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Fish diversity of Haryana and its conservation status

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Abstract: The present study on fish biodiversity of Haryana state was carried out during 2011 to 2014. A total number of 59 fish species inhabits the freshwaters of this state. Maximum number of fish species belonged to the order Cypriniformes (35) followed by the order Siluriformes (12) and Perciformes (8). The orders Beloniformes, Clupeiformes, Osteoglossiformes and Synbranchiformes were represented by only one species each. Out of 59 fish species, 2 are endangered, 11 vulnerable, 28 have lower risk of threat, 8 exotic and 4 fish species have lower risk least concern. The conservation status of six fish species has not been evaluated so far, hence they cannot be included in any of the IUCN categories at this moment. Family Cyprinidae alone contributed 32 fish species followed by Bagridae family. Fish species *Parapsilorhynchus discophorus* was observed for the first time in Haryana waters. This species is the native of Kaveri river basin, the occurrence of this species in river Yamuna may be attributed to some religious activity of people. A decline in fish diversity has been recorded from 82 species in 2004 to 59 species in the present study in the year 2014. The main causes for decrease in fish biodiversity are habitat destruction and fragmentation, changing practices of land use, exotic species introduction, fishing, irrigation needs, pollution and global climate change impacts. It is essential to prevent further decline of fish resources by devising all possible measures of conservation and rehabilitation.

Keywords: Biodiversity, Conservation, Freshwater, Pollution

INTRODUCTION

Biodiversity is the variation in the genetics and life forms of populations, species, communities and ecosystems (Hiddik *et al*., 2008). Biodiversity affects the capacity of living systems to respond to changes in the environment, and essential for providing goods and services from ecosystems. Thus it is the most valuable but least appreciated resource, and its understanding is essential for the maintenance of the world (Wilson, 1992). It is necessary to protect biodiversity in all ecosystems and is essential (whether for agriculture, fishery, forestry systems or evolutionary processes) for stabilization of ecological systems and protection of environmental quality for understanding intrinsic worth of all species on the earth (Ehrlich and Wilson, 1991). Among different ecosystems, freshwater ecosystems are the richest and the most diverse ecosystems on earth (Revenga and Mock, 2000). These comprise only 0.01% of the world's water and cover only 0.8% of the Earth's surface and generate nearly 3% of its net primary production (Alexander, 1999). Yet 6% of all species, and more than 10% of all animal species, occur in fresh water, including 25% of all vertebrates and 40% of all fishes (Balian *et al*., 2008). Moreover, freshwater ecosystems contain 40% of the world's known fish species (Daily, 1997). Studies on diversity and conservation of fish fauna in Haryana is documented by few workers (Johal *et al*., 2002, 2012; Johal and Rawal, 2004; Negi *et al*., 2007; Johal and Jha, 2007, 2010; Vats and Gupta, 2011). Due to limitation of natural water body, pond fish farming contribute significantly to fish yield of the state following suitable management practices (Garg and Bhatnagar, 1996, 1999, 2000, 2002; Bhatnagar and Singh, 2010; Singh and Bhatnagar, 2010). However, with the increase in anthropogenic threats due to development and utilization of resources, a continuous monitoring of biodiversity is essential in this state comprising of two rivers, lakes and number of village ponds. Therefore, the present study was undertaken to monitor the pattern of decline of biodiversity which is essential for fisheries conservation in the Haryana state.

MATERIALS AND METHODS

Topography of the study area : The state of Haryana (27° 39' to 30° 55' N and 74° 28.8' to 77 ° 36.5' E; Area 44,212Km²) is bounded by the river Yamuna in the East and Shivalik hills in the North. Rivers Yamuna and Ghaggar are the two main rivers flowing through the state. The fishery resources of Haryana include river length of 510 Km (Yamuna river 305 Km and Ghagger 205 Km), 12,900 Ha of lentic waters which include ponds, marshy lands, small reservoirs and water logged areas. The fish diversity of Haryana also includes some exotic fishes, which were intro-

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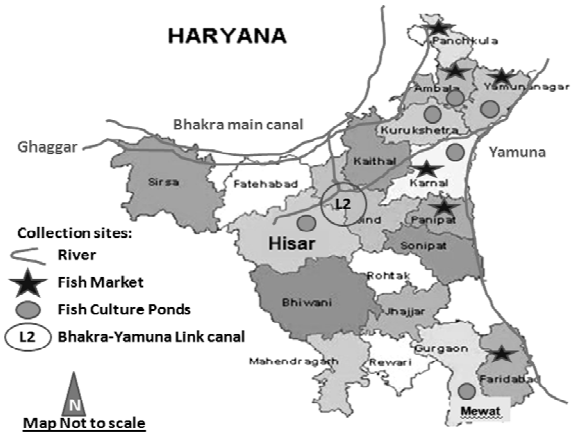

Fig. 1. *Map of Haryana showing collection sites.*

duced in the various water bodies for specific purposes and to increase the fish production. The area bordering the Western Rajasthan has Indus element as the canals originating from rivers Beas and Sutlej of the Indus river system irrigate this area (Johal and Rawal, 2004). All these aquatic ecosystems in Haryana comprised the study area for present study.

Collection of fishes: Fishes were collected at regular intervals from (i) Natural and manmade water bodies (viz., river Yamuna at Yamunanagar, Bhakra-Yamuna link at Narwana, fish culture village ponds in and around Kurukshetra, Yamunanagar, Ambala, Karnal, Hisar and Nuh Mewat) of Haryana with the help of local fishermen using cast net, gill net, drag net and hand net of various mesh sizes and (ii) from fish markets of Panchkula, Yamunanagar, Ambala, Karnal, Panipat and Faridabad. Fig. 1 depicts the map of Haryana showing location of rivers and districts from where ponds and fish markets were selected for sample collection. At the collection site, immediately photographs of fishes were taken with the help of digital camera Sony DSLR α 350. One specimen of each species was preserved in 8% formalin solution and brought to the laboratory. Rest of the specimens were released back in the water bodies. The morphometric characters of the collected fishes were identified with the help of standard keys and monographs (Day, 1878; Johal and Tandon, 1979, 1980; Jayaram, 1999). Morphometric characters include Total length, Head length, Preorbital distance, Postorbital distance, Interorbital distance, Length of dorsal fin, Length of anal fin**,** Distance between pectoral and pelvic fin, Distance between pelvic and anal fin etc. Meristic counts like Dorsal fin rays, Pectoral fin rays, Pelvic fin rays, Anal fin rays, Caudal fin rays, Lateral line scales. The abundance status of fish species observed according to the percentage occurrence of that species. If a fish species was found greater than 70% in quantity in a catch, then it was represented as abundant (++++). If the occurrence of any species was between 50-70%, 30 -50% and less than 30%, then these were represented as common (+++), moderate (++) and rare (+) respectively. The conservation status of different fish species has been assessed according to available literature as per IUCN criteria (Molur and Walker, 1998).

RESULTS AND DISCUSSION

During the present study 59 species of fishes belonging to 39 genera, 20 families and 7 orders were collected from various water bodies and fish markets of Haryana. Total number of fish species, common name, abundance, conservation status and locality of each species are presented in Table 1. The maximum numbers of genera belonged to order Cypriniformes (20) followed by the order Siluriformes (9) and Perciformes (6). The orders Beloniformes, Clupeiformes, Osteoglossiformes and Synbranchiformes were represented by only one genus each. Maximum number of fish species belonged to the order Cypriniformes (35) followed by the order Siluriformes (12) and Perciformes (8). The order Beloniformes, Clupeiformes, Osteoglossiformes and Synbranchiformes included one species each. It has been observed that out of 59 fish species, two were endangered (EN), eleven vulnerable (VU), twenty eight lower risk near threatened (LRnt), eight exotic (Ex) and four lower risk least concerned (LRlc). The conservation status of six fish species has not been evaluated so far, hence they cannot be included in any of the IUCN categories at this moment.

The fish fauna recorded in the present study depicts a mixture of hill stream and typical riverine fish species indicating that this state has varied ecological conditions. The study of fish fauna also include some exotic fish species, which appears to have been introduced some time back in confined waters for specific purposes such as pond fish production, eradication of macrophytes, and to control the algal bloom in ponds having high nitrogen content (Johal and Rawal, 2004). Some fishes like *Gudusia chapra*, *Ctenopharyngodon idella*, *Cyprinus carpio communis*, *Hypophthalmichthyes molitrix* and *Salmophasia bacaila* were observed in abundant quantity and these fishes do not need any special attention regarding conservation point of view. *Catla catla* and *Clarias batracus* were found to be in moderate quantity not very common in the present studies but IUCN status of both fishes showed that these are vulnerable. *Barilius bola*, *Cirrhinus reba*, *C. carpio nudus*, *Labeo dyocheilus*, *L. gonius*, *Puntius amphibius*, *P. chola*, *P. terio*, *P. ticto*, *Notopterus notopterus*, *Heteropneustus fossilis*, *Eutropiichthyes vacha* were observed rarely, while *Bagarius bagarius* was observed very rarely during the present investigations. Some fishes like *Acanthocobitis botia*, *Amblypharyngodon mola*, *Aorichthyes aor*, *Badis badis*, *Botia dario*, *B. lohachala*, *Brachydanio rerio*, *Channa gachua*, *C. marulius*, *C. orientalis*, *Chitala chitala*, *Clupisoma garua*, *Crossocheilus latius*, *Gagata cenia*, *Garra gotyla*, *G. lamta*, *Glyptothorax indicus*, *Heteropneustes microps*, *Labeo angra*, *L. boga*, *L. caeruleus*, *L. dero*, *L. pangusia*, *Macrognathus*

Table 1. List of fish species collected during the present study.

S.N.	Name of fish species	Local name	Abundance	IUCN status	Locality
1.	Order- Beloniformes Family –Belonidae *Xenentodon cancila* (Hamilton, 1822)	Takia machi	++	LRnt	L1, FM1,FM5
2.	Order- Clupeiformes Family- Clupeidae *Gudusia chapra* (Hamilton, 1822)		++	LRlc	L1,FM1,FM 4
3.	Order – Cypriniformes Family – Cobitidae *Botia birdi* Chaudhuri, 1909	Kander	++	LRnt	FM5
4.	Family – Cyprinidae			LRnt	FM4, FM5,L1
5.	*Aspidoparia morar* (Hamilton,1822)	Asala	++	LRnt	L1,FM1,FM4
6.	*Barilius bendelisis* (Hamilton, 1807)	Kandri	++	VU	L1,FM1,FM4
7.	*Raiamas bola* (Hamilton, 1822)	Chilwa	+	VU	L1, P3, P41
8.	*Catla catla* (Hamilton, 1822)	Katla	++	NE	L1, FM2
9.	*Chagunius chagunio* (Hamilton, 1822)	Khadi	++	LRnt	P3, FM4
10.	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	+++	VU	FM5
11.	*Cirrhinus reba* (Hamilton, 1822)	Mori	+	Ex	P2, P3, FM1
12.	*Ctenopharyngodon idella* (Valenciennes, 1844)	Grass carp	++++	Ex	L1, L2, FM4
13.	*Cyprinus carpio* communis Linnaeus, 1758	Golden	++++	Ex	L1
14.	*Cyprinus carpio* nudus Bloch, 1784	Leather	+	Ex	FM4, L2
15.	*Cyprinus carpio* specularis Lacepede, 1803	Mirror carp	++		
16.	*Devario devario* (Hamilton, 1822)	Makhani	++	LRnt	FM1, FM4
17.	*Esomus danricus* (Hamilton, 1822)	Dhoban	++	LRlc	L1, FM1
18.	*Hypophthalmichthyes molitrix* (Valenciennes, 1844)	Silver carp	++++	Ex	P4, FM6
19.	*Hypophthalmichthyes nobilis* (Richardson, 1845)	Bighead	+++	Ex	FM4, FM6
20	*Labeo bata* (Hamilton, 1822)	Bata	++	LRnt	FM4
21	*Labeo calbasu* (Hamilton, 1822)	Kalkoch	++	LRnt	FM1
22.	*Labeo dyocheillus* (McClelland, 1839)	Lohan	+	VU	L1
23.	*Labeo gonius* (Hamilton,1822)	Sirheen	+	LRnt	FM4
24.	*Labeo rohita* (Hamilton, 1822)	Rohu	+++	LRnt	FM1,L1, P2
25.	*Osteobrama cotio* (Hamilton,1822)	Seesa machi	+++	LRnt	FM4
26.	*Puntius amphibeus* (Valenciennes, 1842)	Puthi	+	NE	FM5
27.	*Puntius chola* (Hamilton,1822)	Puthi	+		
28.	*Puntius sarana* (Hamilton,1822)	Puthi	++	VU	FM1, FM4
29.	*Puntius sophore* (Hamilton, 1822)	Chidhu	+++	VU	FM2, FM4
30	*Puntius terio* (Hamilton, 1822)	Puthi	+	LRnt	FM1, FM4
31.	*Puntius ticto* (Hamilton, 1822)	Ticker	+	LRnt	FM5, FM6
32.	*Rasbora daniconius* (Hamilton, 1822)		++	LRnt	FM1, FM4
33.	*Salmophasia bacaila* (Hamilton,1822)	Chail	++++	LRnt	FM1
34.	*Salmophasia horai* (Silas,1951)	Chail	++	LRlc	FM1, FM4
35.	*Tor putitora* (Hamilton, 1822)	Mahaseer	++	NE	FM3
	Schizothorax progastus (McClelland, 1839)	Asala	++	EN LRnt	FM1, L1 L2
	Family – Nemachelidae				
36.	*Acanthocobitis botia* (Hamilton, 1822)	Sundli	++	LRnt	FM5
	Family – Parapsilorhynchidae				
37.	*Parapsilorhynchus discophorus* Hora, 1921	Naaro	++	NE	L1
	Order- Osteoglossiformes				
	Family- Notopteridae				
38.	*Notopterus notopterus* (Pallas, 1769)	Pari	+	LRnt	FM4
	Order- Perciformes				
	Family- Ambassidae				
39.	*Chanda nama* Hamilton, 1822	Seesa machi	+++	LRnt	FM1, FM6
40.	*Parambassis ranga* (Hamilton, 1822)	Chitti Kangi	++	LRnt	FM3, FM4
	Family- Channidae				
41.	*Channa striatus* (Bloch, 1793)	Dolla	+++	LRlc	FM1, P1
42.	*Channa punctatus* (Bloch, 1793)	Goli	+++	LRnt	FM5, FM2
	Family- Cichlidae				
43.	*Oreochromis mossambicus* (Peters, 1852)	Tilapia	+++	Ex	FM1

Contd.

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	Family- Gobidae				
44.	*Glossogobius giuris giuris* (Hamilton, 1822)	Gobi	+++	LRnt	FM1,FM4, FM5
	Family- Osphronemidae				
45.	*Colisa fasciatus* Bloch & Schneider, 1801	Kangi	+++	LRnt	FM1
46.	*Colisa lalius* (Hamilton, 1822)	Kangi	+++	LRnt	FM1
	Order- Siluriformes				
	Family- Bagridae				
47.	*Aorichthyes seenghala* (Sykes, 1839)	Seenghaa	+++	LRnt	FM2
48.	*Mystus bleekeri* (Day, 1877)	Kander	++	VU	FM2, FM4
49.	*Mystus cavasius* (Hamilton,1822)	Kinger	++	LRnt	L1, FM5,
50.	*Mystus vittatus* (Bloch,1794)	Kala	++	VU	FM2
51.	*Rita rita* (Hamilton, 1822)	Khagga	++	LRnt	FM1
	Family – Heteropneustidae				
52.	*Heteropneustes fossilis* (Bloch, 1794)	Singhi	+	VU	FM1
	Family- Claridae				
53.	*Clarias batrachus* (Linnaeus, 1758)	Magur	++	VU	FM4
54.	*Clarias gariepinus* (Burchell, 1822)	Thai Magur	++	NE	FM2, FM3
	Family- Pangasidae				
55.	*Pangasius pangasius* (Hamilton,1822)	Salendhi	+++	NE	FM1, FM2
	Family- Schilbeidae				
56.	*Eutropiichthys vacha* (Hamilton,1822)	Bacha	+	EN	L2
	Family- Siluridae				
57.	*Wallago attu* (Bloch & Schneider, 1801)	Mullee	++	LRnt	FM1, L1
	Family- Sisoridae				
58.	*Bagarius bagarius* (Hamilton, 1822)	Goonch	+	VU	FM5, FM6
	Order- Synbranchiformes				
	Family- Mastacembelidae				
59.	*Mastacembelus armatus* (Lacepede, 1800)	Bam	+	NE	FM5

Present status: ++++ = Abundant, +++ = Common, ++ = Moderate, + = Rare; **IUCN status**: EN=Endangered; Ex = Exotic; LRlc= Lower risk least concerned; LRnt=Lower risk near threatened; VU= Vulnerable; NE = Not evaluated**; Locality:** River Yamuna=L1; BhakhraYamuna link canal=L2; Fish market Yamunanagar=FM1; Ambala=FM2; Panchkula=FM3; Karnal=FM4; Panipat=FM5; Faridabad=FM6; Fish culture ponds of Yamunanagar=P1; Ambala=P2; Karnal=P3; Kurukshetra=P4; mHisar = P5; Nuh Mewat= P6

aculeatus, M. aral, M. pancalus, Nemacheilus denisoni, Ompak bimaculatus, O. pabda, Parambasis baculis, Pseudrotropiuys atherinoiders, Puntius conchonius, P. puntio, Raiamas bola, Rasbora daniconius, Salmostoma phulo, Schimatorhynchos nukta, Securicuila gora, Silonia silonida, Tor chelynoides, T. tor have been reported by Johal and Rawal (2004) from Haryana, but Johal and Jha (2007) did not reported these fishes. Also in the present study these fishes could not be collected except *Acanthocobitis botia, Raiamas bola* and *Rasbora daniconius.* The possible reasons are ecological degradation of natural water bodies, loss of flooding areas, thus diminishing the breeding grounds preventing their auto-stocking in nature and over exploitation of stocks have depleted their population. Therefore, it is clear that may be these fishes not present in freshwater bodies of Haryana or if present their number would be small, that is why these could not be collected. Johal and Jha (2007) reported some fishes like *Lepidocephalus guntea, Nemacheilus denisoni denisoni, Amblypharyngodon mola, Barilius barila, B. vagra, Chela cachius, Garra gotyla gotyla, Labeo angra, L. dero, Salmostoma phulo panjabansis, Amblyceps mangois, Clarias gariepinnus, Heteropneustus microps, Glyptothorax indicus, G. telchitta, Gambusia affinis, Channa gachua, C. marulius, Badis badis*. But these fishes were not collected during the present study. During the present study some fishes like *Cyprinus carpio nudus, Devario devario, Esomus danricus, Puntius amphibeus, P. sarana, Rasbora daniconius, Salmophasia horai, Schizothorax progastus, Parapsilorhynchus discophorus, Colisa lalius, Rita rita, Pangasius pangasius, Eutropiichthyes vacha* have been encountered but these fishes were not reported by Johal and Jha (2007). Out of these species, *P. discophorus* is that species which was reported first time from Haryana. This particular fish showed 75% similarity in morphological characters with *P. discophorus* but 25% with that of genus *Garra* according to the identification key of Jayaram (1999). That is why it was identified as *Parapsilorhynchus discophorus* . This particular fish is the native of Kaveri river basin. According to Dahanukar (2011), *P. discophorus* is assessed as vulnerable as its breeding habitat on the mountain top is threatened due to habitat modification by recreational activities. The reason behind the occurrence of this species in river Yamuna might be some religious activity of people. Sometimes aquarium fishes are released into the natural water bodies by local people based on their religious beliefs. There may also be a reason that it might have entered into river Yamuna along with some other fishes with some stream. Amongst these species *Devario devario, Salmophasia horai, Schizothorax progastus, Rita rita,*

Pangasius pangasius, Eutropiichthyes vacha are carnivorous fishes. *Esomus danricus, Puntius sarana, Rasbora daniconius* and *Colisa lalius* are omnivorous fishes while *Puntius sarana* and *Parapsilorhynchus discophorus* are herbivorous fishes. Out of the 59 fish species, 8 exotic fishes have been reported (Table 1). Exotic species of fishes were introduced in many parts of the world for improving local fishery potential, broadening species diversity in aquaculture programmes, sport fishing, aquarium keeping and controlling of unwanted organisms (Kumar, 2000). The indiscriminate transfer of exotic fishes brought about a worldwide concern as it resulted in a wide array of problems including extirpation of indigenous species. The exotics are a competition to indigenous fishes for food and habitat. They may prey upon native fishes, introduce new diseases and parasites, results in the production of hybrids and cause genetic erosion of indigenous species and degradation of the physico-chemical nature of aquatic ecosystems. All this will subsequently lead to loss of biodiversity (Nyman, 1991). In the present study these exotic species such as *Ctenopharyngodon idella, C. carpio communis, C. carpio specularis, Hypophthalmichthyes molitrix, Hypophthalmichthyes nobilis* and *Oreochromis mossambicus* were found to be abundant or common at most of collection sites supporting the view that sometimes population of these species become so abundant that it affect the population of native species (Kumar, 2000). Moreover, the presence of these exotic species is not viewed positively (Johal and Tondon, 1983; Welcomme, 1988). *Cyprinus carpio nudus* is the only exotic species which was reported rarely. This species was collected only from river Yamuna. The reason behind the rare occurrence of this species may be due to less survival rate.

Out of 59 fish species, some aquarium fishes like *Xenentodon cancila, Barilius bendelisis, Devario devario, Esomus danricus, Acanthocobitis botia, Parambassis ranga, Colisa fasciatus* and *C. lalius* were reported. The human activities that have been causing destruction to the fishery are overfishing (more for commercial purposes than for living) and pollution of the aquatic systems, mainly due to discharge of domestic/ industrial effluents into the aquatic systems. Jhingran (1984) and Das and Barat (1990) have also stated similar reasons about declining fish biodiversity. Thus there is a need to discuss conservation issues in Indian river systems (Menon, 1989; Dubey, 1994; Anonymous, 1995; Kapoor and Sarkar, 2005). Along with enlisting the available species and comparing them with previously documented literature there is a need to ascertain the conservation status of reported fishes. The present study shows that *Ctenopharyngodon idella, Cyprinus carpio communis, Hypophthalmichthyes molitrix* and *Salmophasia bacaila* were found in abundant (++++) quantity. All species are exotic except *S. bacaila*. IUCN also declared *S. bacaila* in LRnt category. All the Indian major carps were found commonly in wild as well as these are important culturable fishes in pond fish culture. *Catla catla* need some attention because IUCN declared *C. catla* as VU species. Minor carps like *Labeo bata, Labeo calbasu* were moderately (++) reported in present study but IUCN criteria of these species shows that they fall under LRnt category. *Cirrhinus reba, Labeo dyocheilus* and *Labeo gonius* were reported rarely (+). According to IUCN these species are VU. Majority of the fish species were found in moderate (++) quantity. Fish species which were found rarely (+) like *Puntius chola, P. terio, Raiamas bola, Notopterus notopterus, Heteropneustes fossilis, Eutropiichthyes vacha, Bagarius bagarius* and *Mastacembelus armatus* need some special attention. There are several ways to reverse the trend of inclusion of fish species in one of the IUCN conservation categories e.g. periodic extensive ichthyofaunal surveys, ascertaining the conservation status of reported fish species, identification and protection of breeding and feeding grounds of fishes and finally declaration of ecologically undisturbed aquatic bodies (Johal and Rawal, 2004). *In situ* conservation is one of the several prominent and suggestive measures for conservation of fish biodiversity.

Conclusion

The ichthyological survey conducted during the period 2011 to 2014 has revealed that the different water bodies of present day Haryana support 59 fish species belonging to 7 orders. It is concluded that due to urbanization, different water management practices and rapid pollution of most of the aquatic bodies in the state, the fish diversity of Haryana show significant changes, when compared with the earlier reports of fish diversity study. It indicates that there is a change in water quality. It is suggested that to evaluate the loss or gain of fish diversity, periodic ichthyological survey must be undertaken and there should be strict regulations for stress causing anthropogenic activities.

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