1
2	*Ceratophyllum demersum*	1	1	1
3	*Hydrilla verticillata*	1	1	1
4	*Ipomea aquatica*	1	1	1
5	*Ipomea fistulosa*	1	1	1
6	*Jussiaea repens*		1	1
7	*Najas indica*	1	1	1
8	*Najas graminae*		1	1
9	*Nitella sp.*		1	1
10	*Potamogeton cricpus*	1	1	1
11	*Potamogeton natans*	1	1	1
12	*Potamogeton pectinatus*	1	1	1
13	*Polygonum glabrum*	1	1	1
14	*Potamogeton nodosus*	1	1	1
15	*Scirpus royeli*	1	1	

16	*Typha angustata*	1	1	1
17	*Vallisneria spiralis*		1	1
		12	17	16

Figure 66. Seasonal macrophytes diversity in Tapti basin of M.P.

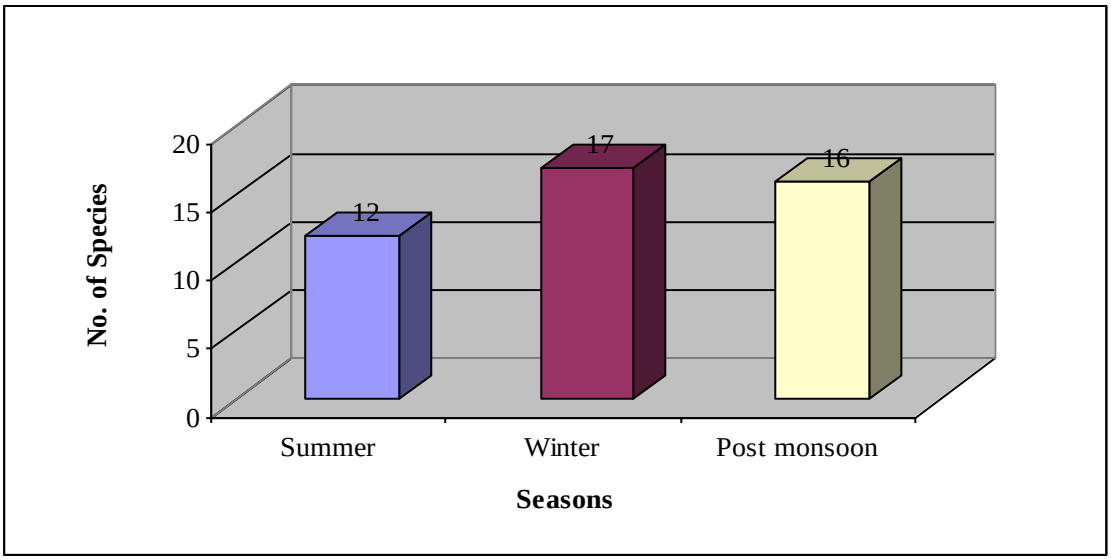


Table 58. Seasonal macrophytes diversity in Sonbasin of M.P.

S.No	Species	Summer	Winter	Post monsoon
1	*Ceratophyllum demersum*	1	1	
2	*Chara sp.*	1		
3	*Eichhornia crassipes*	1	1	1
4	*Hydrilla verticillata*	1	1	1
5	*Ipomea aquatica*	1	1	1
6	*Ipomea fistulosa*	1	1	
7	*Jussiaea repens*	1		
8	*Lemna minor*	1		
9	*Ludwigia adscendens*	1	1	
10	*Myriophylla spathulatum*	1	1	1
11	*Najas indica*	1	1	1
12	*Najas graminae*	1	1	1
13	*Nelumbo nucifera*	1	1	1
14	*Nymphaea lotus*	1	1	1

15	*Potamogeton cricpus*	1	1	1
16	*Potamogeton natans*	1	1	1
17	*Potamogeton pectinatus*	1	1	1
18	*Polygonum glabrum*	1	1	1
19	*Potamogeton nodosus*	1	1	1
20	*Scirpus royeli*	1	1	1
21	*Typha angustata*	1	1	1
22	*Typha latifolia*	1	1	1
23	*Vallisneria spiralis*	1	1	1
		23	20	17

Figure 67. Seasonal macrophytes diversity in Son basin of M.P.

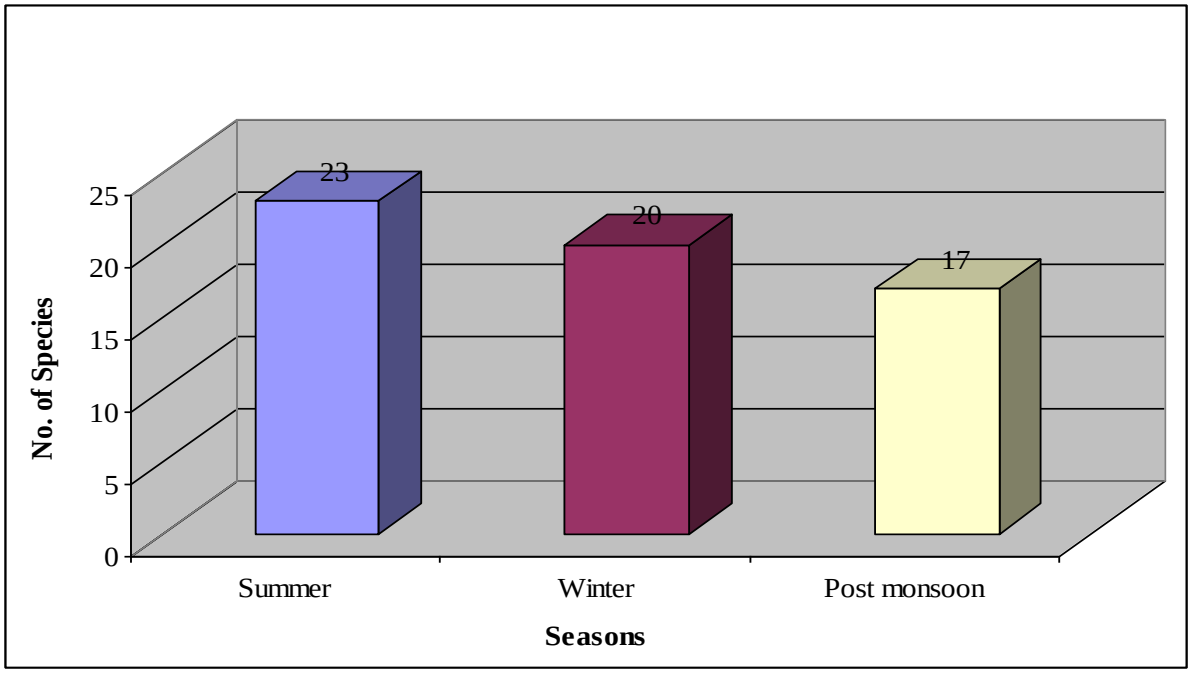


Table 59. Seasonal macrophytes diversity in Rajgarh Distt. of M.P.

S.No	Species	Summer	Winter	Post monsoon
1	*Cyperus rotundus*	1		
2	*Ceratophyllum demersum*	1	1	1
3	*Eichhornia crassipes*	1		1
4	*Hydrilla verticillata*	1	1	1
5	*Ipomea aquatica*	1	1	1
6	*Ipomea fistulosa*	1	1	1

7	*Jussiaea repens*		1	1
8	*Lemna minor*	1	1	1
9	*Myriophylla spathulatum*	1	1	1
10	*Najas graminae*	1	1	1
11	*Nelumbo nucifera*	1	1	1
12	*Nymphaea lotus*	1	1	1
13	*Ottelia alismoides*	1	1	
14	*Potamogeton pectinatus*	1	1	1
15	*Polygonum glabrum*	1	1	
16	*Potamogeton nodosus*	1	1	1
17	*Scirpus royeli*	1	1	1
18	*Typha latifolia*		1	1
19	*Vallisneria spiralis*	1	1	1
		17	**17**	**16**

Figure 68. Seasonal macrophytes diversity in Son basin of M.P.

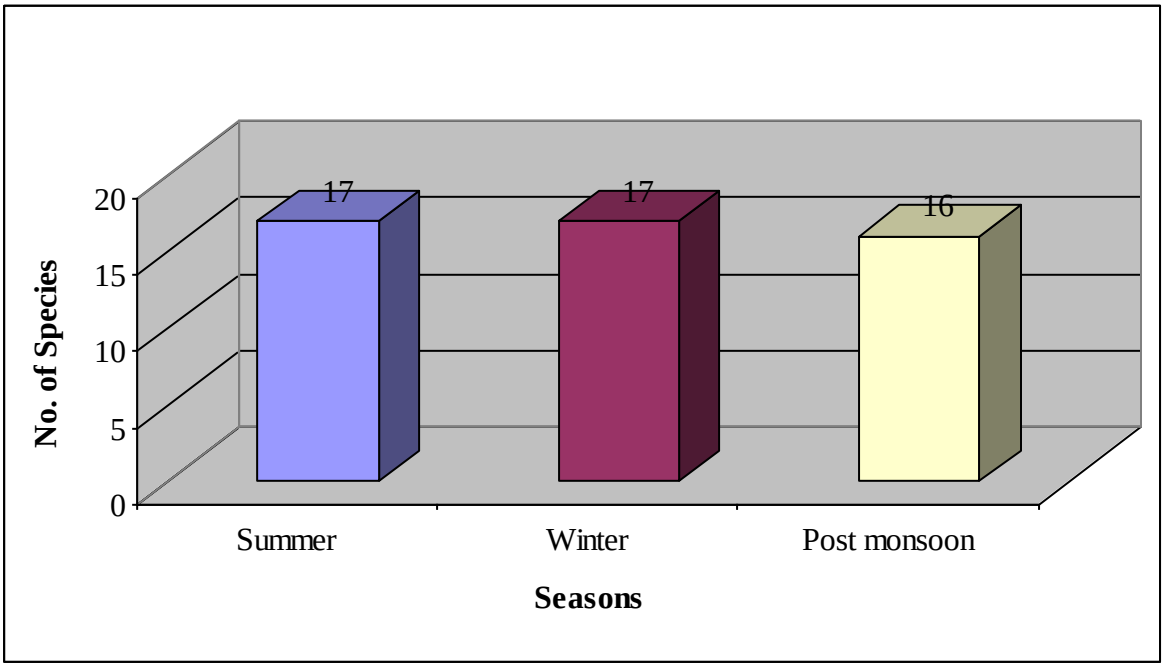
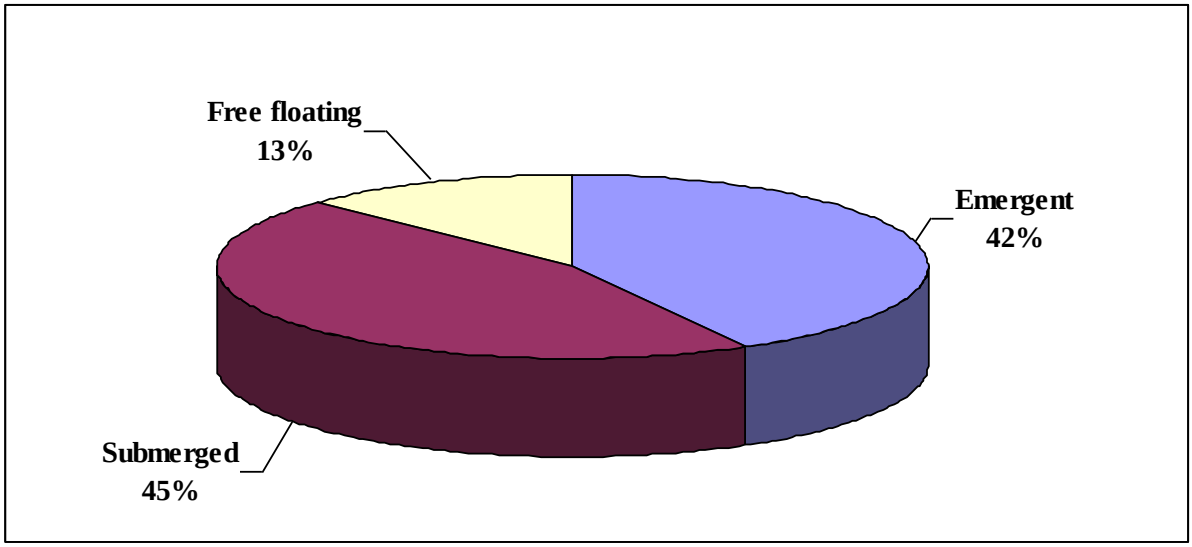


Figure 69. Macrophytes species composition in different river basin of M.P.



12. Birds diversity in different river basin of M.P.

12.1. Betwa basin

On the basis of field survey, total 42 species belonging to 21 families and 10 orders were found in Betwa River (Between Bhojpur and Vidisha, Upper lake, Halali Dam). Study showed that the most abundant family was Ardeidae (57%) followed by the families Charadriidae (20%) and Phalacrocoracidae (13%) in order of abundance. Median egrets (*Egretta intermedia)* and little egrets (*Egretta garzetta)* were the most common birds recorded.

12.2. Chambal basin

Among the diversity of bird species identified in the Chambal River (Between Nagda and Gandhi Sagar Dam, around Shipra river and Gambhir Dam), a total of 66 species belonging to 11 orders and 27 families were recorded. Among these Charadriidae (16%) is the dominant family followed by Anatidae and Ardeidae (10%); Phalacrocoracidae and Rallidae (8%). The most dominant bird was Common Coot (*Fulica atra)*. Other common birds were Median egrets (*Egretta intermedia)* and Indian cormorant (*Phalacrocorax fuscicollis)*.

12.3. Tapti basin

This study identified the diversity of bird species found in Tapti River (Between Betul and Burhanpur) and 36 species falling in 9 orders and 22 families were recorded. Observations of birds were made during the period of migratory season Nov. 2007 to Jan. 2008. Among these, most abundant families were Ardeidae (22%), Charadriidae, Motacillidae and Muscicapidae (14%) and Phalacrocoracidae (13%). The common birds were Median egrets (*Egretta intermedia)* and little egrets (*Egretta garzetta)*.

12.4. Ken basin

On the basis of field survey, total 31 species were recorded belonging to 10 orders and 19 families in Ken River (Between Singora village and Bariyarpur Dam). The study showed that the most abundant family was Ardeidae (25%) followed by the families Charadriidae (20%), Phalacrocoracidae, Anatidae and Rallidae (10%) in order of abundance. Little egrets (*Egretta garzetta)* and Indian pond heron (*Ardeola grayii)* were the common birds recorded.

12.5. Son basin

This study identified bird species in the Son River (Around Govindgarh lake and Bansagar reservoir). A total of 38 species belonging to 9 orders and 18 families were recorded. Among these, Ardeidae (17%) was most dominant family followed by Charadriidae (13%), Rallidae and Anatidae (10%). Indian cormorant (*Phalacrocorax fuscicollis),* Median egrets (*Egretta intermedia)* and Common coot (*Fulica atra)* were the most common birds recorded in these sites.

12.6. Rajgarh District

On the basis of field survey, total 47 species were recorded belonging to 10 orders and 22 families in Betwa River (around Seasonal Ponds and Nawaj river). The study showed that most abundant family was Charadriidae (20%) followed by the families Ardeidae (16%) Rallidae and Motacillidae (9%) in order of abundance. Large egret (*Ardea alba)* and Indian pond heron (*Ardeola grayii)* were the common birds recorded.

Table 60. Birds diversity in different river basin of M.P.

S.No	Order/Family	**Common Name**	**Zoological Name**	**Rajgarh**	**Betwa basin**	**Tapti basin**	**Chambal Basin**	**Ken basin**	**Son basin**
	Order - Pelecaniformes								
1	family - Phalacrocoracidae	Large Cormorant	*Phalacrocorax carbo*	1	1	1	1		
2		Indian Cormorant	*Phalacrocorax fuscicollis*	1	1	1	1	1	1
3		Little Cormorant	*Phalacrocorax niger*	1	1	1	1	1	1
4		Darter	*Anhinga rufa*		1		1		
	Order -Ciconiformes								
5	family - Ardeidae	Grey Heron	*Ardea cinerea*	1	1	1	1	1	1
6		Purple Heron	*Ardea purpurea*	1			1		
7		Large Egret	*Ardea alba*				1		1
8		Little Egret	*Egretta garzetta*	1	1	1	1	1	1
9		Median Egret	*Egretta intermedia*	1	1	1	1	1	1
10		Cattle Egret	*Bubulcus ibis*	1		1	1	1	
11		Indian Pond Heron	*Ardeola grayii*	1	1	1	1	1	1
12	family - Ciconiidae	White necked Stork		1					
13		Openbilled Stork	*Anastomus oscitans*	1			1		
14	family - Threskionithidae	Glossy Ibis	*Plegadis falcinellus*			1			
	Order -Anseriformes								
15	family - Anatidae	Ruddy Shelduck	*Tadorna ferruginea*	1	1	1	1	1	1
16		Spottbill Duck	*Anas poecilorhyncha*				1	1	1
17		Gadwall	*Anas strepera*	1			1		
18		Eurasian Wigeon	*Anas penelope*				1		
19		Mallard	*Anas platyrhynchos*				1		
20		Northern Pintail	*Anas acuta*				1		1
	Order -Falconiformes								
21	family - Accipitridae	Pallas's Fish Eagle	*Haliaeetus leucoryphus*				1		
22		Marsh Harrier	*Circus aeruginosus*				1		
	Order -Galliformes								
23	family - Phasianidae	Indian Peafowl	*Pavo cristatus*	1	1		1	1	
	Order -Gruiformes								
24	family - Rallidae	Whitebreasted Waterhen	*Amaurornis phoenicurus*	1	1	1	1	1	1
25		Indian Moorhen	*Gallinula chloropus*	1	1		1		1
26		Purple Swamphen	*Porphyrio porphyrio*	1			1		
27		Common Coot	*Fulica atra*			1	1	1	1
	Order -Charadriiformes								
28	family - Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	1	1	1	1	1	1
29		River Lapwing	*Vanellus duvaucelii*	1	1		1	1	1
30		Little Ringed Plover	*Charadrius dubius*	1	1	1	1	1	1
31		Kentis Plover	*Charadrius alexandrinus*	1	1		1		
32		Great Stone Plover	*Esacus magnirostris*	1			1		
33		Spotted Redshank	*Tringa erythropus*	1			1		
34		Common Redshank	*Tringa totanus*	1	1		1	1	1
35		Marsh Sandpiper	*Tringa stagnatilis*	1			1		
36		Common Greenshank	*Tringa nebularia*	1	1	1	1		

37		Common Sandpiper	*Tringa hypoleucos*	1					
38	family - Recurvirostrisae	Black-winged Stilt	*Himantopus himantopus*	1	1	1	1	1	1
39	family - Laridae	Brown-headed Gull	*Larus brunnicephalus*				1		
40		River Tern	*Sterna aurantia*	1	1	1	1	1	1
	Order -Columbiformes								
41	family - Columbidae	Bluerock Pigeon	*Columba livia*	1	1	1	1	1	1
42		Red Collared Dove	*Streptopelia tranquebarica*				1		
43		Spotted Dove	*Streptopelia chinensis*	1	1		1		
	Order -Psittaciformes								
44	family - Psittacidae	Rose-ringed Parakeet	*Psittacula krameri*		1	1	1	1	1
	Order -Cuculiformes								
45	family - Strigidae	Spotted Owlet	*Athene brama*	1					
	Order -Coraciiformes								
46	family - Alcedinidae	Whitebrested Kingfisher	*Halcyon smyrnensis*	1	1	1	1	1	1
47		Small Blue Kingfisher	*Alcedo atthis*	1	1		1		
48		Pied Kingfisher	*Ceryle rudis*	1	1	1	1	1	1
49		Storkbilled Kingfisher	*Halcyon capensis*		1				
50	family - Meropidae	Green Bee-eater	*Merops orientalis*	1	1	1	1	1	1
51	family - Coraciidae	Indian Roller	*Coracias benghalensis*	1	1	1	1		
52	family -Upupidae	Hoopoe	*Upupa epops*			1	1		
53	family -Bucerotidae	Indian Grey Hornbill	*Tockus birostris*		1	1	1		
	Order- Passeriformes								
54	family - Alaudidae	Oriental Sky Lark	*Alauda gulgula*	1		1			
55		Ashycrowned Finch Lark		1			1		
56	family - Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*	1	1		1	1	1
57		Swallow	*Hirundo rustica*	1					1
58	family - Daniidae	Bay-backed Shrike	*Lanius vittatus*	1	1		1	1	1
59	family - Dicruridae	Black Drongo	*Dicrurus adsimilis*	1	1	1	1	1	1
60	family - Sturnidae	Brahminy Myna	*Sturnus pagodarum*				1		
61		Common Myna	*Acridotheres tristis*	1			1	1	1
62		Pied Myna	*Sturnus contra*				1		
63	family - Corvidae	House Crow	*Corvus splendens*		1			1	1
64		Jungle Crow	*Corvus macrorhynchos*	1	1	1	1		1
65		Indian Tree Pie	*Dendrocitta vagabunda*			1	1		
66	family - Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*		1	1	1	1	1
67	family -Muscicapidae	Common Babbler	*Turdoides caudatus*	1	1	1	1		1
68		Paradise Flycatcher	*Terpsiphone paradisi*				1		
69		Paddyfield Warbler	*Acrocephalus agricola*		1	1			
70		Magpie Robin	*Copsychus saularis*		1	1	1	1	1
71		Indian Robin	*Saxicoloides fulicata*				1		1
72	family -Motacillidae	Paddyfield Pipit	*Anthus novaeseelandiae*	1	1	1	1	1	1
73		Yellow Wagtail	*Motacilla flava*	1					
74		White Wagtail	*Motacilla alba*	1	1	1	1	1	1
75		Large pied Wagtail	*Motacilla maderaspatensis*	1	1	1	1		1
76	family -Ploceidae	Baya Weaver	*Ploceus philippinus*	1		1	1		
77		Spotted Munia	*Lonchura Punctulata*	1					
			TOTAL	47	42	36	66	31	38

Figure 70. Birds diversity in different river basin of M.P.

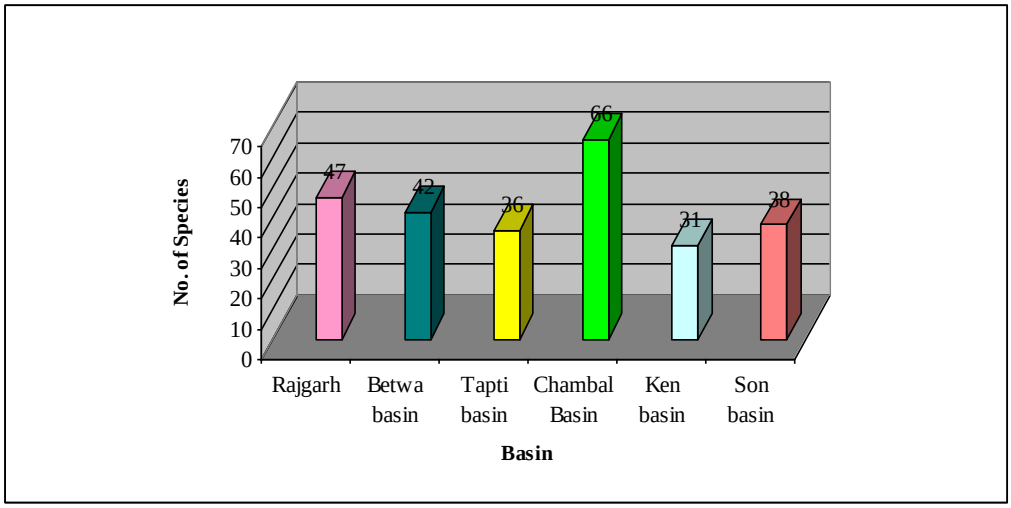
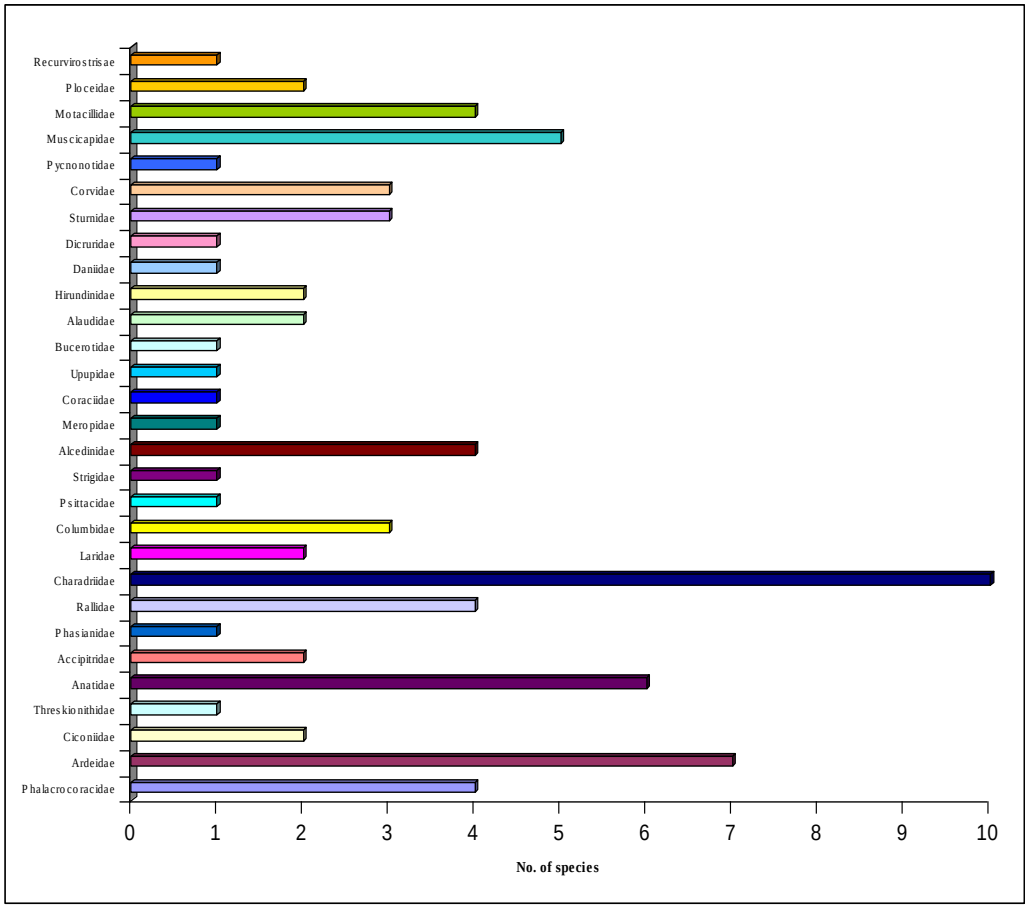


Figure 71. Familywise birds species composition in different river basin of M.P.



13. Physico-chemical properties

Table 61. Physico-chemical variation of Tapti Basin and Chambal Basin during the April- may 2007

	Tapti River								Chambal River		
Parameters	Parasdoh Deep pool	Kotidoh Deep pool		Tedtali		Dhar Deep pool		Nepa Nagar	Basai	Gandhi Sagar	
	Surface	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Surface	Surface	Bottom
Lat.	N-21°40.795'	N-21°48.625'		N-21°29.992'		N-21°48.052'		N-21°25.940'	N-24°4.558'	N-24°41.224'	
Long.	E-77°59.686'	E-77°38.687'		E-76°44.774'		E-76°42.903'		E-76°24.58'	E-77°31.723'	E-75°33.641'	
Depth (m)	6.1	5		3.5		4.2		5	6	230	
Air Temperature (°c)	40	33		36.5		36.5		35.5	38.5	38	
Water,Temperature (°c)	33	30	29	31.5	30	31.5	31.1	33	31	31.8	27
Transparency (cm)	175	225		204		200		70	50	150	
pH	8.2	7.9	8.4	8.7	8.6	8.9	7.4	8.4	8.9	8.7	7.8
TDS(mg/l)	327	214	195	270	270	270	320	360	240	160	270
Conductivity (µs/cm)	520	340	310	410	410	420	500	580	380	240	410
Turbidity (NTU)	9	6.5	4.6	5.7	4.4	8.2	6.8	5.6	7.5	8.3	13
D.O (mg/l)	5.04	6.3	5.46	3.78	2.1	2.94	2.52	2.31	8.4	11.6	0.4
Free $CO_{2\ (mg/l)}$	14	19	6	10	16	Ab.	12	20	18	3.2	16
Carbonate Alkalinity (mg/l)	Ab.	Ab.	Ab.	Ab.	Ab.	4	Ab.	Ab.	Ab.	Ab.	Ab.
Bicarbonate Alkalinity (mg/l)	122	108	126	198	200	220	180	172	200	180	220
Total Alkalinity (mg/l)	122	108	126	198	200	224	180	172	200	180	220
Total Hardness (mg/l)	152	178	134	160	170	156	172	200	160	102	164
Calcium Hardness (mg/l)	122	146	88	108	112	112	118	154	132	68	118
Magnesium Hardness (mg/l)	30	32	42	52	58	46	54	46	28	34	46
Chloride (mg/l)	24.98	31.97	31.97	36.96	40.96	40.96	40	46.95	31.97	46	64

Table 62. Physico-chemical variation of Betwa Basin during the April- may 2007

Parameters	Betwa River								Upper Lake					
	Bhojpur Deep pools		Bhojpur Bridge		Vidisha		Pagneshwar		Behta village		Central Zone		Sehore Naka	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	N-23º06.157'		N23^0 o5.974',		N-23º32.233'		N-23º26.182'		N-23º15'48.1"		N-23º15'12.0"		N-23º13'55.2"	
Long.	E-77º34.591'		E77^0 34.465')		E-77º47.521'		E-77º43.784'		E-77º 20'16.2"		E-77º 20'55.9"		E-77º 19'38.4"	
Depth (m)	6.6		1.2		1.53		2		2.5		4		2	
Air Temperature (ºc)	34		33		40		38		19		19		26	
Water,Temperature (ºc)	20.8	20.5	29	27	34	33	31	30	20	21	23	22	22	20
Transparency (cm)	50		60		40		95		Up to Bottom		9.5		82	
pH	8.2	6.9	8.5	8.2	9.4	9.2	8.1	7.9	9.4	9.3	8.4	84	8.6	8.2
TDS(mg/l)	333	352	333	340	214	239	270	296	88.2	94.5	100	107	100	107
Conductivity (µs/cm)	530	560	530	540	340	380	430	470	140	150	160	170	160	170
Turbidity (NTU)	5.5	13.5	3.6	7.7	41	68	13.5	15.9	9	10.3	17.1	43	16.6	20
D.O (mg/l)	5.88	Nil	9.24	7.14	12.47	8.48	5.88	4.07	11.2	11.2	8	7	8.2	6
Free CO_2 (mg/l)	8	56	6	32	Ab.	Ab.	20.4	14	Ab.	Ab.	4	24	4	12
Carbonate Alkalinity (mg/l)	Ab.	Ab.	Ab.	Ab.	1.8	1.4	Ab.	Ab.	6	10	Ab.	Ab.	Ab.	Ab.
Bicarbonate Alkalinity (mg/l)	164	170	180	156	200	284	294	260	22	18	14	20	18	18
Total Alkalinity (mg/l)	164	170	180	156	201.8	285.4	294	260	28	28	14	20	18	18
Total Hardness (mg/l)	162	322	153	168	80	118	136	142	60	72	70	78	64	86
Calcium Hardness (mg/l)	108	198	82	106	68	84	102	102	18.9	29.4	21	23.1	21	33.6
Magnesium Hardness (mg/l)	54	124	71	62	12	34	34	40	41.1	42.6	49	54.9	43	52.4
Chloride (mg/l)	74.93	82.92	105.9	111.9	33.97	34.97	56.94	61.94	16.98	17.98	17.98	19.98	14.98	14.98

Table 63. Physico-chemical variation of Betwa basin during the Nov- Dec 2007

Parameters	Betwa River						Halali		Upper Lake					
	Bhojpur		Near Pagneshwar		Vidisha				Behta village		Central zone		Sehore Nala	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 06'15.7''		23^0 26'08.1''		23^0 32' 9.8''		23^0 29'9.32''		23°15'48.1"		23°15'12.0"		23°13'55.2"	
Long.	77^0 34'59.1"		77^0 43'.49.3"		77^0 47'45.8"		77^0 33'11.6"		77° 20'16.2"		77° 20'55.9"		77° 19'38.4"	
Depth (m)	6.6		2		14		8		2.5		4		2	
Air Temperature (°c)	9		22		7		24		12		26		29	
Water temperature (°c)	12	8	19	18	11	8	22	19	14	14	20	18	24	23
Transparency (cm)	46		53		38		24		Upto Bottom		11		67	
pH	8.4	7.3	7.6	7.9	8.8	8.2	8.4	7.4	8.8	8.7	8.6	7.9	8.9	8.1
TDS (mg/l)	320	324	240	256	236	256	140	164	76	82	94	112	102	118
Conductivity	536	548	390	420	356	398	260	284	128	148	134	184	138	170
Turbidity (NTU)	4.5	10.5	12.5	18.9	48	84	12.5	36	6	6.4	12.5	18.2	18	22.4
D.O (mg/l)	8.2	Nil	6.2	4.2	10.8	8.2	8.8	6.8	9.2	8.8	8.4	7.6	8.8	6.8
Free co_2 (mg/l)	Absent	42	16.4	8	Absent	18.2	Absent	26	Absent	Absent	Absent	20.4	Absent	16.4
Carbonate Alkalinity (mg/l)	8.4	Absent	Absent	Absent	4.2	Absent	6.4	Absent	4.4	8.6	4	Absent	8.2	Absent
Bicarbonate Alkalinity (mg/l)	156	178	284	296	184	200	40	56	18	24	16	22	14	18
Total Alkalinity(mg/l)	164.4	178	284	296	188.2	200	46.4	56	22.4	32.6	20	22	22.2	18
Total Hardness (mg/l)	184	246	146	154	102	126	128	254	48	60	64	84	58	68
Calcium Hardness (mg/l)	144	182	102	112	56	68	96	174	24	28	36	44	28	32
Magnesium Hardness (mg/l)	40	64	34	42	46	58	32	80	24	32	28	40	30	36
Chloride (mg/l)	84.92	86.92	44.94	56.94	36.98	42.96	22.98	46.94	18.94	19.98	16.94	16.94	12.94	14.98

Table 64. Physico-chemical variation of Chambal basin during the Nov- Dec 2007

Parameters	Chambal River						Shipra River		Gambhir Dam	
	Nagda		Basai Village		Gandhi Sagar		Kimore Ghat			
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 27'48.7"		24^0 04'32.1''		24^0 41'01.3''		23^0 13'18.9''		23^0 12'32.1''	
Long.	75^0 23' 55.0''		75^0 31'46.0''		$75^0$33'55.8''		75^0 47' 06.3''		75^0 38'12.7''	
Depth (m)	5.92		6.67		22.5		2		32	
Air Temperature (^{o}c)	28		26		20		14		28	
Water temperature (^{o}c)	22	20	20	19	18	14	12	11	22	18
Transparency (cm)	24		56		144		12		32	
pH	7.8	7.4	8.1	7.9	8.2	7.8	7.6	6.6	8.6	8.1
TDS (mg/l)	280	340	180	196	130	182	340	410	96	112
Conductivity	352	546	242	255	188	246	556	602	166	212
Turbidity (NTU)	14.2	21.2	9.2	24.2	24.2	20.4	22.2	34.8	7.6	11.2
D.O (mg/l)	7.4	6.6	8.2	7.8	8.6	7.4	7.4	6.8	8.8	8.2
Free co_2 (mg/l)	16	18	4.8	18	2.6	16	16	22	Absent	8.2
Carbonate Alkalinity (mg/l)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	4.6	Absent
Bicarbonate Alkalinity (mg/l)	210	246	180	224	184	212	280	320	80	96
Total Alkalinity(mg/l)	210	246	180	224	184	212	280	320	84.6	96
Total Hardness (mg/l)	160	280	156	240	120	154	180	214	110	184
Calcium Hardness (mg/l)	112	208	112	178	84	112	126	142	78	118
Magnesium Hardness (mg/l)	48	72	44	62	28	42	54	72	32	66
Chloride (mg/l)	55.96	86.94	46.94	52.98	52.94	60.98	48.98	78.98	34.94	40.96

Table 65. Physico-chemical variation of Tapti basin during the Nov- Dec 2007

Parameters	TAPTI RIVER											
	Parasdoh		Baralinga		Amarkash		Tedtali		Raitali		Boat Ghat,Nepanagar	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	$21^0$40’55.9’’		$21^0$48’39.4’’		$21^0$47’98.0’’		$21^0$29’99.2’’		$21^0$28’05.2’’		$21^0$25’94.0’’	
Long.	$77^0$59’ 44.2’’		$77^0$47’ 08.8’’		$77^0$25’68.9’’		$77^0$44’ 77.4’’		$76^0$42’90.6’’		$76^0$24’05.8’’	
Depth (m)	6.1		2.5		6		3.5		4.2		5	
Air Temperature (^{o}c)	14		17		26		16		26		22	
Water temperature (^{o}c)	17	9	16	13	19	17	16	15	20	19	18	17
Transparency (cm)	164		34		26		186		112		28	
pH	8.6	7.8	8.4	7.9	8.8	8.1	8.6	7.6	8.4	7.9	7.8	6.4
TDS (mg/l)	280	320	140	156	210	280	240	270	280	340	390	420
Conductivity	460	530	212	232	310	346	318	340	348	550	596	620
Turbidity (NTU)	6.6	10.4	2.4	6.8	8.8	12.6	6.8	12.2	11.2	14.6	36.2	44.6
D.O (mg/l)	8.6	8.2	8.4	7.8	8.8	8.2	9.4	6.4	7.8	7.2	6.4	4.2
Free co_2 (mg/l)	Absent	14	Absent	Absent	Absent	6.8	Absent	18.2	Absent	12.8	18.2	22.4
Carbonate Alkalinity (mg/l)	9.6	Absent	6.4	6.4	8.2	Absent	8.8	Absent	5.6	Absent	Absent	Absent
Bicarbonate Alkalinity (mg/l)	136	144	82	112	112	136	144	178	156	220	310	460
Total Alkalinity(mg/l)	145.6	144	88.4	118.4	120.2	136	152.8	178	161.6	220	310	460
Total Hardness (mg/l)	160	172	112	132	142	162	156	174	146	168	210	246
Calcium Hardness (mg/l)	128	136	84	98	102	108	116	124	102	112	164	182
Magnesium Hardness (mg/l)	32	36	28	34	40	54	40	50	44	56	48	62
Chloride (mg/l)	20.94	24.98	32.98	34.94	20.94	22.98	38.94	40.94	42.94	44.96	44.96	52.98

Table 66. Physico-chemical variation of Ken and Son basin during the Nov- Dec 2007

Parameters	Ken River						Son river			
	Ken -Sonar river Con.		Salaiya Village		Bariyarpur Dam		Govindgarh Lake		Bansagar	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	24^0 23'50.3''		24^0 48'43.4''		24^0 50'59.7''		24^0 14'83.9''		24^0 22' 4.81''	
Long.	79^0 56'18.3''		80^0 05'19.1''		80^0 5'46.3''		81^0 19'53.4''		81^0 16' 8.98''	
Depth (m)	8		2		11		22.5		8	
Air Temperature (^{o}c)	28		30		16		24		28	
Water temperature (^{o}c)	20	18	28	27	20	16	20	18	24	22
Transparency (cm)	54		42		66		46		80	
pH	8.8	8.4	8.9	8.6	9.2	8.1	8.8	8.2	8.6	8.1
TDS (mg/l)	120	126	102	112	140	168	82	186	136	192
Conductivity	192	212	172	182	252	266	136	296	242	298
Turbidity (NTU)	10.4	17.4	8.6	11.2	7.2	18.8	11.2	26.4	7.6	17.2
D.O (mg/l)	10.2	8.8	9.2	8.6	8.4	8.2	12.4	4.2	8.4	7.2
free co2 (mg/l)	Absent	Absent	Absent	Absent	Absent	8.4	Absent	16.6	Absent	6.8
Carbonate Alkalinity (mg/l)	8.8	7.6	9.4	7.8	6.6	Absent	10.2	Absent	8.2	Absent
Bicarbonate Alkalinity (mg/l)	134	138	120	132	110	118	82	94	102	126
Total Alkalinity(mg/l)	142.8	145.6	129.4	139.8	116.6	118	92.2	94	110.2	126
Total Hardness (mg/l)	126	148	112	136	102	136	84	118	134	210
Calcium Hardness (mg/l)	96	112	84	124	76	108	62	98	92	158
Magnesium Hardness (mg/l)	30	36	28	12	26	28	22	20	42	52
Chloride (mg/l)	24.98	31.94	20.98	28.98	18.94	38.98	28.94	42.94	36.98	44.94

Table 67. Physico-chemical variation of Ponds and Rivers of Rajgarh during the Nov- Dec 2007

	Bandravedra pond		**Kudali pond**		**Newaj River**	
	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 41'42.6''		23^0 42' 46.7''		24^0 0' 24.2''	
Long.	77^0 04' 11.8''		77^0 00' 36.7''		76^0 44'28.4''	
Depth (m)	4.4		3.2		5.5	
Air Temperature (^{o}c)	22		31		28	
Water temperature (^{o}c)	20	18	24	22	22	19
Transparency (cm)	Upto Bottom		Upto Bottom		22	
pH	8.8	8.7	8.2	8	8.2	7.9
TDS (mg/l)	180	210	146	148	132	144
Conductivity	288	294	238	244	240	254
Turbidity (NTU)	3.4	4.6	2.2	2.4	4.6	8.8
D.O (mg/l)	9.2	8.8	8.6	8.2	8.8	7.8
Free co_2 (mg/l)	Absent	Absent	Absent	Absent	Absent	6.8
Carbonate Alkalinity (mg/l)	10.2	9.8	8.6	8.2	6.4	Absent
Bicarbonate Alkalinity (mg/l)	82	96	78	86	102	118
Total Alkalinity(mg/l)	92.2	105.8	86.6	94.2	108.4	118
Total Hardness (mg/l)	122	126	86	98	112	132
Calcium Hardness (mg/l)	80.6	88.2	54.6	72	84	102
Magnesium Hardness (mg/l)	41.4	37.8	31.4	26	28	30
Chloride (mg/l)	22.94	24.98	20.98	24.98	34.96	56.98

Table 68. Physico-chemical variation of Betwa basin during the Sep.-Oct. 2008

Parameters	Betwa River						Halali		Upper Lake					
	Bhojpur		Near Pagneshwar		Vidisha				Behta village		Central zone		Sehore Nala	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 06'15.7''		23^0 26'08.1''		23^0 32' 9.8''		23^0 29'9.32''		23°15'48.1"		23°15'12.0"		23°13'55.2"	
Long.	77^0 34'59.1"		77^0 43'.49.3"		77^0 47'45.8"		77^0 33'11.6"		77° 20'16.2"		77° 20'55.9"		77° 19'38.4"	
Depth (m)	6.6		2		14		8		2.5		4		2	
Air Temperature (°c)	34		36		36		30		28		34		32	
Water temperature (°c)	24	22	28	27	26	19	25	22	26	25	27	24	26	24
Transparency (cm)	62		42		44		32		Upto Bottom		21		88	
pH	8.2	7.9	8.4	8.1	8.7	8.4	8.5	7.8	8.9	8.6	8.6	8.2	8.7	8.4
TDS (mg/l)	410	442	380	430	310	342	210	264	110	112	86	102	180	230
Conductivity	630	658	520	634	482	488	380	398	164	192	122	152	312	368
Turbidity (NTU)	8.2	14.8	16.8	20.2	62	75	14	56	4.5	7	16.8	21	30	42
D.O (mg/l)	8.4	6.8	8.8	8.4	9.2	8.2	8.4	7.2	9.6	8.4	8.4	8.2	9.4	8.4
Free co_2 (mg/l)	Absent	36	Absent	4	Absent	Absent	Absent	18	Absent	Absent	Absent	8.2	Absent	Absent
Carbonate Alkalinity (mg/l)	8.8	Absent	6.8	Absent	8.6	8.4	9.2	Absent	10.2	8.6	6.2	Absent	9.6	8.8
Bicarbonate Alkalinity (mg/l)	136	152	180	216	196	236	62	78	42	48	22	28	18	36
Total Alkalinity(mg/l)	144.8	152	186.8	216	204.6	244.4	71.2	78	52.02	56.6	28.2	28	27.6	44.8
Total Hardness (mg/l)	212	264	188	242	154	184	108	174	52	74	88	112	64	82
Calcium Hardness (mg/l)	156	192	142	178	112	132	56	112	24	32	56	62	32	46
Magnesium Hardness (mg/l)	56	72	46	64	42	52	52	62	28	42	32	50	32	36
Chloride (mg/l)	91.91	100.9	58.94	63.94	45.95	51.95	25.97	31.97	33.97	37.96	21.98	31.97	41.96	45.95

Table 69. Physico-chemical variation of Chambal basin during the Sep.-Oct. 2008

Parameters	Chambal River						Shipra River		Gambhir Dam	
	Nagda		Basai Village		Gandhi Sagar		Kimore Ghat			
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 27'48.7"		24^0 04'32.1''		24^0 41'01.3''		23^0 13'18.9''		23^0 12'32.1''	
Long.	75^0 23' 55.0''		75^0 31'46.0''		$75^0$33'55.8''		75^0 47' 06.3''		75^0 38'12.7''	
Depth (m)	5.92		6.67		22.5		2		32	
Air Temperature (^{o}c)	32		35		26		24		34	
Water temperature (^{o}c)	24	23	27	24	22	13	19	18	21	17
Transparency (cm)	33		74		157		14		46	
pH	7.9	7.6	8.6	8.4	8.7	8.2	7.8	7.2	8.5	8.4
TDS (mg/l)	327	373	242	271	146	190	399	425	135	157
Conductivity	536	612	396	445	240	312	654	696	221	258
Turbidity (NTU)	9.6	18.4	10.2	22	28	34	33	39.4	3.4	13.2
D.O (mg/l)	8.4	7.8	8.8	8.4	9.2	8.2	7.8	7.2	9.6	8.4
Free co_2 (mg/l)	12	16	Absent	Absent	Absent	Absent	10.2	12.4	Absent	Absent
Carbonate Alkalinity (mg/l)	Absent	Absent	6.4	4.8	8.4	6.8	Absent	Absent	3.2	4.6
Bicarbonate Alkalinity (mg/l)	164	192	228	292	204	250	376	428	76	106
Total Alkalinity(mg/l)	164	192	234.4	296.8	212.4	256.8	376	428	79.2	110.6
Total Hardness (mg/l)	184	256	152	252	164	184	272	404	144	236
Calcium Hardness (mg/l)	112.6	172.2	96.6	163.8	96.6	132.3	159.6	268.6	96.6	132.3
Magnesium Hardness (mg/l)	71.4	83.8	55.4	88.2	67.4	51.7	112.4	135.4	47.4	103.7
Chloride (mg/l)	62.94	78.92	51.95	64.94	61.94	68.93	64.94	88.91	25.97	37.96

Table 70. Physico-chemical variation of Tapti basin during the Sep.-Oct. 2008

Parameters	TAPTI RIVER											
	Parasdoh		Baralinga		Amarkash		Tedtali		Raitali		Boat Ghat,Nepanagar	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	21^0 40’55.9’’		21^0 48’39.4’’		21^0 47’98.0’’		21^0 29’99.2’’		21^0 28’05.2’’		21^0 25’94.0’’	
Long.	77^0 59’ 44.2’’		77^0 47’ 08.8’’		77^0 25’68.9’’		77^0 44’ 77.4’’		76^0 42’90.6’’		76^0 24’05.8’’	
Depth (m)	6.1		2.5		6		3.5		4.2		5	
Air Temperature (°c)	24		28		26		30		34		32	
Water temperature (°c)	19	18	24	23	22	20	25	24	27	25	26	24
Transparency (cm)	142		42		56		156		124		32	
pH	8.7	8.4	8.6	8.5	8.8	8.5	8.7	8.5	8.4	8.2	8.1	7.6
TDS (mg/l)	251	333	163	178	204	217	224	250	208	259	339	355
Conductivity	412	546	268	292	336	356	368	410	342	426	556	582
Turbidity (NTU)	10.2	12.4	2.2	8.8	5.2	10.3	3.2	8.6	5.6	12.9	44.2	56.8
D.O (mg/l)	9.6	7.2	9.2	8.8	9.6	8.8	9.6	7.2	9.6	7.2	7.2	4.8
Free co_2 (mg/l)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	12.2	16.4
Carbonate Alkalinity (mg/l)	8.4	7.2	8.8	6.8	9.6	8.2	10.4	6.4	6.6	4.6	Absent	Absent
Bicarbonate Alkalinity (mg/l)	104	152	64	96	124	136	130	144	152	168	324	420
Total Alkalinity(mg/l)	112.4	159.2	72.8	102.8	133.6	144.2	140.4	150.4	158.6	172.6	324	420
Total Hardness (mg/l)	144	168	94	98	92	98	126	144	110	126	114	128
Calcium Hardness (mg/l)	92.4	107.1	81.9	88.2	78.4	62.8	110	120.6	92.4	121.8	96.4	88.2
Magnesium Hardness (mg/l)	51.6	60.9	12.1	9.8	13.6	35.2	16	23.4	17.6	4.2	17.6	39.8
Chloride (mg/l)	25.97	37.96	48.95	51.95	33.97	61.94	51.95	57.94	51.95	55.94	47.95	50.95

Table 71. Physico-chemical variation of Ken and Son basin during the Sep.-Oct. 2008

Parameters	Ken River						Son river			
	Ken -Sonar River Confluence		Near Salaiya Village		Bariyarpur Dam		Govindgarh Lake		Near Deolond Village BansagarRes.	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	**Surface**	**Bottom**	**Surface**	**Bottom**
Lat.	24^0 23’50.3’’		24^0 48’43.4’’		24^0 50’59.7’’		24^0 14’83.9’’		24^0 22’ 4.81’’	
Long.	79^0 56’18.3’’		80^0 05’19.1’’		80^0 5’46.3’’		81^0 19’53.4’’		81^0 16’ 8.98’’	
Depth (m)	8		2		11		22.5		8	
Air Temperature (^{o}c)	31		28		29		30		27	
Water temperature (^{o}c)	24	17	25	24	19	17	22	16	20	18
Transparency (cm)	63		56		74		52		77	
pH	8.7	8.5	8.7	8.4	8.8	8.4	8.8	8.4	8.8	8.5
TDS (mg/l)	143.35	158.6	115.29	128.1	175.07	190.32	99.43	148.84	158.6	198.25
Conductivity	235	260	189	210	287	312	163	244	260	325
Turbidity (NTU)	8.9	22.4	6.3	15.2	3.2	21.5	8.6	22.4	5.2	19.6
D.O (mg/l)	12.8	10	14	12.8	18	12.4	18.4	4.8	14	8.4
Free co2 (mg/l)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Carbonate Alkalinity (mg/l)	10	8	8	4	12	6	14	2	10	2
Bicarbonate Alkalinity (mg/l)	172	188	148	150	146	168	164	176	134	184
Total Alkalinity(mg/l)	182	196	156	154	158	174	178	178	144	186
Total Hardness (mg/l)	148	166	136	148	152	168	106	172	128	184
Calcium Hardness (mg/l)	88.2	111.3	100.8	123.9	86.1	109.2	96.6	123.9	109.2	151.2
Magnesium Hardness (mg/l)	59.8	54.7	35.2	24.1	65.9	58.8	9.4	48.1	18.8	32.8
Chloride (mg/l)	28.0	38.0	31.0	36.0	21.0	26.0	36.0	51.9	34.0	42.0

Table 72. Physico-chemical variation of Ponds and Rivers of Rajgarh during the Sep.-Oct. 2008

Parameters	Bandravedra pond		Kudali pond		Newaj River	
	Surface	Bottom	Surface	Bottom	Surface	Bottom
Lat.	23^0 41'42.6''		23^0 42' 46.7''		24^0 0' 24.2''	
Long.	77^0 04' 11.8''		77^0 00' 36.7''		76^0 44'28.4''	
Depth (m)	4.4		3.2		5.5	
Air Temperature (^{o}c)	28		30		32	
Water temperature (^{o}c)	19	16	22	21	19	17
Transparency (cm)	240		280		46	
pH	8.6	8.5	8.7	8.6	8.6	8.1
TDS (mg/l)	207.4	235.46	162.26	168.36	189.1	204.35
Conductivity	340	386	266	276	310	335
Turbidity (NTU)	4.6	6.8	3.3	4.6	2.3	8.2
D.O (mg/l)	10.4	8.4	11.2	9.6	12.8	8.4
Free co_2 (mg/l)	Absent	Absent	Absent	Absent	Absent	4
Carbonate Alkalinity (mg/l)	8	6	6	4	8	Absent
Bicarbonate Alkalinity (mg/l)	104	134	92	116	128	158
Total Alkalinity(mg/l)	112	140	98	120	136	158
Total Hardness (mg/l)	146	152	112	136	126	142
Calcium Hardness (mg/l)	110.0	124.0	76.0	84	92.0	118.0
Magnesium Hardness (mg/l)	36	28	36	52	34	24
Chloride (mg/l)	25.974	28.971	25.974	26.973	27.972	53.946

14. Resource mapping on GIS platform

Resource Mapping has been started at selected sites. We have collected maps available with Survey of India and Revenue Maps of the area. Study sites have been located on the maps for further analysis. Data of pre-field survey has been collected.

During pre-field survey we collected geographical reference positions of the study sites using a GPS and located this station on the base map for geo-referencing.

We have procured map of M.P. at the scale of 1:1 million and digitized the study areas. Further we are in the process to procure degree sheets at 1:250000 scale to cover the entire state on this scale.

We are procuring satellite data of AWiFS covering the entire state.

All these maps are being digitized and registered on GIS platform for further analysis.

15. Socio-economic status

During socioeconomic surveys we have identified 32 fishermen villages in under different river basin of M.P. out of 32 villages 10 villages belongs to Tapti river basin, 12 villages belongs to Betwa basin,5 villages under Ken basin, 2 village under Son basin,2 villages under Chambal basin, 1 village belong to Rajgarh (Rajgarh city). Details of fisherman village shown in table below.

Table 73. Settlement of fishing villages under the river Basins

River/Reservoir	District	Tehsil/	Village	Latitude	longitude	Sampling Site
Tapti	Betul	Bhanshdehi				
			Kheri	21^0 50’ 59.84’’	77^0 48’ 03.26’’	Baralinga
			Kunkhedi	21^0 48’ 19.1’’	77^0 38’ 7.81’’	Amarkash
		Atner				
			Poni	21^0 42’ 42.67’’	78^0 03’ 15.77’’	Parasdoh
			Goula	21^0 41’ 49.55’’	78^0 02’ 16.91’’	Parasdoh

			Dhanora	21^0 40’ 23.41’’	77^0 58’ 18.59’’	Parasdoh
			Nehri	21^0 43’ 01.34’’	78^0 05’ 36.47’’	Parasdoh
	Burhanpur	Burhanpur				
			Burhanpur	21^0 18’19.4’’	76^0 14’ 32.00’’	
			Tedtali	21^0 29’9.92’’	76^0 44’ 7.74’’	Tedtali
			Dhar	21^0 28’ 05.2’’	76^0 42’ 9.06’’	Raitali
Betwa	Raisen	Bhojpur	Kiratpur	23^0 05’9.74’’	77^0 34’ 46.5’’	Bhojpur
		Raisen	Pagneshwar	23^0 26’ 05.35’’	77^0 43’ 59.28’’	Pagneshwar
	Vidisha	Vidisha	Vidisha	23^0 30’ 52.72’’	77^0 47’ 44.66’’	Ramghat
Upper lake	Bhopal	Huzur	Betagaon	23^0 15’ 38.94’’	77^0 19’ 57.35’’	-
			Prempura	23^0 13’ 07.16’’	77^0 22’ 13.51’’	-
			Goragaon	23^0 13’ 02.82’’	77^0 21’ 00.66’’	-
			Bishankheri	23^0 13’ 43.59’’	77^0 20’ 22.50’’	-
			Majhi Nagar	23^0 15’ 37.20’’	77^0 22’ 06.57’’	-
			Borband	23^0 15’ 32.00’’	77^0 20’ 45.92’’	-
			Halalpur	23^0 15’ 18.12’’	77^0 22’ 06.57’’	-
			Karbala	23^0 15’ 27.66’’	77^0 22’ 23.05’’	-
			Ramnagar colony	23^0 15’ 20.72’’	77^0 21’ 44.89’’	-
Chambal	Ujjain	Nagda	Nagda	23^0 27’ 7.99’’	75^0 23’ 8.80’	Nagda
			Kimor	23^0 13’ 18.9’’	75^0 47’ 06.3’’	Kimor Ghat
Sone	Rewa	Rewa	Govindgarh	24^0 22’ 48.1’’	81^0 16’ 8.98’’	Govindgarh
	Shahdol	Shahdol	Deolond	24^0 14’ 8.39’’	81^0 19’53.4’’	Deolond

Ken	Panna	Panna	Mandla	24^0 43’ 9.62’’	80^0 0’ 42.7’’	Bariyarpur Dam
			Bariyarpur	24^0 50’ 59.7’’	80^0 5’ 46.3’’	Bariyarpur Dam
			Salaiya village	24^0 48’ 43.4’’	80^0 5’ 19.1’’	Salaiya
			Tedi dhar	24^0 20’ 00.5’’	80^0 4’ 7.98’’	-
			Singora	24^0 24’ 58.4’’	79^0 55’ 44.3’’	Sonar-Ken river confluence
Seasonal river and Ponds	Rajgarh	Rajgarh	Rajgarh	24^0 0’ 24.2’’	76^0 44’ 28.4’’	Newaj river

Table 74. Population of fishing villages during the socioeconomic survey

River/Reservoir	Total Fisherman Families	Total population	Male Population	Female population	Yearly income by fishing (%)
Tapti Basin					
Paoni	12	68	42	26	40
Gaula	10	54	32	22	50
Kheri	31	127	81	46	60
Dhanora	5	20	16	4	55
Nehri	12	96	50	44	60
Kunkhedi	10	80	45	35	40
Burhanpur	25	175	95	80	40
Tedtali	12	100	57	43	50
Dhar	7	60	35	25	50
Chambal basin					
Nagda	22	96	52	44	40
Kimor	11	88	48	40	35
Betwa basin					
Pagneshwar	8	45	28	17	60
Kiratpur	9	50	30	20	50
Vidisha	10	42	25	17	60
Upper lake					
Prempura	2	9	4	5	40
Goragaon	12	70	38	32	50
Betagaon	62	360	189	171	50

Majhinagar	22	143	81	62	40
Halalpur	1	12	6	6	30
Borband	14	88	50	38	40
Karbala	11	88	45	43	30
Ramnagar colony	1	10	6	4	30
Rajgarh	81	332	163	159	50
Son basin					
Govindgarh	7	56	26	25	50
Deolond	50	400	230	370	60
Ken basin					
Mandla	9	81	46	35	40
Bariyarpur	11	90	50	40	50
Salaiya village	6	48	28	20	35
Tedi dhar	7	57	26	21	40
Singora	11	105	55	50	50

Figure 72. Yearly income percentage by fishing in different river basin of M.P.

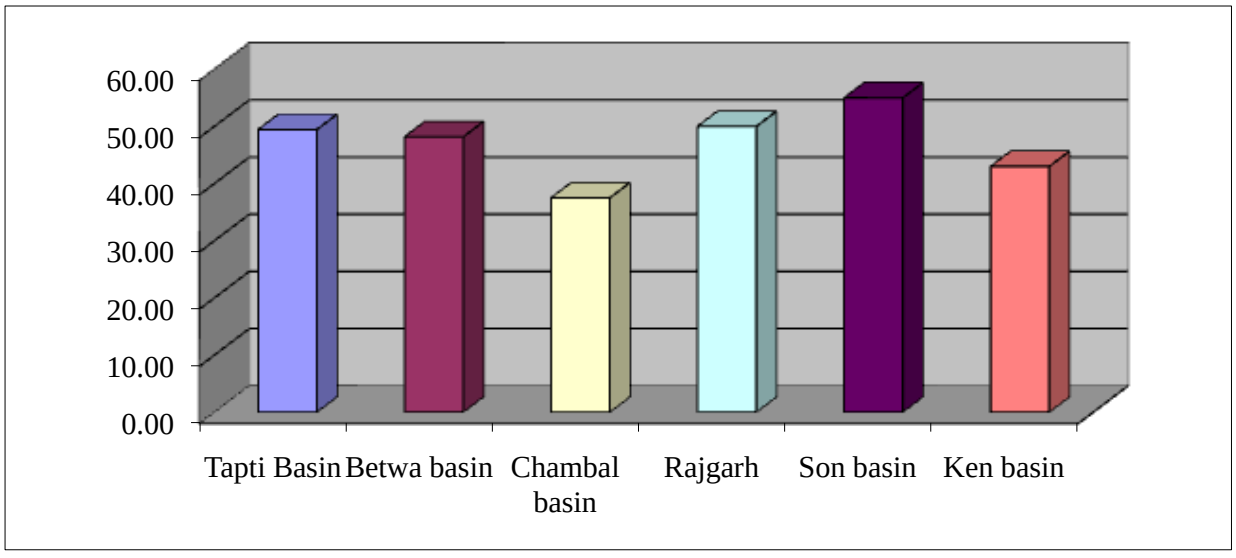
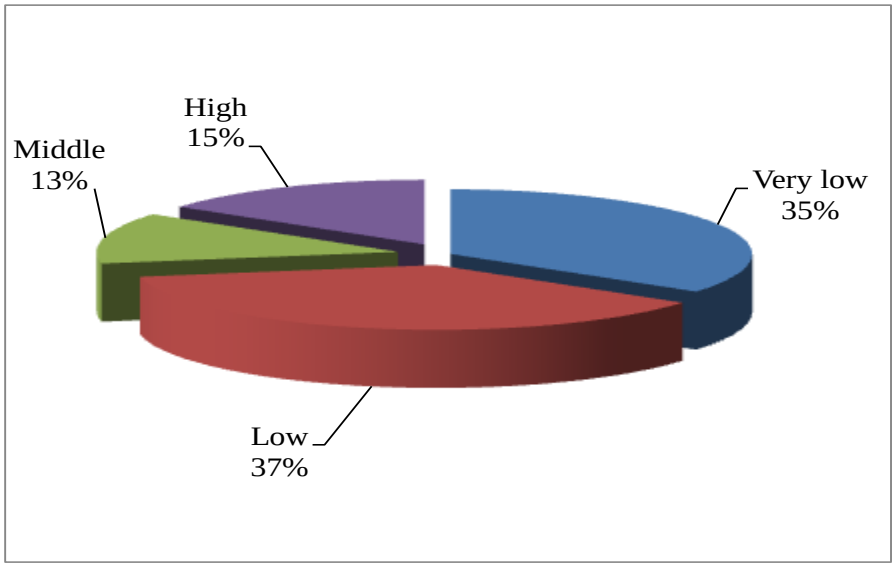


Table 75. Commercial status of fishes in different river basin of M.P.

S.No	Species	Very low	Low	Middle	High
1	*Amblypharyngodon mola*	*			
2	*Cenopharyngodon idella*		*		
3	*Barilius bandelisis*	*			
4	*Barilius barila*	*			
5	*Catla catla*				*
6	*Chela laubuca*	*			
7	*Esomus danricus*	*			
8	*Cirrhinus mrigala*				*
9	*Cyprinus carpio*			*	
10	*Crossocheilus latius*	*			
11	*Danio davario*	*			
12	*Garra gotyla*		*		
13	*Garra lamta*		*		
14	*Hypopthalimenthys molitrix*			*	
15	*Labeo bata*		*		
16	*Labeo boga*		*		
17	*Labeo calbasu*			*	
18	*Labeo dyocheilus*		*		
19	*Labeo fimbriatus*			*	
20	*Labeo gonius*		*		
21	*Labeo rohita*				*
22	*Labeo dero*		*		
23	*Labeo angra*		*		
24	*Labeo pangusia*		*		
25	*Labeo boggut*		*		
26	*Labeo dussuniere*		*		
27	*Puntius conchonius*	*			
28	*Puntius phutunio*	*			
29	*Puntius dorsalis*	*			
30	*Puntius sarana*		*		
31	*Puntius sophore*		*		
32	*Puntius ticto*	*			
33	*Puntius amphibius*	*			
34	*Puntius chrysopoma*	*			
35	*Puntius ambasis*	*			
36	*Puntius chola*	*			
37	*Puntius titius*	*			
38	*Osteobrama cotio*		*		
39	*Osteobrama vigorsii*	*			
40	*Oxygaster bacaila*		*		
41	*Oxygaster gora*		*		
42	*Oxygaster clupeoides*	*			

43	*Rasbora daniconius*		*		
44	*Rasbora elanga*	*			
45	*Tor tor*				*
46	*Lepidocephalichthys guntea*	*			
47	*Nemacheilus botia*	*			
48	*Nemacheilus duyi*	*			
49	*Nemacheilus evezardi*	*			
50	*Clupisoma garua*			*	
51	*Eutropiichthys vacha*			*	
52	*Silondia silondia*			*	
53	*Glossogobius giuris*	*			
54	*Heteropneustes fossilis*			*	
55	*Gonialosa manmina*		*		
56	*Gudusia chapra*		*		
57	*Mastacembelus armatus*				*
58	*Mastacembelus pancalus*		*		
59	*Clarius batrachus*				*
60	*Channa gachua*		*		
61	*Channa marulius*				*
62	*Channa punctatus*		*		
63	*Channa striatus*		*		
64	*Chanda nama*	*			
65	*Chanda ranga*	*			
66	*Chanda baculis*	*			
67	*Mystus aor*				*
68	*Mystus bleekeri*		*		
69	*Mystus cavasius*		*		
70	*Mystus seenghala*				*
71	*Mystus tengra*		*		
72	*Rita rita*				*
73	*Notopterus chitala*				*
74	*Notopterus notopterus*				*
75	*Ompok bimaculatus*			*	
76	*Ompok pabda*			*	
77	*Wallago attu*				*
78	*Nandus nandus*	*			
79	*Xenentodon cancila*		*		
80	*Rhinomugil corsula*		*		
81	*Colisa fasciatus*	*			
82	*Anabas testudineus*		*		
83	*Badis badis*		*		
84	*Tilapia mossambica*		*		
85	*Bagarius bagarius*			*	
86	*Parapsilorhynchus tentaculatus*	*			
		30	32	11	13

Figure 73. Commercial Status of fishes in different river basin of M.P

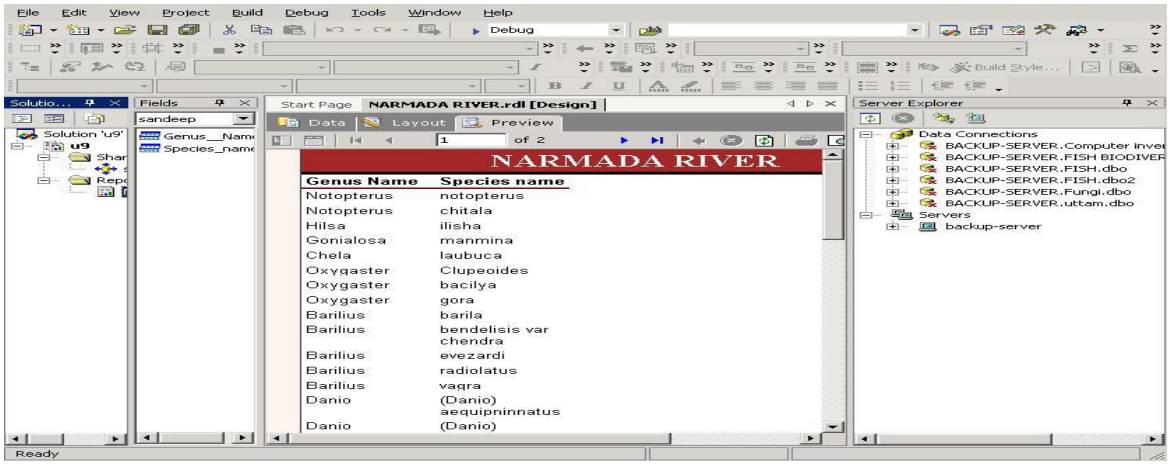


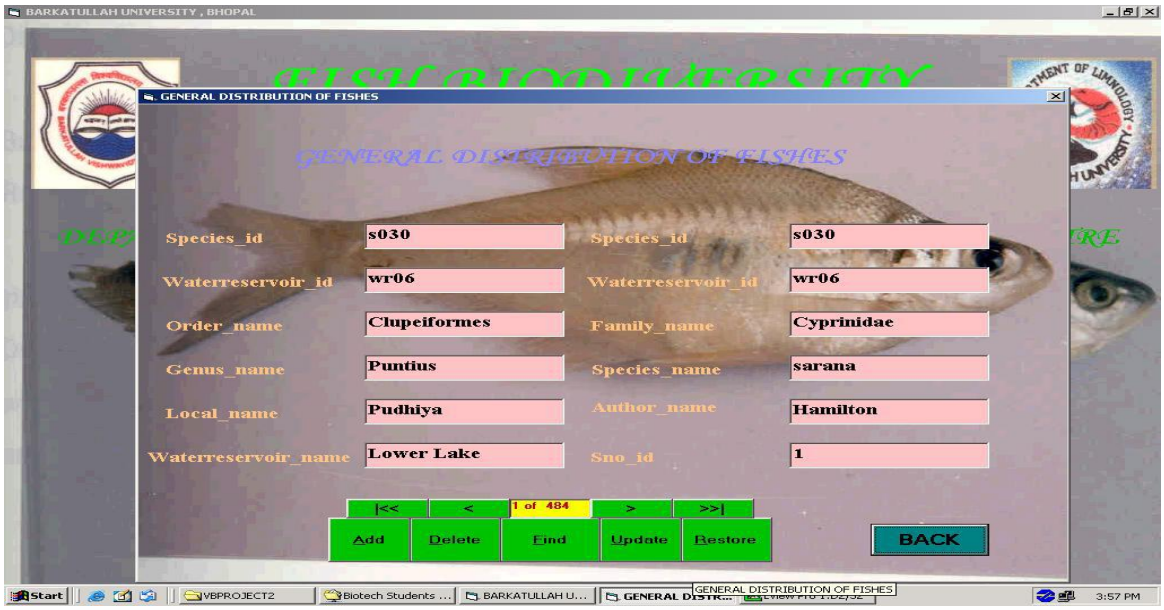
16. Developing digital database of fish biodiversity

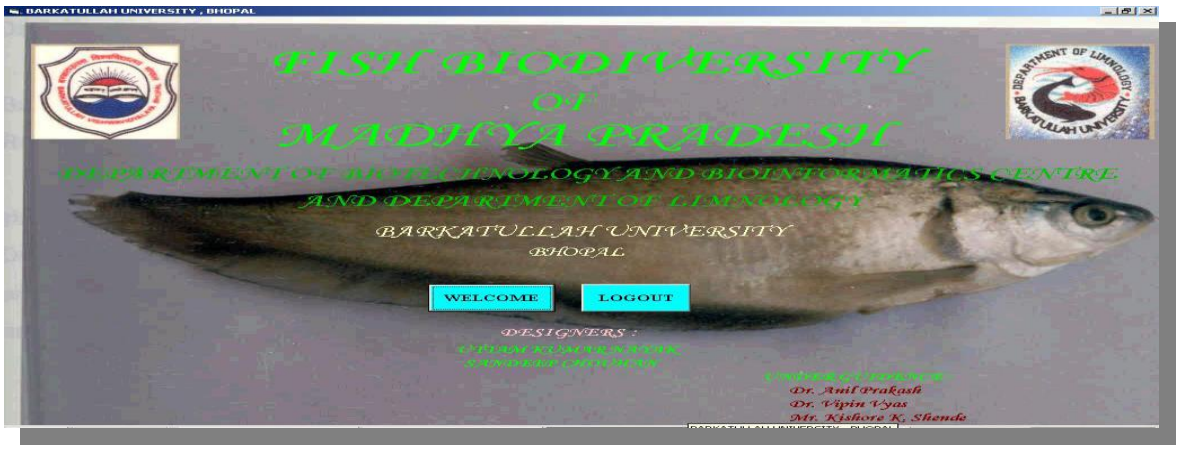
Digitization of Data base of Fishes of MP is already in progress in the Department of Limnology in association of Bioinformatics Center of the University. We have so far digitized data-base of more than 139 fish species available in different river systems of M.P.

The available information on the selected study sites will be stored in different fields of MS Access 2000 in the back end and Visual Basic will be used as Front end of the data-base. This database will be user friendly and selecting a query can retrieve data.

16.1. Window showing the data base







17.Action Plan of Aquatic Biodiversity conservation

Legal and Institutional Framework for Conservation and Management of Aquatic Biodiversity

A sound Action Plan for Conservation and Management of Biodiversity should address the following three aspects:

- Global Issues
- National State Policies
- Local Concern

Since the study conducted during the project period was based on the guiding principles of CBD, it addresses the global concern.

As far as National Policies are concerned the following National/State policies were taken into consideration and the functional part of the action plan addresses issues mentioned in National/State Policies. This ensures

- Interphase of the academia with implementing agencies
- Institutional framework for better implementation
- Financial arrangement from government agencies

Following are the highlights of some of the National, State policies which became basis of this plan.

National Biodiversity Action Plan (2008)

This action plan was released by the MoEF in 2008 and it highlights some of the action points for Biodiversity Conservation.

There are 11 Action Points mentioned in NBAP (2008). Each Action Points has some activities to implement. This action point suggests networking and coordinating agencies. It also suggests timeframe for each activity based on its priority. In order to simplify the action points a matrix has been prepared in the document.

We tried to incorporate these points while preparing the action plan for conservation of fish biodiversity.

Biodiversity Act 2002 & Rules 2004

The Biological Diversity Act, 2002 (No.18 of 2003) was notified by the Govt. of India on 5th February 2003.The Act extends the whole of India and reaffirms the sovereign rights of the country on its biological resources. Subsequently the Govt. of India published Biological Diversity Rules, 2004(15April, 2004).

Following are the highlights of these instruments

- This Act focuses on Biodiversity exclusively
- Since India is a signatory party of CBD, it ensures obligation of the country an signatory and follows principles of CBD
- It ensures involvement of the community (which perhaps any other related Act does not) as the section 22 of the rules states that "Every local body shall constitute a Biodiversity Managing Committee (BMC) within its area of jurisdiction.
- This ensures 3 tier institutional framework upto gross root level.
- It has scope of networking of Civil society, Community, Govt Agencies and Scientific institutions.

Conservation Assessment of Freshwater Fishes 2006

CAFF is an effort to assess conservation status of freshwater species initiated by National Bureau of Fish Genetic Resources Lucknow, an institute of ICAR.

CAFF (2006) has produced a list of species indicating their conservation status following a methodology prescribed by IUCN. It also suggests some action points which have been taken into consideration while preparation of Action Plan under this project.

MP Fisheries Rules

Certain sections of MP Fisheries Rules have provision of declaration of "No Fishing Zones" in rivers and lakes. This is also an important measure for *In-Situ* conservation of fish bio-diversity. Following are the highlights of MP Fisheries Rules:-

In-Situ conservation

MP Fisheries Rules, 1971, have provisions of "No Fishing Areas" in some riverine stretches. Two notifications have been issued in this regard declaring… "No Fishing Areas". First notification was issued in 1973 declaring…areas. Some of these areas are now in Chattisgarh

state. Another notification was issued in 2001 declaring 16 deep pools of Narmada as no fishing areas.

These legal instruments have not been proved to be effective due to the following reasons:-

- The rules have provision of declaring no fishing areas but they lack effective monitoring and management system in the implementing species.
- Fisheries Department of the Govt. of MP is the implementing agency under these rules but due to lack of trained and sensitized man-power., implementation of these legal instruments is difficult. Moreover, the department has its main focus on development of aquaculture activities; conservation efforts do not get priority in the action plan of the department.
- The rules lack provision of community participation in conservation efforts.In recent years, there has been growing awareness regarding community participation like JFM and BMC. The rules need amendments tom ensure provision of community participation. This initiative will help in monitoring of the reserve area.
- Declaration of "No Fishing Area" and no fishing period certainly affect livelihood of the fisherman community depending on these resources. There is no provision of compensatory incentives of PES. Recently , the concept of PES has been identified as a tool to involve community in conservation and this needs to be explored in Aquatic Ecosystem also.

Habitat Restoration

Habitat Restoration is also an approach for *In-situ* conservation. Habitat destruction has been identified as one of the main reason folosss of biodiversity.

Conservation Action Plan

In situ –

Habitat Restoration :-

According to NBAP (2007) augmentation of Natural Resources Base is one of the most important action points for in- situ conservation of bio-diversity. Under this action points some of the action points are directly related with restoration of aquatic habitats.

- River Basin Management and Catchment area Treatment is an important action point which will have direct impact on the stream/river ecosystem. Soil erosion and siltation will be checked with catchment area treatment and qualitative augmentation of water in the river will also be ensured.

- **Afforestation in Head water stream:-**

  According to River Continuum Concept , head water streams are mainly dependent on riparian vegetation for its organic matter input. This organic matter from allochthonus source is utilized by the benthic organisms which help in mineralization and availability of nutrients and food for fishes. Hill stream forum of fishes solely dependent on these sources. Therefore, afforestation in headwater areas is an important action point.

- **Restoration of Riparian Vegetation (50m) :-**

  Riparian zone plays an important role in River Ecology and its biota distribution. Riparian zones with vegetation coer provide habitats of many aquatic and amphibian organisms.

  In recent years riparian zones of large and small rivers have suffered the brunt of urbanization and development. Restoration of buffer ship of at least 50 meters on both the side of the river is an important action point in this context.

  National Forest Commission (2006) also suggest recommends quantitative and qualitative augmentation of water by afforestation in catchment.(No. 47 (6.16)).

  According to a circular of Forest Deptt. . Some rivers have been identified where tree felling have been banned up to 2 km at both the banks. (No. 3033/ 1859/10/2/82 dated

01/09/1982). This is a major action point in creating green buffer zone along the river stretch.

Habitat Restoration Acton Plan (Pilot Scale)

We propose to start some Pilot Scale Plans for restoration of habitats.

Following are some of the points:-

- In Central stretch of Narmada *Gadaria Nala, Kaliadeh and Bhagner nala* can be taken up for pilot scale habitat mapping and restoration. These three streams have significance in ecology of Narmada as these streams originate from hilly area of Budhani forests and join the main river from northern side. The stretch where these streams join the mani river is kown breeding grounds of Mahseer and other fishes.

In these areas, all the three action points like conservation of head water streams, catchment treatment and development of riparian buffer strip along the main course of river can be implemented simultaneously. This can be taken-up under JFM.

In addition to this, other rivers can also be identified for this purpose. In Chambal river, origin of the stream near Janapao and in Betwa origin of the stream near Jhiri can also be taken-up at Pilot Scale.

At least one working plan of forest can be taken-up on Pilot Scale including stream catchment restoration and habitat restoration.

Deep Pools :- Pilot Scale Action Points

Deep pools play an important role in river ecology as they serve as refugia for fishes during lean period. Brooders get refugee in deep pools and migrate to breeding grounds when river is on spate.

We propose, a Pilot Scale, Budhani Ghat deep pool can be taken up for the following action activities.

- Formation of Biodiversity Management Communities/SHGs along the deep pool.
- Resource mapping in the selected area to identify appropriate breeding sites for fishes wit the help of BMC/SHGs.
- Installation of Cage in the deep pool/ and stocking with IMC can be helpful in providing alternative source of income.
- Regulation of fishing by BMC/SHGs members.
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Ex-situ Conservation : Pilot Action Points

According to NBAP (2007) two main action points are suggested which are relevant in the present context.

- Consolidate, augment and strengthen network of zoos, aquaria etc.
- Technical and financial support for Captive breeding of endangered species.
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Captive Breeding of Endangered Species

We propose to start captive breeding of endangered fishes like *Mahseer* and *Chitala* in the state. There are hatcheries of Govt. of MP and private farmers which can be utilized to breed these fishes and ranch the rivers and reservoirs with juveniles for further propagation.

National Bureau of Fish Genetic Resources can play a vital role in this direction as they have developed technology for propagation of these fishes.

Live Gene Banking and Cryo-preservation of Genetic Material :

This can also be very helpful in preserving gene pool of endangered species. NBFGR can be a nodal agency for this task.

Scales of Conservation Strategies

There has been a lot of debate on the scale of conservation strategies. A school of thoughts suggest that there should be a larger land-scape for conservation whereas others suggest considering ecosystem and flagship species to initiate conservation efforts.

However, Denny (1995) has suggested a hybrid approach incorporating all the scale. He suggests that there should be a flagship landscape harboring a mosaic of ecosystems and a flagship species can be identified to focus conservation efforts around it. Focusing on flagship species will result in consideration of its habitat which will indirectly improve the ecosystem health in the landscape.

Central Narmada Landscape

In order to adopt this strategy in Madhya Pradesh we tried to identify a suitable landscape and found Central Narmada landscape as the most suitable landscape for this purpose on the following grounds:-

An ideal land scape for this purpose should have the following elements

- It should have some socio-cultural significance
- It should have mosaics of ecosystems
- It should have a flagship species endemic to this system and needs some conservation efforts.

Socio-cultural Significance

Narmada is one of the holy rivers in India and about 88% of its total stretch falls in M.P. It has a great cultural influence on the Central and Western part of the state. It has many pilgrim places on its banks. “Narmada Parikrama” a pilgrim expedition devotee prefer to perform on foot from its origin in Amarkantak to its end when it meets to Arabian Sea. This makes it a unique river which is connected to socio-cultural life of the community, residing in its catchment area and even below it.

For the purpose of conservation efforts, central part of the basin can be an ideal site. This falls between downstream of Bargi to upstream of Indira Sagar.This landscape has a mixed type of land use including dense forests on one land and intensive agriculture and large urban agglomerates on the other. It harbors some important land based Protected area like Pachmarhi Biosphere Reserve and Barna Singhori Sanctuary and some part of Ratapani Tiger Reserve.

There are several “No Fishing Zones” declared under fisheries Rules and some sacred Ghats fall in this stretch where fishing is prohibited due to the religious reason.

Have this flagship land scape can be considered for this purpose.

Mosaic of Ecosystems

An ideal land scape should have a mosaic of ecosystems. The central Narmada landscape has a mosaic of ecosystems. In addition to about 500 km of main river stretch , it harbors hill stream of high gradient like Denwa and its sub-tributaries, reservoirs like Tawa, Barna and Kolar, tributaries like Barna, Kolar and Tawa, unregulated rivers like Dudhi , Ganjal and Sip. Some part of these rivers/streams form wetlands which give support to wintering wetland birds also particular the back waters of reservoirs.

Mosaics of Ecosystem in Central Narmada Basin

River	**Reservoir/Wetlands**	**Wetlands**
Dudhi	Kolar	Back waters of Reservoirs
Ganjal	Barna	
Seep	Tawa, Indira Sagar	

Mahseer: A flagship Species

Narmada River was once known for its Mahseer fisheries. Three species of Mahseer, *Tor tor, Tor putitora, and Tor khudree* were recorded in the river, however, *Tor tor* was the dominant one. About 20-255 of the total catch was contributed by Mahseer species. There are 6 seed collection sites around Hoshangabad which wee known for collection of wild seed of Mahseer. But in recent years these sites have lost their importance as the population of Mahseer has declined significantly at an alarming rate.

This needs due attention and consideration while preparing any action plan for fish diversity conservation.

Mahseer qualifies all the aspects to be considered as flagship species namely:-

- It is a majestic sport fish and known for sport fishery
- It prefers well-oxygenated water with moderate flow and pebble river bed to breed which contribute Pristine Stream conditions.
- It has taste value also

It is clear from the above discussion that the Central Narmada can be an ideal landscape for conservation due to its socio-cultural importance. Mosaics of ecosystems and harboring a flagship species like Mahseer.