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Seasonal fish faunal diversity and water quality of Jamuna River in south Bengal region

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Abstract
The diversity of fish species of Jamuna River at six study sites were studied from January 2014 to January 2017 in premonsoon and monsoon and post monsoon season, Hydrological parameters like Dissolved Oxygen, Free Carbondioxide, Ph and total Alkalinity of river water was also studied at the same six study sites in premonsoon and monsoon and post monsoon season following (Sarkar and Banerje 2010), The field work was divided into three different parts of river Jamuna including upper portion of river Jamuna near Kachrapara, middle portion of river Jamuna near Chowberia of Nadia dist and lower portion of river Jamuna near Gobardanga of North 24- paraganas, Extensive surveys were conducted to explore the diversity of fishes, distribution patterns, abundance, threat, and habitat status in the upper, middle, and lower stretch of river Jamuna River a tributary of river Ichamoti, Altogether 46 fish species belonging to 18 families and 36 genera were collected from various sampling sites, The Statistical analysis of the results indicates the uniqueness of this watershed and unfolds a wide prospect of ichthyofaunal diversity which will fulfill the requirement of fish eating people of Bengal.

Keywords: Ichthyofauna, diversity, seasonal variation, hydrology

Introduction
Tropical Floodplain Rivers are home to the largest fraction of freshwater fish biodiversity (Dudgeon 2000; Lundberg 2001) [2, 3] and as such should be a focal point of global conservation efforts,

Recently, conservationists have focused their efforts on species conservation identification and conservation of hotspots (i, e, areas with high levels of endemism) (Meyers *et al*, 2000) [4], In this context it is necessary to study the diversity of fauna and flora composition of that watershed which are unexplored and faces less human infiltration, These water bodies might be the conservatory pool of many native species which should be brought under proper conservation, Ichthyofaunal diversity refers to variety of fish species depending on context and scale; it could refer to alleles or genotypes within of life forms within a fish community and to species or life forms across aqua regimes (Burton *et al*, 1992) [5],

It is alarming that Rivers faces a number of anthropogenic threats (Allan and Flecker 1993; Crisman *et al*, 2003) [6, 7] which includes water locking, Dam building, using river water irrationally and using river bed as pollutant dumping ground thus, damaging tropical riverine biodiversity (Pringle *et al*, 2000) [8], Large floodplain rivers are characterized by a remarkable degree of spatiotemporal heterogeneity in their natural state (Ward *et al*, 1999) [9] and this heterogeneity is maintained by fluvial dynamics acting on landscape features (Brooks *et al*, 2002) [10], But here this river is shorter in length and interactions among seasonal hydrology, variable land use and anthropogenic activity all puts lots of pressure on the life system of the river and puts direct effect on species richness and abundance, It follows that alteration of seasonal water level fluctuation (e, g, damming) and habitat heterogeneity (e.g. channelization) should have substantial and negative consequences on the maintenance of regional biodiversity pools in floodplain Rivers, The flood plain of Jamuna River shows a vast and variable flood plain, Better ecological understanding is needed to properly manage and preserve biological diversity in this area to maintain the diversity of the large Flood plain area of Ichamoti river which is spreader over India as well as Bangladesh, Moreover, the study reveals that, Jamuna tributary seems to be the rich breeding ground, Availability of Oozing female fishes in monsoon and post monsoon catch and handsome juvenile population encountered during all post monsoon study enhances this possibility,

Jamuna River Basine
The basin area of Jamuna river is started from 5°30°E to 55°40°E and 51°10°N to 9°50°N, The basin of river Jamuna originates from River Hooghly opposite to Tribeni in the District of Nadia and fall to river Itchamati at Tippi in the Dist, of North 24- Paraganas, The whole basin area of river Jamuna is 255, 06 mile, The portion of river Jamuna is between river Hoogly and Kalyanai Ranaghat main rail line for a length of about 10, 69 km has become defunct and do not carry any eastward discharge, However remaining portion of the river of length about 50, 50km drains out about 651, 33 sq km area covering vast portion of Nadia and North 24 Paragana district,

Description of the river
In the western part of the area near Kachrapara and Haringhata, urban settlement are concentrated along the right bank of the Bhagirathi and continuously increased southerly, At Bangaon and Gobardanga area human settlement has been

settled on high ground highest population density, The maximum rural settlements are seen in the Gaighata, Chowberia area of the basin Jamuna, Cultivated land is found all over the area, A large area is covered by orchard and plantation, This is located beside the urban settlement, Some perennial water bodies are found both the bank of the Jamuna River, Changra khal and Pragati khal has been found in this area also, During its course Jamuna has created several ox' box lakes, The most famous of these lakes is the Konkona boar in Gobordanga, The channel is right now use for fishery at the upstream area near Kachrapara and several embankment was found there, Now the river is very narrow in the upper portion but it is linked with the two big jhils like Mathura and Gayeshpur Kulia jhil, From this jhil some amount of water is passed through the channel in rainy season, In the 1st, section of upper portion of River Jamuna near Kachrapara the jhil is quite wide in range and fishery activity is prominent there with the collaboration of W, B Govt, and private companies, On the right bank of the river some plantation are covered the fallow land and the left bank of the river is mainly occupied by the grassland and natural vegetation, Depth of the river is varies in 7 to 8 fit, In the 2nd, section of river Jamuna in upper portion near Kachrapara the river is narrow apparently the previous one, Some portion of river bed is occupied for fishing cultivation and to store the water for one place sometime they constructed some embankment, The lower region requires intense study because this region shows tidal effect, This is important for faunal diversity,

Materials and Method

Six sampling points were selected on the basis of some features such as: effective factors in water's quality, human and environmental factors and the probability of pollution by emission sources,

Fish were collected monthly; the present study was conducted for consecutive three years from January 2014 to January 2017 from six study sites namely 1, Haringhata 2, Bonga 3, Gobordanga 4, Chouberia 5, Gaighata 6, Konkona, during premonsoon (March to June), monsoon (July to October), and postmonsoon (November to February) periods,

Fishes were sampled throughout the day (9 a, m, to 5 p, m,) using cast nets with mesh size (1 cm ×1 cm and 1, 5 cm ×1, 5 cm), depending on anthropogenic infiltration and crop cultivation and presence of factory as well as house hold outlet sampling segments were selected along the river, All fish caught in the cast net were kept in a bucket of water, Measurements such as total body length (cm) and body depth (cm) were taken and the fishes were released thereafter, Unidentified fish samples were preserved in 20% formalin solution and brought to the laboratory for further identification following (Sarkar and Banerjee 2010) [1],

Analyses of the abiotic factors (water temperature, dissolved oxygen, pH and conductivity) of the six sites were performed, Water samples were collected from 6 study sites from where fish samples were procured, These water samples were collected during three seasons in three years during premonsoon (March to June), monsoon (July to October), and postmonsoon (November to February) periods for estimation of routine hydrological parameters following standards procedures, Hydrological parameters which were studied are alkalinity, pH, temperature, dissolve carbon dioxide, dissolved oxygen and transparency,

Results

Species richness, determined using both gill-net and sieve, resulted in 46 species, The text figure 6, Indicates the fish catch variation according to the sites comparison, Altogether 46 fish species belonging to 18 families and 36 genera were collected from various sampling sites,

Among the total catch, Family Cyprinidae (24species) comprised 56% and Notopteridae (1 species); Clupeidae (1 species), Cobitidae (1 species); Claridae (1 species); Heteropneustidae (1 species); Synbranchidae (1 species); Gobidae (1 species); Eletridae (1 species); Anabantidae (1 species); Belontidae (1 species); Channidae (1 species); Mastacembelidae (1 species) comprises 2% each of total catch whereas Bagridae (2 species); Siluridae (2 species); Ambassisae (2 species); Mugilidae (2 species); comprised 4% each of the total catch, Interestingly it was noticed (Text, Fig, 7 and 8,) that out of the 46 species documented, 8 species showed significant variation in catch data in pre monsoon, monsoon and post monsoon period, *Cirrhinus reba*, *Labeo boga* catch significantly increased in post monsoon period compared to premonsoon and monsoon period, *Puntius sarana sarana*, *Puntius ticto* catch significantly increased in monsoon and postmonsoon period compared to premonsoon period, *Esomus danricus*, *Ophieleotris aporos*, *Colisa fasciatus* catch significantly increased in postmonsoon period compared to premonsoon period, *Macrognathus pancalus* catch significantly decreased in postmonsoon period compared to premonsoon period, This study reveals that River Jamuna houses a good number of fish diversity,

The extensive study of hydrological parameters of river water is six study sites reveals that there was not much variation of water parameters, The values of alkalinity during study (Text Fig, 1); the minimum value 5 mg/L of alkalinity was recorded in monsoon and the highest 47, 5 mg/L was recorded in premonsoon season, this study corroborates the findings of (Karr 1981) [11], The study indicates that Alkalinity of river water is moderate over all in all the study sites, Though interestingly the alkalinity of Chauberia was more compared to Haringhata in pre monsoon period, The alkalinity was maximum at Ghaighata in the post monsoon period compared to other sites, Alkalinity not only helps to regulate the pH of the water body but also alters metal toxicity, Levels of 20-200 mg/l of alkalinity are typical of freshwater, Compared to this, alkalinity value was observed to be moderate at all stations, indicating less interference of bicarbonate precipitation as Calcium carbonate which may occur in highly industrialized area and contaminated water body,

While studying the pH of river water (Text Fig, 2), moderately higher pH value was observed during the monsoon season, Observation also reveals that during monsoon, river water overflows and gets mixed up with the adjoining water bodies and domestic sewage, which is the only cause of increased pH values, The value of pH above 8, 85 was observed at Konkona, Bongao and Chauberia during monsoon and at Gaighata and also Konkona during post monsoon, According to the study of Sarkar and Banerjee (2012) [12] fish and other aquatic organisms prefer pH value between 6, 7 and 8, 4 and

pH value below the 5 or above 8, 8 may be detrimental or even lethal to aquatic life (Lower and higher pH ranging from 5, 0 to 6, 6 and 9, 1 to 11, 0 result in low productivity [11], On the other hand very high (greater than 9, 5) or very low (less than 4, 5) pH values are unsuitable for most aquatic life, The present study indicates that there was no significant variation in the pH levels of different sampling site in pre monsoon, monsoon and post monsoon period,

In case of water temperature, (Text Fig, 3) interestingly there was no significant difference in the different site in premonsoon period, though the temperature was much reduced in the post monsoon,

In case of Dissolved carbon di oxide level (Text Fig, 4), the study results indicates, significant reduction in post monsoon period compared to pre monsoon period, Alterations in water quality or other habitat conditions, including land use pattern in the watershed, commonly result in shifting availabilities of many food resources and changes in the fish community that can then be measured (Karr 1981) [11],

While studying the Dissolve Oxygen content no drastic variation was observed, Text Fig, 5, explains the dissolved oxygen content fluctuated between 4, 01 -8, 2 mg/L, The minimum amount 4, 01 mg/L was recorded in monsoon at Haringhata, Whereas the maximum amount 8, 2, mg/L was recorded in pre monsoon at Gobordanga and Chauberia and also in post monsoon season at Konkona, However there was no significant variation in the level of dissolved oxygen in different sites at pre monsoon monsoon and post monsoon period, But the interesting fact is that Dissolve Oxygen content was found varying inversely proportional to temperature at Bonga, Konkona and Gaighata, The study of Plankton population also shows that the rate of increase and decrease of Planktons at Konkona and Gaighata largely depended on temperature variation, Shivanikar (1999) [13] recorded dissolve oxygen from river Chambal, which was least in summer but highest in winter, The present study reveals that in Haringhata and Gobordanga, Dissolve oxygen content is highest and in Bongao, Konkona and Gaighata during post monsoon Dissolve oxygen shows higher value, Such variation may be due to more anthropogenic disturbance, moreover there are no natural canopy or forest cover in the valley so, hydrological parameters varies differently, Sing and Srivastava, (1988) [14], observed similar low oxygen concentration during May to November in the River Ganga near Buxar,

The transparency of (Text Fig, 6) river water ranges from 12, 38(during monsoon) to 55, 65(during postmonsoon) However, the range falls within the acceptable limits as prescribed by WHO (1985) [15] and thus, do not pose any form of threat to the aquatic organism,

The most positive findings which should be appreciated is that, during this study occurrence of oozing female of *Osteobrama cotio cotio*; *Chela labuca*; *Puntius sarana sarana*; *Puntius phutunio*; *Puntius ticto; wallago attu; anabas testudineus, Nangra nangra;* along with a of good number of juveniles indicates that the river water still retains suitable environment for fish breeding ground, which should be taken care of,

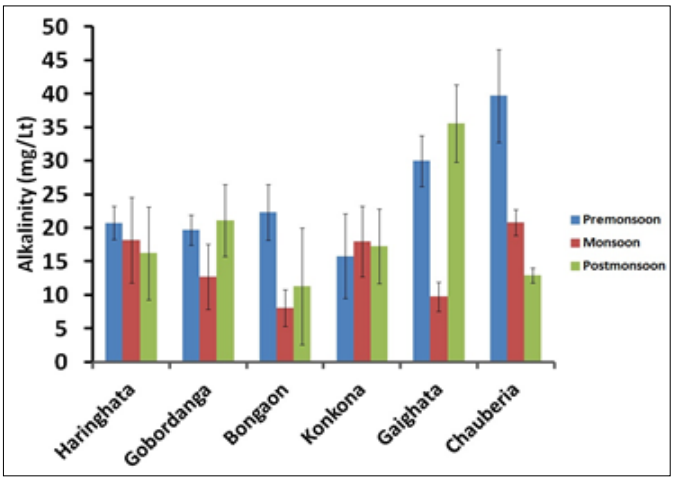

Fig 1: Graphical representation of Alkalinity of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ±SEM of three consecutive years,

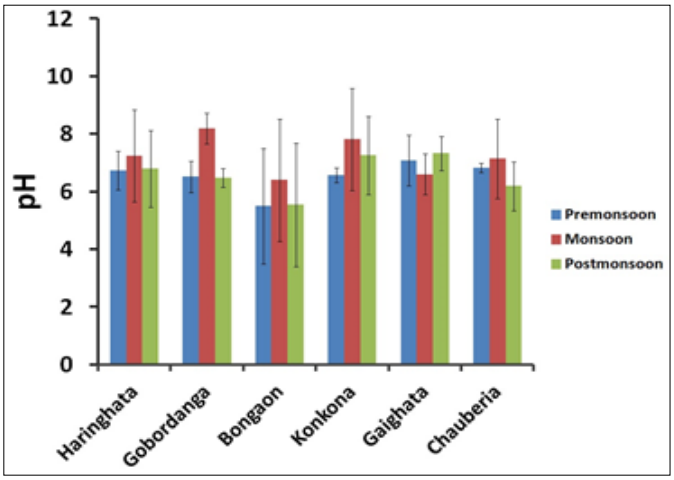

Fig 2: Graphical representation of pH of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ±SEM of three consecutive years,

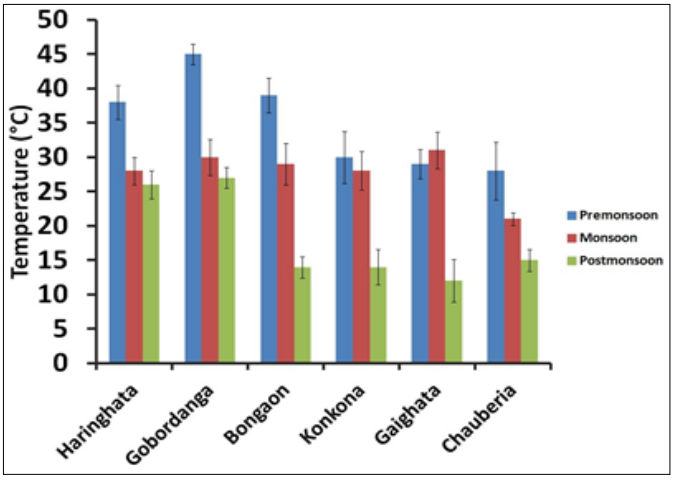

Fig 3: Graphical representation of temperature of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ± SEM of three consecutive years,

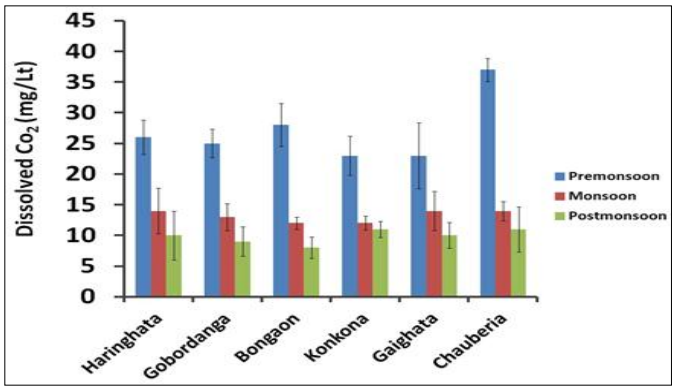

Fig 4: Graphical representation of Dissolved carbon di oxide of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ± SEM of three consecutive years,

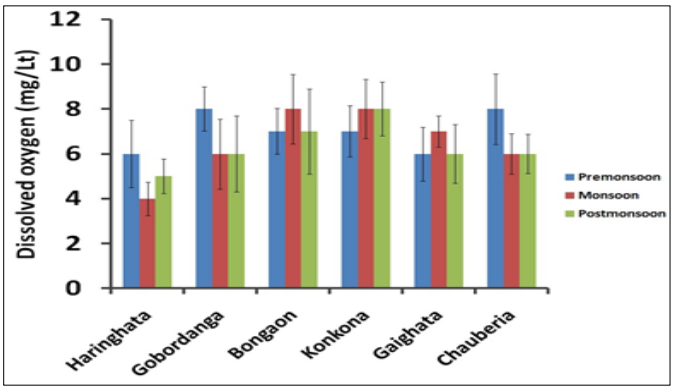

Fig 5: Graphical representation of Dissolved oxygen of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ±SEM of three consecutive years,

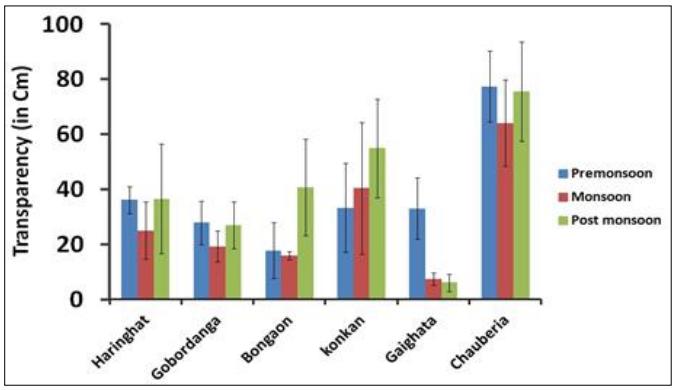

Fig 6: Graphical representation of Transparency of mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ±SEM of three consecutive years

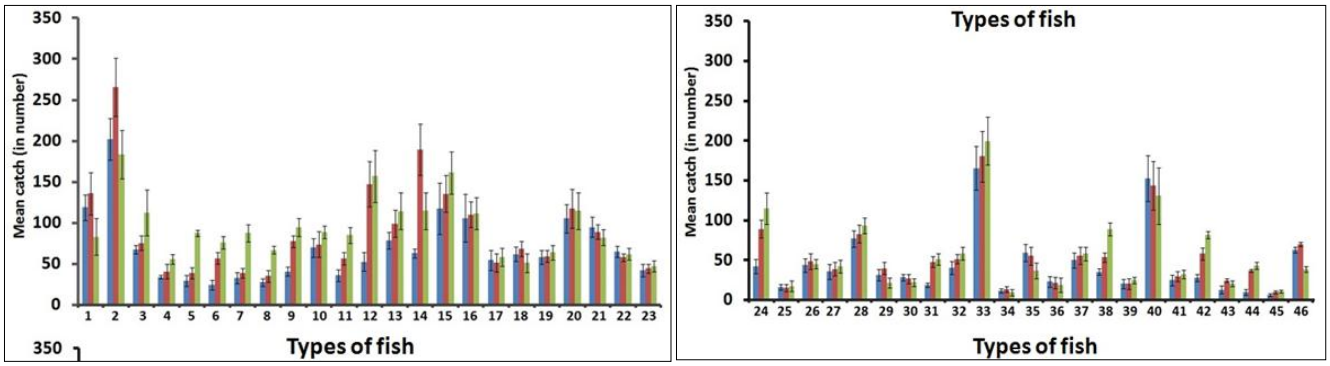

Fig 7: Graphical representation of mean catch of fish at mentioned sites at premonsoon, monsoon and postmonsoon season, Data represented as mean ± SEM of three consecutive years, Number representation following fish, *1, Notopterus notopterus (Pallas) 2, Gudusia chapra (Hamilton Buchanan) 3, Catla catla (Hamilton Buchanan) 4, Cirrhinus mrigala(Hamilton Buchanan) 5, Cirrhinus reba(Hamilton Buchanan) 6, Labeo bata(Hamilton Buchanan) 7, Labeo boga(Hamilton Buchanan) 8, Labeo Calbasu (Hamilton Buchanan) 9, Labeo rohita(Hamilton Buchanan) 10, Osteobrama cotio cotio(Hamillon Buchanan) 11, Puntius phutunio(Hamillon Buchanan) 12, Puntius sarana sarana (Hamillon Buchanan) 13, Puntius sophore (Hamilton Buchanan) 14, Puntius ticto(Hamilton Buchanan) 15, Chela cachius (Hamilton Buchanan) 16, Chela labuca(Hamilton Buchanan) 17, Satmostoma bacaila(Hamilton Buchanan) 18, Satmostoma phulo(Hamilton Buchanan) 19, Securicula gora(Hamilton Buchanan) 20, Amblypharyngodon mola (Hamilton Buchanan) 21, Aspidoparia morar(Hamilton Buchanan) 22, Brachydanio rerio (Hamilton Buchanan) 23, Danio aequipnnatus (McClelland) 24, Esomus danricus(Hamilton Buchanan) 25, Parluciosoma daniconius (Hamilton Buchanan) 26, Crossocheilus latius latius (Hamilton Buchanan) 27, Lepidocephalicthys guntea(Hamilton Buchanan) 28, Aorichthys aor (Hamilton Buchanan) 29, Mystus tengara(Hamilton Buchanan) 30, Ompok Pabo (Bloch) 31, Wallago attu (Schneider) 32, Ailia coila (Hamilton Buchanan) 33, Nangra nangra (Hamilton Buchanan) 34, Clarius Batracus Linnaeus 35, Heteropneustes fossilis (Bloch) 36, Monopterus cuchia (Hamilton Buchanan) 37, Chanda nama(Hamilton Buchanan) 38, Parambassis thomassi (Day) 39, Rhinomugil corsula (Hamilton Buchanan) 40, Sicamugil cascasia(Hamilton Buchanan) 41, Glossogobius giuris giuris (Hamilton Buchanan) 42, Ophieleotris aporos(Bleeker) 43, Anabas testudineus (Bloch) 44, Colisa fasciatus(Schneider) 45, Channa amphibius Schneider 46, Macrognathus pancalus (Hamilton Buchanan)*

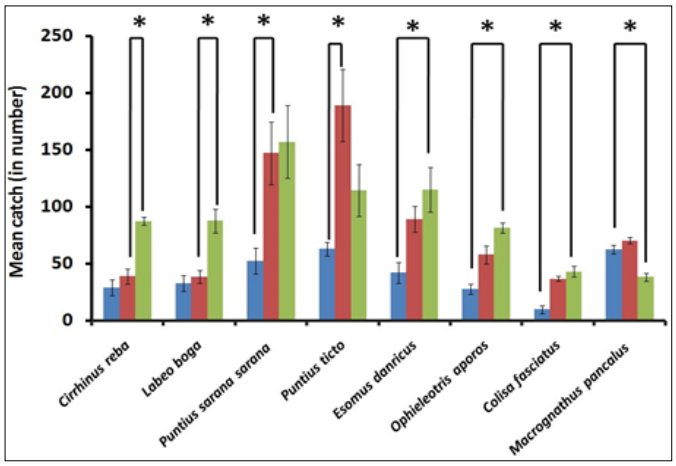

Fig 8: Graphical representation of mean catch of mentioned fish in at premonsoon, monsoon and postmonsoon season Data represented as mean ± SEM of three consecutive years, Asterisk represents significant difference between the means of indicated classes, *p< 0, 05,

Conclusion

The present study shows a diagonal pattern of ichthyofaunal diversity, the Baor and Jhil region contributes richer species diversity, offering physical conditions for sheltering a larger number of species, The total number species of fish found in the Jamuna river and based on collection directly from the river and fish landing stations near the river bank, Though fish species of a lotic ecosystem has to cope up with many hydrological complexes, which may be climatic, chemical, or anthropogenic or, it may be sudden unusual drought and flood or may be physicochemical stresses for fishes like thermal extremes, oxygen depletion, sharp salinity, gradient, extreme acidity or alkalinity and other interaction, The present study reveals the occurrence of good number of oozing females during late monsoon and post monsoon period along with their juveniles, which indicates that this river definitely preserves suitable breeding ground for fishes yet,

Though water quality is neither a static condition of a lotic system, nor can it be defined by the measurement of only one parameter, Here the study reveals that there was not much variation in different sites in the water parameters studied, Interestingly, fish assemblages acts as ecological indicators to assess and evaluate the level of degradation and health of rivers and streams at various spatial scales Sarkar and Banerjee (2012) [12], The present study corroborates the fact, Jamuna River houses of good number of fish species which needs a long-term conservation strategy for conserving the native fishes of Bengal by identifying the rich breeding grounds and restrict domestic sewage inflow during over flooded condition in monsoon season,

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