Biodiversity, Threat Status and Conservation Priority of Icthyo-fauna of River Gomti at Lucknow Region, India

Farah Bano & Mohammad Serajuddin[*]

Department of Zoology, Lucknow University, Lucknow-226007 (U.P.), India; e-mail: lu.fisheries@gmail.com
[*]Corresponding author

ABSTRACT

The present study was carried out to know the current status of vanishing icthyo-faunal biodiversity in river Gomti, a tributary of river Ganga at Lucknow region covering a stretch of about 940 km. The results of this study revealed the occurrence of 56 species belonging to 41 genera, 9 orders and 21 families. Among the collected species the maximum number of species recorded was under the Order Cypriniformes (33.91%) followed by Siluriformes (30.32%), Perciformes (17.85%), Ophiocephaliformes (5.37%), Mastacembeliformes (3.59%), Clupeiformes (3.59%), Mugiliformes (1.79%), Beloniformes (1.79%) and Tetraodontiformes (1.79%). According to IUCN most of the species (46) are under Least Count, while some others including *Ompok bimaculatus*, *Ompok pabda*, *Wallago attu*, *Bagarius bagarius*, and *Ailia coila* are in Near Threatened category. *Cyprinus carpio*, *Ctenopharyngodon idellus*, *Oreochromis mossambicus* and *Hypophthalmichthys molitrix* are not counted because exotic species and *Anabas testudines* falls into data-deficient category. Simpson diversity index, fish species richness and abundance assessed for the fishes of three different sampling sites of river Gomti, at Lucknow Region were found to be statistically significant (p<0.05).

KEY WORDS Biodiversity; Itchyo-fauna; IUCN; Threats.

INTRODUCTION

Biodiversity is one of the key components of our basic life support system. Huge fishery resources of India with tremendous diversity of species distribution offer unmatched scope for genetic and evolutionary studies. It is now widely realized that sub-species, species, genera and even ecosystems that are being lost at an increasingly accelerated pace must be properly investigated, managed and conserved. The Global Biodiversity Assessment warns that, unless actions are taken to protect biodiversity, we will lose forever the opportunity of reaping its full potential benefit to human kind. Altogether 28,500 fish species have been so far recorded from all over the world (Nelson, 1994), out of these, 22 hundred fish species are known to occur in different aquatic habitats of India. National Bureau of Fish Genetic Resources (Lucknow) recently enlisted 79 species of threatened fishes of India under different categories of threatened status. Biodiversity became a main issue of 21st century as under threat worldwide (Bowker, 2000) and also considered as a key element in environmental planning (Schiemer, 2000). Fish culture can generate gainful employment, alternate income and stimu-

lates growth of new subsidiary industries (Goswami et al., 2012).

The river Gomti is a major tributary of the river Ganga which originates from a natural lake named "Gomat Taal" (elevation of about 200 m; North latitude 28º34´and East longitude 80º07´) situated in the forested area of Pilibhit district of Uttar Pradesh, India. The river Gomti is a perennial which covers an area of about 950 kilometers of rich alluvial plains of Uttar Pradesh before meeting the Ganges River near Saidpur in the same state. The river Gomti enters Lucknow after covering 240 km of its journey from its origin. Kathna, Reth, Sarayan, Luni, Kalyani and Sai rivers are the tributaries of river Gomti which serves as a domestic water supply to different geographical areas of the country. The city Lucknow along with 15 prominent cities situated on the banks of river Gomti pour untreated sewage, domestic waste-water, industrial waste and effluent from sugar factories and distilleries with negative effects on the ecosystem, threatening particularly ichthyo-fauna. The mass mortality of fishes in river Gomti was reported because of sewage pollutants and habitat alteration (Nagpure et al., 2001; Sarkar et al., 2010). The river experiences a heavy pollution load from both point and nonpoint sources during its course of about 730 km (Srivastava et al., 2014). A number of workers working on this line reported the degradation of biodiversity because of human intervention resulting into habitat loss, invasion of exotic species and environmental pollution (Gibbs, 2000; Saunders et al., 2002; Davis et al., 2010; Sarkar et al., 2010)

Although attempts are being made by many countries to control overgrowing water pollution, improvements in this direction of aquatic communities are quite restricted due to extreme lack in habitats of river channels and floodplains (Aarts et al., 2004) and, as a result, species become rare, endangered and ultimately extinct. A number of workers such as Hoggarth et al. (1996 a & b), Sarkar & Bain (2007) and Shrestha (2003) discussed the issue and pointed out that conservation area, management zones, and sanctuaries need to be defined soon, although knowledge of the ecological requirements of large river is poor and conservation programmes need guidance for maintaining them. Keeping in mind the paucity of information on the current status of ichthyofauna of the river Gomti the present study was carried out.

MATERIAL AND METHODS

Sampling sites and collection of fish

Three major sites of river Gomti were selected for samplings which are Site-1 (Shahid Smarak), Site-2 (Hanuman setu) and Site-3 (Kudiaghat). Fishes were collected using gill, drag and scoop nets during a period of one year from January 2015 to December 2015. Fishes were brought to the laboratory after preserving in 5% formalin for their further study.

The relative abundance and species richness of fish across the different sites were worked out. Simpson's diversity index (1-D) was used to estimate the biodiversity using the equations:

D = $\sum$ ni (ni-1)/ N (N-1), where D = Simpson's Index of Dominance; ni = total number of indiViduals of a particular species; N = the total number of individuals of all species (Simpson, 1949).

The status of threat to each species of fish in the present study was assessed by following the methods as adopted and developed by International Union for the Conservation of Nature and Natural Resources (IUCN), 2015.

Identification and calculation

The fishes were identified using the manuals and keys given by Talwar & Jhingran (1991) and Jayaram (1999). The colour, banding patterns, morphometric and meristic characters were studied and fin formulas of each species of the collected indigenous and exotic fishes were derived as per Srivastava (1980 & 1988). The data collected for three different sampling sites were analysed using one way ANOVA. All the calculations were done with the help of Graph Pad Prism5.

RESULTS

Altogether 56 species belonging to 41genera, 9 orders and 21 families were recorded in the present study. Out of them the maximum number of species was found to belong to Order Cypriniformes (33.91%) followed by Siluriformes (30.32%), Perciformes (17.85%), Ophiocephaliformes (5.37%), Mastacembeliformes (3.59%), Clupeiformes (3.59%), Mugiliformes (1.79%), Beloniformes (1.79%) and Tetraodontiformes (1.79%) (Fig.1).

The details of fin formula, IUCN status, and current population status of ichthyo-fauna of river Gomti are given in Table 1. Also number and percentage composition of family, genus and species in each order were calculated as in Table 2. Percentage composition of each family was determined as in figure 2.

The threat status of fish collected in the present study is as follows: most of them (46) are under Least Count (LC), few of them including *Ompok bimaculatus*, *Ompok pabda*, *Wallago attu*, *Bagarius bagarius* and *Ailia coila*, are under Near Threatened category. The exotic *Cyprinus carpio*, *Ctenopharyngodaon idellus*, *Hypophthalimichthys molitrix* and *Oreochromis mossambicus* were collected from the sampling sites with low to moderate abundance and placed under Not Evaluated category and *Anabas testudines* under data deficient category.

Simpson's index of dominance (D) value for ichthyofauna was found to be high at site 1 (0.0509) followed by site 2 (0.0433) and lowest in site 3 (0.0419) (Table 3). The value of this index ranges between 0 and 1, 0 indicating infinite diversity and 1 indicating no diversity (the bigger the value of D, the lower the diversity). In present study the Simpson's Index of Diversity (1-D) was found to be high at site 3 (0.9581) followed by site 2 (0.9567) and lowest at site 1 (0.9491). The data collected during the study revealed the highest richness in site 3 (56) little less for site 2 (53) and lowest for site 1 (49). The abundance of species also showed the same sequence as high at site 3 (1495) followed by site 2 (1188) and lowest at site 1 (796). The most dominant species recorded in the present study were *Salmostoma bacaila* (380), *Puntius sophore* (318), *Trichogaster fasciata* (275), *Trichogaster lalia* (190), *Puntius sarana* (179), *Channa punctatus* (151), *Rasbora daniconius* (123), *Puntius ticto* (117) and *Rita rita* (116) while *Ompok pabda* was the least recorded species (1) at site 3 (see Table 4).

Analysis of variance (ANOVA) - carried out for the three different sites of the study area - revealed a significant difference (p<0.05) across these sampling sites of river Gomti.

DISCUSSION

The number of fish species (56) recorded in the present study is similar as that reported by Sarkar et al. (2010) in the same river, although collection sites were different, indicating a rich species diversity. Many researchers reported a strong dominance of Piscean fauna in different rivers, notable among them are Rao (2001) who reported 83 fish species in the upper Ganga (Rishikesh-Kanpur); Payne et al. (2004) reported 30 and 56 fish species in Allahabad (U.P.) and Patna (Bihar) stretches of River Ganga, respectively. In addition to these, Sarkar et al. (2007) studied the fish fauna of Samaspur Bird Sanctuary of Uttar Pradesh and recorded 46 fish species in the year 2007.

The order Cypriniformes was found to be the most dominant group compared to other orders in the current study. Out of 21 families, Cyprinidae was the most dominant group with 19 species, as in Sarkar et al. (2010), who reported 20 species out of 56, under this family from the same site river Gomti. Sharma et al. (2014) also reported a total of 56 fish species from Upper Lake of Bhopal (M.P.) where Cyprinidae was also found to be dominant with 13 species. Patra & Saha (2013) reported 46 species from Damodar River at Burdwan district, West Bengal where Cyprinidae was dominant with 14 species; Das & Sabitry (2012) reported 62 ornamental fish species from the river island, Masuli, Assam where Cyprinidae was dominant with 20 species.

Most of the species of fish in the present study were found to be under least count (LC). Similarly, many researchers such as Sharma et al. (2014) and Patra & Saha (2013) reported under the LC category 30 out of 56 species from upper Lake of Bhopal (M.P.) and 31 out of 46 species from Damodar River at Burdwan district (West Bengal), respectively. *Ompok bimaculatus*, *Ompok pabda*, *Wallago attu*, *Bagarius bagarius* and *Ailia coila* were found to be near threatend, hence, in extreme danger of extinction in the future.

A survey in the present study revealed that the fishes mostly exploited by fishermen due to their high value as food were *Mystus aor*, *M. seenghala*, *M. cavasius*, *Labeo bata*, *L. calbasu*, *L. rohita*, *Channa marulius*, *C. punctatus*, and *C. striatus*. The threatened fish species recorded in the present study were *Ompok pabda*, *O. bimaculatus*, *Clupisoma garua*, *Wallago attu*, *Ailia coila*, *Eutropiichthys vacha*. Four exotic species, namely *Ctenopharyngodon idellus*, *Cyprinus carpio*, *Hypophthalmichthys molitrix* and *Oreochromis mossambicus* were found to pose serious threats to migratory and

Order/Family	S. No	Fish Name	Local Name	Fin formulae	IUCN Status	Current Population Status
Clupeiformes Clupeidae	1	*Gudusia chapra* (Hamilton, 1822)	Suhia	D 14-15(3/11-12); P 13; V 8; A 22-24;C 17	LC	Decreasing
Notopteroidae	2	*Notopterus notopterus* (Pallas, 1769)	Patara	D 8(1/7); P17; V 6; A100; C 19	LC	Unknown
Cypriniformes Cyprinidae	3	*Catla catla* (Hamilton, 1822)	Bhakur	D 18-19(3/15-16); P 19; V 9; A8(3/5); C 19	LC	Unknown
	4	*Cirrhinus mrigala* (Hamilton, 1822)	Nain	Diii-iv12-13; P I 17; Aiii 5; V I 8	LC	Stable
	5	*Cirrhinus reba* (Hamilton, 1822)	Rewa bata	D2/9; P16; V9; A2/6; C19	LC	Stable
	6	*Ctenopharyngodon idella* (Valenciennes, 1884)	Grass carp	D 10; P18; V 9; A 10-11; C 26-32	-	Unknown
	7	*Cyprinus carpio* Linnaeus, 1758	China rah	D iii-iv 18-20; P 1/15; V 1/8; A3-5	-	Unknown
	8	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Silver carp	D10-11; P20-21; A 14-15; V 8	-	Unknown
	9	*Esomus danricus* (Hamilton, 1822)	Dendua	D 8-9(2/6-7); P 11-12; V 8; A9(3/6)	LC	Stable
	10	*Labeo bata* (Hamilton, 1822)	Bata	D11-12(2-3/9-10); P 18; V 9; A 7(2/5); C 19	LC	Unknown
	11	*Labeo calbasu* (Hamilton, 1822)	Karaunchi	D17(3/14); P19; V 9; A7(2/5); C19	LC	Unknown
	12	*Labeo gonius* (Hamilton, 1822)	Kursi	D16(3/13); P 17; V 9; A 7 (2/5) ; C19	LC	Unknown
	13	*Labeo rohita* (Hamilton, 1822)	Rohu	D16(3/13); P 17; V 9; A7 (2/5) ; C 19	LC	Unknown
	14	*Osteobrama cotio* (Hamilton, 1822)	Gurda	D11(2/9); P 14-15; V 10; A 33-35(2/31-34); C 19	LC	Unknown
	15	*Salmostoma bacaila* (Hamilton, 1822)	Chalhawa	D2/7-9; P12-13; V 9; A 2/13-15; C 19	LC	Stable
	16	*Puntius sarana* (Hamilton, 1822)	Sidhari	D3/8-9; P 15-16; V 8-9; A 3/5 ; C19	LC	Unknown
	17	*Puntius sophore* (Hamilton, 1822)	Sidhari	D 3/ 8; P 15-16; V 9; A 3/5; C19	LC	Unknown
	18	*Puntius ticto* (Hamilton, 1822)	Sidhari	D 3/ 8; P13 ;V9; A3/8; C 19	LC	Unknown
	19	*Rasbora daniconius* (Hamilton, 1822)	Dendua	D 2/ 7; P 15;V.9; A 2/ 5; C 19	LC	Unknown
Cobitidae	20	*Botia lohachata* (Chaudhuri, 1912)	Bagha	D2/ 9; P 13-15; V 8; A 2/ 5; C 19	LC	Unknown
	21	*Lepidocephalichthys guntea* (Hamilton, 1822)	Nakati	D 2/ 6; P 8; V 7; A 2/ 5; C 16	LC	Unknown
Siluriformes Siluroidae	22	*Ompok bimaculatus* (Bloch, 1794)	Jalkapoor	D4; P 1/ 13-14; V 8; A 2/63-67; C18	NT	Unknown
	23	*Ompok pabda* (Hamilton, 1822)	Pabda	D4-5; P 1/ 11-13; V 1/ 6-7 A 2/ 48-54	NT	Decreasing
	24	*Wallago attu* (Bloch et Schneider, 1801)	Padhani	D 5; P1/14; V 10; A 4/82; C17	NT	Decreasing
Bagridae	25	*Mystus seenghala* (Sykes, 1839)	Tengan	D1/7/0; P 1/ 9; V 6; A 3/ 8-9; C 19-21	LC	Unknown
	26	*Mystus tengara* (Hamilton, 1822)	Tengra	D1/ 7/0; P 1/ 8; V 6; A2-3/9-10; C19	LC	Unknown
	27	*Mystus vittatus* (Bloch, 1794)	Tengara	D 1/ 7/0; P 1/8; V 6; A 2/9; C17	LC	Decreasing
	28	*Mystus cavasius* (Hamilton, 1822)	Dariai Tengar	D1/ 7/0; P 1/9 8; V 6; A 3-4/7-8; C 16	LC	Decreasing

Table 1/1. Classification, local name, fin formulae, IUCN status, and current population status of local icthyo-fauna of river Gomti at Lucknow, India.

Order/Family	S. No	Fish Name	Local Name	Fin formulae	IUCN Status	Current Population Status
	29	*Mystus aor* (Hamilton, 1822)	Tengan	D 1/ 7/0; P 1/10;V 6; A 3/10; C 17	LC	Stable
	30	*Rita rita* (Hamilton, 1822)	Hunna	D 1/ 6; P 1/ 10; V 8; A 4/9 ; C 19	LC	Decreasing
Sisoridae	31	*Bagarius bagarius* (Hamilton, 1822)	Gonch	D1/6/0 ;P 1/12 ;V 6 ; A 3/10 ;C 17	NT	Decreasing
	32	*Nangra nangra* (Hamilton, 1822)	-	D 1/ 6; P 1/ 8; V 6; A 11-12; C 18	LC	Stable
	33	*Gagata cenia* (Hamilton, 1822)	Baghi	D8 (2/ 6) 1/0; P 1/ 8-9; V 1/ 5; A 3/ 10-11; C 19	LC	Unknown
Schilbeidae	34	*Ailia coila* (Hamilton, 1822)	Patasi	D0; P I 13-14; V 6; A 72-75; C 19	NT	Decreasing
	35	*Clupisoma garua* (Hamilton, 1822)	Karahi	D1/ 7; P 1/11; V 6; A 3/29 ; C 17	LC	Decreasing
	36	*Eutropiichthys vacha* (Hamilton, 1822)	Banjhoo	D I /7; P 1/ 15-17; V 6; A 3/45; C 17	LC	Decreasing
Heteropneustidae	37	*Heteropneustes fossilis* (Bloch, 1794)	Singhi	D 6; P 1/7; V 6; A62-66; C19	LC	Stable
Claridae	38	*Clarias batrachus* (Linnaeus, 1758)	Mangur	D 65-70; P1/8; V6; A47; C17	LC	Unknown
Mugiliformes Mugilidae	39	*Rhinomugil corsula* (Hamilton, 1822)	Hunra	D 4/1/8; P 5; V1/5; A3/8-9; C15	LC	Unknown
Beloniformes Belonidae	40	*Xenentodon cancila* (Hamilton, 1822)	Kauwa	D 16-17; P 11; V 6; A 17; C 15	LC	Unknown
Ophiocephali-formes	41	*Channa marulius* (Hamilton, 1822)	Souri	D 46; P 18; V 6; A 32; C 12	LC	Unknown
Ophiocephalidae	42	*Channa punctata* (Bloch, 1793)	Girohi	D 29-30; P 16-17; V 6; A 20-22; C 12	LC	Unknown
	43	*Channa striata* (Bloch, 1793)	Souri	D 41-43; P 16-18 ;V 6 ; A 24-25 ; C 14	LC	Unknown
Perciformes Ambassidae	44	*Chanda nama* (Hamilton, 1822)	Chanari	D 1+7/1/16-17; P 12-13; V 1/ 5;A 3/16-18; C17	LC	Decreasing
Sciaenidae	45	*Sciaena coitor* (Hamilton, 1822)	Patharchatti	D11/2/27; P 17; V1/5; A 2/7; C17	LC	Stable
Nandidae	46	*Badis badis* (Hamilton, 1822)	Sumha	D 16/ 7-10; P 12; V 15; A 3/7 ; C 16	LC	Unknown
	47	*Nandus nandus* (Hamilton, 1822)	Dhebari	D 13/11-13; P 15; V 1/5; A3/8; C 15	LC	Unknown
Anabantidae	48	*Anabas testudineus* (Bloch, 1792)	Kawai, Koi	D 17/9-10 ; P 15; V1/5; A 10-11; C16	DD	Unknown
	49	*Trichogaster chuna* (Hamilton, 1822)	Khosti	D 17/7; P 9; V 1; A17/10-12; C 15	LC	Unknown
	50	*Trichogaster fasciata* (Bloch et Schneider, 1801)	Khosti	D 15-17/ 9-11; P 10; V1; A 16-17/ 15-16; C 15	LC	Unknown
	51	*Trichogaster lalius* (Hamilton, 1822)	Khosti	D 15-17 / 7-10; P 10; V 1; A 17-18/ 13-14 C15	LC	Unknown
Gobioidae	52	*Glossogobius giuris* (Hamilton, 1822)	Bulla	D 6/1/9; P 20; V 1/ 5; A 1/8; C 17	LC	Unknown
Cichlidae	53	*Oreochromis mossambicus* (Peters, 1852)	-	D15-16/10-12; P 14-15; V1/5 ; A3/10-11; C17	-	Unknown
Mastacembele-formes	54	*Macrognathus pancalus* (Hamilton, 1822)	Bam	D 24-26 30-37; P 19; A 3/ 31-40; C 12	LC	Unknown
Mastacembelidae	55	*Mastacembelus armatus* (Lacepède, 1800)	Bam	D 37-39/78-82 ; P 21-27; A 3/ 75-78	LC	Unknown
Tetraodontiformes Tetraodontidae	56	*Tetraodon cutcutia* (Hamilton, 1822)	Galphulani	D 10-; P 21; A 10; C7	LC	Unknown

Table 1/2. Classification, local name, fin formulae, IUCN status, and current population status of local icthyo-fauna of river Gomti at Lucknow, India.

S. No	Order	Family	Genus	Species	% of Families in Order	% of Genera in Order	% of Species in Order
1	Clupeiformes	2	2	2	9.52	4.89	3.59
2	Cypriniformes	2	13	19	9.52	31.70	33.91
3	Siluriformes	6	12	17	28.58	29.26	30.32
4	Mugiliformes	1	1	1	4.76	2.44	1.79
5	Beloniformes	1	1	1	4.76	2.44	1.79
6	Ophiocephaliformes	1	1	3	4.76	2.44	5.37
7	Perciformes	6	8	10	28.58	19.50	17.85
8	Mastacembeliformes	1	2	2	4.76	4.89	3.59
9	Tetraodontiformes	1	1	1	4.76	2.44	1.79
Total		21	41	56	100	100	100

Table 2. Number and percentage composition of family, genus and species in each order of local icthyo-fauna of river Gomti at Lucknow, India.

Biodiversity Parameters	Site-1	Site-2	Site-3
Species Richness	49	53	56
Abundance (N)	796	1188	1495
Simpson,s index of dominance (D)	0.0509	0.0433	0.0419
Simpson,s index of diversity (1-D)	0.9491	0.9567	0.9581

Table 3. Fish species richness, abundance and biodiversity indices of fish species of river Gomti at Lucknow, India.

S.No	Name of Species	Site-1	Site-2	Site-3	Richness	Abundance
1	*Gudusia chapra*	15	29	25	3	69
2	*Notopterus notopterus*	15	18	29	3	62
3	*Catla catla*	5	15	25	3	45
4	*Cirrhinus mrigala*	16	20	25	3	61
5	*Cirrhinus reba*	3	1	2	3	6
6	*Ctenopharyngodon idella*	1	-	3	2	4
7	*Cyprinus carpio*	25	27	35	3	87
8	*Hypophthalmichthys molitrix*	1	-	2	2	3
9	*Esomus danricus*	-	7	4	2	11
10	*Labeo bata*	7	17	11	3	35
11	*Labeo calabasu*	10	21	21	3	52
12	*Labeo gonius*	14	15	13	3	42
13	*Labeo rohita*	5	7	16	3	28

Table 4/1. Fish species richness and abundance in three sampling sites of river Gomti at Lucknow, India.

S.No	Name of Species	Site-1	Site-2	Site-3	Richness	Abundance
14	*Osteobrama cotia*	15	19	20	3	54
15	*Salmostoma bacaila*	95	130	155	3	380
16	*Puntius sarana*	42	51	86	3	179
17	*Puntius sophore*	85	103	130	3	318
18	*Puntius ticto*	27	35	55	3	117
19	*Rasbora daniconius*	21	55	47	3	123
20	*Botia lohachata*	-	1	2	2	3
21	*Lepidocephalus guntea*	3	9	10	3	22
22	*Ompok bimaculatus*	5	9	11	3	25
23	*Ompok pabda*	-	-	1	1	1
24	*Wallago attu*	3	9	10	3	22
25	*Sperata seenghala*	10	22	34	3	66
26	*Mystus tengara*	23	32	39	3	94
27	*Mystus vittatus*	18	22	19	3	59
28	*Mystus cavasius*	10	12	15	3	37
29	*Sperata aor*	19	39	27	3	85
30	*Rita rita*	24	42	50	3	116
31	*Bagarius bagarius*	3	6	8	3	17
32	*Nangra nangra*	1	2	1	3	4
33	*Gagata cenia*	3	11	12	3	26
34	*Ailia coila*	1	6	11	3	18
35	*Clupisoma garua*	7	15	20	3	42
36	*Eutropiichthys vacha*	2	9	12	3	23
37	*Heteropneustes fossilis*	7	15	22	3	44
38	*Clarias batrachus*	5	7	12	3	24
39	*Rhinomugil corsula*	2	1	1	3	4
40	*Xenenthodon cancilla*	10	25	27	3	62
41	*Channa marulius*	-	1	1	2	2
42	*Channa punctata*	35	51	65	3	151
43	*Channa striata*	18	12	31	3	61
44	*Chanda nama*	7	8	12	3	27
45	*Sciaena coitor*	2	2	1	3	5
46	*Badis badis*	-	5	7	2	12
47	*Nandus nandus*	3	13	19	3	35
48	*Anabas testudineus*	2	5	7	3	14
49	*Trichogaster chuna*	10	14	15	3	39
50	*Trichogaster fasciata*	70	95	110	3	275
51	*Trichogaster lalia*	50	60	80	3	190
52	*Glossogobius giuris*	6	4	13	3	23
53	*Oreochromis mossambica*	15	7	31	3	53
54	*Mastacembelus pancalus*	5	23	29	3	57
55	*Mastacembelus armatus*	15	23	25	3	63
56	*Tetraodon cutcutia*	-	1	1	2	2

Table 4/2. Fish species richness and abundance in three sampling sites of river Gomti at Lucknow, India.
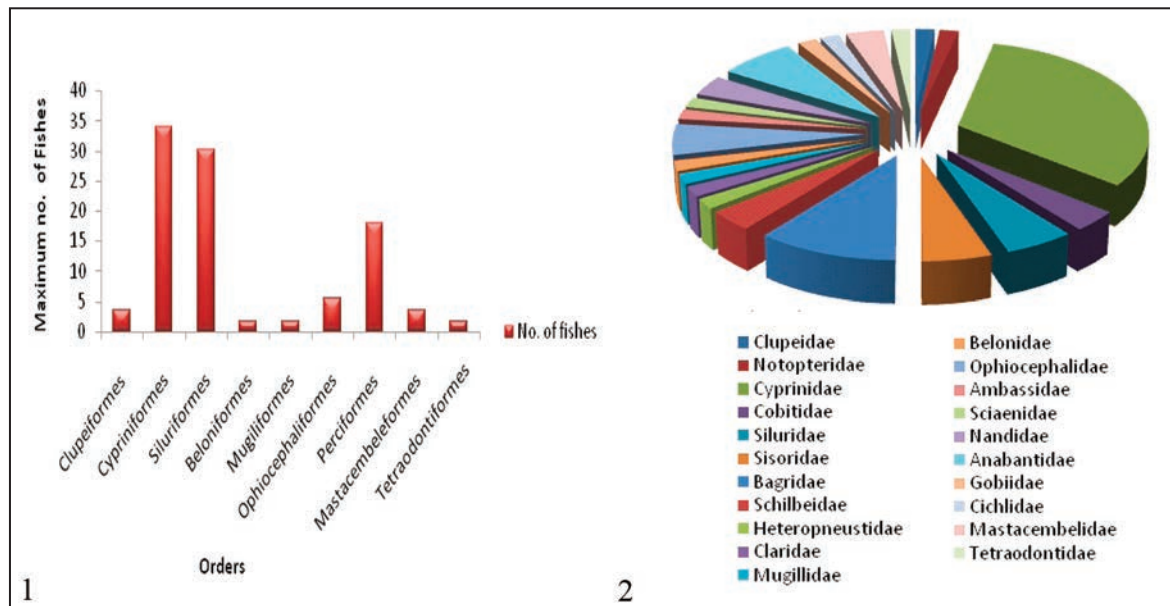
Fig. 1. Percentage representation of species at order level in river Gomti.
Fig. 2. Percentage representation of species at family level in river Gomti

threatened species, particularly to those having small size groups. Many Authors such as Garcia-Berthou et al. (2005); Garcia-Berthou (2007); Lakra et al. (2008); De Silva et al. (2009); and Singh & Lakra (2011) reported that the exotic species are the major causes of erosion or devastation of the native fish biodiversity in freshwater ecosystems. Canonico et al. (2005) also pointed out that the invasive alien fish populations are causing environmental and ecological problems in many countries, including India.

Sarkar et al. (2010) emphasized in their report that overfishing, excessive use of poison, use of fine mesh size, long nylon mosquito nets, indiscriminate killing of fishes including early life stages and brooders are major causes for drastic deterioration of fish biodiversity, particularly in river Gomti. Other scientists such as Sebastian et al. (1999) or Kurup et al. (2004) pointed out that intensive use of pesticides (such as endosulfan) to protect the agricultural crop in the cultivated areas causes severe health problems in fishes leading to large scale fish mortality.

CONCLUSIONS

The richness of fish biodiversity in the river is considered to be high. Anthropogenic causes such as overpopulation, commercial exploitation, indiscriminate use of chemical pesticides and fertilizers, habitat alteration, water diversion and introduction of exotic species were found to be the reasons for the threat to the fishfauna in river Gomti. Susceptibility to extinction was not the same for all the recorded fish species. Some fishes with large body size, high food value and narrow range of distribution are more susceptible to threats, and according to the IUCN extant data, some of the fish species are in the state of extreme danger to get extinct in the near future.

ACKNOWLEDGEMENTS

REFERENCES

Aarts B.G.W., Van Den Brink F.W.B. & Nienhuis P.H., 2004. Habitat loss as the main cause of the slow recovery of fish faunas of regulated large rivers in Europe: the transversal floodplain gradient. River Research and Applications, 20: 3–23. doi: 10.1002/rra. 720

Bowker G.C., 2000. Biodiversity data diversity. Social studies of science, 30: 643–683.

Canonico G.C., Arthington A., McCrary J. K. & Thieme M.L., 2005. The effects of introduced tilapias on native biodiversity. Aquatic Conservation: Marine and Freshwater Ecosystems, 15: 463–483.

Das M.K. & Sabitry B., 2012. Icthyofaunal Resources of Inland water Bodies of the River Island Majuli, Assam, India. Asian Journal of Experimental Biological Sciences, 3: 51–58.

Davis J., Sim L. & Chamber J., 2010. Multiple stressors and regime shifts in shallow aquatic ecosystems is antipodean landscapes. Freshwater Biology, 55: 5–18.

De Silva S.S., Nguyen Thuy T.T., Turchini G.M., Amarasinghe U.S. & Abery N.W., 2009. Alien species in aquaculture and biodiversity: a paradox in food production. Ambio, 38: 24–28.

Garcia-Berthou E., Alcatraz C., Pou-Rovira Q., Zamora L., Coenders G. & Feo C., 2005. Introduction pathways and establishment mates of invasive aquatic species in Europe. Canadian Journal of Fisheries and Aquatic Sciences, 62: 453–463.

Garcia-Berthou E., 2007. The characteristics of invasive fishes: what has been learned so far? Journal of Fish Biology, 71 (Supplement D): 33–55.

Gibbs H., 2000. Wetland loss and biodiversity conservation. Conservation Biology, 14: 314–317. doi: 10.1046/j. 1523–1739.2000.98608.x

Goswami U.C., Basistha S.K., Bora D., Shyamkumar K., Saikia B. & Changsan K., 2012. Fish diversity of north east India inclusive of the Himalayan and Indo Burma biodiversity hotspots zone: A checklist on their taxonomic status, economic importance, geographical distribution, present status and prevailing threats. International Journal of Biodiversity and Conservation, 4: 592–613.

Hoggarth D.D., Cowan V.J., Halls A.S., Aeron-Thomas M. McGregor J.A., Garaway, C.A., Payne AI. & Welcomme R., 1996a. Management guidelines for Asian floodplain river fisheries: Part 1: A spatial, hierarchical and integrated strategy for adaptive co-management. Fisheries Technical paper 384/1. Food and Agriculture Organization of the United Nations, Rome.

Hoggarth D.D., Cowan V.J., Halls A.S., Aeron-Thomas M. McGregor J.A., Garaway C.A., Payne A.I. & Welcomme R., 1996b. Management guidelines for Asian floodplain river fisheries: Part 2: Summary of DFID research. Fisheries Technical Paper 384/2, F. Food and Agriculture Organisation of the United Nations, Rome.

IUCN, International Union for Conservation of Nature and Natural Resources, 2015. Available at www.iucnredlist.org.

Jayaram K.C., 1999. The freshwater fishes of the Indian region. Narendra Publ. House, New Delhi, 551 pp.

Kurup B.M., Radhakrishnan K.V. & Manojkumar T.G., 2004. Biodiversity status of fishes inhabiting rivers of Kerala (S. India) with special reference to endemism, threats and conservation measures. In: Welcome R.L. & Petr T. (Eds.), Proceeding of LARS2. 2nd large rivers symposium. Mekong River Commission and Food and Agricultural Organization, 162–163.

Lakra W.S., Singh A.K. & Ayyappan S. (Eds.), 2008. Fish introduction in India: Status Potential and Challenge. Narendra Publishers, New Delhi, India, 303 pp.

Nagpure N.S., Singh P.J., Srivastava S.K. & Lakra W.S., 2007. Mass mortality of fishes in Gomti River. Fish Chimes, 26: 46–48.

Nelson J.S., 1994. Fishes of the World. John Wiley and Sons, New York, 600 pp.

Patra B.C. & Saha, M.K., 2013. Present Status of Icthyofaunal Diversity of Damodar River at Burdwan District, West Bengal, India. International Journal of Scientific & Research Publications, 3: 1–11.

Payne A.I., Sinhua R., Singh H.R., & Huq S., 2004. A review of the Ganges basin; its fish and fisheries. In: Welcome R.L & Petr R. (Eds.), Proceedings of the Second International Symposium on the Management of Large Rivers for fisheries, vol 1. Food and Agriculture Organization of the United Nations, Regional Office for Asia and Pacific; Mekong River Commission (MRC), Fisheries Programme (FP), 229–251.

Rao R.J., 2001. Biological resources of the Ganga River. Hydrobiologia 458, 159–168.doi:10.1023/A: 1013173204091.

Sarkar U.K. & Bain M.B., 2007. Priority habitats for the conservation of large river fishes in the Ganges river basin. Aquatic Conservation: Marine and Freshwater Ecosystems, 17: 349–359. doi:10.1002/aqc.782.

Sarkar U.K., Gupta B.K., & Lakra W.S., 2010. Biodiversity, ecohydrology, threat status and conservation priority of the freshwater fishes of river Gomti, a tributary of river Ganga (India). Environmentalist, 30: 3–17.

Sarkar U.K., Kapoor D., Paul S.K., Pathak A., Basheer V.S., Deepak P.K., Srivastava S.K & Tyagi L.K., 2007. Fish biodiversity in the water bodies of Samaspur bird Sanctuary, Uttar Pradesh: towards developing a freshwater aquatic sanctuary. Journal of the Bombay Natural History Society, 104: 51–54.

Saunders D.L., Meeuwig J.J. & Vincent A.C.J., 2002. Fresh water protected areas: strategies conservation. Conservation Biology, 16, 30–41. doi: 10.1046/j. 1523–1739.2002.99562.x

Schiemer F., 2000. Fish as indicators for the assessment of the ecological integrity of large rivers. Hydrobiologia, 422–423: 178–271.

Sebastian M.K., Peters D.M. & Feustal C., 1999. Impact of fishing by tribals on the fish biodiversity of Kerala sector of Nilgiri biosphere reserve. Proceedings of the Fourth Indian Fisheries Forum. Asian Fisheries Society, Indian Branch, 107–108.

Sharma R., Borana K., Gupta S.K., Pandey V. & Khan A., 2014. Biodiversity and Composition of Ornamental Fish Fauna inhabiting in Upper lake of Bhopal (M.P.). International Journal of Pharmaceutical and Life Sciences, 5: 3651–3659.

Shrestha T.K., 2003. Conservation and management of fishes in the large Himalayan Rivers of Nepal. Paper presented to the Second International Symposium on the Management of large rivers for fisheries, 1–19.

Simpson E.H., 1949. Measurement of Diversity. Nature, 163: 688.

Singh A.K. & Lakra W.S., 2011. Risk and benefit assessment of alien fish species of the aquaculture and aquarium trade into India. Reviews in Aquaculture, 3: 3–18.

Srivastava S.C., Verma P. & Tripathi M., 2014. Comparative Analysis of the microbial load in cat fish (*Mystus aor*) And Carp fish (*Labeo bata*) from Gomti River, Lucknow India. Flora and Fauna, 20: 77–82.

Srivastava G.J., 1980. Fishes of U.P. & Bihar, Vishwavidyalaya Prakashan, Varanasi, India, 204 pp.

Srivastava G.J., 1988. Fishes of U.P. & Bihar. 3rd Edition, Vishwavidyalaya Prakashan, Varanasi, India, 163 pp.

Talwar P.K. & Jhingran A.G., 1991. Inland fishes of India and adjacent countries. Vols. 1-2. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, 1097 pp.