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Status of Fish Diversity in Lower West Rapti River, Banke

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Abstract: This research work aims to explore the status of fish diversity in the lower stretch of West Rapti River, Banke. A total of 3 sampling stations were sampled from September 2021 to May 2022 to cover 3 seasons. 42 diverse fish species were identified from the various locations of the lower stretch of West Rapti River, which belongs to 5 orders, 14 families, and 25 genera. The principal order and family as determined by fish capture of the West Rapti River were found to be Cypriniformes (67%) and Cyprinidae (60%) respectively. The principal fish species determined was *Cabdio morar* followed by *Barilius bendelesis*, *Salmostoma phulo*, and *Barilius barna*. Using the Shannon-Wiener index (H) and Pielou's Evenness index (J), the species diversity was examined. The station wise-value of H' ranged from 2.90 to 3.15 and the values of J ranged from 0.77 to 0.84. Similarly, the seasonal value of H' ranged from 2.8 to 3.36 and the value of J ranged from 0.75 to 0.90. This analysis indicates fairly rich fish diversity in the lower West Rapti River, Banke. This result is expected to contribute skeletal information for the future studies in the West Rapti River and other different freshwater bodies.

Keywords: Banke district, dominant, fish diversity, lower, Stretch, West Rapti River,

1. Introduction

A group of vertebrates with an estimated 34,300 species, fishes are one of the most significant and diversified groups which are directly related to the well-being of individuals, and in the approximately 100,000 species that make up the world's freshwater ecosystems, the fish species of freshwater contribute 13,000 species which primarily inhabit in rivers and lakes (Lévêque et al., 2008). However, research on the variety of fish fauna in tropical Asia, including Nepal, is still in its early stages. Surveys are still patchy and intermittent, and many species are either unknown or have not yet been named (Lévêque et al., 2008).

With elevation diversity ranging from 50 meters to the highest peaks in the world, and in terms of freshwater resources, Nepal is one of the richest nations. The Koshi, Karnali, and Gandaki river systems make up the majority of Nepal's 6,000 rivers and rivulets, which are abundant in water resources. The rivers of Nepal can be categorized as major, medium, or minor rivers which originate from the Higher Himalayas, Mahabharat Hills, or Siwalik-Churia Hills, respectively (Ghimire & Koju, 2021). The origin, volume of flow, and sediment load of the rivers vary morphologically (Adhakari, 2013). According to Froese and Pauly (2020) and all the relevant materials included in the study, the freshwater system of Nepal is home to 255 different fish species. They include 15 endemic and 15 non-resident fish species and are organized into 12 Orders, 41 Families, and 124 Genera. Khatri et al. (2020) published a review paper indicating a rich ichthyofaunal diversity and described 220 fish species in the freshwater system of the country. The diverse rivers of Nepal are rich in aquatic biodiversity and are habitats for over 252 fish species from several climate zones (Adhikari, 2013; Shrestha, 2008). 24 different fish species were recognized in the Babai River in the Dang area after research was done between October 2018 and May 2019. The dominant species were recorded as *Puntius sophore*, *Puntius terio*, *Puntius ticto*, and *Barilius bendelesis* (Punam & Limbu, 2019). Campus (2019) recorded 28 species of fish from 10 sampling sites in the Bheri and Babai Rivers and their upstream tributaries in 2018. (Sharma et al., 2001) listed a total of 35 species of fish from the Tinau River of Western Nepal belonging to 25 genera, 12 families, and 5 orders. Shrestha and Edds (2012) published a mapping of the distribution of 141 fish species in Nepal with voucher specimens using the specimens collected during a 1996 fish survey of Nepal.

Due to pollution, population development, and climatic change, the freshwater habitat has recently become one of the most fragile habitats in the world (Pacheco et al., 2021). Water quality and biodiversity in freshwater ecosystems have been greatly impacted by human activities such as land use changes, excessive sediment extraction, and chemical inputs (Mohd Izam et al., 2021). Therefore, managing fish species and their habitats has been a major concern for many nations, including Nepal.

Concern over the loss of aquatic ecosystems and related biodiversity is growing on a global scale (Georges & Cottingham, 2002), especially for riverine landscapes (Dunn, 2003). It is thought that fish extinction rates are higher than those of higher vertebrates, making freshwater fishes probably a group of animals that, after amphibians, is most at risk of extinction (Bruton, 1995). Many aquatic species

are, however, disappearing quickly as a result of slow and insufficient conservation efforts to lessen the impact of the stresses. The introduction of exotic species, the degradation and fragmentation of habitats, the diversion of water resources, pollution, and the effects of global climate change are the primary causes of the loss of biodiversity in freshwater (Gibbs, 2000). According to numerous reports, environmental factors play a crucial part in controlling the diversification and abundance of fish (Brown, 2000; Tejerina-Garro et al., 1998). These variables include topographical features (Platts, 1979), climate (Eaton & Scheller, 1996), hydrological regime (Poff & Allan, 1995), riparian land use (Lammert & Allan, 1999), and water physical-chemical variables including dissolved oxygen and pH (Matthews, 2012). In addition to the abiotic influences, biotic factors like competition and predation have an impact on fish assemblages in both direct and indirect ways (Jackson et al., 2001). According to Khatiwada et al. (2021) 64 mammals, 469 birds, 48 herpetofauna, and 77 fish are supported by west Terai and Siwalik but an inadequate analysis of the freshwater diversity limits the development of protection and management measures.

One of the most vital water sources in the western Terai is the Rapti River for the locals who depend on agriculture and fishing for their livelihood. Despite being a significant river in Nepal, the Rapti River is not well known for the quality of its water, the diversity of its fauna, and other environmental aspects. Despite its tremendous importance regarding aquatic faunal diversity, the lower West Rapti River stretch has been very less explored. Therefore, this study aims to study this stretch of the river to provide knowledge by documenting the biodiversity status of the river to fulfill the knowledge gaps.

2. Material and Methods

2.1. Area of research

This research work was carried out in the lower west Rapti River of the Banke district. It is one among the most significant rivers in the Mid-west region. The hills of Rolpa, Pyuthan, and Argakhachi are the origin areas of the Rapti River that flows through the Mahabharat range of mountains to the plains of Dang and Banke and finally releases into Uttar Pradesh, India. The origin of the river is near Rangon, at a height of 3523 meters. The source of the West Rapti River is Madi Khola and near Airawati, it connects to the Lungri Khola and Jhimru Khola, and moves along the Tarai region. Major small tributaries of the West Rapti River are Sit Khola, Arun Khola, Ransin Khola, and Jhijhiri Khola. The study area includes a 35 km segment of river from Saipur village at 28°3'5.30" N 81°52'59.28" E to Narainapur at 27°56'18.4" N 81°46'29.0" E. (Fig-1). The period of study was from September 2021 to May 2022 to cover the autumn, winter, and spring seasons.

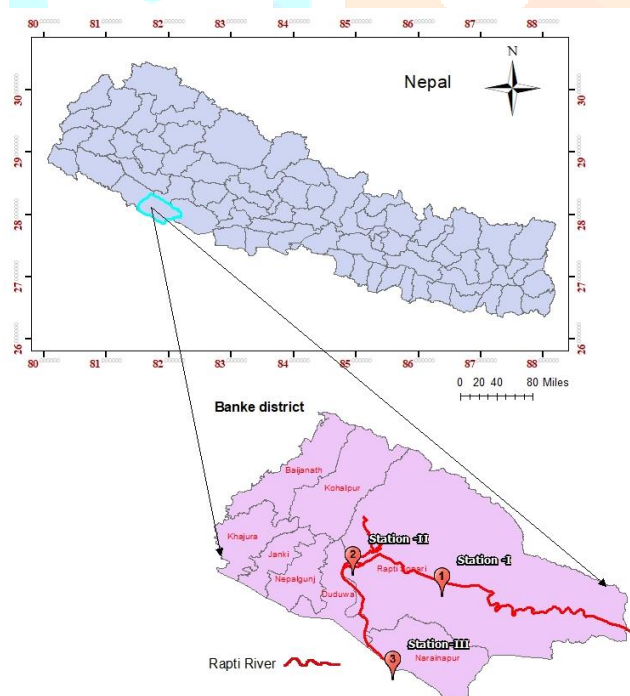


Figure 1: Map showing the Research area of West Rapti River

2.2. Selection of sampling stations

While establishing a sampling station, a preliminary survey was made. Lower to the Sikta irrigation dam, three sampling stations were established. Station-I (28°3'5.30" N 81°52'59.28"E) is near Sapurwa village which is a human impact area due to the mining of stone and sand from the river. Station-II (28°05'14.2"N 81°44'00.3"E) was near Khajura Gaun where a small tributary of the Jhijhiri Khola confluences to the mainstream of West Rapti River. Station-III (27°56'18.4"N 81°46'29.0"E) was selected near Bhagwanpur police station, Narainapur.

2.3. Sample collection, preservation, and Identification

Various kinds of locally available fishing gear such as cast nets (mesh size of 0.5 cm, 1 cm, and 2 cm) and drag nets (mesh size of 5 cm and 6 cm) of 15 m and 18 m lengths were used for catching fish in each station. Helka (local hand-made semi-circular nets), and Tapi (local hand-made square-shaped nets) were also used for capturing small sized-fishes. Each sampling station was visited three times during the study period and attempts were also made to try to collect the samples from all habitats of the station. Some fish were also collected from local fishermen of the location. The captured samples were put down in solution of 10% formalin, and carried to the Department of Zoology at the M.M. Campus in Nepalgunj for additional studies. The samples were identified with the help of taxonomic references (Shrestha, 1981; P. Talwar & A. Jhingran, 1991; P. K. Talwar & A. G. Jhingran, 1991), and (Jayaram, 2010) to the species level.

2.4. Data Analysis

All the data were analyzed using M. S. Office (Excel) 2010 edition. Shannon-Weiner diversity index (Wiener & Shannon, 1963) was computed using the following “Eq. 1”.

$$H' = - \sum_{i=1}^s P_i \ln P_i \quad (1)$$

Here, S is the total number of species and P_i is the relative cover of i^{th} of species. Pielou's Evenness Index “Eq. 2” was used to calculate the Evenness Index J

$$J = \frac{H'}{H_{max}} \quad (2)$$

$$H_{max} = \ln s$$

Here, H' is the calculated Shannon-Wiener diversity index and H_{max} is species diversity under maximum equitability conditions and \ln is the natural logarithm and S is the total number of species.

3. Result and Discussion

Out of the 979 fish caught in the lower West Rapti River, 42 fish species belonging to 5 orders, 14 families, and 25 genera were reported in the present study (Table 1). *Glossogobius giuris* (5 individuals) was the rarest species in the river, while *Cabdio morar* (241 individuals) was recorded as a dominating species with 24.61% of the total capture. The family with the greatest number of species was found to be Cyprinidae (11 genera and 25 species) (Table 1). Station III recorded 344 catches for the most fish, whereas station I recorded 317 catches for the fewest fish. Fish quantity and seasonal fluctuation increased in winter and spring and dropped in autumn. The highest number of individuals 356 were recorded in winter and spring (December to April) and the least number of individuals 267 were recorded in autumn (September). Oli (2016) has identified 20 species from the West Rapti River of Dang then again 28 fish species have been identified from the West Rapti River, Banke between Siktaghat and Saipur village, which belong to 7 orders, 10 families, and 19 genera (Chaudhary et al., 2020). In the Shrivasti and Balrampur District of Uttar Pradesh, India, Sanjay and Prakash (2020) reported 46 species of fish from the Rapti River.

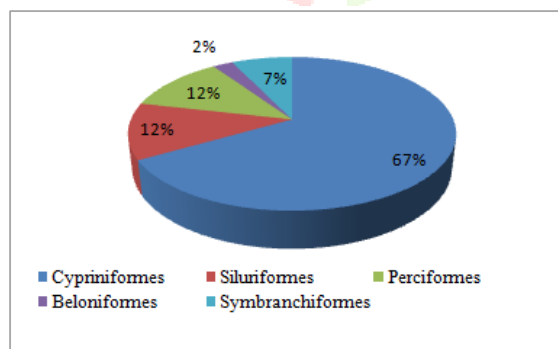


Figure 2: Order-wise fish distribution

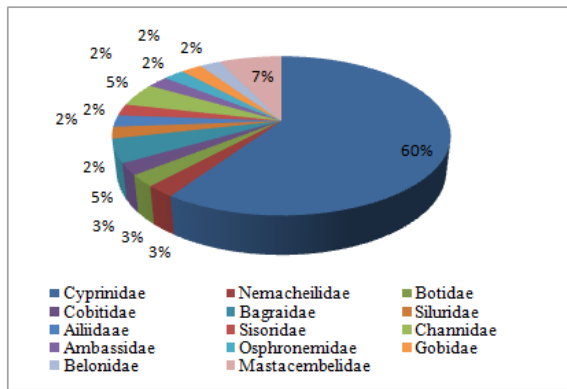


Figure 3: Family-wise fish distribution

Order Cypriniformes included 28 species, and belonged to 4 families: (Cyprinidae, Nemacheilidae, Botidae, and Cobitidae). 4 families of the order Siluriformes included Bagridae, Siluridae, Ailiidae, and Sisoridae with 5 species followed by Perciformes comprised of 4 families: (Channidae, Ambassidae, Osphronemidae, and Gobidae) with 5 species. Order Symbranchiformes included a single family: Mastacembelidae contain 3 species and Order Beloniformes comprised a single family: Belonidae with 1 species.

Table1. Fish Distribution Data in lower West Rapti River, Banke

S.N.	Fish species	Family	St. I	St. II	St. III	Total	Autumn season	Winter season	Spring season
CYPRINIFORMES									
1.	<i>Labeo boga</i> (Hamilton, 1822)	Cyprinidae	8	4	3	15	7	6	2
2.	<i>Labeo gonius</i> (Hamilton, 1822)	Cyprinidae	6	6	9	21	6	9	6
3.	<i>Labeo dero</i> (Hamilton, 1822)	Cyprinidae	1	2	7	10	2	3	5
4.	<i>Labeo bata</i> (Hamilton, 1822)	Cyprinidae	12	7	9	28	6	9	13
5.	<i>Labeo fimbriatus</i> (Hamilton, 1822)	Cyprinidae	6	5	11	22	8	9	5
6.	<i>Labeo dyocheilus</i> (Hamilton, 1822)	Cyprinidae	11	20	14	45	14	16	15
7.	<i>Tor putitora</i> (Hamilton, 1822)	Cyprinidae	8	0	0	8	3	3	2
8.	<i>Tor tor</i> (Hamilton, 1822)	Cyprinidae	6	3	0	9	4	4	1
9.	<i>Garra gotyla</i> (Gray, 1830)	Cyprinidae	14	1	0	15	4	5	6
10.	<i>Garra rupicola</i> (Hora, 1921)	Cyprinidae	7	1	0	8	1	4	3
11.	<i>Puntius sophore</i> (Hamilton, 1822)	Cyprinidae	1	15	15	31	12	11	8
12.	<i>Puntius ticto</i> (Hamilton, 1822)	Cyprinidae	1	8	15	24	5	10	9
13.	<i>Puntius terio</i> (Hamilton, 1822)	Cyprinidae	3	4	9	16	5	6	5
14.	<i>Danio devario</i> (Hamilton, 1822)	Cyprinidae	0	10	13	23	5	11	7
15.	<i>Barilius bendelisis</i> (Hamilton, 1807)	Cyprinidae	23	13	11	47	22	23	2
16.	<i>Barilius vagra</i> (Hamilton, 1822)	Cyprinidae	5	8	5	18	9	6	3
17.	<i>Barilius barila</i> (Hamilton, 1822)	Cyprinidae	11	13	16	40	11	14	15
18.	<i>Barilius barna</i> (Hamilton, 1822)	Cyprinidae	20	13	9	42	13	17	12
19.	<i>Aspidoparia morar</i> (Hamilton, 1822)	Cyprinidae	3	8	14	25	7	10	8
20.	<i>Cabdio morar</i> (Hamilton, 1822)	Cyprinidae	72	75	94	241	38	68	135
21.	<i>Raimas bola</i> (Hamilton, 1822)	Cyprinidae	6	4	2	12	2	3	7
22.	<i>Salmostoma phulo</i> (Hamilton, 1822)	Cyprinidae	28	9	8	45	15	21	9
23.	<i>Salmostoma acinaces</i> (Valenciennes, 1844)	Cyprinidae	7	0	0	7	4	2	1
24.	<i>Salmostoma bacaila</i> (Hamilton, 1822)	Cyprinidae	5	9	2	16	5	7	4
25.	<i>Rasbora daniconius</i> (Hamilton, 1822)	Cyprinidae	1	5	4	10	2	4	4
26.	<i>Paracanthobotis botia</i> (Hamilton, 1822)	Nemacheilidae	6	0	0	6	2	3	1
27.	<i>Botia lohachata</i> (Chaudhari, 1912)	Botidae	17	3	1	21	7	9	5
28.	<i>Lepidocephalichthys guntea</i> (Hamilton, 1822)	Cobitidae	10	7	3	20	6	8	6
SILURIFORMES									
29.	<i>Mystus seenghala</i> (Sykes, 1839)	Bagridae	0	5	9	14	3	5	6
30.	<i>Mystus tengra</i> (Hamilton, 1822)	Bagridae	0	9	12	21	4	7	10
31.	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Siluridae	0	3	3	6	3	1	2
32.	<i>Chupisoma garua</i> (Hamilton, 1822)	Ailiidae	3	11	6	20	4	9	7
33.	<i>Gagata cenia</i> (Hamilton, 1822)	Sisoridae	15	5	1	21	6	11	4
PERCIFORMES									
34.	<i>Channa punctatus</i> (Bloch, 1793)	Channidae	0	2	4	6	1	3	2
35.	<i>Channa gachua</i> (Hamilton)	Channidae	0	3	3	6	1	2	3
36.	<i>Chanda nama</i> (Hamilton, 1822)	Ambassidae	0	2	9	11	5	2	4
37.	<i>Colisa fasciatus</i> (Bloch & Schneider, 1801)	Osphronemidae	0	1	6	7	2	1	4
38.	<i>Glossogobius giuris</i> (Hamilton, 1822)	Gobidae	0	1	4	5	1	1	3
BELONIFORMES									
39.	<i>Xenentodon cancila</i> (Hamilton, 1822)	Belonidae	0	10	4	14	4	5	5
SYMBRANCHIFORMES									
40.	<i>Mastacembelus armatus</i> (Lecepede, 1800)	Mastacembelidae	1	3	3	7	1	4	2
41.	<i>Macrornathus aculeatus</i> (Bloch, 1786)	Mastacembelidae	0	4	3	7	3	2	2
42.	<i>Macrornathus pancalus</i> (Hamilton, 1822)	Mastacembelidae	0	6	3	9	4	2	3

Total	31 7	31 8	34 4	979	267	356	356
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The Shannon-Wiener diversity index (H') and evenness (J) values were computed for every station and season. The maximum Shannon-Wiener diversity index (3.15) was computed at station II, whereas station I had the lowest value (2.90). The highest Evenness index was quantified at station II (0.84), and the lowest at station I (0.77) (Fig.-4). Similarly, in seasonal analysis, the highest Shannon-Weiner diversity index was quantified in autumn (3.36) followed by winter (3.28), and the lowest value was computed in spring (2.83). The evenness index was also found to be highest in autumn (0.90), (0.87) in winter, and lowest in spring (0.75) (Fig.-5). The column chart shows the Shannon-Weiner's diversity index (H') and evenness (J) values at every station and season for the research area.

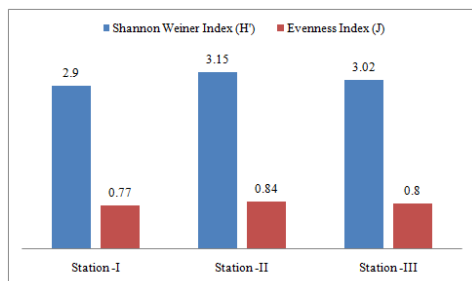


Figure 4: Station-wise diversity index and evenness

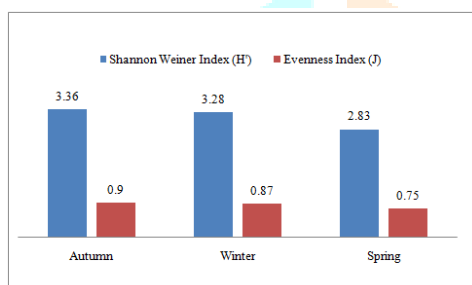


Figure 5: Season-wise diversity index and evenness

4. Acknowledgment

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