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Diversity and conservation status of Ichthyofauna in the river Jaldhaka, West Bengal

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Abstract

The river Jaldhaka is a glacier feed torrential river and originates from Bitang lake in Sikkim. This river is famous for cold water as well as warm water fishes. A study was carried out from March 2014 to February 2016 to assess the Ichthyofauna density and diversity indices in the river Jaldhaka. A total of 119 fish species belongs to 10 order, 29 families and 72 genera were recorded. Monthly variation of Catch per unit effort (CPUE), number of ichthyofauna genera, Shannon-Wiener diversity index (H'), evenness index (J'), Margalef's richness index and dominance index was varied from 38 to 115, 30 to 67, 3.34 to 4.13, 0.927 to 0.988, 7.97 to 13.74 and 0.016 to 0.034 respectively over the study period. Catch per unit effort (CPUE), number of ichthyofauna genera, Shannon-Wiener diversity index (H') and Margalef's richness index were recorded maximum during monsoon season. Out of 119 fish species 19 Endangered, 44 vulnerable species, 17 low risks near threatened and 4 low risks least concern fishes were recorded.

Keywords: Jaldhaka, diversity indices, endanger, vulnerable

1. Introduction

The river Jaldhaka is a transboundary river of India, Bhutan and Bangladesh and its total length is 192 kilometer. The river Jaldhaka is originated from Bitang lake in Sikkim. This river is previously known as Dichu river. It flows through the Kalimpong, Alipurduar and Cooch Behar district of Bengal. The main tributaries of the river Jaldhaka are the Murti, the Naksal Khola, the Sutunga, the Jarda, the Diana and the Mujnai. After entering the Bangladesh river Jaldhaka joins with the river Dharla and open into the river Brahmaputra. Many dams had been made in river Jaldhaka for generating electricity. Fishes are very important ecologically as well as a cheap source of protein. Mitigating protein deficiency developing country like India [1]. This river originates and partly flows through the eastern Himalaya biodiversity hotspot and so rich in ichthyodiversity. India possesses huge freshwater fish diversity [2]. The eastern Himalaya has a greater diversity of cold water fish than the western part of Himalayan [3]. Rivers of the Dooars region famous for cold water fishes. Fish diversity in all the rivers of the Dooars region drastically decreased in number due to over and indiscriminate fishing and pollution. Many workers studied on the ichthyofauna diversity in the Dooars region of North Bengal, such as [4-6, 1, 7-17]. The objectives of the study to determine the distribution, abundance and diversity of fish fauna of the river Jaldhaka. Additionally, this study is helpful for formulating new conservation and management policy.

2. Materials and Method

2.1 Study site

Two sites were selected for study, site -I at Betgara (altitude and longitude 26°34'41.0''N, 88°55'49.4''E) and site-II Mathabhanga (altitude and longitude 26°19'27.8''N, 89°14'17.6''E).

2.2 Duration of study

Duration of study was two years from March 2014 to February 2016.

Fishes were collected monthly interval with the help of fishermen by using the different net. After collection immediately photograph was taken (Canon SX160) and then identified the fishes in the laboratory with the help of references such as [18, 4, 19, 20, 11].

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Collected fishes were then preserved in 6-8% formalin. Conservation status was assigned based on IUCN classification as per CAMP-NBFGR [21] and NBFGR [22].

2.3 Data analysis

Shannon-Weiner index (H), Margalef species richness index(R), Evenness index and Simpson dominance index (D) were calculated with the help of software PAST, version 3.

Shannon Weiner diversity index depends [23] on the number of species and the distribution of individuals among species. The Shannon Weiner [24] diversity expressed by the following formula:

$$H' = \sum Pi \times \log Pi,$$

Where, $Pi = ni/N$.

Where ni equals the number of individuals of each species in the sample, N is the total number of the individual organism of all the species in the sample.

Margalef richness index(R) [25] was used to calculate species richness by the following formula

$$R = (S-1)/\ln N$$

where, S equals the number of different species and N equals the total number of individual organisms in the sample.

Evenness [26] is a measure of the relative abundance or how evenly distributed different species which contribute the richness of an area. Measured by using the following formula:

$$E = \frac{H}{\log 2S}$$

Where, E = Evenness index H' = Shannon-Wiener diversity index

Simpson's dominance index [27] is often used to quantify the biodiversity of habitat which taken into account the number of species, as well as the abundance of each species.

Formula used for calculation is

$$D = \sum ni(ni-1) / N(N-1)$$

N equals the total number of individual organisms in the sample.

3. Results and discussion

All the 119 species belonged to 10 order, 29 families and 72

genera were recorded in river Jaldhaka. Most dominant family was Cyprinidae comprising 47 species then followed by Sisoridae with 12 species, Bagridae and Balitoridae 7 species each, Cobitidae 5 species, Channidae and Scheilbeidae 4 species each, Centropmidae, Mastacembelidae and Osphronemidae 3 species each, Amblycypidae, Silurida, Nandidae, Psilorhynchidae and Notopteridae 2 species each and Claridae, Heteropneustidae, Anabantidae, Chacidae, Cichlidae, Gobidae, Anguilidae, Ophinthidae, Belonidae, Clupeidae, Mugilidae, Synbranchidae, Olyridae and Tetrodontidae 1 species each (Tab.-1). Previously Dey and Sarkar were observed a total 113 fish species from the river Jaldhaka [12]. Patra found a total of fiftyfive fish species from the Karala River [9]. Debnath recorded 73 fish species from the river Gadadhar at Cooch Behar District, West Bengal [28]. All the 83 fish species from different rivers and reservoirs of Teari region of West Bengal were recorded by Sakar and Pal [7]. Over and indiscriminate fishing over the years in the river Jaldhaka has resulted in a decrease in fish diversity. Similar finding recorded by Acharjee and Barat [15] in the river Relli.

Monthly variation of Catch per unit effort (CPUE) and a number of ichthyofauna genera was varied from 38 to 115 and 30 to 67 over the study period. Recorded monthly variation of Shannon-Wiener Diversity Index (H') was ranged from 3.34 to 4.13. Highest Shannon-Wiener Diversity Index (H') was recorded in the month of September and October. Value of Shannon-Wiener Diversity Index (H') above the 4 is an indication of the very good quality of water [29]. Assessed monthly variation of evenness index (J') was ranged from 0.927 to 0.988. Monthly variation of Margalef's Richness Index was varied from 7.97 to 13.74. Maximum Margalef's Richness Index was recorded in the month of September and October. Assessed monthly variation of dominance index in the river Jaldhaka was ranged from 0.016 to 0.034 (Fig.-1-4). Seasonal variations of a number of Ichthyofauna genera, Catch per unit effort, Margalef's richness index (R'), Shannon-Wiener diversity index (H') and species evenness index (E) were highest in monsoon season. Lowest seasonal variation of species dominance index (D) was found in monsoon season. Bisht, Badoni and Bahuguna also observed maximum fish genera during the monsoon season in Dangchaura [30]. Huge inputs of organic and inorganic nutrients along with the niche availability during monsoon season enrich the river water. So the number and diversity indices of fishes were increased during monsoon season.

Table 1: Checklist of ichthyofauna and conservation status in the river Jaldhaka from March 2014 to February 2016.

Fish species found with order and family	Types of fish	2014-15		2015-16		Conservati-On status
		Site-I	Site-II	Site-I	Site-II	
Order-Cypriniformes		50.4	51.94	51.32	50.45	
Family- Cyprinidae		39.6	40.18	39.82	37.61	
<i>Amblypharyngodon Mola</i> (Hamilton)	Fd Or	+	+	+	+	LRlc
<i>Aspidoparia Morar</i> ((Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Aspidoparia Jaya</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Barilius Barila</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Barilius Barna</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Barilius Bola</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Barilius Shacra</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Barilius Vagra</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Barilius Bendelisis</i> (Hamilton)	Fd Or	+	-	+	+	LRnt
<i>Barilius Tileo</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Chagunius Chagunio</i> (Hamilton)	Fd	+	+	+	+	
<i>Chela Laubuca</i> (Hamilton)	Fd Or	+	+	+	+	LRlc
<i>Cirrhinus Reba</i> (Hamilton)	Fd	+	-	+	+	VU
<i>Crossocheilus Latia</i> (Hamilton)	Fd	+	+	+	-	END

<i>Danio Devario</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Danio Rerio</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Danio Aequipinnatus</i> (McClelland)	Fd Or	+	+	+	+	
<i>Danio Dangila</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Esomus Danricus</i> (Hamilton)	Fd Or	+	+	+	+	LRlc
<i>Rasbora Daniconius</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Garra Gotyla</i> (Gray)	Fd Or	+	+	+	+	VU
<i>Garra Amandalei</i> (Hora)	Fd Or	+	+	-	+	
<i>Garra McClellanei</i> (Jerdon)	Fd Or	+	+	+	+	
<i>Labeo Bata</i> (Hamilton)	Fd	+	+	+	+	LRnt
<i>Labeo Boga</i> (Hamilton)	Fd	+	+	+	+	LRnt
<i>Labeo Calbasu</i> (Hamilton)	Fd	+	+	+	+	LRnt
<i>Labeo Dero</i> (Hamilton)	Fd	+	+	+	+	VU
<i>Labeo Dyocheilus</i> (McClelland)	Fd Sp	+	+	+	+	VU
<i>Labeo Goniis</i> (Hamilton)	Fd	+	-	+	-	LRnt
<i>Labeo Pangusia</i> (Hamilton)	Fd Sp	+	+	+	+	LRnt
<i>Labeo Rohita</i> (Hamilton)	Fd Sp	+	-	+	+	LRnt
<i>Neolissocheilus Hexagonolepis</i> (McClelland)	Fd Sp	+	+	+	+	
<i>Osteobrama Cotio Cotio</i> (Hamilton)	Fd Or	+	-	+	+	LRnt
<i>Puntius Conchoniis</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Puntius Geliis</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Puntius Stigma</i> (Hamilton)	Fd Or	+	+	+	-	
<i>Puntius Sophore</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Puntius Sarna</i> (Hamilton)	Fd Or	-	+	+	+	VU
<i>Puntius Ticto</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Oreochthys Cosuates</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Schizothoracichthys Progastus</i> (McClelland)	Fd Sp	+	+	-	-	LRnt
<i>Schizothorax Richardsonii</i> (Gray)	Fd Sp	+	+	+	+	VU
<i>Semiplotus Semiplotus</i> (McClelland)	Fd Or	+	+	+	+	VU
<i>Tor Putitora</i> (Hamilton)	Fd Sp	+	+	+	+	EN
<i>Tor Tor</i> (Hamilton)	Fd Sp	+	+	+	+	EN
<i>Ctenopharyngodon Idella</i> (Valenciennes)	Fd	-	-	+	+	EX
<i>Cyprinus Carpio</i> (Linnaeus)	Fd	+	+	+	+	EX
Family- Psilorhynchidae		1.80	1.96	1.76	1.83	
<i>Psilorhynchus Balitora</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Psilorhynchus Sucatio</i> (Hamilton)	Fd Or	+	+	+	+	EN, END
Family- Balitoridae		5.40	5.88	5.30	6.42	
<i>Aborichthys Elongatus</i> (Hora)	Fd Or	+	+	+	+	EN, END
<i>Nemacheilus Botia</i> (Hamilton)	Fd Or	+	+	+	+	LRnt, END
<i>Nemachilus Devdevi</i> (Hora)	Fd Or	+	+	+	+	EN, END
<i>Schistura Corica</i> (Hamilton)	Fd Or	-	+	-	+	
<i>Schistura Rupicula</i> (McClelland)	Fd Or	+	+	+	+	LRnt, END
<i>Schistura Savona</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Schistura Multifasciatus</i> (Day)	Fd Or	+	+	+	+	VU
Family- Cobitidae		3.60	3.92	4.42	4.58	
<i>Acanthocobitis Botia</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Botia Dario</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Botia Lohachata</i> (Chaudhuri)	Fd Or	+	+	+	+	EN
<i>Lepidocephalichthys Guntea</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Somileptes Gongota</i> (Hamilton)	Fd Or	+	+	+	+	
Order- Siluriformes		25.2	26.46	25.66	26.60	
Family- Bagridae		6.30	5.88	6.19	6.42	
<i>Batasio Batasio</i> (Hamilton)	Fd Or	+	+	+	+	END
<i>Batasio Tengana</i> (Hamilton)	Fd Or	+	+	-	+	
<i>Mystus Vittatus</i> (Bloch)	Fd Or	+	+	+	+	VU
<i>Mystus Bleekeri</i> (Day)	Fd Or	+	-	+	+	VU
<i>Mystus Tengra</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Sperata Aor</i> (Hamilton)	Fd	+	+	+	+	
<i>Rita Rita</i> (Hamilton)	Fd Sp	+	+	+	+	LRnt
Family- Schilbeidae		3.60	3.92	3.56	3.66	
<i>Ailia Oila</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Clupisoma Garua</i> (Hamilton)	Fd Or	+	+	+	+	VU
<i>Eutropiichthys Murius</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Eutropiichthys Vacha</i> (Hamilton)	Fd Or	+	+	+	+	EN
Family- Sisoridae		9	10.78	10.61	11.00	
<i>Bagarius Bagarius</i> (Hamilton)	Fd Sp	+	+	+	+	VU, END
<i>Glyptothorax Cavia</i> (Hamilton)	Fd Or	+	+	+	+	EN
<i>Glyptothorax Horai</i> (Shaw & Shhebeare)	Fd Or	+	+	+	+	

<i>Glyptothorax Pectinopterus</i> (McClelland)	Fd Or	-	+	+	+	
<i>Glyptothorax Telchitta</i> (Hamilton)	Fd Or	-	+	+	+	LRnt
<i>Hara Horai</i> (Misra)	Or	+	+	+	+	EN, END
<i>Hara Jerdoni</i> (Day)	Or	+	-	+	+	
<i>Gagata Cenia</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Nangra Punctata</i> (Day)	Fd Or	+	+	+	+	
<i>Pseudolaguvia Ribeiroi</i> (Hora)	Or	+	+	+	+	LRnt
<i>Pseudolaguvia Shawi</i> (Hora)	Or	+	+	+	+	EN, END
<i>Sisor Rhabdophorus</i> (Hamilton)	Or	+	+	+	+	EN,
Family- Olyridae		0.9	0.98	0.88	0.90	
<i>Olyra Kempfi</i> (Chaudhuri)	Fd Or	+	+	+	+	
Family- Amblycepidae		1.80	1.96	0.88	1.83	
<i>Amblyceps Mangios</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
<i>Amblyceps Apangi</i> (Nath And Dey)	Fd Or	+	+	-	+	VU, END
Family- Clariidae		0.9	0.98	0.88	0.91	
<i>Clarias Batrachus</i> (Linnaeus),	Fd	+	+	+	+	
Family- Heteropneustidae		0.9	0.98	0.88	--	
<i>Heteropneustes Fossilis</i> (Bloach)	Fd	+	+	+	-	VU
Family- Siluridae		1.80	0.98	1.70	1.83	
<i>Ompak Pabda</i> (Hamilton)	Fd	+	-	+	+	EN
<i>Wallago Attu</i> (Schenider)	Fd Sp	+	+	+	+	LRnt
Order-Perciformes		14.4	12.74	13.27	13.76	
Family- Anabantidae		0.9	0.98	0.88	0.91	
<i>Anabas Testudineus</i> (Bloch)	Fd Or	+	+	+	+	VU
Family- Chacidae		0.9	0.98	0.88	0.91	
<i>Chaca Chaca</i> (Hamilton)	Or	+	+	+	+	
Family- Channidae		3.60	3.92	3.53	2.75	
<i>Channa Punctatus</i> (Bloch)	Fd	+	+	+	+	LRnt
<i>Channa Striatus</i> (Bloch)	Fd	+	-	+	-	LRlc
<i>Channa Marulius</i> (Hamilton)	Fd	+	+	+	+	LRnt
<i>Chann Gachua</i> (Hamilton)	Fd Or	+	+	+	+	
Family- Centropomidae		2.70	2.94	2.65	2.75	
<i>Pseudambassis Baculis</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Pseudambassis Ranga</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Chanda Nama</i> (Hamilton)	Fd Or	+	+	+	+	
Family- Cichlidae		0.90	0.98	0.88	0.91	
<i>Oreochromis Nilotica</i> (Linnaeus)	Fd	+	+	+	+	EX
Family- Gobidae		0.90	0.98	0.88	0.91	
<i>Glossogobius Giuris</i> (Hamilton)	Fd	+	+	+	+	LRnt
Family- Nandidae		1.80	1.96	1.76	1.83	
<i>Badis Badis</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Nandus Nandus</i> (Hamilton)	Fd Or	+	+	+	-	LRnt, END
Family- Osphronemidae		1.80	1.96	1.76	2.75	
<i>Colisa Chuna</i> (Bloch)	Fd Or	+	+	+	+	
<i>Colisa Labiosus</i> (Das)	Fd Or	+	+	+	+	
<i>Ctenops Nobilis</i> (McClelland)	Fd Or	+	-	-	+	
Order-Anguliformes		0.90	1.96	1.76	0.91	
Family- Anguillidae		0.90	0.98	0.88	0.91	
<i>Anguilla Bengalensis</i> (Gray & Hardwicke)	Fd	+	+	+	+	EN
Family- Ophihthidae		--	0.98	0.88	--	
<i>Psidonophis Boro</i> (Hamilton)	Fd	-	+	+	-	
Order-Beloniformes		0.90	0.98	0.88	0.91	
Family- Belonidae		0.90	0.98	0.88	0.91	
<i>Xenentodon Cancila</i> (Hamilton)	Fd Or	+	+	+	+	LRnt
Order-Clupeiformes		0.90	0.98	0.88	0.91	
Family- Clupeidae		0.90	0.98	0.88	0.91	
<i>Gudusia Chapra</i> (Hamilton)	Fd	+	+	+	+	LRlc
Order-Synbranchiformes		3.60	1.96	3.53	7.75	
Family- Mastacembelidae		2.70	1.96	2.65	1.84	
<i>Mastacembelus Armatus</i> (Lacepede)	Fd Or	+	+	+	+	
<i>Mastacembelus Pancalus</i> (Hamilton)	Fd Or	+	+	+	+	
<i>Rhynchobdella Aculeata</i> (Bloch)	Fd Or	+	-	+	+	
Family- Synbranchidae		0.90	--	0.88	0.91	
<i>Monopterus Cuchia</i> (Hamilton)	Fd	+	-	+	+	LRnt
Order-Osteoglossiformes		1.80	0.98	0.88	0.91	
Family- Notopteridae		1.80	0.98	0.88	0.91	
<i>Notopterus Notopteros</i> (Pallas)	Fd	+	+	+	+	
<i>Chitala Chitala</i> (Hamilton)	Fd	+	-	-	-	

Order-Mugiliformes		0.90	0.98	0.88	0.91	
Family- Mugilidae		0.90	0.98	0.88	0.91	
<i>Rhinomugil Corsula</i> (Hamilton)	Fd	+	+	+	+	VU
Order-Tetrodontiformes		0.90	0.98	0.88	0.91	
Family- Tetrodontidae		0.90	0.98	0.88	0.91	
<i>Tetrodon Cutcutia</i> (Hamilton)	Or	+	+	+	+	LRnt

Fd- food fish, Or- ornamental fish, Sp- sports fish, END-endemic, EN- Endanger, VU- Vulnerable,LRnt-low risks near threatened, LRLc-low risks least concern '+'=found and '-'= not found

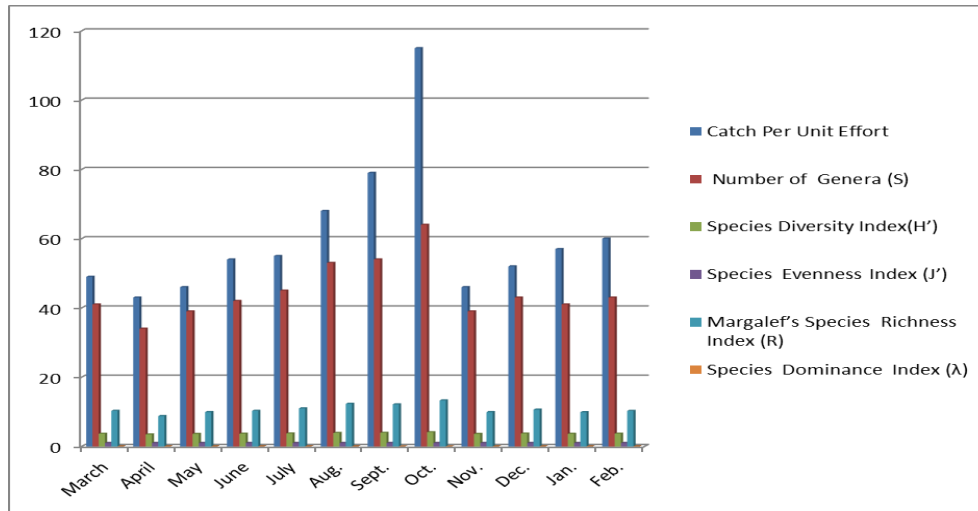


Fig 1: Monthly variation of ichthyofauna diversity indices at the site -I from March 2014- February 2015.

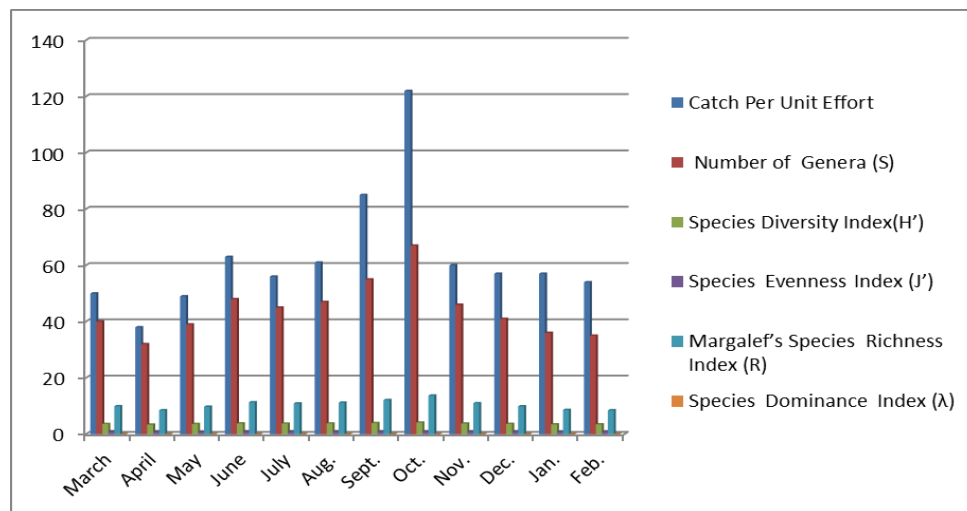


Fig 2: Monthly variation of ichthyofauna diversity indices at the site -I from March 2015- February 2016

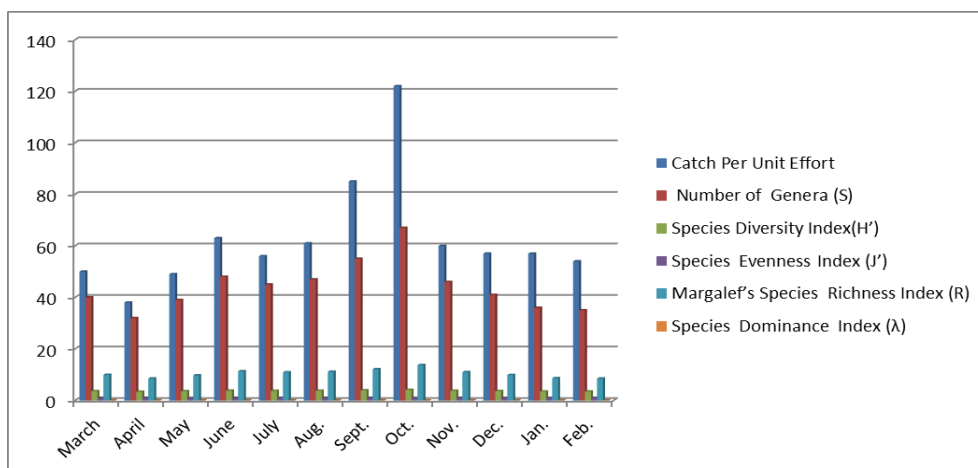


Fig 3: Monthly variation of ichthyofauna diversity indices at the site -II from March 2014- February 2015

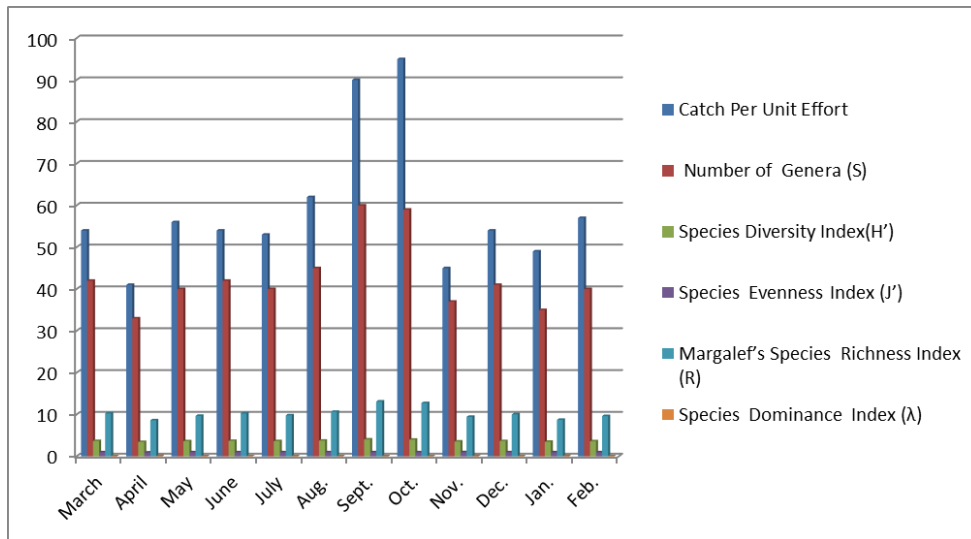


Fig 4: Monthly variation of ichthyofauna diversity indices at the site –II from March 2015- February 2016.

According to IUCN classification as per CAMP- NBFGR [21] out of 119 recoded fish species 13 are Endanger (EN), 21 species Vulnerable (VU), 31 are low risk near threatened (LRnt) and 5 low risk least concern (LRlc). But recent revised by NBFGR [22] few fish species such as *Amblyceps mangios*, *Channa gachua*, *Chagunius chagunio*, *Chaca chaca*, *Notopterus notopterus* and *Chitala chitala* are also categorized as Endanger and 23 species are vulnerable (Fig.-5). Twelve endemic fish species are found in the river Jaldhaka, out of which 5 are Endanger (EN), 2 vulnerable (VU) and 3 are low risk near threatened (LRnt). Among 119 fish species 7 are considered as ornamental fish, 75 ornamental fish with food value, 26 as food fish and 11 species are food fish with sport value [15, 14, 31]. A total of 36 cold water fishes were recorded from the river Jaldhaka [3]. Three exotic fishes such as *Ctenopharyngodon idella*, *Cyprinus carpio* and *Oreochromis nilotica* were recorded from this river. Few migratory fishes also found such as *Labeo dyocheilus*, *L. dero*, *L. pangusia* *Schizothorax richardsonii*, *Tor* spp. etc. but dam made on the river inhibit their migration from lower altitude to a higher altitude during the breeding season. When these migratory fishes migrated from their breeding ground to winter home or downstream easily caught by the fishermen. Many fishes were found which are highly adapted to live in torrential water such as *Barilus* spp. *Psilorhynchus* spp. *Glyptothorax* spp.

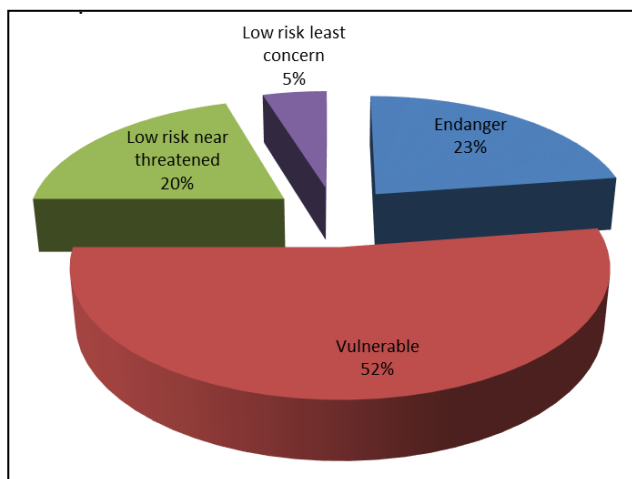


Fig 5: Percentage composition of conservation status

4. Conclusion

Though the Jaldhaka is a small river but rich in ichthyofauna the diversity, this diversity drastically decreased day by day. A total of 119 fish species found during the study period. Over and indiscriminate fishing, dynamiting, poisoning and electro-fishing are mainly responsible for decreasing fish diversity. Total 19 Endangered fish species, 44 vulnerable species, 17 low risks near threatened and 4 low risks least concern fishes were recorded from the river Jaldhaka. So 70.5 % of fishes of this river under threatened and needs immediate conservation steps to protect them from extinction. However, the study helps to formulate the future policy for conservation and management of the fish diversity in the river Jaldhaka. It is recommended that avoid illegal fishing, riverine natural habited should not be disturbed, poisons or pesticide should not apply in the river bank area and increasing public awareness to conserve ichthyo diversity in the River Jaldhaka.

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